
SME
Productivity
and
Innovation
in Asia
Policies for a Resilient Future
Asian Productivity Organization
APO

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SME PRODUCTIVITY AND INNOVATION IN ASIA: POLICIES FOR A RESILIENT FUTURE

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SME Productivity and Innovation in Asia: Policies for a Resilient Future

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FOREWORD

Small and medium-sized enterprises (SMEs) form the backbone of many Asian economies, contributing significantly to employment, innovation, and economic dynamism. Beyond their role in economic stability, SMEs are essential drivers of technological progress and competitiveness. However, their sustained growth depends largely on their ability to enhance technological capabilities, access finance, and integrate into evolving global value chains. As the world navigates the post-COVID-19 recovery, SMEs face pressing challenges in productivity and innovation. Strengthening their capacity for technological advancement is vital for fostering economic resilience and ensuring long-term prosperity.

A thriving SME sector requires not only sound policies but also an environment that nurtures entrepreneurship, fosters collaboration, and encourages the adoption of new technologies. Enhancing financial inclusion, building digital capabilities, and strengthening linkages with research institutions and larger enterprises are key to ensuring that SMEs remain dynamic and competitive in an ever-evolving marketplace.

This report presents an in-depth exploration of the challenges and opportunities facing SMEs across the diverse economic contexts of the 12 APO members covered in the study. Through a comprehensive analysis of key productivity trends and innovation dynamics, it sheds light on the varying factors that influence SME growth and sustainability. By evaluating different policy approaches and their effectiveness, this study provides a roadmap for enhancing SME competitiveness and resilience in an increasingly interconnected global economy. Notably, the findings reveal significant variations in SME productivity. While high-income economies benefit from structured policies, lower-middle-income economies struggle with fragmentation, which limits SME innovation. The study underscores the critical role of digital transformation, showing SMEs leveraging Industry-4.0 technologies achieve notable gains in efficiency and market reach. A key insight is the impact of demand-side policies, which have proven effective in fostering SME innovation in certain middle-income economies.

The APO extends gratitude and appreciation to all the experts who contributed to this report, led by Chief Expert Dr. Patarapong Intarakumnerd, Professor of National Graduate Institute for Policy Studies (GRIPS), Japan, and national experts from the Republic of China, India, Japan, Lao PDR, Mongolia, Nepal, Pakistan, the Philippines, Singapore, Thailand, Turkiye, and Vietnam. It is hoped that *SME Productivity and Innovation in Asia: Policies for a Resilient Future* serves as a valuable resource for advancing SME development in Asia. Creating an enabling environment for innovation and productivity will be essential in building a more competitive and resilient future for SMEs in the region.

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INTRODUCTION

BACKGROUND

According to the 2023 APO report *SME Transformation for Meeting the SDGs in Asia*, SMEs constitute a significant economic force in Asian countries, contributing almost 70% of employment. Enhancing technological capabilities through participation in global value chains and benefiting from foreign investment spillover effects were key strategies for SME development. However, the COVID-19 pandemic disrupted these dynamics, impacting SMEs profoundly. SMEs, reliant on these mechanisms for technological advances, faced severe setbacks.

After the pandemic, SMEs are facing productivity and innovation challenges. Formulating effective support policies will be critical to their recovery and sustainable growth. Given that technological capabilities are a key determinant of SME productivity and innovation, it is essential to design informed policies to enhance firms' technological capabilities and their enabling innovation system.

The objectives, definitions, scope, and methodology of the study are illustrated in the following sections.

OBJECTIVES

1. Assess the current state of SMEs' technological capabilities and supporting innovation system;
2. Evaluating the content, implementing mechanisms and effectiveness of the existing financial and non-financial government supporting measures for enhancing SME technological and innovation capabilities; and
3. Proposing policy recommendations to a) improve the existing policy measures, b) initiate new ones, and c) upgrade innovation system enabling effective implementation of these policies.

DEFINITIONS USED IN THE STUDY

Terms in the study have specific meanings and concepts behind.

Productivity

Productivity refers to "the ability of a firm, industry or economy to produce more output by better combining labor, capital and other inputs, owing to new ideas, technological innovations, more efficient processes, and new business models" (Faggian and Ascani 2021, p. 21). Productivity is measured by labor productivity and total factor productivity.

The ratio of total output to hours worked is known as *labor productivity.* It gauges how effectively labor input is employed in the production process and integrated with other production elements (OECD, n.d.).

Growth in *total factor productivity (TFP)*, under certain simplifying assumptions about production technology, is the percentage of output growth that cannot be accounted for by increases in the conventionally measured labor and capital inputs utilized in production (Comin, 2010).

Technological Capability

There are two kinds of technological capability:

- *Production capability*: "the capability to *carry on* producing goods and services with given product technology, and to use and operate given forms of process technology in *existing* organizational configurations" (Bell, 2009:11);
- *Innovation capability*: "the capability to create *new* configurations of product and process technology and to implement *changes* and *improvements* to technologies already in use" (Bell, 2009:11).

Innovation

We adopt the definitions proposed by the Oslo Manual (OECD/Eurostat, 2018).

Innovation is "a *new* or *improved* product or business process (or combination thereof) that differs *significantly* from the firm's previous products or business processes and that has been *introduced on the market* or *brought into use* by the firm" (OECD/Eurostat, 2018, p. 20).

Innovation may also be defined as incremental and radical.

For this study, new or improved product or business process is considered 'innovation', if it is ***new to the firm*** even though it is not new to the country, market, or the world.

Product Innovation is "a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market" (OECD/Eurostat, 2018, p. 21).

Business Process innovation is "a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use in the firm" (OECD/Eurostat, 2018, p. 21). Categories of business process innovation include the following: production of goods or services, distribution and logistics, marketing and sales, information and communication systems, administration and management, and product and business process development activities to scope, identify, develop, or adapt products or a firm's business processes.

Innovation System

An innovation system is defined as a set of *institutions* whose *interactions* determine the innovative performance of national firms (Nelson, 1993, p.4).

For this study, we focus on 'institutions' which stimulate or obstruct SMEs to innovate, namely, laws and regulations, societal attitude to failures, trust among firms and between firms of other actors (e.g. public research institutes, universities, government agencies, financial organizations), and opportunity-based entrepreneurship (e.g. ability of an entrepreneur to sense and seize external opportunities and leverage the knowledge and skills of other people).

SCOPE AND METHODOLOGY

The study comprises reports from 12 APO members, namely, the ROC, India, Japan, Lao PDR, Mongolia, Nepal, Pakistan, the Philippines, Singapore, Thailand, Turkiye, and Vietnam, that are further classified as high-income economies, upper-middle-income economies, and lower-middle-income economies, analyzing the implications of economic development on SMEs' productivity, innovation and technological capability.

Each country report consists of three parts.

An overview of productivity and innovation of SMEs

For productivity, each report analyzes annual *labor* and *multifactor (total factor)* productivity growth of SMEs in the past 10–20 years or so.

For innovation, if Community Innovation Surveys (CIS) have been conducted in the country, a country report will provide the latest figures and the trend over the past 10 years of new-to-firm *overall innovation*, *product innovation*, and *business process innovation*. If the CIS Surveys are not available, a country report will report the results of similar surveys on innovation of SMEs in the country.

The CIS Survey focuses, among others, on the following aspects:

- product innovation (new to firm; new to the market)
- business process innovation
- innovation development
- innovation activities
- innovation expenditure
- turnover from innovative products
- incentives for the implementation of innovation
- innovation cooperation
- source of financing for innovation
- sources of information on innovation
- barriers to innovation

If there is no survey of SMEs' innovation and their enabling innovation system, a country report will summarize previous quantitative and qualitative research and anecdotal stories/evidence on SMEs' innovation and level of technological capability in the country.

Analysis of contents, implementation mechanisms, and effectiveness of policy instruments for enhancing technological capabilities and innovation of SMEs

Country reports investigate three types of policies for promoting innovation and technological capabilities of SMEs in their countries; supply-side technology policies, demand-side technology policies, and systemic technology policies.

A) Supply-side technology Policy

The aim of supply-side policies is to increase incentives to invest in innovation by reducing costs. Supply-side policies encourage investments that otherwise might not be undertaken as liquidity constraints caused by capital market imperfections can be substantial when it comes to innovation.

The most commonly employed supply-side technology policies are subsidies in a broader sense for R&D, technological capability enhancement, and innovation. These include the following instruments:

- Tax incentives
- Grants/subsidies
- Low-interest loans, credit rating, and guarantees
- Direct equity participation (direct government investment on firms' projects)
- Indirect financial support through government owned/linked venture capital
- Financial and non-financial assistance to train skilled workers, technicians, scientists, engineers, designers, researchers and others necessary for firms' innovation

B) Demand-side technology policy

Demand-side technology policy means not just policies to create markets for innovative products made by SMEs, but also stimulate demand of SMEs themselves to innovate. Demand-side technology policy includes the following.

- Government procurement. Government agencies can procure goods and services from SMEs, with certain conditions such as that they clear certain technological thresholds or are able to deliver products or services with better functions than existing ones.
- Government stimulus for the 'private' market to accept innovative products/services through various mechanisms. These include labeling, market promotion, and subsidizing and/or providing tax incentives for buyers of those innovative products or adopters of innovative processes.

C) Systemic technology policy

In addition to the supply-side technology policy and demand-side technology policy, there is a set of technology policies that aims to improve the performance of an innovation system mainly by promoting better coordination of actors in such an innovation system.

Targeted subsidies can be provided for collaborative development of particular technology or product between *SMEs and universities/public research institutes*.

Some government have explicit policies to encourage *SMEs to work and learn from large multinational and domestic firms*.

Policies to set up or strengthen existing *'innovation intermediaries'* are also very important. Basically intermediaries perform main four roles: (1) consultant, providing information and advice in the recognition, acquisition and utilization of the relevant intellectual property (or knowledge) and technological capabilities; (2) broker, 'brokering a transaction between two or more parties'; (3) mediator, acting as an independent 'third party' who assists two organizations to form a mutually beneficial collaboration; and (4) resource provider, acting as an agent who secures access to funding and other material support for the innovation outcomes of such collaborations. These intermediaries can have many organizational forms, including as research technology organizations (RTOs), industrial and trade associations, professional associations, and private foundations (Intarakumnerd and Chaoroenporn, 2013:109).

Each policy instruments of these three types of policies are critically analyzed.

- *Policy content*: effective period, responsible agencies, policy objectives, any targeted sectors/clusters/technologies/products/components? Any change overtime?
- *Policy implementation*: implementing mechanisms, cross-organization coordination mechanisms, monitoring mechanisms, evaluation period (mid-term, final), evaluation processes (self vs. third party)
- *Evaluation outputs/outcomes/impacts*. Evaluations of 'additionality' impacts of the policy instruments by comparing before and after recipient firms benefited from the policy instrument were conducted. The following results were observed and reported.
  - increase in firms' own investment in R&D/innovation activities
  - product innovation
  - business process innovation
  - new/upgraded R&D/innovation management system
  - new recruitment of engineers, technicians, researchers, designers, brand managers, etc.
  - export existing products to more demanding/profitable markets
  - diversification to new products
  - new market segments
  - upgrade position in global/regional value changes e.g. from original equipment manufacturers (OEMs) to own design manufacturers (ODMs) and owned brand manufacturers (OBMs)
  - be able to produce more technologically sophisticated/higher value-added components locally.

Secondary data were collected from government policy documents, evaluation reports, databases, and media.

In most country reports, case studies via in-depth interviews of a few selected recipient firms successfully and/or unsuccessfully benefited from key policy instruments were investigated. Subsequently, cross-case comparisons of these case studies were carried out to understand why some policy instruments were successful or not successful or certain policy instruments were beneficial for some firms and not so in others. Can success and failures be attributed to content and implementation of these policy instruments? And how?

Institutions affecting effectiveness of policies

There are several institutions which can affect policy initiation, planning, implementation, and effectiveness:

- Capacity of execution of government agencies
- Level of cross-ministerial/agency coordination
- Level of trust between government agencies and firms
- Attitude of policy makers in helping firms and having selective policies for particular sectors, clusters, products, and others
- Societal attitude to failure
- Availability of opportunity-based entrepreneurs
- Others

Country reports analyze these institutions and others whether and how they affected effective initiation, planning, and implementation of the policies.

Policy recommendations to improve content, implementation mechanisms and enabling institutions are suggested and included in the conclusion section of the country reports.

REFERENCES

Asian Productivity Organization. (n.d.) Glossary: Productivity. Available at https://www.apo-tokyo.org/p_glossary/productivity/ (Accessed on 2 March 2024).

Bell, M. and Pavitt, K. (1995). "The Development of Technological Capabilities," in Haque, I. (ed.), *Trade, Technology and International Competitiveness*, Washington D.C.: The World Bank. Available at https://documents1.worldbank.org/curated/en/265331468765926233/pdf/multi0page.pdf (Accessed on 2 March 2024)

Bell, M. (2009) *Innovation Capabilities and Directions of Development*, STEPS Working Paper 33, Brighton: STEPS Centre. Available at https://steps-centre.org/wp-content/uploads/bell-paper-33.pdf (Accessed on 2 March 2024)

Comin, D. (2010). Total factor productivity. In: Durlauf, S.N., Blume, L.E. (eds) *Economic Growth*. The New Palgrave Economics Collection. Palgrave Macmillan, London.

Faggian, Alessandra; Ascani, Andrea. (2021). Productivity and resilience: A post-COVID-19 perspective. Paper presented at on OECD-EC high-level expert workshop series Productivity Policy for Places on 09–10 June 2021.

Intarakumnerd, P. and Charoenporn, P. (2013) The roles of intermediaries in sectoral innovation system in developing countries: public organizations versus private organizations, *Asian Journal of Technology Innovation*, 21(1), 108-119.

OECD (n.d.) *Labour Productivity and Utilization*. Available at https://www.oecd.org/en/data/indicators/labour-productivity-and-utilisation.html#:~:text=Labour%20productivity%20is%20the%20ratio,all%20persons%20engaged%20in%20production (Accessed on 26 February 2025).

OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg. https://doi.org/10.1787/9789264304604-en

REPUBLIC OF CHINA

EXECUTIVE SUMMARY

Introduction

The Republic of China (ROC) stands as a remarkable example of economic resilience in the face of global challenges. In 2022, despite ongoing pandemic impacts and geopolitical tensions, the country maintained a robust 2.45% GDP growth rate and secured top rankings in the IMD Global Competitiveness Report among nations with populations over 20 million. This success is largely attributed to its vibrant SME sector, which forms the backbone of ROC's economy, accounting for 98% of all enterprises, employing 80% of the workforce, and contributing over 50% of the total market share. The sector's dynamism is evidenced by a 7% annual growth in exports, reaching TWD3.6 trillion in 2022.

However, the COVID-19 pandemic exposed critical vulnerabilities within ROC's SME ecosystem. Between 2020 and 2022, 68% of SMEs reported revenue declines, with technology-intensive industries experiencing disproportionate impacts. Beyond immediate financial pressures, the crisis revealed deeper structural challenges: significant disparities in technological readiness between small and large enterprises, limited innovation capabilities, and regional imbalances in access to resources and support. These challenges highlight the urgent need for strategic intervention to enhance SME resilience and competitiveness in an increasingly digital and innovation-driven global economy.

This comprehensive study evaluates the productivity and innovation dynamics of ROC's SMEs, focusing on their post-pandemic recovery and transformation. The research examines three critical dimensions: operational efficiency through productivity metrics, innovation capacity through R&D investments and technological adoption, and the effectiveness of government support mechanisms. By analyzing these aspects, the study aims to identify key success factors and barriers in SME development, ultimately providing actionable recommendations for policy enhancement and sector growth.

The analysis employs a multi-faceted approach combining quantitative and qualitative methods. Primary data sources include business tax filings, customs clearance records, and the ROC Community Innovation Survey, providing robust insights into SME performance across different sectors and regions. The study measures both labor productivity and total factor productivity to assess operational efficiency, while innovation capacity is evaluated through metrics including R&D intensity and technological adoption rates. This comprehensive methodology enables a nuanced understanding of the challenges and opportunities facing ROC's SMEs, forming the basis for evidence-based policy recommendations.

The report is structured in five key sections. Section 2 analyzes SME productivity and innovation trends, examining labor productivity, total factor productivity, and R&D investment patterns. Section 3 evaluates government policies supporting SME innovation, including supply-side, demand-side, and systemic technology initiatives. Section 4 presents an empirical analysis of digital technology adoption, highlighting disparities between SMEs and large enterprises while

featuring successful transformation cases. Section 5 synthesizes key findings and offers strategic policy recommendations for fostering sustainable SME growth.

Through this analysis, the study aims to provide actionable insights for policymakers and stakeholders, addressing critical challenges in technological adoption, regional development, and innovation capacity. The findings and recommendations are particularly relevant for developing economies seeking to strengthen their SME sectors and enhance global competitiveness.

Overview of Productivity and Innovation Among SMES

Section 2 presents a comprehensive analysis of productivity and innovation trends among ROC's SMEs, defined as businesses with paid-in capital under TWD100 million or fewer than 200 regular employees. Despite economic challenges, including a slowdown in ROC's growth rate from 6.53% in 2021 to 2.35% in 2022, SMEs demonstrated remarkable resilience, maintaining their dominant position at 98.90% of all enterprises.

The productivity analysis reveals divergent patterns between labor productivity (LP) and TFP from 1998 to 2022. While LP showed consistent upward momentum, reaching TWD4.80 million per person in 2022, TFP exhibited considerable volatility, peaking at 18.25 in 2010 before declining to 9.43 in 2022. This disparity suggests that while SMEs successfully enhanced their labor efficiency, they faced challenges in optimizing overall resource utilization.

R&D investment trends indicate steady growth in absolute terms, with SME R&D expenditure rising from TWD455.58 billion to TWD686.75 billion between 2012 and 2021. However, SMEs' share of total corporate R&D spending decreased from 14.14% to 9.93% during this period, reflecting accelerated R&D investments by larger firms. R&D intensity (R&D expenditure to sales ratio) showed an overall upward trend from 0.76% in 1998 to 1.09% in 2022, though experiencing a slight decline from its 2019 peak of 1.19%.

The innovation analysis, based on the Third Industrial Innovation Survey (TIS3), revealed significant sectoral variations in innovation patterns. Of the 13,841 firms surveyed, 70.2% reported active engagement in innovation activities. The manufacturing sector demonstrated higher innovation rates compared to services, with 49.80% of manufacturing firms engaging in technological innovation versus 23.74% of service firms. Among specific industries, electronic component manufacturing and financial services showed particularly strong innovation performance, with technological innovation rates of 66.92% and 62.5% respectively.

The study also examined collaboration patterns in innovation, finding robust engagement across different partnership types. Equipment suppliers (58.89%), customers (66.42%), and institutional partners (universities at 65.06% and government organizations at 66.22%) emerged as key collaboration sources. Sectoral analysis revealed that manufacturing firms showed stronger customer collaboration (69.29%) compared to service firms (63.69%), while service firms demonstrated higher competitor collaboration rates (44.42% versus 41.86%). These findings highlight the complex and interconnected nature of ROC's SME innovation ecosystem, characterized by diverse collaborative relationships and sector-specific innovation strategies.

Overview of Analysis of Policies to Boost SME Innovation and Technological Capabilities

Section 3 presents a comprehensive analysis of ROC's policies aimed at boosting SME innovation and technological capabilities through three main approaches: supply-side, demand-side, and systemic technology policies.

The supply-side technology policies are anchored by several key programs. The ROC's Small Business Innovation Research (SBIR) program, launched in 1998, provides subsidies covering up to 50% of R&D costs across different phases, from concept development to commercialization. Despite pandemic-related challenges during 2020–2023, the program demonstrated resilience, with government subsidies reaching TWD2.58 billion and supporting 212 approved innovation projects in 2022. The Industrial Technology Development Program (ITDP), which evolved into the A+ Industrial Innovation R&D Program in 2014, represents another significant initiative focusing on forward-looking technologies, R&D center establishment, and global innovation partnerships. The program has shown substantial growth, particularly in the semiconductor sector through the IC Design Summit Subsidy Program, with funding levels experiencing a significant upward trajectory from 2022 onward. The SME Credit Guarantee Fund (SMEG) has been instrumental in facilitating SME access to financing, with the number of credit guarantee recipients growing from 100,714 in 2018 to 186,953 in 2022.

The demand-side technology policy, implemented through Public Procurement for Innovation (PPI), was launched in 2018 with the ROC's Startup Procurement Program. This initiative creates pathways for startups to introduce innovative solutions aligned with public sector requirements through two key mechanisms: the Mature Support Program and the R&D Support Program. The program has shown steady growth in proposal submissions and approvals between 2018 and 2023, though a notable policy shift occurred in 2024 with increased submissions but no approvals.

The ROC's systemic technology policy framework is built around a network of 16 Government-Sponsored Research Institutes (GSRIs) under the Ministry of Economic Affairs (MOEA). The Local Industrial Innovation Engine Program (LIIEP) serves as a cornerstone initiative, organizing R&D alliances in less-developed regions and mobilizing GSRIs to share resources with local firms. This approach is complemented by regional innovation centers and specialized programs focusing on digital innovation, creative industries, and international market expansion. The system is distinguished by its hierarchical support structure, regional integration mechanisms, and emphasis on cross-sector collaboration, creating a comprehensive ecosystem that effectively promotes industrial innovation while addressing regional development needs and supporting traditional industries.

This multi-faceted policy approach demonstrates the ROC's commitment to fostering a robust innovation ecosystem that supports SMEs across various stages of development while ensuring balanced regional growth and technological advancement. The success of these initiatives is evidenced by increased participation rates, substantial financial support, and positive economic outcomes across multiple sectors.

Overview of Digital Technology Adoption and Innovation Capabilities of ROC's SMEs

Section 4 presents a comprehensive empirical analysis of digital technology adoption and innovation capabilities among ROC's SMEs from 2021 to 2023. The study examines the digital transformation experiences of SMEs compared to large enterprises, focusing on investment patterns, tool adoption rates, and operational outcomes within ROC's business landscape, where SMEs constitute 98.9% of enterprises and employ 80.9% of the workforce.

The analysis reveals significant disparities between SMEs and large enterprises in their digital transformation journeys. While large enterprises typically invest over TWD1 million annually in digital initiatives with comprehensive strategies, nearly half of SMEs (48.5%) allocate less than TWD500,000 annually, leading to more fragmented and tactical approaches. The government has responded with targeted initiatives, including the Project for Assisting Small and Micro Enterprises in Digital Transformation and the Micro-enterprises Digital Application Coaching Program, designed to bridge this digital divide.

Sector-specific analysis shows varying adoption rates across industries. In manufacturing, supply chain management system adoption increased from 18.5% to 24.7%, while the retail and service sector demonstrated stronger progress, with customer relationship management (CRM) adoption rising from 38.0% to 51.7%. The study identifies persistent challenges, including financial constraints, skill gaps, and technological barriers, with SMEs consistently trailing large enterprises in adopting advanced technologies like AI and IoT (15.6% vs. 62.0% adoption rates by 2023).

The research includes a detailed case study of Taiwan Lung Meng Advanced Composite Materials, a manufacturer of environmentally friendly paper products, demonstrating successful digital transformation through government support. The company's experience highlights how policy initiatives can effectively enable SMEs to overcome resource constraints and achieve significant technological advancement, resulting in doubled production capacity and improved operational efficiency.

Looking forward, the study emphasizes the need for continued policy support and strategic initiatives to ensure SMEs remain competitive. The government has set ambitious targets for 2026, including increasing advanced tool adoption from 15.6% to 40.0% among SMEs. The analysis concludes that success in digital transformation requires sustained focus on inclusivity, innovation, and sustainability, supported by stronger public-private collaboration and targeted policy interventions to address persistent gaps between SMEs and large enterprises.

Overview of conclusion and policy recommendations

Section 5.1 presents comprehensive findings from the evaluation of ROC's SMEs during 2021-2023, highlighting key developments in innovation, digital transformation, and policy effectiveness.

In terms of innovation and R&D investment, SMEs demonstrated resilience by maintaining an R&D intensity of 1.09% by 2022, despite economic challenges. However, significant disparities exist between SMEs and large enterprises in R&D capabilities. Government programs like SBIR and ITDP have been crucial in supporting SMEs' innovation efforts, though the declining share of SMEs in overall corporate R&D expenditure indicates persistent challenges in maintaining long-term R&D investments.

Digital technology adoption patterns reveal a strategic shift among SMEs, with basic tool usage declining from 73.3% to 67.6% while advanced technology adoption, including AI and IoT, grew by 39.3%. Notable regional disparities emerged, with northern ROC achieving a 54.3% digital adoption rate compared to 33.5% in southern ROC and 21.9% in eastern ROC. The case of Taiwan Lung Meng Advanced Composite Materials exemplifies successful digital transformation, demonstrating how government support can enable significant operational improvements.

Policy implementation outcomes show mixed results. While supply-side initiatives like SBIR and SMEG have effectively supported innovation and financing, with SMEG facilitating TWD22.6417 trillion in loans across 8.28 million cases by 2022, benefits have been unevenly distributed. Larger firms and those in well-developed regions have gained more advantages from these programs, highlighting the need for more targeted support for smaller SMEs and businesses in underdeveloped areas.

The analysis of policy measures reveals a sophisticated framework combining supply-side, demand-side, and systemic approaches. Key programs include the ROC Startup Procurement Program, Regional Innovation and Research Parks/Centers Program, and Digital Innovation Initiatives. These initiatives have created an interconnected innovation ecosystem, though future policies need to focus on enhancing connectivity between innovation centers and expanding support for traditional industries to ensure more balanced development across all regions and sectors.

Main policy recommendations:
Section 5.2 presents comprehensive strategic policy recommendations based on ROC's successful experience in supporting SMEs, which account for 98% of all businesses and employ 80% of the workforce. The recommendations focus on three key areas: modifications to existing policies, new initiatives, and institutional reforms.

For existing policies, the recommendations include enhancing the SBIR program by increasing subsidy rates from 50% to 70% for high-risk innovation projects, particularly in strategic sectors like semiconductors and biotechnology. The SME Credit Guarantee Fund should be reformed to provide 90% guarantee coverage for underserved areas and implement region-specific credit assessment standards. Digital transformation support should be strengthened through a targeted voucher system for advanced technologies and the establishment of regional digital transformation demonstration centers.

New policy initiatives focus on three major programs: the Regional Innovation Hub Network, which aims to establish physical centers in underserved areas equipped with advanced manufacturing tools and industry specialists; the Green Technology Transition Fund, offering up to 70% subsidies for environmentally friendly technology adoption; and the Cross-Border SME Innovation Alliance Program, designed to facilitate international collaboration and market access.

To resolve institutional obstacles, the recommendations propose establishing a Digital Economy Coordination Committee to improve interdepartmental coordination, creating Regional Digital Innovation Councils to address local challenges, and developing a unified digital service platform to streamline access to government resources. These recommendations aim to achieve three main goals: bridging urban-rural divides, enhancing digital and green transformation, and strengthening global competitiveness.

The policy framework emphasizes feasibility through phased implementation, clear prioritization of sectors and regions, and collaboration with international development agencies. The recommendations are designed to be adaptable for developing economies, providing a practical roadmap for fostering SME innovation and inclusive economic growth while addressing regional disparities and sustainability challenges.

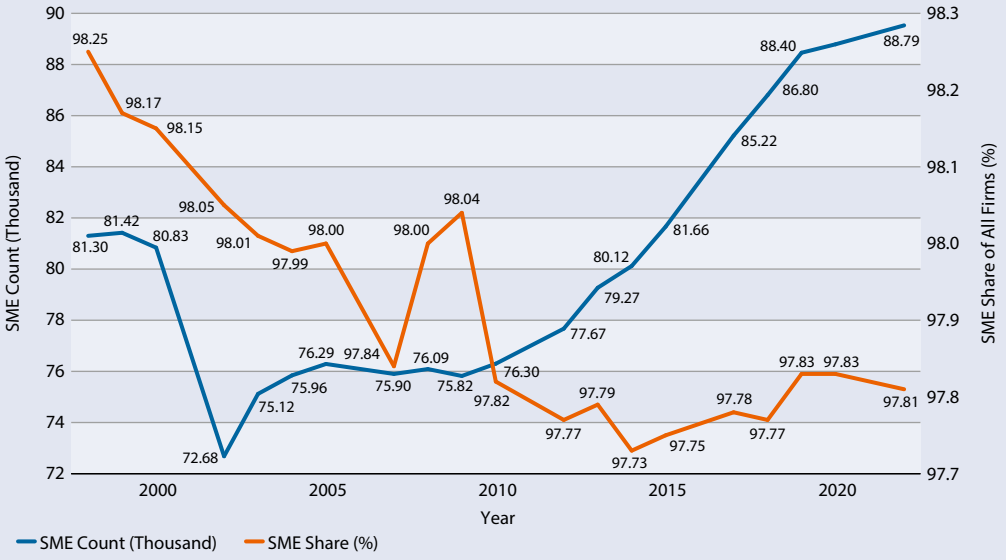
Report of SMEs' R&D Investment in ROC

INTRODUCTION

In recent years, ROC has demonstrated remarkable economic resilience, emerging as a leader in global competitiveness despite significant challenges. With a robust GDP growth rate of 2.45% in 2022 and consistent top rankings in the IMD Global Competitiveness Report, ROC's economic strength is particularly evident in its SME sector. SMEs, accounting for 98% of all enterprises and employing 80% of the workforce, serve as the backbone of ROC's economy, contributing over 50% of market share and achieving a 7% annual export growth rate in 2022, as detailed in Figure 1.

FIGURE 1

OVERVIEW OF ROC SMES



Source: Reproduced with permission from MOEA (n.d.a).
Notes: Missing data include 2001, 2006, 2011, 2016 and 2021.

However, the COVID-19 pandemic served as a catalyst that not only exposed existing weakness in the SME sector but also intensified structural and technological challenges that continue to reshape the global business landscape. According to a July 2021 survey by the *Economic Daily News* (2021), 80.7% of ROC's SMEs reported revenue declines, while 62.7% experienced reduced order volumes. Beyond these immediate economic impacts, the pandemic also accelerated the adoption of new consumption patterns, many of which are anticipated to persist in the post-pandemic era. These enduring shifts continue to challenge traditional business models. Moreover, the pandemic has compounded long-standing structural pressures on global supply chains. These include escalating trade tensions, heightened geopolitical risks, rising costs of raw materials and transportation, and increasing environmental awareness. Together, these factors have reshaped the configuration of global supply chains and imposed complex, multidimensional challenges on SMEs. These developments highlight a significant research gap: how SMEs in the ROC can strengthen their innovation capacity and leverage emerging technologies to sustain competitiveness in an increasingly digital and interconnected global economy.

This study addresses this gap by examining the performance, challenges, and opportunities of ROC's SME sector between 2021 and 2023, with particular emphasis on innovation and productivity dynamics. The research focuses on three critical dimensions: labor productivity, total factor productivity, and research and development (R&D) investments. Of particular interest is the digital transformation journey undertaken by ROC SMEs during this period, marked by the adoption of advanced technologies such as AI, IoT, and enterprise resource planning systems.

The primary objectives of this research are to:

1. Analyze productivity and innovation trends through examination of labor productivity, TFP, and R&D investments
2. Evaluate the progress and impact of digital transformation across different sectors
3. Assess the effectiveness of government support programs in enhancing SMEs' technological capabilities
4. Develop evidence-based policy recommendations for improving SME competitiveness

This research contributes to both academic literature and policy development by providing a comprehensive analysis of how sector-specific priorities, such as supply chain digitalization in manufacturing and customer relationship management in retail, influence adoption patterns and productivity outcomes. Additionally, it critically assesses key government initiatives, including the Small Business Innovation Research (SBIR) program and the SME Credit Guarantee Fund, identifying gaps and proposing actionable recommendations to enhance policy efficacy.

The remainder of this paper is organized as follows: Section 2 presents an overview of productivity and innovation among SMEs; Section 3 analyzes policies aimed at boosting SME innovation and technological capabilities; Section 4 examines the digital transformation of SMEs between 2021 and 2023; and Section 5 concludes with policy recommendations and future research directions.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

This section examines the productivity and innovation trends of ROC's SMEs within the framework established by the Standards for Identifying Small and Medium-sized Enterprises, revised by the MOEA on June 24, 2020. According to these standards, SMEs are defined as businesses with paid-in capital of less than TWD100 million or fewer than 200 regular employees. These criteria encompass a diverse spectrum of enterprises, from small retail establishments to medium-sized manufacturing firms.

The analysis of revenue figures, encompassing both domestic sales and exports, draws primarily from business tax filings and customs clearance data provided by the Ministry of Finance. It's important to note that these figures are subject to fluctuations due to factors such as exchange rate variability, data coverage limitations, and methodological differences in calculation. Export values derived from sales tax filings may occasionally diverge from other valuation methods, potentially resulting in minor statistical discrepancies.

The COVID-19 pandemic's impact in 2020 introduced additional complexity to SME performance analysis. Manufacturing firms, in particular, adopted various operational adjustments including reduced working hours, shortened shifts, or temporary closures. The anonymized nature of sales tax data, while protecting privacy, constrains our ability to track specific year-over-year changes for individual firms, especially those significantly affected by temporary shutdowns.

A crucial methodological consideration is that business taxation data often includes cascading calculations across supply chains—from raw material production through processing to final sales. This can result in aggregate figures higher than value-added calculations, which eliminate such duplications. Therefore, careful interpretation is required when comparing these metrics against broader economic indicators.

Employment data encompasses workers across SMEs, large enterprises, and approximately 1.021 million individuals in the public sector. The figures also account for workers registered in ROC but assigned to overseas operations in regions such as Mainland China, Hong Kong, and Macau, providing a comprehensive view of workforce distribution across domestic and international operations.

Despite a significant moderation in ROC's overall economic growth rate from 6.53% in 2021 to 2.35% in 2022, the SME sector demonstrated remarkable resilience. By the end of 2022, ROC's registered business count reached 1,652,038, marking a 2.40% year-over-year increase. SMEs maintained their dominant position in the business landscape, constituting 98.90% of all enterprises, with their absolute numbers increasing by 37,960 from 2021, representing an annual growth rate of 2.38% (Table 1).

TABLE 1

NUMBER OF ENTERPRISES, ANNUAL SALES, EMPLOYED PERSONS AND PAID EMPLOYEES IN ROC BY ENTERPRISE SIZE, 2021–2022

(Unit: Enterprises; million TWD; thousand persons; %)

Enterprise size / Year / Indicator	All enterprises		SMEs		Large enterprises	
	2021	2022	2021	2022	2021	2022
No. of enterprises	1,613,281	1,652,038	1,595,828	1,633,788	17,453	18,250
Share of total	100	100	98.92	98.9	1.08	1.1
Annual growth rate	3.04	2.4	3.03	2.38	3.87	4.57
Total sales	50,693,753	55,429,805	26,619,499	28,592,007	24,074,255	26,837,798
Share of total	100	100	52.51	51.58	47.49	48.42
Annual growth rate	16.19	9.34	13.01	7.41	19.93	11.48
Domestic sales	37,749,226	40,768,096	23,258,464	24,984,763	14,490,762	15,783,332
Share of total	100	100	61.61	61.29	38.39	38.71
Annual growth rate	13.1	8	11.49	7.42	15.79	8.92
Export sales	12,944,528	14,661,710	3,361,035	3,607,244	9,583,493	11,054,466
Share of total	100	100	25.96	24.6	74.04	75.4
Annual growth rate	26.25	13.27	24.75	7.33	26.79	15.35
No. of employed persons	11,447	11,418	9,200	9,132	1,222	1,265
Share of total	100	100	80.37	79.98	10.68	11.08
Annual growth rate	-0.5	-0.25	-1.19	-0.74	4.62	3.52
No. of paid employees	9,169	9,188	6,923	6,904	1,221	1,263
Share of total	100	100	75.5	75.14	13.32	13.75
Annual growth rate	-0.1	0.21	-0.9	-0.27	4.63	3.44

Source: Reproduced with permission from Fiscal Information Agency, Ministry of Finance (2021–2022), Directorate-General of Budget, Accounting and Statistics (DGBAS) (2021–2022).

Productivity Dynamics

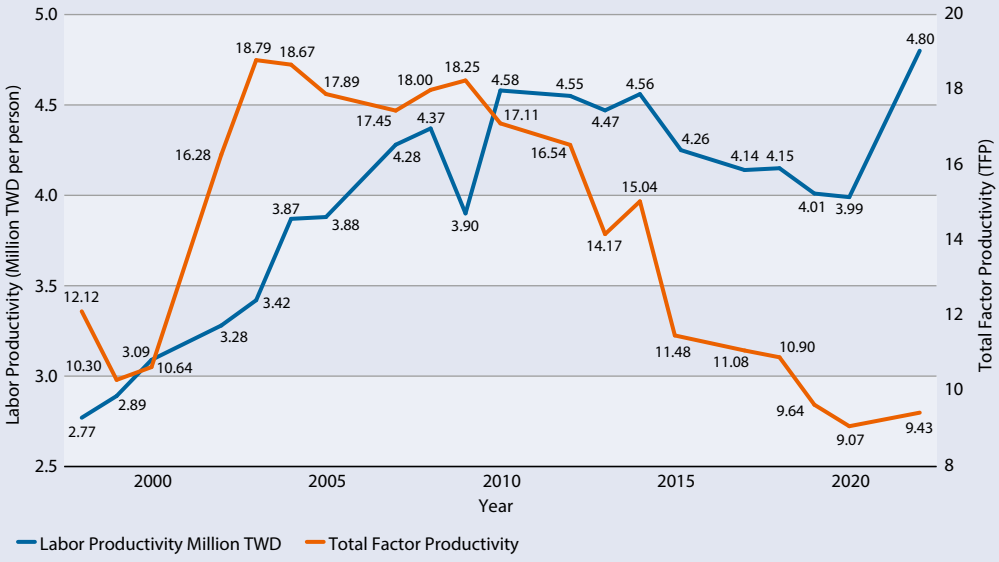
LP and TFP among ROC's SMEs exhibited distinct trajectories between 1998 and 2022, revealing important trends in the sector's efficiency and resource utilization. As shown in Figure 2, labor productivity (measured in million TWD per person) and total factor productivity followed notably different patterns over this period.

Labor productivity demonstrated consistent upward momentum, particularly after 2005. Following a period of relative stability from 2010 to 2020, LP experienced a marked acceleration, ultimately reaching its peak of TWD4.80 million per person in 2022. This steady improvement highlights the sector's growing capacity to enhance output per worker, driven by technological adoption, workforce development, and operational efficiency gains.

In contrast, total factor productivity exhibited considerable volatility. TFP experienced a sharp upward trend in the early 2000s, reaching its zenith of 18.25 in 2010. However, this was followed by a sustained decline, with TFP falling to its nadir of 9.07 in 2020. A modest recovery ensued, bringing TFP to 9.43 in 2022, though this level remains significantly below historical peaks, indicating persistent structural challenges within the SME sector.

FIGURE 2

LABOR PRODUCTIVITY AND TOTAL FACTOR PRODUCTIVITY OF SMES, 1998–2022



Source: Reproduced with permission from MOEA (n.d.a).
Notes: Missing data for 2001, 2006, 2011, 2016 and 2021.

The divergent trajectories of LP and TFP suggest a complex narrative: while ROC's SMEs have successfully enhanced their labor productivity, they continue to face substantial barriers in optimizing overall resource efficiency. The post-2014 decline in TFP, occurring alongside gains in LP, points to potential misalignments in capital allocation, innovation adoption, or integration of advanced technologies across production processes. This disparity underscores the critical need for targeted policy interventions to address these inefficiencies.

These productivity dynamics are further complicated by changes in the SME count and their share of total firms, which continue to represent a dominant portion of ROC's economy. While the increasing number of SMEs signifies sector growth, the challenges in improving TFP may constrain their ability to maintain long-term competitiveness and economic contributions.

To address the TFP gap, a dual focus on improving resource utilization and fostering innovation appears necessary. Policies aimed at enhancing technological integration, encouraging collaborative research initiatives, and streamlining operational processes could yield significant gains. Additionally, facilitating access to advanced tools and practices for smaller firms within the SME sector could drive substantial improvements in both efficiency and productivity metrics.

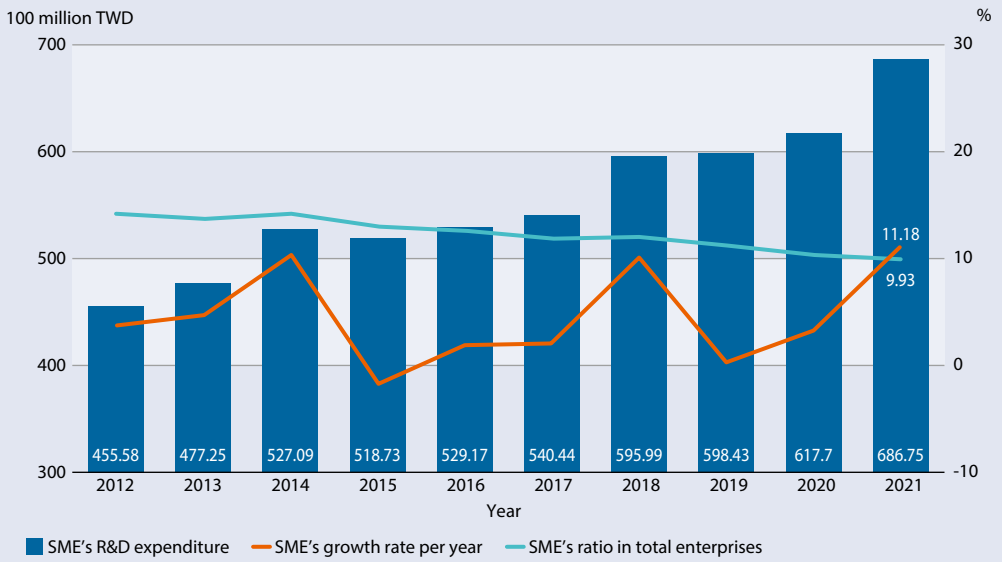
Trends in R&D Investment

R&D plays a pivotal role in sustaining the competitiveness and innovation capacity of ROC's SMEs. According to the Indicators of Science and Technology ROC 2022, published by the National Science and Technology Council (NSTC), total R&D expenditures in ROC reached TWD820.632 billion in 2021, with the corporate sector accounting for 84.28% of this investment. Within this framework, SMEs contributed TWD68.675 billion, representing 11.18% of overall R&D spending by enterprises. While the absolute value of R&D investments by SMEs has shown consistent growth over time, their proportion of corporate R&D expenditures has experienced a gradual decline—from 14.14% in 2012 to 9.93% in 2021.

Figure 3 illustrates the evolution of SME R&D expenditures and growth rates from 2012 to 2021. During this period, SME R&D expenditure demonstrated substantial growth, rising from TWD455.58 billion to TWD686.75 billion, reflecting a steady upward trajectory. However, the share of SMEs in total corporate R&D spending has progressively diminished, indicating accelerated R&D investments by larger firms.

FIGURE 3

OVERVIEW OF SMES' R&D EXPENDITURE, 2012–2021



Source: Reproduced with permission from National Science and Technology Council (2022).
Note: SMEs here are those enterprises with fewer than 200 employees.

Notable peaks in SME R&D growth occurred in 2018 and 2021, with annual growth rates exceeding 10%. These surges likely reflect the impact of policy-driven initiatives or sectoral shifts that incentivized innovation during these periods. Nevertheless, the overall decline in SMEs' relative contribution to corporate R&D underscores the competitive pressures posed by larger corporations with greater resources for scaling innovation.

Figure 4 provides insights into SMEs' R&D intensity—defined as the ratio of R&D expenditure to sales—between 1998 and 2022. This key indicator of innovation investment relative to revenue shows a gradual upward trend, increasing from 0.76% in 1998 to a peak of 1.19% in 2019. However, this ratio experienced a slight decline to 1.09% in 2022, potentially reflecting external challenges such as the COVID-19 pandemic and its impact on economic conditions.

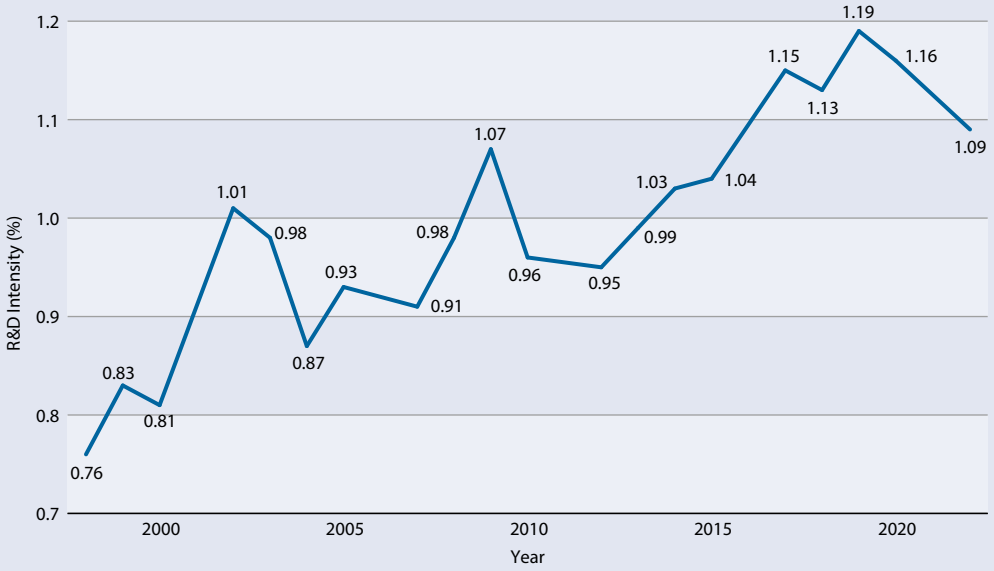
The historical trajectory reveals significant phases in R&D intensity development. The late 1990s and early 2000s witnessed a notable rise, with the ratio climbing from 0.76% in 1998 to 1.01% in 2000, suggesting heightened focus on innovation. The mid-2000s showed notable fluctuations, including declines to 0.87% in 2004 and 0.91% in 2007, before recovering to 1.07% in 2010. The period from 2010 to 2019 exhibited steady growth, culminating in the highest recorded intensity of 1.19%, indicating SMEs' strengthened commitment to innovation and development prior to external economic pressures.

While the upward trend in R&D intensity demonstrates growing investments in innovation, the post-2019 decline suggests vulnerabilities within the SME sector. The disruptions caused by the COVID-19 pandemic, including supply chain constraints and reduced revenue streams, likely impacted SMEs' ability to maintain consistent innovation efforts. Missing data for key years—2001,

2006, 2011, 2016, and 2021—presents challenges in interpreting long-term trends, creating gaps in understanding the complete trajectory of SME R&D performance.

FIGURE 4

OVERVIEW OF SMES' R&D INTENSITY, 1998–2022



Source: Reproduced with permission from MOEA (n.d.a).
Notes: Missing data include 2001, 2006, 2011, 2016 and 2021. (R&D Expenditure/ Sales)

Innovation of SMEs in ROC

From 2010 to 2012, ROC implemented its TIS3, with a strategic focus on SMEs. The survey aimed to assess the adoption rates of both technological and non-technological innovations across the industrial sector and provide comprehensive analysis of innovation activities. Aligned with the Community Innovation Survey 2008 (CIS2008) and Oslo Manual (2005) frameworks, the study conceptualized innovation as the implementation of novel technologies or management practices designed to enhance firm performance and revenue generation.

The survey adopted a holistic approach to innovation, encompassing the development and implementation of new materials, processes, products, organizational structures, and market strategies. Innovation activities were classified into two primary categories: technological and non-technological (managerial) innovations. The technological category comprised product and process innovations, while non-technological innovations encompassed organizational and marketing innovations that did not involve technical modifications.

The TIS3 collected data from a representative sample of 13,841 firms, with 9,715 firms (70.2%) reporting active engagement in innovation activities. The subsequent analysis focuses on two critical dimensions of innovation: (1) the sources and drivers of technological innovation and (2) patterns of innovation collaboration among surveyed firms.

The sources of technological innovation:
This study evaluates the technological innovation performance of ROC enterprises through four distinct metrics: Technological Innovation (TI), Narrow Technological Innovation (NAR_TI), Narrow Innovation Intensity, and Broad Innovation Intensity.

Technological Innovation comprises two primary dimensions: product and process innovation. Product innovation encompasses the introduction of new or significantly improved goods or services. In the manufacturing sector, this involves the development of technically novel or substantially enhanced products, while in the service sector, it refers to the implementation of new or significantly improved front-end services in terms of design or content. A firm is designated as product innovative if it reports at least one such activity during the survey period. Process innovation involves the implementation of new or significantly improved methodologies. In manufacturing, this includes innovations in production systems, logistics networks, or operational support functions (e.g., maintenance and information management). In services, process innovation manifests as advancements in back-end operations supporting front-end service delivery. Firms reporting at least one such activity are classified as process innovative. A firm achieves TI status by demonstrating either or both forms of innovation.

Narrow Technological Innovation represents a more focused metric that specifically examines technically novel or significantly improved process innovations. For manufacturing firms, this metric exclusively considers innovations in production methodologies, while for service firms, it focuses on back-end process improvements directly supporting front-end service delivery. This refined definition distinguishes NAR_TI from the broader TI metric through its emphasis on technical advancement in process implementation.

The study also incorporates two measures of innovation intensity. Narrow Innovation Intensity measures the proportion of sales revenue generated from products or services that represent market-level innovations. Broad Innovation Intensity captures the percentage of sales revenue derived from products or services that are new or significantly improved from the firm's perspective, regardless of their market novelty.

Analysis of the survey data reveals distinct patterns in innovation activities across ROC enterprises. As detailed in Table 2, of the total sample, 21.36% (2,957 firms) demonstrated market-level innovation, as indicated by positive Narrow Innovation Intensity values. A larger proportion, 24.90% (3,446 firms), reported firm-level innovations, suggesting that 3.54% of firms achieved firm-level improvements without introducing market novelties. When including process innovations not directly linked to sales revenue, 34.14% (4,725 firms) exhibited Technological Innovation. Within this group, 30.21% (4,182 firms) achieved Narrow Technological Innovation, indicating substantial engagement in significant process improvements.

These findings, illuminate the diverse innovation strategies employed by ROC enterprises and their differential contributions to firm-level and market-level advancement during the study period. This comprehensive assessment underscores the vital role of both product and process innovations in driving technological progress across industrial sectors.

TABLE 2

PATTERNS OF TECHNOLOGICAL INNOVATION (N=13,841)

All Industries	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	4725	4182	2957	3446
Proportion of Firms with Innovation	34.14%	30.21%	21.36%	24.90%
Average Innovation Intensity	—	—	26.94%	48.38%

Source: Reproduced with permission from Wu Se-hua (2013).

To examine the heterogeneity across specific industries, the full sample was divided into manufacturing and service sectors. Within the manufacturing sector, 1,636 firms (29.63%) reported launching products that were entirely new to the market, as indicated by a Narrow Innovation Intensity greater than zero. Meanwhile, 1,812 firms (32.81%) introduced products that were new or significantly improved from their own perspective, but not necessarily novel in the market, as reflected by a Broad Innovation Intensity greater than zero. This indicates that 2.47% of firms (32.81% 29.63%) innovated at the firm level without achieving market-level novelty. These findings are summarized in Table 3.

TABLE 3

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS THE MANUFACTURING SECTOR (N=5,522)

Manufacturing Sector	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	2750	2407	1636	1812
Proportion of Firms with Innovation	49.80%	43.59%	29.63%	32.81%
Average Innovation Intensity	—	—	25.66%	49.85%

Source: Reproduced with permission from Wu Se-hua (2013).

When process innovations that do not directly reflect in sales are included, the number of firms successfully engaging in Technological Innovation, encompassing both product and process innovation, rises to 2,750 (49.80%). Similarly, 2,407 firms (43.59%) successfully engaged in Narrow Technological Innovation, which includes product and specific process innovations.

In the service sector, analysis revealed distinct patterns of innovation adoption. Among the surveyed firms, 1,321 (15.88%) introduced market-novel products, as measured by positive Narrow Innovation Intensity values. A larger segment of 1,624 firms (19.52%) developed products that were new or significantly improved from their organizational perspective, though not necessarily novel to the market, as indicated by positive Broad Innovation Intensity values. The differential between these percentages (3.64%) represents firms achieving firm-level innovation without market-level novelty. Table 4 presents these findings in detail.

TABLE 4

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS THE SERVICE SECTOR (N=8319)

Service Sector	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	1975	1775	1321	1624
Proportion of Firms with Innovation	23.74%	21.34%	15.88%	19.52%
Average Innovation Intensity	—	—	28.51%	48.85%

Source: Reproduced with permission from Wu Se-hua (2013).

The innovation landscape expands notably when considering process innovations without direct sales impact. The total number of firms successfully implementing Technological Innovation—encompassing both product and process innovations—reached 1,975 (23.74%). Within this group, 1,775 firms (21.34%) achieved Narrow Technological Innovation, which specifically combines product innovation with targeted process improvements.

To examine industry heterogeneity, the analysis encompassed six major sectors in ROC: textile industry; metal product manufacturing; electronic component manufacturing; computer, electronic and optical product manufacturing; retail trade; and financial and insurance services.

Within the textile industry, innovation patterns revealed significant variations. A substantial portion—63 firms (36.21%)—introduced market-novel products, as measured by positive Narrow Innovation Intensity values. An even larger segment of 105 firms (60.34%) developed products that were new or significantly improved from their organizational perspective, though not necessarily novel to the market, as indicated by positive Broad Innovation Intensity values. The differential between these percentages (24.14%) represents firms achieving firm-level innovation without market-level novelty. These findings are detailed in Table 5.

TABLE 5

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS THE TEXTILE INDUSTRY (N=174)

Textile Industry	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	87	80	63	105
Proportion of Firms with Innovation	50%	45.98%	36.21%	60.34%
Average Innovation Intensity	—	—	26.60%	32.68%

Source: Reproduced with permission from Wu Se-hua (2013).

When considering process innovations without direct sales impact, half of the sampled firms (87; 50%) successfully implemented Technological Innovation, which encompasses both product and process innovations. Similarly, 80 firms (45.98%) achieved Narrow Technological Innovation, combining product innovation with specific process improvements.

In the metal product manufacturing industry, analysis revealed distinct patterns of innovation intensity. Of the sampled firms, 100 (19.23%) introduced market-novel products, as measured by positive Narrow Innovation Intensity values. A slightly larger group of 112 firms (21.54%) developed products that were new or significantly improved from their organizational perspective, though not necessarily novel to the market, as indicated by positive Broad Innovation Intensity values. The differential between these percentages (2.31%) represents firms achieving firm-level innovation without market-level novelty. Table 6 presents these findings in detail.

TABLE 6

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS THE METAL PRODUCT MANUFACTURING INDUSTRY (N=520)

Metal Product Manufacturing Industry	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	197	158	100	112
Proportion of Firms with Innovation	37.88%	30.38%	19.23%	21.54%
Average Innovation Intensity	—	—	19.10%	38.09%

Source: Reproduced with permission from Wu Se-hua (2013).

The scope of innovation broadens considerably when considering process innovations without direct sales impact. The total number of firms successfully implementing Technological Innovation—encompassing both product and process innovations—reached 197 (37.88%). Within this group, 158 firms (30.38%) achieved Narrow Technological Innovation, which specifically combines product innovation with targeted process improvements.

The electronic component manufacturing industry exhibits substantial innovation activity across multiple dimensions. Market-level innovation, measured by positive Narrow Innovation Intensity, was achieved by 40.03% of firms (265 firms). A higher proportion of firms (44.86%, 297 firms) demonstrated firm-level innovation capabilities, as indicated by positive Broad Innovation Intensity. The differential between these metrics (4.83%) represents firms that successfully implemented firm-level innovations without achieving market novelty.

When incorporating process innovations not directly reflected in sales metrics, the sector's innovation profile expands significantly. Total Technological Innovation, encompassing both product and process innovations, reached 66.92% (443 firms). Within this group, 54.38% (360 firms) achieved Narrow Technological Innovation, indicating substantial engagement in specific process improvements alongside product innovation. These findings, detailed in Table 7, suggest a robust innovation ecosystem within the electronic component manufacturing sector, characterized by high rates of both product development and process advancement.

TABLE 7

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS ELECTRONIC COMPONENT MANUFACTURING (N=662)

Electronic Component Manufacturing	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	443	360	265	297
Proportion of Firms with Innovation	66.92%	54.38%	40.03%	44.86%
Average Innovation Intensity	—	—	22.44%	47.05%

Source: Reproduced with permission from Wu Se-hua (2013).

The computer, electronic product, and optical product manufacturing industry demonstrates robust innovation performance across multiple metrics. As detailed in Table 8, a substantial proportion of firms (44.84%, 165 firms) achieved market-level innovation, as evidenced by positive Narrow Innovation Intensity values. The sector showed slightly higher performance in firm-level innovation, with 47.55% (175 firms) reporting new or significantly improved products from their organizational perspective in terms of broad innovation. The modest differential between these metrics (2.71%) represents firms that achieved firm-level innovations without introducing market novelties.

TABLE 8

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS COMPUTER, ELECTRONIC PRODUCT, AND OPTICAL PRODUCT MANUFACTURING (N=368)

Computer, Electronic Product, and Optical Product Manufacturing	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	246	223	165	175
Proportion of Firms with Innovation	66.85%	60.60%	44.84%	47.55%
Average Innovation Intensity	—	—	21.29%	47.94%

Source: Reproduced with permission from Wu Se-hua (2013).

The inclusion of process innovations not directly linked to sales revenue significantly elevates the sector's innovation profile. Total Technological Innovation, encompassing both product and process innovations, reached 66.85% (246 firms). A considerable portion of these innovative firms (60.60%, 223 firms) achieved Narrow Technological Innovation, indicating substantial engagement in specific process improvements alongside product innovation. These findings suggest a highly dynamic innovation ecosystem within the sector, characterized by significant rates of both market-level novelty and process advancement.

Analysis of innovation patterns in the retail industry reveals moderate levels of innovation activity across multiple dimensions. As detailed in Table 9, market-level innovation, measured by positive Narrow Innovation Intensity, was achieved by 15.06% of firms (413 firms). A larger proportion of firms (19.00%, 521 firms) demonstrated firm-level innovation capabilities, as indicated by positive Broad Innovation Intensity. The differential between these metrics (3.94%) represents firms that successfully implemented firm-level innovations without achieving market novelty.

TABLE 9

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS RETAIL (N=662)

Retail	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	648	583	413	521
Proportion of Firms with Innovation	23.63%	21.26%	15.06%	19.00%
Average Innovation Intensity	—	—	26.28%	49.40%

Source: Reproduced with permission from Wu Se-hua (2013).

The inclusion of process innovations not directly reflected in sales metrics substantially enhances the sector's innovation profile. Total Technological Innovation, encompassing both product and process innovations, reached 23.63% (648 firms). Within this group, 21.26% (583 firms) achieved Narrow Technological Innovation, indicating significant engagement in specific process improvements alongside product innovation. These findings suggest that while the retail sector demonstrates lower overall innovation rates compared to some other industries, it maintains a substantial focus on process improvements and organizational adaptation.

Analysis of the financial, insurance, and securities industry reveals distinct innovation patterns. As detailed in Table 10, a substantial proportion—413 firms (58.70%)—demonstrated market-level innovation, as measured by positive Narrow Innovation Intensity values. The sector exhibited even stronger performance in firm-level innovation, with 223 firms (60.60%) developing products that were new or significantly improved from their organizational perspective, as indicated by positive Broad Innovation Intensity values. The differential between these percentages (1.90%) represents firms achieving firm-level innovation without market-level novelty.

TABLE 10

PATTERNS OF TECHNOLOGICAL INNOVATION ACROSS FINANCE (N=368)

Finance	Technological Innovation	Narrow Technological Innovation	Narrow Innovation Intensity	Broad Innovation Intensity
Number of Firms with Innovation	230	225	216	223
Proportion of Firms with Innovation	62.5%	61.14%	58.70%	60.60%
Average Innovation Intensity	—	—	23.42%	41.90%

Source: Reproduced with permission from Wu Se-hua (2013).

The sector's innovation profile becomes more pronounced when considering process innovations without direct sales impact. The number of firms successfully implementing Technological Innovation—encompassing both product and process innovations—reached 230 (62.50%). Within this group, 225 firms (61.14%) achieved Narrow Technological Innovation, which specifically combines product innovation with targeted process improvements. These findings indicate a robust innovation ecosystem in the financial sector, characterized by high rates of both market-level novelty and process advancement.

Innovation Collaboration:
This section examines the collaborative R&D ecosystem in ROC, focusing on partnerships among industry, government, academia, and research institutions across various sectors. From a total sample of 13,841 firms spanning multiple industries, 9,715 firms reported engagement in "at least one innovation activity." This subset of innovation-active firms forms the basis for analyzing collaborative innovation patterns.

The study categorizes potential innovation partners into five distinct groups: equipment, material, or software suppliers (COSUP); customers or consumers (COCUS); competitors (COCOM); universities or other higher education institutions (COUNI); and government or nonprofit research organizations (COGMT). This classification enables systematic analysis of collaboration patterns across different partnership types.

Analysis of collaboration patterns, presented in Table 11, reveals substantial engagement across all partnership categories among innovation-active firms. Equipment, material, or software supplier partnerships (COSUP) were established by 58.89% of firms, while customer collaborations (COCUS) reached 66.42%. Competitor partnerships (COCOM), though less prevalent, still involved 43.17% of firms. Notably, institutional collaborations showed strong representation, with 65.06% of firms engaging with universities or higher education institutions (COUNI) and 66.22% partnering with government or nonprofit research organizations (COGMT). These findings indicate a robust and diversified collaborative innovation ecosystem within ROC's industrial landscape.

TABLE 11

INNOVATION COLLABORATION (N=9,715): TYPE OF PARTNER

	COSUP	COCUS	COCOM	COUNI	COGMT
Number of Innovation Collaboration	5,721	6,453	4,194	6,321	6,433
Proportion of Firms with Innovation Collaboration (%)	58.89%	66.42%	43.17%	65.06%	66.22%

Source: Reproduced with permission from Wu Se-hua (2013).

An analysis of firms' collaborative partnerships, as presented in Table 12, reveals intricate patterns of multi-partner engagement across ROC's industrial ecosystem. Among the surveyed 9,715 firms, suppliers (COSUP) emerged as a prominent collaboration category, with 5,721 firms (58.89%) engaging in such partnerships. Customer collaboration (COCUS) showed even higher prevalence, involving 6,453 firms (66.42%), highlighting the significant role of market-oriented partnerships.

The data demonstrates substantial cross-category collaboration. For instance, 4,528 firms (46.61%) engaged simultaneously with both suppliers and customers, indicating strong vertical integration in collaborative networks. Competitor collaboration (COCOM) was reported by 4,194 firms (43.17%), with notable overlap in supplier partnerships (3,571 firms, 36.76%) and customer relationships (3,565 firms, 36.70%).

TABLE 12

INNOVATION COLLABORATION (N=9,715): MULTIPLE COLLABORATIVE PARTNERS

	COSUP	COCUS	COCOM	COUNI	COGMT
COSUP	5,721				
Proportion of Firms with Innovation Collaboration (%)	58.89%				
COCUS	4,528	6,453			
Proportion of Firms with Innovation Collaboration (%)	46.61%	66.42%			
COCOM	3,571	3,565	4,194		
Proportion of Firms with Innovation Collaboration (%)	36.76%	36.70%	43.17%		
COUNI	4,419	5,147	3,495	6,321	
Proportion of Firms with Innovation Collaboration (%)	45.49%	52.98%	35.98%	65.06%	
COGMT	4,479	5,161	3,477	5,273	6,433
Proportion of Firms with Innovation Collaboration (%)	46.10%	53.12%	35.79%	54.28%	66.22%

Source: Reproduced with permission from Wu Se-hua (2013).

Academic partnerships (COUNI) represented another significant collaborative dimension, with 6,321 firms (65.06%) engaging with universities or research institutions. These academic collaborations frequently intersected with customer partnerships (5,147 firms, 52.98%) and supplier relationships (4,419 firms, 45.49%). Government institution partnerships (COGMT) showed similar patterns, involving 6,433 firms (66.22%), with substantial overlap in customer collaborations (5,161 firms, 53.12%) and academic partnerships (5,273 firms, 54.28%).

This complex web of concurrent partnerships suggests that firms strategically cultivate diverse collaborative portfolios, leveraging complementary knowledge sources and capabilities across different partner types. The high degree of overlap between different partnership categories indicates that firms adopt a holistic approach to collaboration, rather than pursuing isolated partnerships, thereby potentially enhancing their innovation capabilities through multi-faceted knowledge exchange and resource sharing.

To investigate cross-industry heterogeneity in innovation partnerships, this study bifurcates the sample into manufacturing and service sectors. Table 13 and Figure 5 present a comparative analysis of innovation collaborations across these sectors, examining various partnership types and their respective frequencies.

TABLE 13

INNOVATION COLLABORATION MANUFACTURING VS SERVICE

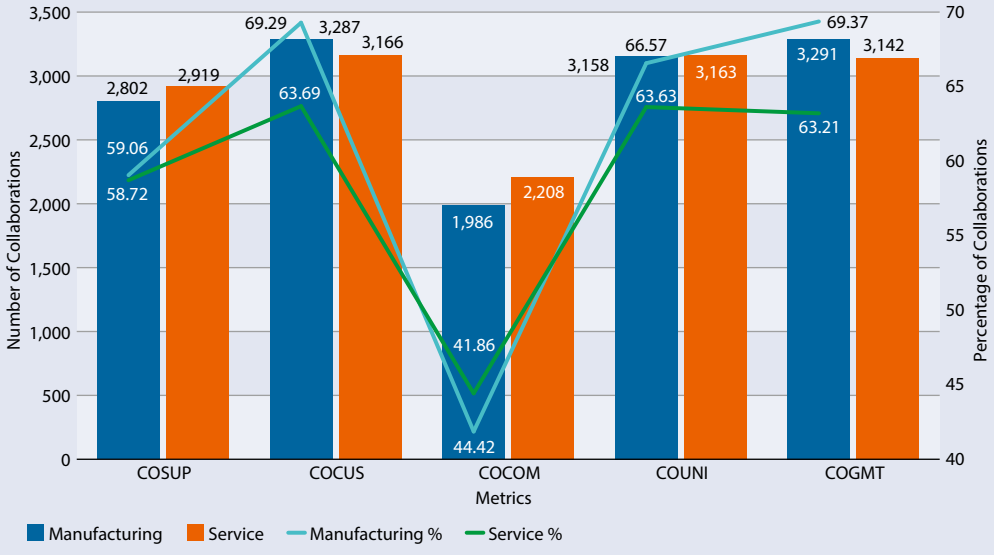
Manufacturing (N=4,744)	COSUP	COCUS	COCOM	COUNI	COGMT
Number of Innovation Collaboration	2,802	3,287	1,986	3,158	3,291
Proportion of Firms with Innovation Collaboration (%) in Manufacturing	59.06%	69.29%	41.86%	66.57%	69.37%
Service(N=4971)	COSUP	COCUS	COCOM	COUNI	COGMT
Number of Innovation Collaboration	2,919	3,166	2,208	3,163	3,142
Proportion of Firms with Innovation Collaboration (%) in Service	58.72%	63.69%	44.42%	63.63%	63.21%

Source: Reproduced with permission from Wu Se-hua (2013).

Analysis of supplier collaborations (COSUP) reveals comparable engagement levels between manufacturing (59.06%, 2,802 collaborations) and service sectors (58.72%, 2,919 collaborations), suggesting that supplier partnerships play an equally vital role in innovation processes across both sectors. However, customer collaborations (COCUS) demonstrate marked sectoral differences, with manufacturing industries showing substantially higher engagement (69.29%, 3,287 collaborations) compared to service industries (63.69%, 3,166 collaborations). This disparity indicates that manufacturing firms place greater emphasis on customer relationships as drivers of innovation, possibly reflecting the sector's need for direct customer input in product development and improvement processes.

FIGURE 5

INNOVATION COLLABORATION MANUFACTURING VS SERVICE



Source: Reproduced with permission from Wu Se-hua (2013).

Analysis of competitor collaborations (COCOM) reveals a distinctive pattern between sectors, with the service industry demonstrating higher engagement (44.42%, 2,208 collaborations) compared to manufacturing (41.86%, 1,986 collaborations). This heightened propensity for competitive collaboration in the service sector likely reflects the inherently collaborative nature of service innovation ecosystems, where shared knowledge and capabilities often drive value creation.

Academic partnerships (COUNI) demonstrate remarkable consistency across sectors, with manufacturing and service industries reporting comparable rates of university collaboration (66.57%, 3,158 collaborations and 63.63%, 3,163 collaborations, respectively). This convergence highlights the universal significance of academic partnerships as catalysts for innovation, transcending traditional sector boundaries.

Government collaboration patterns (COGMT) indicate stronger engagement within the manufacturing sector (69.37%, 3,291 collaborations) relative to services (63.21%, 3,142 collaborations). This disparity likely stems from the manufacturing sector's strategic alignment with public sector initiatives, particularly in areas of technological development, infrastructure enhancement, and policy-driven innovation programs. The differential may also reflect the historical emphasis of government support programs on manufacturing-based industrial development.

Moreover, this study segments ROC's industrial landscape into six major sectors to facilitate detailed analysis: textile industry, metal product manufacturing, electronic component manufacturing, computer/electronic/optical product manufacturing, retail industry, and financial/insurance/securities industry.

The analysis of collaboration patterns, presented in Table 14, reveals distinct sectoral variations in partnership strategies. The textile industry demonstrates a strong customer-oriented approach, with 65.16% of firms engaging in customer collaborations (COCUS). Institutional partnerships also play a significant role, with 66.45% of firms maintaining relationships with government or nonprofit research organizations (COGMT) and 57.42% collaborating with universities (COUNI). Supply chain collaboration is moderately strong, with 50.32% of firms engaging with suppliers (COSUP). Notably, competitive collaboration is relatively limited, with only 23.87% of firms partnering with competitors (COCOM), suggesting a more protective approach to innovation within this traditional manufacturing sector.

TABLE 14

INNOVATION COLLABORATION OF SIX MAJOR INDUSTRIES

Textile (N=155)	COSUP	COCUS	COCOM	COUNI	COGMT
Number of Innovation Collaboration	78	101	37	89	103
Proportion of Firms with Innovation Collaboration (%) in Textile	50.32%	65.16%	23.87%	57.42%	66.45%
Metal Product Manufacturing (N=439)	**COSUP**	**COCUS**	**COCOM**	**COUNI**	**COGMT**
Number of Innovation Collaboration	290	298	220	248	236
Proportion of Firms with Innovation Collaboration (%) in Metal Product Manufacturing	66.06%	67.88%	50.11%	56.49%	53.76%
Electronic Component Manufacturing (N=653)	**COSUP**	**COCUS**	**COCOM**	**COUNI**	**COGMT**
Number of Innovation Collaboration	398	404	191	405	486
Proportion of Firms with Innovation Collaboration (%) in Electronic Component Manufacturing	60.95%	61.87%	29.25%	62.02%	74.43%
Computer, Electronic, and Optical Product Manufacturing (N=360)	**COSUP**	**COCUS**	**COCOM**	**COUNI**	**COGMT**
Number of Innovation Collaboration	175	242	124	232	245
Proportion of Firms with Innovation Collaboration (%) in Computer, Electronic, and Optical Manufacturing	48.61%	67.22%	34.44%	64.44%	68.06%
Retail (N=1437)	**COSUP**	**COCUS**	**COCOM**	**COUNI**	**COGMT**
Number of Innovation Collaboration	895	1011	721	990	965
Proportion of Firms with Innovation Collaboration (%) in Retail Sector	62.28%	70.35%	50.17%	68.89%	67.15%
Financial (N=338)	**COSUP**	**COCUS**	**COCOM**	**COUNI**	**COGMT**
Number of Innovation Collaboration	229	213	128	291	284
Proportion of Firms with Innovation Collaboration (%) in Financial Sector	67.75%	63.02%	37.87%	86.09%	84.02%

Source: Reproduced with permission from Wu Se-hua (2013).

Analysis of innovation collaboration patterns reveals distinct sectoral variations across ROC's industrial landscape. The metal product manufacturing sector demonstrated robust external engagement, with customer partnerships (67.88%) and supplier collaborations (66.06%) forming the cornerstone of innovation activities. This sector also maintained substantial competitive cooperation (50.11%) while fostering meaningful relationships with academic institutions (56.49%) and government bodies (53.76%).

The electronic component manufacturing industry exhibited a different collaborative profile, characterized by exceptionally strong ties with government and nonprofit research organizations (74.43%). While maintaining substantial engagement with traditional value chain partners customers (61.87%) and suppliers (60.95%) this sector also developed significant academic partnerships (62.02%). Notably, competitive collaboration was less prevalent (29.25%), suggesting a more protective approach to proprietary innovation.

In the computer, electronic, and optical product manufacturing sector, institutional partnerships predominated, with government collaborations (68.06%) leading, followed closely by customer engagement (67.22%) and academic partnerships (64.44%). This sector showed relatively lower levels of supplier collaboration (48.61%) and competitive cooperation (34.44%), indicating a possible preference for institutional rather than industry-based innovation partnerships.

The retail sector demonstrated the strongest customer-centric approach, with the highest rate of customer collaboration (70.35%) among all sectors studied. This customer focus was complemented by substantial institutional partnerships with universities (68.89%) and government bodies (67.15%), while maintaining significant supplier engagement (62.28%) and competitive collaboration (50.17%).

The financial sector exhibited a distinctive collaboration pattern, marked by exceptionally high rates of institutional partnerships, 86.09% with universities and 84.02% with government or nonprofit organizations. While maintaining substantial supplier relationships (67.75%) and customer engagement (63.02%), this sector showed relatively modest competitive collaboration (37.87%), suggesting a preference for institutional knowledge transfer over industry-based innovation sharing.

ANALYSIS OF POLICIES TO BOOST SME INNOVATION AND TECHNOLOGICAL CAPABILITIES

Supply Side Technology Policy

Supply-side technology policies serve as critical instruments for stimulating innovation investment by addressing capital market imperfections and liquidity constraints. These policies encompass various mechanisms, including tax incentives, subsidies, low-interest loans, credit guarantees, and government equity participation. Beyond direct financial support, they facilitate indirect assistance through government-affiliated venture capital and comprehensive support for developing human capital essential to innovation from skilled workers to researchers.

ROC's implementation of supply-side technology policies reflects a strategic approach to fostering innovation through targeted government grant programs. At the heart of this framework lies the ROC SBIR program, launched in 1998 by the MOEA. The program operates through dual tracks: the national SBIR program and the Local SBIR program, each serving distinct but complementary roles in ROC's innovation landscape.

The ROC Small Business Innovation Research (SBIR) program

The SBIR program promotes four fundamental types of research and development: (1) creation of new ideas, concepts, or technologies; (2) novel applications of existing technologies; (3) implementation of new technologies or business models in existing applications; and (4) enhancement of existing technologies or products. SMEs can receive subsidies covering up to 50% of their R&D costs, provided they meet key eligibility criteria: classification as an SME under ROC's standards, absence of tax liabilities, and a clean record in government technology development programs over the past five years.

To ensure comprehensive coverage of innovation support needs, the program established the "Promotion of Innovative R&D for Local Industries Program" (Local SBIR) in 2008. While the national SBIR program focuses on broader technological advancement and innovation across industries, Local SBIR specifically targets the development of characteristic local industries through coordinated efforts between the MOEA and local governments. This dual-track approach creates a robust framework that addresses both national technological competitiveness and local economic development needs (Table 15).

TABLE 15

DESCRIPTION OF THE SBIR AND THE LOCAL SBIR

Item	SBIR	Local SBIR
Implementation	SMEs apply for R&D projects related to technology and product innovation; applications are submitted to the SBIR Program Office of the MOEA.	Coordinated by the MOEA with local governments, the program supports R&D projects focused on local characteristic industries; applications are submitted to the respective municipal, county, or city governments.

Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023)

The implementation structure of these programs reflects their distinct objectives. The national SBIR program processes applications through the SBIR Program Office of the MOEA, focusing on technology and product innovation across various sectors. In contrast, Local SBIR applications are managed by respective municipal, county, or city governments, ensuring that innovation support aligns with local industrial characteristics and development priorities. This differentiated yet complementary approach has proven effective in creating a comprehensive innovation support ecosystem that serves both national and local development goals.

The SBIR program's structure facilitates innovation through two primary application categories: individual applications and R&D alliances. Individual applications allow single companies to pursue R&D subsidies independently, while R&D alliances require collaboration between at least three members. These alliances, while primarily composed of SMEs, can include partnerships with academic institutions and other legal entities, both domestically and internationally. To maintain focus on SME development, at least half of alliance members must be SMEs.

The program supports two main project categories: Innovative Technologies and Innovative Services. The first category drives the development of cutting-edge technologies and products aimed at elevating ROC's industrial technical standards. The second focuses on creating innovative business models, service platforms, and knowledge-driven services that catalyze industrial growth through the integration of advanced technologies with practical applications.

Implementation follows a three-phase structure designed to guide projects from concept to commercialization. Phase I, dedicated to preliminary research and planning, requires applicants to validate creative concepts through experimental or statistical analysis while outlining potential industrial benefits and implementation strategies. Phase II emphasizes detailed R&D, enabling product development, production methods, or service mechanisms based on validated concepts. Phase II+ focuses on commercialization, supporting the transition from technical innovation to market-ready solutions through product design, trial production, and market analysis (Table 16).

The funding structure reflects the progressive nature of these phases. Phase I, exclusive to individual applications, provides up to TWD1 million for six-month projects. Phase II supports both individual projects and R&D alliances with more substantial funding individual projects can receive up to TWD5 million annually (maximum TWD10 million over two years), while alliances may receive up to TWD5 million per member annually (maximum TWD30 million over two years). Phase II+ offers funding for commercialization efforts, with individual projects eligible for up to TWD5 million over six months to one year, and alliances qualifying for up to TWD5 million per member (maximum TWD25 million) for projects lasting nine months to one year.

TABLE 16

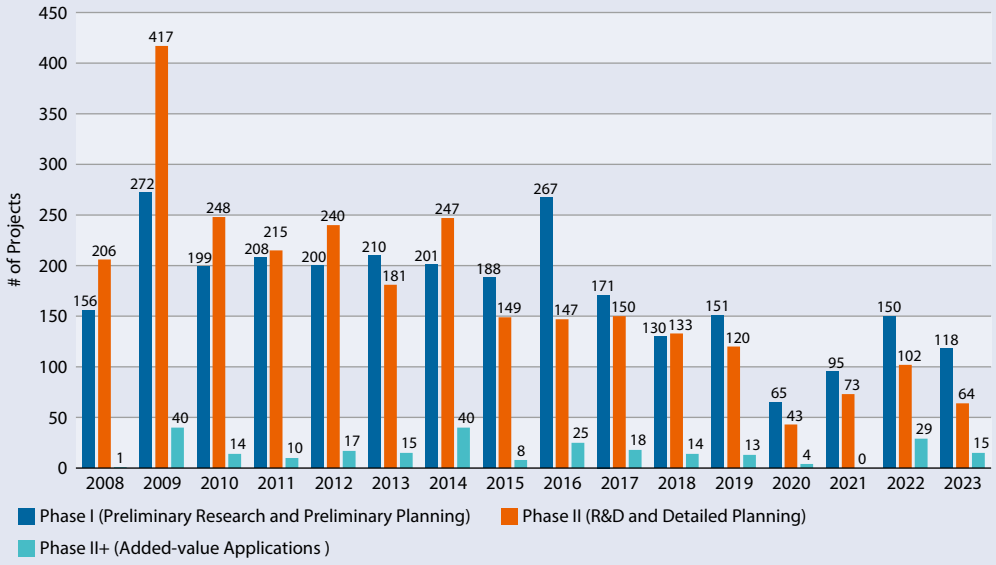
ROC SBIR PROJECT DURATION AND FUNDING

Phase	Application Type	Duration	Funding Cap
Phase I	Individual Applications	Limited to 6 months	TWD1million
Phase II	Individual Applications	6 months to 2 years	TWD5million/year (up to TWD10million total for 2 years)
	R&D Alliances	6 months to 2 years	TWD5 million /member/year (up to TWD30 million total for 2 years)
Phase II+	Individual Applications	6 months to 1 year	TWD5 million
	R&D Alliances	9 months to 1 year	TWD5 million /member (up to TWD25 million)

Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023).

FIGURE 6

NUMBER OF PROJECTS FUNDED BY ROC SBIR PROGRAM FOR 2008–2023



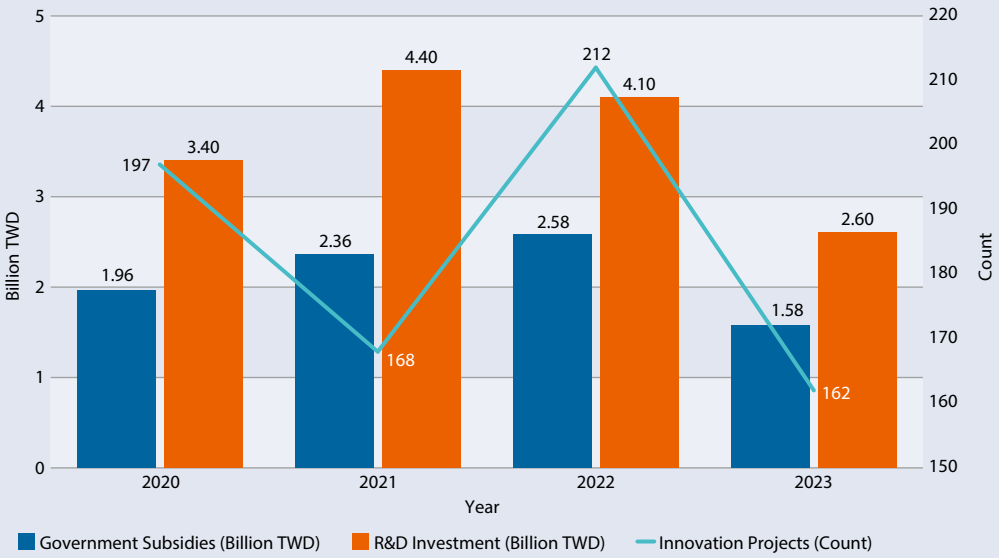
Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023)

The implementation data from 2008–2023 reveals distinct patterns in program utilization across phases. Phase I participation peaked at 272 projects in 2009 but experienced a decline after 2016, reaching a low of 65 projects during the 2020 pandemic before rebounding to 150 projects in 2022. Phase II followed a similar trajectory, with a peak of 417 projects in 2009, followed by gradual decline and pandemic-related disruption in 2020–2021. Phase II+ consistently funded fewer projects due to its advanced nature, with notable peaks of 40 projects in 2009 and 2014, followed by pandemic-related disruption and subsequent recovery in 2022 with 29 projects (Figure 6).

The SBIR program's performance during the COVID-19 pandemic period (2020–2023) demonstrates its resilience and adaptability in supporting innovation through economic challenges. In 2020, despite global uncertainties, the program maintained robust performance with government subsidies of TWD1.96 billion and private R&D investment of TWD3.40 billion, supporting 197 approved projects. This initial resilience suggested the effectiveness of ROC's innovation support mechanisms during crisis periods (Figure 7).

FIGURE 7

ROC SBIR: GOVERNMENT SUBSIDIES, R&D INVESTMENT AND APPROVED INNOVATION PROJECTS



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The program expanded significantly in 2021, with government subsidies increasing to TWD2.36 billion and R&D investment reaching a peak of TWD4.40 billion. While approved projects decreased slightly to 166, the higher investment levels indicated a shift toward more capital-intensive projects, potentially reflecting adaptations to pandemic-driven market changes and digital transformation needs.

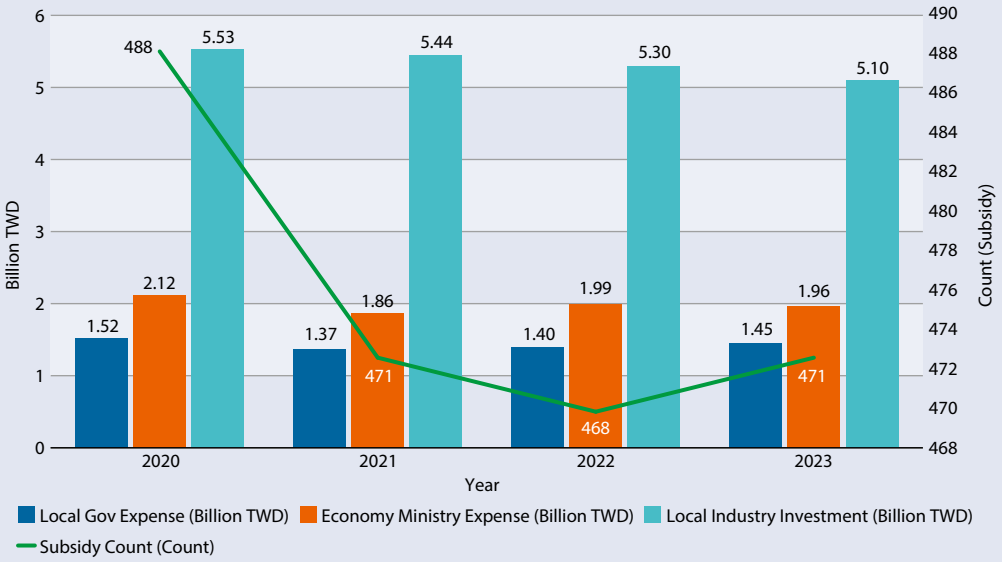
The post-pandemic recovery peaked in 2022, marked by the highest government support level at TWD2.58 billion, sustained R&D investment of TWD4.10 billion, and a record 212 approved innovation projects. This surge reflected both pent-up demand for innovation funding and successful adaptation to post-pandemic business conditions. However, 2023 showed an adjustment across all metrics, with government subsidies decreasing to TWD1.58 billion, R&D investment falling to TWD2.60 billion, and approved projects dropping to 162, indicating a recalibration phase in the post-pandemic economy.

The Local SBIR program exhibited complementary trends during this period. In 2020, the program achieved peak performance with 488 subsidized firms, supported by local government expenses of TWD1.52 billion and Economy Ministry expenses of TWD2.12 billion. Local industry R&D investment reached its highest level at TWD5.53 billion, demonstrating strong private sector engagement despite economic uncertainties (Figure 8).

The program underwent strategic adjustments in 2021, maintaining strong local industry R&D investment at TWD5.44 billion while government support mechanisms showed modest decreases. Local government expenses fell to TWD1.37 billion and Economy Ministry expenses to TWD1.86 billion, with subsidized firms declining to 471. This adjustment reflected a more focused approach to resource allocation during continued pandemic uncertainty.

FIGURE 8

LOCAL SBIR: GOVERNMENT SUBSIDIES, R&D INVESTMENT AND APPROVED INNOVATION PROJECTS



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The 2022–2023 period marked stabilization and resilient recovery for Local SBIR. By 2023, the program maintained healthy participation with 471 subsidized firms and local industry R&D investment of TWD5.10 billion, while government funding stabilized at TWD1.45 billion for local governments and TWD1.96 billion from the Economy Ministry. This recovery pattern demonstrates the program's successful adaptation to post-pandemic conditions while maintaining its commitment to local innovation support.

The parallel analysis of both SBIR and Local SBIR programs during 2020–2023 reveals complementary patterns in supporting ROC's innovation ecosystem through the pandemic crisis. While SBIR focused on broader technological advancement with relatively larger project investments, Local SBIR maintained consistent support for a wider base of firms with emphasis on regional development.

The SBIR program demonstrated flexibility in project scale and funding intensity. Its shift toward fewer but more capital-intensive projects during peak pandemic years (2021–2022) suggests strategic adaptation to market needs. The subsequent recalibration in 2023, marked by decreased funding but maintained project numbers, indicates a transition toward more efficient resource allocation in the post-pandemic environment.

In contrast, Local SBIR maintained relatively stable numbers of supported firms throughout the period, even as funding levels fluctuated. This consistency in reach, combined with sustained high levels of private R&D investment (remaining above TWD5 billion through most of the period), demonstrates the program's effectiveness in maintaining local innovation momentum despite economic challenges.

The programs' combined impact shows the success of ROC's dual-track approach to innovation support. The national SBIR program's ability to pivot toward higher-value projects complemented Local SBIR's consistent broad-based support, creating a robust innovation support system that maintained effectiveness through various phases of the pandemic crisis.

This analysis suggests that ROC's supply-side technology policy framework, particularly through its SBIR programs, successfully balanced the needs for both focused technological advancement and broad-based innovation support during a period of significant economic uncertainty. The programs' ability to maintain private sector engagement while adjusting support mechanisms demonstrates the resilience and adaptability of ROC's innovation support system.

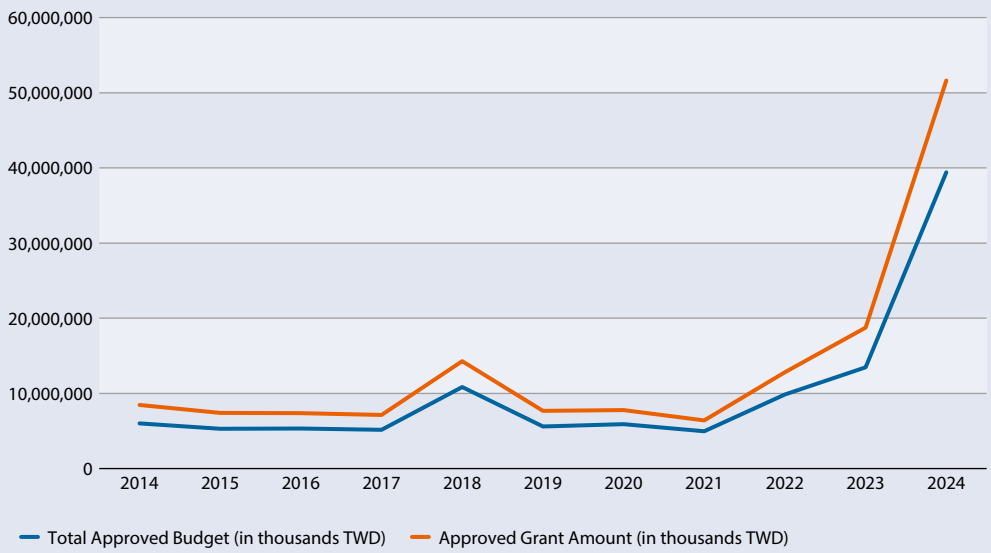
The Industrial Technology Development Program (ITDP)

Introduction and Context ROC has established itself as a global leader in innovation and technological development, achieving significant economic growth through robust R&D initiatives. In 2014, the MOEA launched the A+ Industrial Innovation R&D Program as a successor to the ITDP. This transition marked a strategic shift to align ROC's industrial policies with forward-looking technologies, global standards, and interdisciplinary collaboration.

The A+ Program places a strong emphasis on key areas such as AI, renewable energy, and biotechnology, aiming to position ROC as a global innovator. It fosters partnerships across businesses, academia, and research institutions to enhance resource efficiency and build comprehensive industrial ecosystems. The program's evolution from 2014 to 2024 reflects ROC's proactive response to the increasing complexity of global economic challenges.

FIGURE 9

TOTAL APPROVED BUDGET AND GRANT AMOUNTS FOR ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM, 2014–2024



Source: The Industrial Technology Development Program (n.d.)

A key aspect of this transformation is the notable change in funding trends, as illustrated in Figure 9, which tracks the total approved budget and grant amounts for the program. Between 2014 and 2021, funding levels remained relatively stable, with annual budgets ranging between TWD5 and 10 billion. However, from 2022 onward, funding levels began a significant upward trajectory, culminating in a dramatic increase in 2024. This surge reflects the introduction of high-impact initiatives such as the IC Design Summit Subsidy Program, which has attracted extensive participation from ROC's leading semiconductor companies[1].

The transformation of ROC's A+ Program signifies a concerted effort to enhance industrial competitiveness, sustainability, and global market integration. Subsequent sections will delve into the program's structure, key policy changes, and strategic implications while referencing figures and data to illustrate these developments.

Overview of the A+ Program The A+ Industrial Innovation R&D Program encompasses a diverse array of initiatives designed to strengthen ROC's industrial innovation capabilities. Each component addresses specific strategic goals, fostering the development of forward-looking technologies and industrial ecosystems. The main subcategories of the program include:

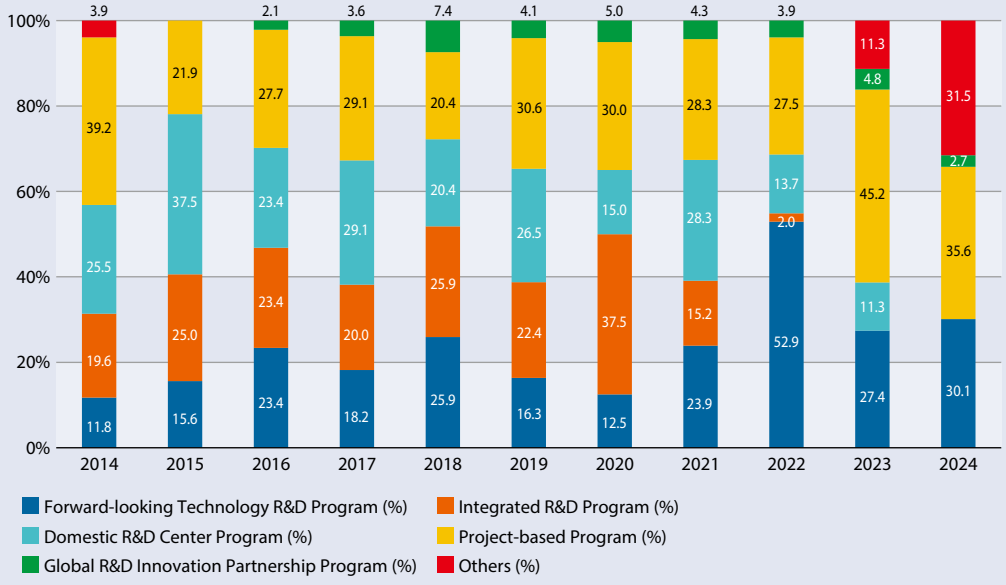
1. Forward-looking Technology R&D Program: Encourages investment in advanced and high-potential technologies that are not yet mature, with subsidies covering up to 50% of project costs.
2. R&D Center Establishment: Supports the creation of domestic R&D centers, enabling enterprises to cultivate core technological capabilities and facilitate technology transfer.
3. Global R&D Innovation Partnerships: Fosters collaborations between ROC companies and international partners, leveraging external expertise to enhance local R&D capacity.
4. Integrated Projects: Promotes cross-sectoral system integration to develop comprehensive value chains and collaborative frameworks.
5. Project-based Initiatives: Offers targeted support to address unique industry needs and emerging trends.

The program's evolution is clearly reflected in its performance metrics and funding allocations, as shown in Figure 10 and Figure 11. Figure 10 illustrates the total number of projects and cases under the program, highlighting a steady expansion of initiatives across various categories. Meanwhile, Figure 11 provides insight into the funding distribution between individual and alliance projects, demonstrating the program's adaptability in addressing industry-specific requirements.

1 The relevant statistical data does not explicitly differentiate between the statistical participation of large firms and SMEs in the A+ Industrial Innovation R&D Program. The following statistics aggregates data on the total number of firms participating across various program categories.

FIGURE 10

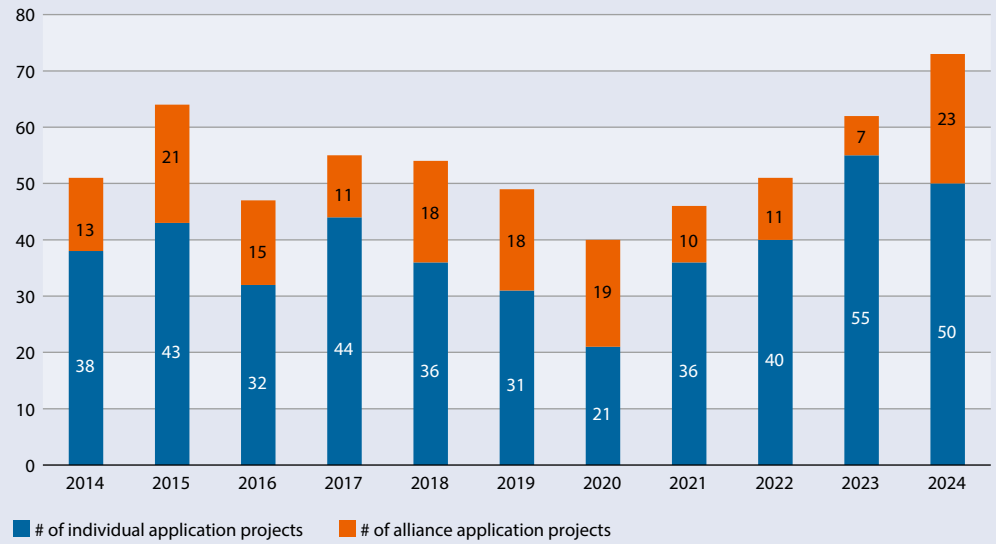
THE BREAKDOWN OF ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM IN TOTAL NUMBERS OF PROJECTS/CASES



Source: The Industrial Technology Development Program (n.d.)

FIGURE 11

TOTAL AMOUNTS OF ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM IN INDIVIDUAL & ALLIANCES PROJECTS



Source: The Industrial Technology Development Program (n.d.)

Through these diverse subcategories, the A+ Program fosters a collaborative innovation environment, enabling ROC enterprises to remain resilient and competitive. The subsequent sections will examine the policy adjustments and trends that have shaped the program from 2014 to 2024.

Policy Adjustments and Trends (2014–2024) The A+ Industrial Innovation R&D Program has undergone significant policy shifts and realignments between 2014 and 2024, reflecting ROC's evolving priorities in industrial innovation. Key adjustments include the phasing out of certain traditional initiatives, increased focus on forward-looking technologies, and expanded international collaborations.

One of the most notable transitions was the discontinuation of the Integrated R&D Program in 2023. This program initially played a prominent role, reaching peak participation in 2015 with 16 projects involving 56 companies. However, shifting priorities toward emerging sectors and interdisciplinary projects led to its conclusion, marking a strategic reallocation of resources.

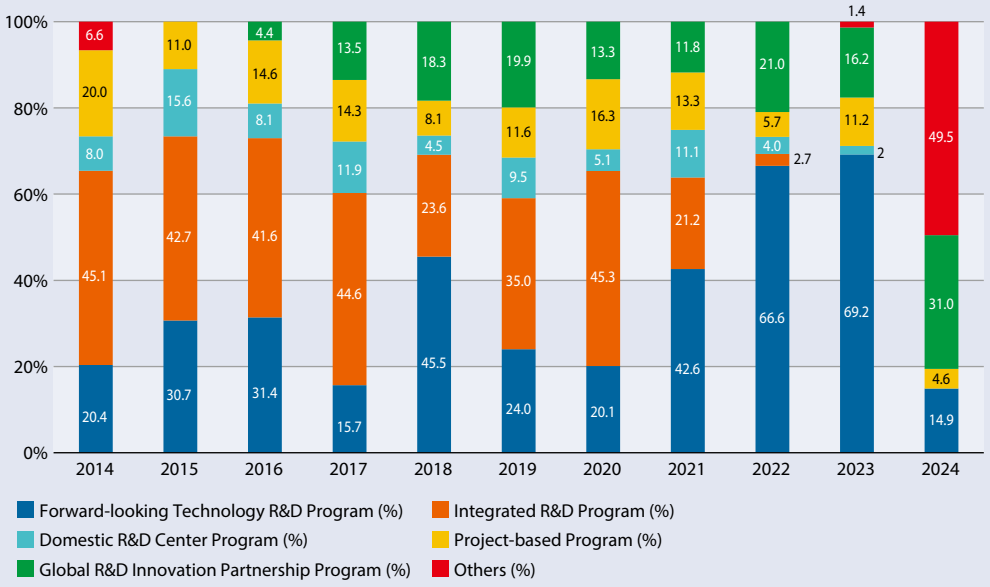
Simultaneously, forward-looking programs witnessed unprecedented growth. The Forward-looking Technology R&D Program, for instance, expanded significantly from 6 projects in 2014 to 27 projects involving 45 firms in 2022, as shown in the Appendix Table. Funding allocations for this program increased sharply, signaling the government's commitment to fostering advanced technologies such as artificial intelligence, green energy, and biotechnology.

Another striking development is the rapid expansion of the Global R&D Innovation Partnership Program. Although initially modest, with only one project in 2016, this program saw substantial growth by 2024, attracting increased budget allocations to support international collaborations. The dramatic rise in funding levels, highlighted in Figure 12, underscores strategic emphasis on global market integration.

Furthermore, the year 2024 marked a transformative milestone with the introduction of the IC Design Summit Subsidy Program, which attracted leading semiconductor firms like MediaTek and Realtek Semiconductor. The program contributed significantly to the spike in budgetary allocations, as depicted in Figure 13, where the approved budgets show a sharp increase in 2024.

FIGURE 12

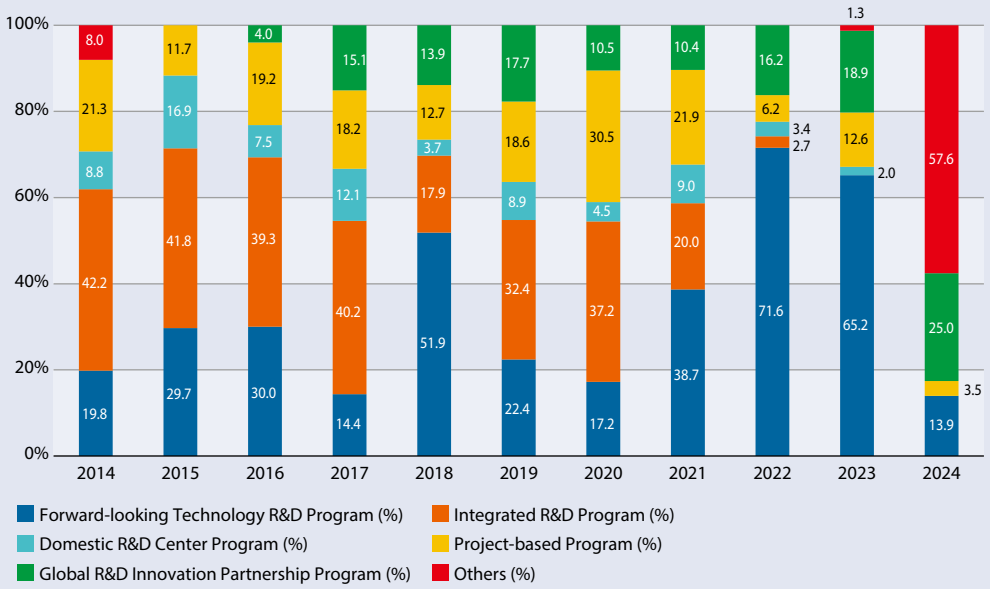
THE BREAKDOWN OF ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM IN APPROVED GRANT AMOUNT



Source: The Industrial Technology Development Program (n.d.)

FIGURE 13

THE BREAKDOWN OF ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM IN APPROVED BUDGET AMOUNT



Source: The Industrial Technology Development Program (n.d.)

These trends indicate a deliberate shift in ROC's innovation strategy toward high-impact technologies and global collaboration. With these adjustments, the A+ Program aims to ensure ROC's sustained leadership in critical industries and its alignment with global technological advancements. The next section will explore the broader strategic implications of these policy changes.

Strategic Implications The strategic adjustments and trends within the A+ Industrial Innovation R&D Program have far-reaching implications for ROC's industrial and economic landscape. By emphasizing forward-looking technologies and international collaboration, the program aligns with global innovation trends while addressing domestic industrial needs.

Sustainability and Carbon Neutrality A central focus of the updated program is sustainability. By prioritizing green energy and energy efficiency, the program supports ROC's commitment to the 2050 carbon neutrality goals. This strategic alignment ensures that ROC's industries remain competitive in global markets increasingly driven by eco-conscious policies. Key initiatives like the Electric-Assisted Bicycle Localization Pilot Program exemplify the integration of green technologies into ROC's industrial innovation.

Global Competitiveness The emphasis on international partnerships through the Global R&D Innovation Partnership Program strengthens ROC's global standing. By fostering collaborations with international firms, the program integrates global expertise and accelerates the development of proprietary technologies. This approach not only enhances ROC's role in global supply chains but also mitigates risks associated with overdependence on foreign technology sources.

Focus on High-Value Sectors The significant investment in the semiconductor industry through the IC Design Summit Subsidy Program reflects ROC's strategic response to global market demands. With 23 projects involving 35 companies, the program addresses the growing demand for advanced integrated circuits, further cementing ROC's position as a leader in semiconductor innovation. This targeted focus enables ROC to maintain a competitive edge in high-value industries.

Enhanced Innovation Ecosystems The program's integrated R&D projects and project-based initiatives foster cross-sectoral collaboration, leading to cohesive value chains and industrial ecosystems. By encouraging partnerships between academia, industry, and research institutions, the program enhances resource efficiency and promotes a culture of collaborative innovation.

These strategic shifts are supported by the substantial increase in funding allocations. As illustrated in Figures 12 and 13, the 2024 surge in budgets and grants demonstrates a strong commitment to innovation and long-term industrial resilience. Furthermore, the detailed metrics in the Appendix Table highlight the program's ability to adapt to emerging trends while maintaining a steady growth trajectory.

Through these strategic enhancements, the A+ Program positions ROC to sustain economic growth, generate high-value intellectual property, and lead in critical global industries. The next section will focus on the mechanisms that drive the program's implementation and ensure its success.

The SME Credit Guarantee Fund (SMEG)

The Small and Medium Enterprise Credit Guarantee Fund of Taiwan (Taiwan SMEG), established in 1974, serves as a cornerstone of SME financial support in ROC. By providing credit guarantees to SMEs, the fund facilitates access to institutional funding, playing a vital role in fostering economic growth and maintaining social stability through SME sector development.

The SMEG operates through three primary mechanisms: Addressing collateral challenges by helping SMEs overcome insufficient security requirements; Incentivizing financial institutions to extend loans to SMEs through guarantee provisions; Enhancing the effectiveness of other SME support initiatives through coordinated guidance projects.

The fund's operational model combines government budget allocations with contractual agreements with financial institutions, creating a risk-sharing structure that enables sustainable credit guarantee provision. This arrangement particularly benefits SMEs with strong development potential but insufficient traditional collateral.

SMEs can apply for a credit guarantee through various channels, including financial institutions, directly through the SME Credit Guarantee Fund, or via a dedicated service window, depending on their specific needs (https://www.smeg.org.tw/). Table 17 illustrates the SMEG's performance from 2018 to 2022. During this period, the number of credit guarantee recipients grew steadily from 100,714 in 2018 to 186,953 in 2022, while the annual number of credit guarantee applications accepted ranged from 288,273 to 347,904. The combined value of credit guarantees remained relatively stable, reaching TWD1,003,846 million in 2022, enabling SMEs to secure total financing of TWD1,261,769 million. Outstanding credit guarantees at year-end increased from TWD602,386 million in 2018 to TWD650,521 million in 2022, with outstanding financing reaching TWD809,425 million by the end of 2022.

TABLE 17

SMEG GUARANTEES SME FUND, 2018–2022

(Unit: Recipients; items; million TWD)

Item / Year	No. of credit guarantee recipients	No. of credit guarantee applications accepted	Combined value of credit guarantees	Total amount of financing secured	Outstanding credit guarantees at year-end	Outstanding financing at year-end
2018	100,714	329,775	1,001,024	1,301,778	602,386	790,077
2019	118,767	347,904	1,023,956	1,305,446	628,137	809,446
2020	131,536	306,499	910,570	1,149,962	591,007	751,027
2021	170,887	315,180	926,536	1,161,326	602,287	753,712
2022	186,953	288,273	1,003,846	1,261,769	650,521	809,425

Note: The number of guaranteed service accounts refers to the number of accounts with any transaction record, balance of guarantees, or advance payment of repayment reserve in the current year.
Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023)

The program demonstrated particular resilience during the COVID-19 pandemic period (2020–2021). Credit guarantee recipients increased dramatically from 130,742 in 2019 to 1,188,784 in 2020, reaching a peak of 1,926,766 in 2021. This surge reflected enhanced loan programs, including worker relief initiatives. Total secured financing peaked at TWD1,711,438 million in 2020, maintaining strong levels through 2022 despite slight declines in recipient numbers (Table18).

The outstanding credit guarantees and financing amounts at year-end also saw significant increases during this period, with outstanding credit guarantees rising from TWD614,174 million in 2018 to TWD1,354,176 million in 2022, while outstanding financing rose from TWD803,281 million to TWD1,615,296 million over the same period. These figures underscore the crucial role SMEG played in bolstering SME access to financial resources, particularly in times of economic hardship.

TABLE 18

SMEG GUARANTEES ALL CASES, 2018–2022

(Unit: Recipients; items; million TWD)

Item / Year	No. of credit guarantee recipients	No. of credit guarantee applications accepted	Combined value of credit guarantees	Total amount of financing secured	Outstanding credit guarantees at year-end	Outstanding financing at year-end
2018	113,018	334,789	1,006,592	1,308,104	614,174	803,281
2019	130,742	352,814	1,029,377	1,311,731	639,903	822,740
2020	1,188,784	1,457,182	1,405,787	1,711,438	1,086,682	1,312,862
2021	1,926,766	1,140,632	1,296,420	1,584,632	1,370,509	1,627,279
2022	1,869,510	324,206	1,123,198	1,407,508	1,354,176	1,615,296

Notes: 1. The number of guaranteed service accounts refers to the number of accounts with any transaction record, balance of guarantees, or advance payment of repayment reserve in the current year.
2. The number of cases from 2020 to 2022 include worker relief loans.
Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023)

The program's effectiveness is evidenced by its participants' growth trajectories. Many SMEs achieved financial independence within years of receiving guarantees, either through market capital raising or direct bank lending. By 2022, 2,650 former participants had grown into large enterprises, while 1,021 had achieved public listings across various markets. Notably, 48.90% of all listed companies in ROC had previously utilized SMEG guarantees, with particularly high representation in emerging markets (63.21%) and OTC markets (59.03%) (Table 19).

TABLE 19

NUMBER OF LISTED, OTC, AND EMERGING MARKET COMPANIES THAT UTILIZED CREDIT GUARANTEES DURING THEIR SME STAGE AS OF 2022

Category	Total Number of Listed, OTC, and Emerging Market Companies (A)	Number of Companies Previously Using Credit Guarantees (B)	Percentage of Companies Using Guarantees (B/A)
Stock Exchange (TWSE)	981	355	36.19%
OTC Market	808	477	59.03%
Emerging Market (GISA)	299	189	63.21%
Total	2,088	1,021	48.90%

Source: Reproduced with permission from Small and Medium Enterprise and Startup Administration (2021–2023)

Government Resources Allocated to SMEs

The ROC government maintained robust support for SMEs through multiple channels. In 2022, the MOEA allocated TWD34.33 billion in its final budget, with TWD24.68 billion—representing 71.89%—specifically directed toward SME initiatives. This marked an increase of TWD1.671 billion from 2021, driven primarily by enhanced funding from key agencies, as detailed in Table 20.

TABLE 20

MOEA RESOURCES AND FUNDING ALLOCATED TO SMES, 2021–2022

(Unit: 100 million TWD; %)

Annual funding / Organizer	Fiscal year final accounts		Total amount allocated to SMEs		Increase
	2021	2022	2021 (1)	2022 (2)	(1)-(2)
SMESA (SME Development Fund included)	61.12	64.23	61.12 (100.00)	64.23 (100.00)	3.11
IDA (Industrial technology guidance and Industrial Park Development and Management Fund included)	79.31	84.83	46.75 (58.95)	52.44 (61.81)	5.69
ITA (Trade Promotion Fund included)	37.18	42.29	32.26 (86.75)	38.03 (89.94)	5.77
AOC (Promotion of trade modernization and commercial technology development included)	7.78	7.17	5.43 -69.83	5.54 -77.28	0.11
DOIT	129.71	144.78	84.53 (65.17)	86.56 (59.79)	2.03
Total	315.1	343.3	230.09 (73.02)	246.80 (71.89)	16.71

Notes: Figures in parentheses represent the percentages in the final accounts
Source: Various agencies of MOEA, Small and Medium Enterprise and Startup Administration (2021–2023).

The Department of Industrial Technology (DOIT) emerged as the largest contributor, allocating TWD86.56 billion (59.79% of its budget) to SME development in 2022. The Small and Medium Enterprise Administration (SMESA) followed with TWD64.23 billion, representing 100% of its budget and demonstrating its dedicated focus on SME support. The IDA provided TWD52.44 billion (61.81% of its budget), emphasizing its commitment to industrial growth and technological innovation within the SME sector.

The year-over-year growth from 2021 to 2022 was particularly notable across agencies. The International Trade Administration (ITA) showed the strongest increase at 15.52%, followed by the IDA at 7.17% and SMESA at 5.09%. Collectively, these increases contributed to total SME allocations rising from TWD230.09 billion in 2021 to TWD246.80 billion in 2022.

Complementing these core allocations, additional support came from 36 financial institutions and 6 credit cooperatives, which contributed TWD2.699 billion to the ROC SME Credit Guarantee Fund. The Workforce Development Agency under the Ministry of Labor further supplemented this support with TWD0.382 billion for SME training programs.

As shown in Table 21, the government maintained diverse special loan programs in 2022. The SME Development Fund provided TWD5.00 billion in fully government-funded export and investment loans. Special assistance programs included root-taking loans (TWD0.08 billion), startup and employment initiatives (TWD3.53 billion), sports services industry support (TWD8.49 billion), and indigenous development funding (TWD5.75 billion). These programs collectively totaled TWD22.85 billion in loan amounts, with TWD10.85 billion coming directly from government funding.

TABLE 21

SPECIAL LOANS TO SMES FUNDED BY THE GOVERNMENT, 2022

(Unit: 100 million TWD)

Name of loan	Eligible applicant	Structure	Status	
			Total loan amount	Government funding
Small and Medium Enterprises Development Fund Supported Export Loans Overseas Investment Loans Overseas Construction Project Loans	SMEs	SME Development Fund	5.00	5.00
Special Loan Assistance for SMEs to Take Root	SMEs	Supported with long-term; special funding allocation of the National Development Councilor banks with proprietary funds	0.08	0.00
Micro-Business Start-up Phoenix Loan Employment Insurance Startup Loans for the Jobless Startup Loans for Unemployed Middle-aged and Elderly Persons	Women aged 18–65; Residents aged 18–65 with household registration in outlying islands; Citizens aged 45–65; Jobless individuals covered by employment insurance; Unemployed middle-aged and elderly persons	Loans provided by banks' own funds and interests subsidized by the Ministry of Labor	3.53	0.10
SME Sports Services Industry Loans	SMEs	Supported with credit guarantee funds set up by the Sports; Development Fund and Credit Guarantee Fund	8.49	0.00
Indigenous Integrated Development Fund Loans (Indigenous Youth Business Loans, Indigenous Economic Industry Loans, Indigenous Micro-Business Activities Loans included for production use)	Indigenous people aged 18–65	Fully funded by the Council of Indigenous Peoples	5.75	5.75
Total			22.85	10.85

Source: Various government agencies, Small and Medium Enterprise and Startup Administration (2021–2023).

The government's commitment to SME development was further evidenced in procurement practices. According to 2023 Government Procurement System statistics, SMEs secured TWD522.398 billion in contracts during 2022, representing 86.85% of the total government procurement value of TWD601.518 billion.

Eligible SMEs in ROC have access to the following various types of special loans: Small and Medium Enterprises Development Fund Supported Export Loans, Overseas Investment Loans, Overseas Construction Project Loans, SME Development Fund Special Loans, Micro-Business Startup Phoenix Loans and Employment Insurance Startup Loans for the Jobless, SME Sports Services Industry Loans and Indigenous Integrated Development Fund Loans. A total of TWD1.085 billion in government-funded SMEs loans were excluded in 2022.

Demand-side Technology Policy: Public Procurement for Innovation

Public Procurement for Innovation (PPI) represents a significant demand-side innovation policy instrument, defined as "procurement activities carried out by public institutions (such as central and local governments) that lead to innovation" [9-10]. Edler and Georghiou (2007) identify three fundamental rationales for implementing PPI as an innovation driver: (1) the critical role of primary users and demand, (2) the necessity to address market and system failures, and (3) PPI's potential to enhance public policies and services. In ROC, PPI initiatives commenced in 2018 with the launch of the "ROC Startup Procurement Program," designed to create pathways for startups to introduce innovative solutions aligned with public sector requirements.

The ROC's Startup Procurement Program strategically leverages unmet needs within the government sector to stimulate innovation among local startups. Spearheaded by the SMEA under the MOEA, the program addresses gaps where existing commercial solutions fall short of government requirements. It establishes clearly defined innovation needs that guide targeted procurement efforts, thereby reducing barriers to entry for startups.

Tendering and Procurement Process

The program operates through two key support mechanisms: the Mature Support Program and the R&D Support Program. The Mature Support Program targets municipal and county governments, encouraging them to procure innovative products or services from startups through streamlined procedures. Subsidy rates range from 70% to 90%, depending on the financial capacity of the local government, with a funding cap of TWD2 million per project. Meanwhile, the R&D Support Program focuses on startups, offering funding of up to TWD1 million per project for developing innovative solutions to address specific market needs. Startups are required to self-finance part of their projects, ensuring a commitment to the development process.

The procurement framework follows a "Government Poses the Challenge, Startups Solve It" model. By incorporating startup innovations into government joint supply contracts, the program simplifies procurement procedures and facilitates early-stage collaboration. This process enables startups to engage in prototyping and small-scale validation within government-managed environments, ensuring that solutions are effectively tailored to meet public sector needs.

Contracting and Implementation

Contract awards emphasize the innovative potential of proposed solutions. The government positions itself as the first customer or lead user, providing startups with a critical platform to validate their products in real-world applications. This process fosters iterative collaboration between startups and government agencies, enabling continuous refinement of products and ensuring alignment with public sector requirements.

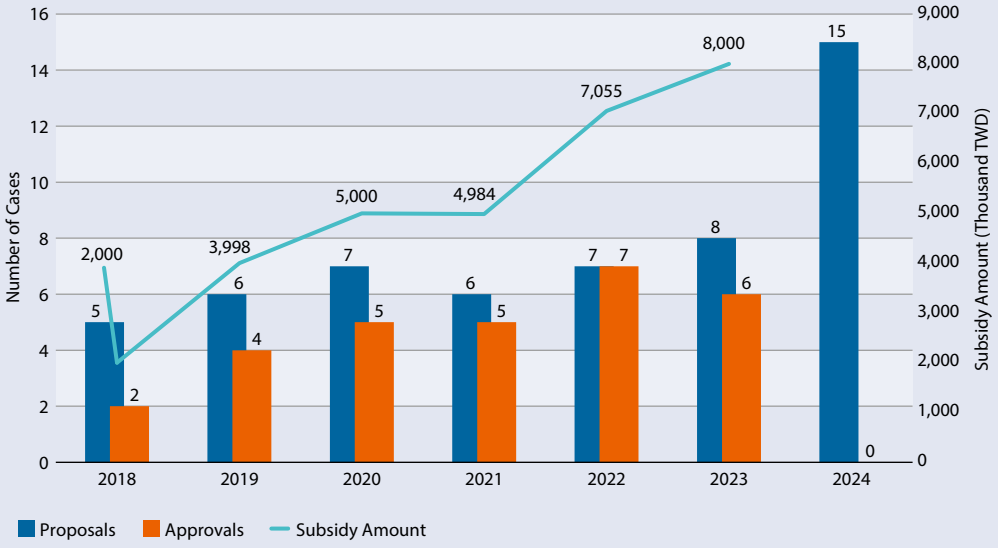
Through ongoing engagement, startups not only gain valuable market entry opportunities but also enhance their solutions' functionality and scalability. For governments, this collaborative model ensures the procurement of cutting-edge innovations that address public challenges effectively.

Outcomes and Impacts

The ROC's Startup Procurement Program exhibited a clear growth trajectory from 2018 to 2024. As illustrated in Figure 14, proposal submissions and approvals maintained relative stability between 2018 and 2023, with annual submissions ranging from 5 to 8 proposals and approvals varying from 2 to 7 projects. During this period, the government demonstrated increasing financial commitment, with subsidy allocations rising steadily from TWD3.997 million in 2019 to TWD8 million in 2023, reflecting enhanced support for innovation initiatives. A notable shift occurred in 2024, when despite a substantial increase in proposals to 15, no projects received approval, potentially indicating an evolution in policy direction or evaluation criteria. These trends underscore ROC's sustained commitment to fostering innovation through strategic financial investment.

FIGURE 14

ROC'S STARTUP PROCUREMENT PROGRAM, 2018–2024



Source: Reproduced with permission from Small and Medium Enterprise Administration, MOEA (n.d.b)

A notable policy shift occurred in 2024, characterized by a significant increase in submissions (15 proposals) but no approvals. This shift may indicate a strategic recalibration of evaluation criteria or a reallocation of resources toward more targeted goals. Despite this anomaly, the program has successfully nurtured innovation, helping startups access public procurement markets while advancing the public sector's adoption of innovative solutions.

ROC's implementation of PPI exemplifies how government procurement can serve as a catalyst for innovation. By addressing unmet needs, fostering collaboration, and providing financial support, the ROC's Startup Procurement Program has cultivated an ecosystem where startups can thrive. The policy's evolution in 2024 underscores the dynamic nature of innovation procurement, highlighting the need for ongoing refinement of frameworks and methodologies to ensure sustained impact. As ROC continues to adapt its PPI policies, its commitment to leveraging public procurement for innovation remains evident.

Comparative Features of ROC's PPI: Insights from the Cases of the People's Republic of China (PRC) and Brazil

ROC's PPI policies, while relatively recent in implementation, demonstrate a distinctive approach to fostering innovation through public procurement. Initiated in 2018, ROC's program stands in contrast to earlier implementations such as the PRC's 2006 initiative and Brazil's early 2000s programs. The cornerstone of ROC's approach is its focused support for startups and emphasis on agile responses to government challenges, implemented through the innovative "Government Poses the Challenge, Startups Solve It" model.

The institutional framework of ROC's PPI is characterized by its streamlined structure, led by the SMEA of the MOEA. This framework is designed to minimize institutional barriers for startups, creating an accessible environment for innovative companies to engage with public sector procurement opportunities. The program operates through a challenge-based mechanism where government agencies identify specific operational needs and invite startups to propose solutions, fostering direct collaboration between innovators and public sector users.

Based on the studies of Li et al. (2020) and Kundu et al. (2020) about PRC and Brazilian cases, ROC's PPI approach is distinguished by its unique contracting process, primarily executed through the Entrepreneur Proof of Concept Program (see Table 22). ROC's Public Procurement for Innovation (PPI) policy, launched in 2018, distinguishes itself through a challenge-based, bottom-up approach, contrasting sharply with the PRC's centrally planned model and Brazil's mixed, sector-focused framework. ROC's policy prioritizes startup innovation, addressing public sector challenges with agile, solution-oriented approaches. The streamlined procurement process, characterized by challenge-based selection and rapid prototyping, is specifically tailored to benefit startups, SMEs, and innovative solution providers. This contrasts with the PRC's catalog-based, technology-certified procurement that supports domestic firms and strategic industries, and Brazil's sector-specific, bureaucratic rules centered on state-owned enterprises (SOEs) and local suppliers.

Governance and coordination are key strengths of ROC's PPI framework, with the SMEA playing a leading role, supported by clear inter-ministerial coordination. This decentralized governance model ensures high policy coordination, enabling agile decision-making. In comparison, the PRC employs a centralized governance model with robust policy integration, while Brazil faces challenges with a fragmented and SOE-dominated structure, resulting in lower coordination and effectiveness.

TABLE 22

COMPARATIVE ANALYSIS TABLE OF PUBLIC PROCUREMENT OF INNOVATION (PPI) POLICIES

Dimension	ROC	PRC	Brazil
Policy Implementation			
Start Year	2018	2006	Early 2000s (2004)
Policy Approach	Bottom-up, challenge-based	Top-down, centrally planned	Mixed, sector-focused
Primary Focus	• Startup innovation • Public sector challenges • Agile solutions	• Indigenous innovation • Strategic sector development • Technological self-reliance	• Industrial development • Local content creation • Sector-specific growth
Implementation Mechanisms			
Key Tools	• Challenge programs • Proof of concept initiatives • Simplified procurement	• Innovation catalogs • Accreditation systems • Preferential policies	• Local content requirements • SOE procurement • R&D outsourcing
Procurement Process	• Streamlined for startups • Challenge-based selection • Rapid prototyping	• Catalog-based • Technology certification • National champion support	• SOE-driven • Sector-specific rules • Complex bureaucracy
Target Recipients	• Startups • SMEs • Innovative solutions providers	• Domestic firms • National champions • Strategic industries	• Local suppliers • State enterprises • Industry partners
Institutional Framework			
Governance	• SMEA-led • Ministry coordination • Clear structure	• Strong central control • Multi-agency coordination • Policy integration	• Fragmented • SOE-dominated • Multiple agencies
Policy Coordination	High	Very High	Low
Decision Making	Decentralized	Centralized	Mixed
Strategic Focus			
Key Sectors	• Health • ICT • Public services	• Telecommunications • Energy • High-tech industries	• Oil & gas • Healthcare • Defense
Innovation Type	• Solution-focused • Rapid innovation • Service innovation	• Indigenous technology • Core capabilities • Strategic innovation	• Industrial innovation • Process innovation • Technical capability

Dimension	ROC	PRC	Brazil
Outcomes & Impacts			
Successes	• Growing startup participation • Increased proposal submissions • Public sector innovation	• Strong domestic capabilities • Reduced technology dependence • National champions	• Sector-specific achievements • Local supplier development • Technical capabilities
Challenges	• Early stage development • Limited track record • Recent policy shifts	• International criticism • Trade tensions • Market access issues	• Policy fragmentation • Implementation issues • Political instability
Policy Environment			
Support Mechanisms	• Financial incentives • Technical support • Mentoring	• Policy support • Financial backing • Market protection	• SOE contracts • Local content rules • Industry partnerships
Market Approach	Market-driven	State-directed	Mixed/Hybrid
International Integration	High	Limited	Moderate
Future Directions			
Development Focus	• Expanding startup ecosystem • Deepening innovation impact • International collaboration	• Increasing self-reliance • Expanding domestic innovation • Strategic independence	• Institutional reform • Policy coordination • Capability building
Key Priorities	• Solution scaling • Ecosystem development • International linkages	• Technology leadership • Industry dominance • Innovation self-sufficiency	• Policy effectiveness • Institutional strength • Innovation capacity
Policy Learning			
Strengths	• Agility • Startup engagement • Low barriers	• Strategic focus • Policy integration • Resource alignment	• Sector expertise • Technical depth • Industry links
Areas for Improvement	• Scale • Track record • Market impact	• International integration • Market access • Transparency	• Coordination • Implementation • Policy consistency

Sources: This study, Kundu et al. (2020), and Li et al. (2020)

ROC's strategic focus spans health, ICT, and public services, emphasizing solution-focused, rapid, and service-oriented innovation. The country's policy successes include increased startup participation, a surge in proposal submissions, and notable public sector innovation. However, ROC's PPI is in the early stages of development and faces challenges like limited track record and scaling issues. The PRC, with its emphasis on indigenous technology and core capabilities, has developed strong domestic innovation capacity but struggles with international criticism and trade tensions. Meanwhile, Brazil's sectoral focus has driven local supplier development and technical capabilities but suffers from policy fragmentation and political instability.

Looking forward, ROC aims to expand its startup ecosystem, deepen the innovation impact, and enhance international collaboration. Its focus on scaling solutions, ecosystem development, and fostering global linkages underscores its market-driven approach and high international integration. By contrast, the PRC prioritizes self-reliance and strategic independence with limited international integration, while Brazil's hybrid model seeks institutional reform, policy coordination, and enhanced innovation capacity. ROC's agility, startup engagement, and low barriers are notable strengths, but the need for greater scale, a stronger track record, and increased market impact remain areas for growth.

ROC's Systemic Technology Policy

To foster a high-quality environment for innovation in ROC, the government is actively developing a comprehensive ecosystem that supports creativity, innovation, and entrepreneurship. Central to this effort are entrepreneurship incubation and assistance programs designed to nurture and accelerate the growth of new ventures. These initiatives ensure that ROC remains at the forefront of technological innovation and economic development. This section examines the content of these policies, their implementation efficiency, and their overall effectiveness.

The success of policies aimed at enhancing the technological capabilities and competitiveness of ROC's SMEs is significantly influenced by institutional support. Beyond providing financial resources through technology projects, the government strategically engages public R&D institutes to assist SMEs in upgrading their technologies and to support the development of local industrial clusters.

A Case of Local Industrial Innovation Engine Program

A cornerstone of this strategy is LIIEP, which focuses on organizing R&D alliances in less-developed regions. The program aims to balance regional development by strengthening the innovation capabilities of industrial clusters and SMEs. Additionally, it seeks to scale up these alliances by incorporating more partners, particularly from the service sector, to enhance the commercialization of innovations. This integrative approach underscores the government's commitment to fostering inclusive and sustainable technological advancement. (Figure 15)

FIGURE 15

MECHANISM OF LOCAL INDUSTRY INNOVATION ENGINE PROGRAM.

Source: Reproduced with permission from Liu (2015)

The rationale behind LIIEP was rooted in the evolving landscape of innovation policy, where R&D alliances emerged as a favored strategy to enhance the technological capabilities of local firms. Widely adopted in various countries (Czarnitzki et al., 2007), these alliances internalized the positive externalities of knowledge creation and enabled the sharing of costs and risks between governments and participating firms. LIIEP aimed to strengthen research infrastructure (Knoll, 2003), with government-sponsored research institutes (GSRIs) playing a key role by providing specialized expertise and additional R&D resources.

LIIEP also addressed information asymmetries that historically hindered private investment in less-developed regions. These asymmetries often prevented local firms from securing essential funding. Through government R&D subsidies, the program bridged this gap (Kleer, 2010), tackling market failures by employing a mix of innovation policy instruments to stimulate public R&D while encouraging private sector investment. GSRIs were mobilized to share their resources with local firms, fostering new investment opportunities in technologically underdeveloped areas.

The implementation of LIIEP followed a systematic approach, assigning various R&D institutions to administrative divisions across ROC. Each institute was tasked with developing a specific industry within a designated county or municipality. They established industrial cluster R&D alliances, promoted innovative activities, increased awareness of technology project outcomes, and assisted firms in leveraging policy tools and securing R&D subsidies, thereby accelerating regional innovation.

In the broader context of ROC's innovation ecosystem, GSRIs play a critical role. ROC's industrial success was often attributed to effective industrial technology policies, including the establishment of diverse GSRIs to advance industrial technologies and meet local industries' technical needs. These institutes facilitated the transfer of innovative products and technologies to local firms, stimulated scientific research (Dodgson, 2009), and served as intermediaries in the innovation process, enhancing ROC's industrial competitiveness.

To date, ROC's MOEA oversees 16 Government-Sponsored Research Institutes (GSRIs), each specializing in distinct industrial technologies. The Industrial Technology Research Institute (ITRI) and the Institute for Information Industry (III) stand as the largest and most comprehensive institutions, with approximately 6,000 and 1,782 employees respectively. ITRI, established in 1973, covers diverse fields including electronics, information technology, mechanical systems, materials, green energy, and biomedical technology. III, founded in 1979, focuses on digital technologies, smart applications, and market intelligence (Table 23).

TABLE 23

GOVERNMENT-SPONSORED RESEARCH INSTITUTES UNDER MOEA, 2022/2023

Research institutes	Main technology fields	Year established	Size (employees)
ITRI (Industrial Technology Research Institute) *	Electronics and Optoelectronics Information and Communications, Mechanical and Systems, Materials and Chemicals, Green Energy and Environment, Biomedical Technology and Devices	1973	6000
III (Institute for Information Industry)	Networks and Multimedia, Innovative Digi-Tech-Enabled Applications and Services, Emerging Smart Technology, Digital Education, Market Intelligence and Consulting	1979	1782
MIRDC (Metal Industries Research & Development Center) *	Casting Technology, Metal Forming Technology, Welding Technology, Molding and Precision Machining, Fluid Control Technology, Industrial Automation	1963	988
DCB (Development Center for Biotechnology) *	Biologics, Small Molecule Drugs, Botanical Drugs	1984	340
FIRDI (Food Industry Research and Development Institute)*	Food Processing Technology, Bio-Resource Collection and Research	1965	405
ARTC (Automotive Research and Testing Center)*	Vehicle Performance Testing, Emission and Fuel Economy Testing, Automotive Light Testing, Electromagnetic Compatibility	1990	430
TTRI (Taiwan Textile Research Institute) *	Textile Industry-Related Technology, Fibers and Related Products	1959	346
PMC (Precision Machinery Research & Development Center)	Machine Tool Inspection, Testing Technology, Safety of Machinery and Environmental Protection	1993	273
Agricultural Technology Research Institute (ATRI)	Aquatic Technology, Plant Technology, Animal Technology	2014	535
PIDC (Plastics Industry Development Center)	Injection Molding Technology, Multifunctional Materials Technology, Green Materials Technology, Smart Material Technology, Medical Device Products	1992	244
FRT (Footwear & Recreation Technology Research Institute)	Footwear and Recreation, Assistive Devices, High-Performance Elastomers, Nano-Elastomers, Environmentally Friendly Materials	1991	150
USDDC (United Ship Design and Development Center)	Marine Industry Research, Shipping, Naval, Yacht Building and Fishing	1976	254
PITDC (Medical and Pharmaceutical Industry Technology and Development Center)	Medical and Pharmaceutical Technology	1993	135
CHC (Cycling & Health Tech. Industry R&D Center)	Bicycle Creative Design and Interaction Interface Technology, Sports/Medical Devices	1992	89
SRDC (Stone & Resource Industry R&D Center)	Stone-Related Technology, Inorganic Waste Treatment Technology	1992	84
PTRI (Printing Technology Research Institute)	Printing Exports, Manufacturing and Quality Control Management	1993	40
SOIC (Ship and Ocean Industries R&D Center)*	Ship Design and Performance, Yacht Technology, Offshore Wind Energy, Floating Platform Development	1989	266

***:** DOIT's major partner institutes
Source: Reproduced with permission from the websites of each government-sponsored R&D institute under the MOEA in ROC (2024/06/17) and Liu (2015)

The remaining GSRIs are smaller, specialized institutions targeting specific industrial sectors. The Metal Industries Research & Development Center (MIRDC), established in 1963, is the third largest with 988 employees, focusing on metal processing and industrial automation. Mid-sized institutions include the Agricultural Technology Research Institute (ATRI, 535 employees) and the Automotive Research and Testing Center (ARTC, 430 employees), specializing in agricultural technology and automotive testing respectively.

Several institutes serve traditional manufacturing sectors, such as the Food Industry Research and Development Institute (FIRDI, 405 employees), Taiwan Textile Research Institute (TTRI, 346 employees), and Development Center for Biotechnology (DCB, 340 employees). The smallest institutions include the Cycling & Health Tech Industry R&D Center (CHC, 89 employees), Stone & Resource Industry R&D Center (SRDC, 84 employees), and Printing Technology Research Institute (PTRI, 40 employees).

This hierarchical structure reflects ROC's strategic approach to industrial research and development, with larger institutes addressing broad technological domains while smaller, specialized centers support specific industrial sectors.

Overall, the strategic mobilization of GSRIs under programs like LIIEP demonstrates the critical role these institutions play in advancing ROC's industrial technology and innovation capabilities. Through these efforts, ROC continues to enhance its industrial competitiveness and drive economic growth in both developed and less-developed regions.

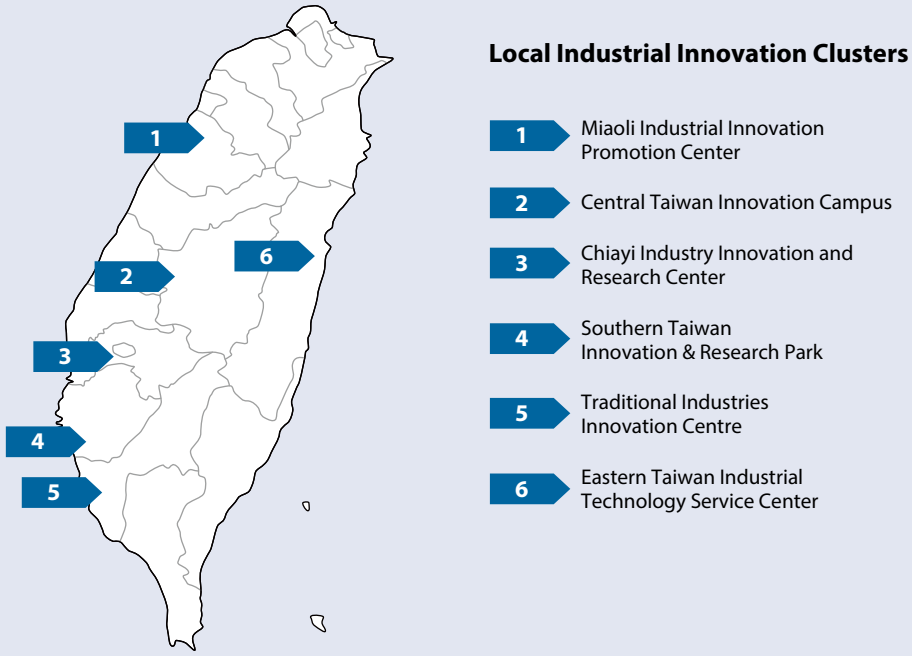
Updated ROC's systematic technology policies

ROC has established a comprehensive framework of systemic technology policies designed to enhance the technological and economic capabilities of SMEs. These policies integrate local revitalization, innovation promotion, and international market expansion efforts, reflecting a holistic approach to SME growth and regional equity. Below, key initiatives illustrate the systemic nature of these policies.

(1) **The Regional Innovation and Research Parks/Centers Policy**, initiated under ROC's "5+2 Industrial Innovation Plan" in 2016, aims to foster industrial innovation, enhance competitiveness, and drive the nation's transformation into a high-tech economy. The policy integrates resources from academia, research institutions, and industry to create specialized innovation clusters in areas such as biotechnology, precision machinery, green energy, and smart machinery. By leveraging geographic and technological synergies, it promotes balanced regional development through the establishment of interconnected innovation corridors across ROC. These centers, strategically located in regions like Miaoli, Chiayi, and Tainan, support traditional industries' transformation while fostering emerging sectors, entrepreneurial incubation, and talent development.

FIGURE 16

ROC LOCAL INDUSTRIAL INNOVATION CLUSTERS



Source: Reproduced with permission from https://www.moea.gov.tw/MNS/doit_e/content/Content.aspx?menu_id=5441

Operationally, the policy emphasizes resource integration, collaboration, and sustainability. These centers serve as hubs for cross-disciplinary R&D and industrial upgrades by providing advanced facilities, green infrastructure, and trial production capabilities. Tailored to regional strengths, they promote localized clusters and offer diverse collaboration pathways such as R&D alliances and professional services. The policy aligns with national strategies, such as the Asia Silicon Valley initiative and circular economy development, fostering a cohesive innovation ecosystem while stimulating economic growth and sustainability across ROC.

The **Miaoli Industrial Innovation Promotion Center (MIIPC)** was established in 2015 as an upgraded initiative to bolster industrial innovation and transformation in the Miaoli region. Originating from the Miaoli Industrial Innovation Platform initiated in 2014, the center focuses on integrating regional and central resources to create an innovation-driven ecosystem. By leveraging expertise from research institutions, local universities, and industry alliances, MIIPC aims to enhance local industries such as powder metallurgy, high-value ceramics, and smart tourism services. The center employs methods such as deep-dive diagnostics, micro-consultations, and advanced technology applications to assist in industrial upgrades. In addition, it connects with key innovation hubs across ROC, forming a comprehensive "Industrial Innovation Corridor" along the island's western coast. Through its systemic and sustainable mechanisms, MIIPC continues to strengthen industry clusters, elevate regional economic competitiveness, and promote the development of cross-disciplinary industrial ecosystems. (https://www.miipc.org/about/1.htm)

The **Central ROC Innovation Campus (CTIC)** serves as a driving force for regional industrial transformation and innovation, connecting six major industrial innovation corridors across ROC. Established to enhance resource integration among industrial zones, research institutions, and universities, CTIC fosters innovation-driven industry clusters and accelerates the development of ROC as a technology hub. It focuses on three core R&D areas: next-generation smart machinery, advanced greenhouse systems, and service technology with sensibility design. By providing an open innovation platform, advanced R&D facilities, and cross-disciplinary collaboration opportunities, CTIC enables industries to adopt cutting-edge technologies, create high-value products, and transition into emerging markets. Additionally, CTIC promotes synergy among academia, research, and industry to enhance ROC's global competitiveness and stimulate regional economic growth. (https://www.ctirp.org.tw/SciencePark_Info.aspx)

The **Chiayi Industry Innovation and Research Center (CIIRC)** was established by ROC's MOEA to support the development of industrial parks in the Yunlin, Chiayi, and Tainan regions and the Central and Southern Science Parks. Managed by the Food Industry Research and Development Institute, the center integrates resources from leading research institutions such as the Metal Industries Research & Development Centre, Precision Machinery Research & Development Center, and Bicycle & Health Tech R&D Center. CIIRC focuses on health and wellness, promoting industrial upgrades and innovation through collaborative R&D services, technology transfer, and process improvements. As a smart, eco-friendly green building, the center provides state-of-the-art facilities, including trial production capabilities, to foster research outcomes and innovation. By uniting academic, industrial, and research efforts, CIIRC aims to strengthen ROC's industrial innovation corridor, driving advancements in biotechnology, precision machinery, and health industries while boosting regional competitiveness and sustainability. (https://enwww.ciic.org.tw/1.aspx)

The **Southern ROC Innovation and Research Park (STIRP)**, located in the Tainan Technology Industrial Park, features five modern buildings with advanced facilities. Established in 2005 by ROC's MOEA, STIRP aims to balance regional development by integrating innovation resources in southern ROC. Strategically positioned near Tainan and Kaohsiung with excellent connectivity, it serves as a linkage hub for academia, industry, and research institutions, such as the Industrial Technology Research Institute and Food Industry Research and Development Institute. The park supports the transformation of traditional industries through innovation, promotes startup incubation, and fosters industrial clustering. Companies can join through various pathways, including entrepreneurial incubation, R&D alliances, or professional service provision. By nurturing innovation and collaboration, STIRP drives economic growth and industrial upgrades in southern ROC.

The **Traditional Industry Innovation Value-Adding Center** was established by ROC's MOEA in 2018 in Kaohsiung to facilitate the upgrade and transformation of traditional industries in southern ROC. The center focuses on enhancing the competitiveness of sectors such as metal products, machinery, and automotive components by integrating advanced materials, digital manufacturing processes, and innovative product development. It serves as a collaborative hub, linking academic institutions, research organizations, and industry players to foster innovation and increase the added value of traditional industries.

The **Eastern ROC Industrial Technology Service Center (ETITSC)**, established under the Stone and Resource Industry Research and Development Center (SRDC), integrates resources from the Alliance for Innovative Traditional Industries (AITI) to support the innovation and transformation of traditional industries in Eastern ROC. The center focuses on three core areas: stone materials, deep-sea water, and local specialty industries. By leveraging advanced technology and product development, it helps establish autonomous key technologies, fosters industrial clusters, and drives regional revitalization. Originally created to advance the stone industry, ETITSC now also oversees the Deep-Sea Water Innovation R&D Center and plays a pivotal role in the Eastern Innovation Corridor and sustainable development initiatives for the region. (https://www.eitsc.org.tw/eitsc/)

(2) **The Creative Life Industry Development Program**, initiated by ROC's MOEA in 2003, aims to integrate cultural and creative elements into businesses, particularly SMEs. By infusing innovative thinking and cultural significance into business models, the program encourages the development of unique products and services that enhance customer experiences and elevate the economic value of creative industries. The program emphasizes industry-specific marketing and fosters collaborations among stakeholders to strengthen regional brands and cultural identities, contributing to a cohesive national narrative. Through initiatives such as mentoring, diverse investment and financing, and organizing events like the Creative Expo ROC, the program supports the growth and international presence of ROC's cultural and creative sectors. By promoting sustainable business practices that combine culture and aesthetics with industrial innovation, the program aims to lead ROC's industries toward upgrading, transformation, and enhanced competitiveness.

(3) **Digital Innovation and International Linkage Initiatives:** Recognizing the critical role of digital transformation in enhancing the competitiveness of SMEs, ROC's MOEA initiated the "Project for Promoting Digital Innovation and International Linkage for SMEs" in 2019. This initiative aims to expedite SMEs' expansion into international markets by supporting the adoption of digital tools and fostering cross-border collaborations. Key components of the program include organizing matchmaking events and providing diagnostic consulting services to align SMEs with emerging global market opportunities. The program operates in conjunction with ROC's broader digital economy strategies, such as the "DIGI+: Digital Nation and Innovative Economic Development Program," which seeks to integrate technologies like AI, IoT, and big data into industry and daily life. By leveraging ROC's strengths in information and communication technology, these initiatives collectively aim to transform SMEs into agile entities capable of competing on a global scale, thereby reinforcing ROC's position as a hub for digital innovation.

Features of ROC's Systemic Technology Policies

ROC's systemic technology policies are distinguished by several interconnected features that create a comprehensive framework for industrial innovation and development. At the foundation is a sophisticated hierarchical support structure, orchestrated by the MOEA through its network of 16 Government-Sponsored Research Institutes (GSRIs). This hierarchy is carefully designed, with major institutes like ITRI (6,000 employees) and III (1,782 employees) addressing broad technological domains such as electronics, information technology, and digital transformation. Medium-sized institutes, including MIRDC (988 employees) and ATRI (535 employees), focus on specific industrial sectors like metal processing and agricultural technology. Smaller specialized institutes serve niche traditional industries, ensuring that even the most specialized sectors receive targeted support.

The regional integration mechanisms form another crucial feature of ROC's approach. The LIIEP served as the primary integrator, systematically matching R&D institutions with specific regions to address local needs and capabilities. This regional focus is strengthened through strategically positioned innovation centers such as MIIPC, ETITSC, and CIIRC. These centers are connected through the "Industrial Innovation Corridor" concept, which facilitates resource sharing and knowledge transfer while allowing each region to develop specialized capabilities based on local strengths.

Support for traditional industries is implemented through a multi-dimensional approach. Direct technological assistance comes from specialized GSRIs that understand sector-specific challenges and requirements. This is complemented by the Creative Life Industry Program, which helps traditional businesses integrate cultural and creative elements into their operations, adding value to their products and services. The digital transformation dimension is addressed through the SME Digital Innovation Project, which provides targeted support for technological modernization. Access to advanced facilities and trial production capabilities ensures that traditional industries can experiment with and implement new technologies without bearing the full cost of infrastructure investment.

Market failure mitigation represents a critical feature of ROC's policy framework. The strategic deployment of R&D subsidies helps overcome funding gaps, particularly in less-developed regions where private investment might be scarce. GSRIs play a crucial role in reducing information asymmetries by sharing resources and expertise with local firms. This approach ensures that SMEs and traditional industries in all regions have equitable access to innovation resources and opportunities for international market expansion.

The integration of sustainable development principles distinguishes ROC's approach from conventional industrial policies. Innovation centers are designed with eco-friendly infrastructure, demonstrating a commitment to environmental sustainability. The long-term vision for industrial transformation balances technological advancement with environmental considerations, while the focus on creating sustainable industrial clusters ensures that economic development doesn't come at the expense of environmental protection.

Cross-sector collaboration serves as a binding feature that maximizes the effectiveness of these policies. By integrating academia, industry, and research institutions, ROC creates powerful synergies that drive innovation. Public-private partnerships facilitate resource sharing and risk distribution, while cross-disciplinary R&D initiatives encourage breakthrough innovations. The shared use of facilities and resources ensures efficient utilization of public investments and creates opportunities for knowledge spillovers between different sectors and regions.

The adaptive nature of ROC's policy framework ensures its continued relevance and effectiveness. The system is designed to be responsive to emerging technological trends while maintaining flexibility in supporting different industry needs. Regular updates to programs and initiatives address changing market conditions, while new initiatives are seamlessly integrated within existing frameworks. This adaptability is crucial for maintaining the competitiveness of ROC's industries in a rapidly evolving global economy.

Together, these features create a cohesive system that effectively promotes industrial innovation while addressing regional development needs and supporting traditional industries. The success of this approach lies in its ability to balance multiple objectives: fostering technological advancement, ensuring regional equity, supporting traditional industries, and promoting sustainable development. Through this comprehensive framework, ROC has created an environment where industries of all sizes and types can access the resources and support needed for continuous innovation and growth.

DIGITAL TECHNOLOGY ADOPTION AND INNOVATION CAPABILITIES OF ROC'S SMES

Introduction and Background

Overview of ROC's Business Landscape

In recent years, the rapid pace of technological advancements and the increasing importance of digital transformation have significantly reshaped global business landscapes. For SMEs, which are the backbone of many economies, including ROC's, navigating these changes presents both opportunities and challenges. SMEs often face distinct barriers—such as limited financial resources, skill shortages, and restricted access to advanced technologies—that inhibit their ability to adopt digital innovations at the same scale as large enterprises. However, the urgency of digital transformation is heightened by its potential to drive competitiveness, operational efficiency, and market responsiveness, particularly in a technology-driven global economy.

ROC's SMEs, which constitute 98.9% of all enterprises and employ 80.9% of the workforce, are central to the country's economic resilience and growth. Recognizing the pivotal role of these businesses, the ROC government has implemented comprehensive policies aimed at supporting their digital transformation. These initiatives are designed to bridge the digital divide between smaller enterprises and their larger counterparts, ensuring that SMEs can thrive in an increasingly interconnected and competitive global market. By providing financial subsidies, expert guidance, and access to digital tools, these policies aim to empower SMEs to overcome resource constraints, adopt innovative solutions, and achieve sustainable growth.

This study examines the digital transformation experiences of ROC's SMEs compared to large enterprises from 2021 to 2023, focusing on critical questions that explore the disparities in investment, tool adoption, and operational outcomes. By drawing on survey data collected over three years, the research highlights the challenges and opportunities SMEs face in their transformation journey, as well as the effectiveness of government interventions. Key questions addressed include: How do SMEs' investment levels and technology adoption differ from those of large enterprises? What specific challenges hinder SMEs' digital progress? How are government policies impacted in bridging the digital divide and fostering inclusive economic growth?

The study also delves into industry-specific dynamics, comparing the transformation trajectories of sectors such as manufacturing and services, which exhibit diverse adoption patterns and challenges. For instance, manufacturing SMEs often focus on digital supply chain solutions and automation, while retail and service enterprises prioritize customer engagement platforms and e-commerce. By analyzing these sectoral variations and integrating government policy outcomes, the research seeks to provide actionable insights for enhancing the digital readiness and competitiveness of ROC's SMEs.

Ultimately, this report underscores the importance of a cohesive, multi-faceted approach to digital transformation that aligns national policies with the specific needs of SMEs. The lessons drawn from ROC's experiences offer valuable perspectives not only for policymakers and industry leaders but also for SMEs themselves, illustrating how targeted strategies can drive digital innovation and economic sustainability in a rapidly evolving global landscape.

This study employs a robust methodological approach, drawing on three consecutive years (2021–2023) of comprehensive surveys conducted by PwC ROC in collaboration with government and industry bodies. The data collection methods ensure a high degree of statistical validity and reliability, featuring sample sizes of 3,233 respondents in 2021, 3,016 in 2022, and 1,569 in 2023.

Digital Transformation Context

The comparative analysis of digital transformation between SMEs and large enterprises reveals distinct characteristics in their approaches and capabilities. Large enterprises demonstrate substantial commitment to digital transformation through significant financial investment, typically allocating over TWD1 million annually to digital initiatives. These organizations implement comprehensive transformation strategies that align closely with their broader organizational goals, ensuring cohesive implementation across all business units. Their transformation efforts are driven by dedicated teams possessing significant expertise, and they benefit from ready access to international expertise, resources, and advanced technological solutions.

In contrast, SMEs face considerable resource constraints that shape their digital transformation journey. Nearly half (48.5%) of SMEs allocate less than TWD500,000 annually for digital adoption, significantly limiting their transformation scope. Their approach to digital initiatives tends to be more fragmented and tactical, primarily addressing immediate operational needs rather than pursuing long-term strategic transformation. Due to limited internal expertise, SMEs often depend heavily on government support programs and external consultants to guide their digital transformation efforts. Moreover, they face substantial challenges in accessing advanced technology and global expertise, primarily due to financial and operational limitations.

While large enterprises leverage substantial financial and human resources to drive cohesive and far-reaching digital transformation, SMEs contend with significant barriers stemming from limited budgets and expertise. Despite these constraints, SMEs exhibit agility and adaptability, often exploring innovative, low-cost solutions to overcome structural disadvantages. This dichotomy highlights the importance of targeted support mechanisms tailored to SMEs' unique needs to enhance their digital transformation trajectories.

Digital Transformation Strategies

ROC's government has adopted a proactive and multi-faceted approach to supporting SMEs in their digital transformation journey, recognizing the critical role these enterprises play in the national economy. From 2021 to 2023, several time-bound and sector-specific initiatives have been implemented to address the unique challenges SMEs face, including financial constraints, limited digital expertise, and uneven access to technology. These strategies emphasize inclusivity, sustainability, and practical application, enabling SMEs to transition into a technology-driven global marketplace.

Government Initiatives and Key Projects

ROC has implemented a comprehensive series of government-led projects aimed at facilitating digital transformation among SMEs, with a particular focus on providing financial assistance, technical guidance, and access to digital tools. The cornerstone of these efforts includes two major initiatives: the Project for Assisting Small and Micro Enterprises in Digital Transformation and Innovation Service in the Cloud Era (2021–2023) and the Micro-enterprises Digital Application Coaching Program. These programs have been specifically designed to support micro and small enterprises, with special attention given to businesses employing fewer than nine people, helping them develop essential digital capabilities including cloud services, data analytics, and basic e-commerce platforms. (See Table 24)

The government's approach demonstrates a clear understanding of the varying needs across different business segments. For instance, the Project for Assisting Small and Micro Enterprises focuses on localized digital empowerment and has been particularly effective in increasing digital adoption within shopping districts. Meanwhile, the Micro-enterprises Digital Application Coaching Program emphasizes basic digital tools and data-driven decision-making, which has resulted in enhanced operational efficiency for participating businesses.

TABLE 24

SUMMARIES OF THE MAJOR INITIATIVES AND THEIR FOCUS AREAS

Initiative	Target Group	Key Features	Impact
Project for Assisting Small and Micro Enterprises	Micro and small enterprises	Adoption of digital tools, cloud services, and localized digital empowerment	Increased digital adoption in shopping districts
Micro-enterprises Digital Application Coaching Program	Micro-enterprises	Basic digital tools, data-driven decision-making	Enhanced operational efficiency
Small and Medium Manufacturing Enterprise Digital Transformation Project	Manufacturing SMEs	Supply chain digitalization, AI, and IoT integration	Improved supply chain resilience
Data Sharing Innovation Service Project	Retail and service SMEs	Subsidies for digital marketing and e-commerce solutions	Enhanced customer engagement
Tcloud Marketplace	All SMEs	Points-based marketplace for subsidized cloud solutions	Broader access to affordable digital tools

Source: This study and the Small and Medium Enterprise and Startup Administration (2021–2023)

In the manufacturing sector, the Small and Medium Manufacturing Enterprise Digital Transformation Project addresses the specific needs of manufacturing SMEs, focusing on supply chain digitalization and the integration of advanced technologies such as AI and IoT. This targeted approach has contributed to improved supply chain resilience among participating companies. Complementing these efforts, the Data Sharing Innovation Service Project provides subsidies for digital marketing and e-commerce solutions, particularly benefiting retail and service SMEs in enhancing their customer engagement capabilities.

A notable innovation in this ecosystem is the Tcloud Marketplace, which serves all SMEs through a points-based system for accessing subsidized cloud solutions. This platform has been instrumental in broadening access to affordable digital tools across the SME sector. Together, these initiatives form a comprehensive support structure that addresses the diverse digital transformation needs of ROC's SME sector, from basic digital adoption to advanced technology integration, demonstrating the government's commitment to ensuring no business is left behind in the digital era.

The success of these programs lies in their tiered approach, which recognizes that digital transformation is not a one-size-fits-all process. By providing tailored support for different business sizes and sectors, ROC has created a robust framework for digital advancement that considers both the immediate needs and long-term sustainability of its SME sector.

Sector-Specific Strategies and Localized Empowerment

To improve digital technology adoption among SMEs, ROC's government has implemented targeted policies emphasizing accessibility and inclusivity. The introduction of platforms like Tcloud Marketplace exemplifies this commitment, offering SMEs a points-based, government-subsidized system to select and implement digital tools with reduced financial burden.

The sector-specific adoption rates from 2021 to 2023 reveal distinct digital transformation patterns across industries. In manufacturing, the adoption of supply chain management systems increased significantly from 18.5% to 24.7%, while inventory management systems showed steady growth from 25.3% to 29.9%. The retail and service sector demonstrated even more substantial progress, with CRM adoption rising from 38.0% to 51.7%, and digital marketing tools usage increasing from 30.5% to 42.8%. (See Table 25)

TABLE 25

SECTOR-SPECIFIC DIGITAL TOOL ADOPTION RATES FOR SMES, 2021–2023

Sector	Digital Tools	2021	2022	2023
Manufacturing	Supply Chain Management Systems	18.5%	21.6%	24.7%
	Inventory Management Systems	25.3%	27.6%	29.9%
	Data Analysis Platforms	12.0%	15.5%	18.7%
Retail and Service	CRM	38.0%	45.0%	51.7%
	Digital Marketing Tools	30.5%	37.2%	42.8%
	Analytics Platforms	25.6%	31.5%	39.1%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

The 5G Innovative Application Development Program (2020–2023) has further accelerated this transformation, promoting advanced technologies like augmented reality (AR) and smart logistics, particularly in traditional and indigenous industries. The program also integrates environmental sustainability through green technologies and net-zero initiatives.

The government's strategies are carefully tailored to address sector-specific needs. Manufacturing SMEs receive specialized support focused on supply chain resilience and smart technology adoption, as evidenced by the growing use of data analysis platforms from 12.0% to 18.7%. Meanwhile, retail and service sectors have emphasized customer engagement tools, reflected in the dramatic increase in analytics platforms adoption from 25.6% to 39.1%.

Localized empowerment remains central to ROC's digital transformation approach. Projects targeting shopping districts and indigenous businesses focus on building digital capacity at the community level, with particular attention to regions where digital adoption has traditionally lagged. For instance, initiatives in Central and Southern ROC support industries such as textiles, food processing, and metal products through customized educational materials, case studies, and hands-on training sessions.

These comprehensive strategies demonstrate ROC's commitment to empowering SMEs, fostering innovation, and ensuring equitable distribution of digital transformation benefits. The next section will explore the challenges SMEs face in digital transformation and the measures needed to overcome them.

Challenges and Government Solutions

The digital transformation journey for ROC's SMEs is fraught with numerous challenges that stem from resource limitations, skill shortages, and structural constraints. While these barriers can hinder progress, ROC's government has implemented targeted solutions to address them, aiming to bridge the digital divide and promote sustainable development. This section highlights the key challenges faced by SMEs and the government's strategic responses.

Digital Investment Scale

The scale and impact of digital transformation investments between 2021 and 2023 reveal stark disparities between large enterprises and SMEs in ROC. Survey data shows a dramatic contrast in investment capabilities, with 79.6% of large enterprises allocating more than TWD1 million to digital transformation initiatives, while only 15.4% of SMEs can match this level of investment. More concerning is that 8.8% of SMEs report no digital investment at all, and nearly half (48.5%) limit their spending to less than TWD500,000. In comparison, virtually all large enterprises maintain some level of digital investment, with only 5.1% spending less than TWD500,000.

TABLE 26

INVESTMENT LEVELS IN DIGITAL TRANSFORMATION, 2021–2023

Investment Level	SMEs (%)			Large Enterprises (%)		
	2021	2022	2023	2021	2022	2023
No investment	26.3%	12.6%	8.8%	0%	0.5%	0%
<TWD500,000	48.5%	42.3%	48.5%	4.8%	4.3%	5.1%
TWD500,000–1M	21.2%	31.5%	27.3%	11.4%	12.7%	15.3%
>TWD1M	4.0%	13.6%	15.4%	83.8%	82.5%	79.6%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

This investment disparity is further reflected in the returns achieved through digital transformation efforts. The majority of SMEs (53.5%) report modest revenue growth of less than 5% from their digital investments, with only a small fraction (8.8%) achieving substantial growth exceeding 20%. In contrast, large enterprises demonstrate more robust returns, with 30% of these organizations realizing revenue growth above 15%. This performance gap suggests a compelling correlation between investment scale and transformation success.

The data reveals a concerning cycle: large enterprises' ability to make substantial digital investments not only enables more comprehensive transformation initiatives but also yields higher and more consistent financial returns, which in turn supports continued investment in digital capabilities. Conversely, SMEs' limited investment capacity often results in lower returns, potentially constraining their ability to increase future digital investments. This pattern underscores the critical importance of addressing resource disparities to prevent a widening digital divide between large enterprises and SMEs in ROC's business landscape.

Digital Skill Requirements

The evolving landscape of digital transformation has created significant demands for specific digital skills, particularly highlighting the challenges faced by SMEs in ROC. According to Table 27, the most critical skill requirement among SMEs is data analysis and database management, with 27.0% of SMEs identifying this as a priority need. This is followed by digital project management skills at 20.0%, system development and integration capabilities at 18.0%, and system interface operation skills at 17.0%.

These statistics paint a concerning picture of the digital skills gap in SMEs. Despite recognizing the importance of these technical capabilities, SMEs face persistent challenges in accessing and retaining high-skilled talent. This limitation significantly impacts their ability to implement and execute complex digital initiatives. The relatively low percentages across all skill categories suggest that many SMEs may be struggling to identify or articulate their specific digital skill needs, possibly due to limited understanding of digital transformation requirements or resource constraints in recruiting specialized talent.

TABLE 27

PRIORITY DIGITAL SKILLS NEEDED, 2021–2023

Skill Type	Percentage of SMEs Requiring		
	2021	2022	2023
Data Analysis & Database Management	21.5%	24.3%	27.0%
Digital Project Management	15.0%	18.5%	20.0%
System Development & Integration	12.8%	15.7%	18.0%
System Interface Operation	10.3%	13.6%	17.0%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

This skills gap presents a fundamental barrier to digital transformation among SMEs, suggesting a critical need for targeted support in talent development and acquisition strategies. The data underscores the importance of developing comprehensive solutions that address not only the technical skill requirements but also the underlying challenges SMEs face in attracting and retaining digitally skilled workers. Thus, SMEs remain constrained by limited access to high-skilled talent, which impedes their ability to execute complex digital initiatives.

To address these gaps, the government has prioritized workforce development through training programs and partnerships with academic institutions. The Micro-enterprises Digital Application Coaching Program provides hands-on training to small business owners, while industry collaboration initiatives facilitate access to expert consultants and technical advisors.

Technological and Operational Challenges

The digital transformation landscape among ROC businesses reveals a significant disparity between SMEs and large enterprises in their adoption of digital technologies. Data from PricewaterhouseCoopers Taiwan covering 2021-2023 highlights substantial gaps across all categories of digital tools, with SMEs consistently trailing behind their larger counterparts in technology adoption rates (Table 28).

TABLE 28

TOOL CATEGORY ADOPTION BY SMES AND LARGE FIRMS, 2021–2023

Tool Category	SMEs			Large Enterprises		
	2021	2022	2023	2021	2022	2023
Advanced Tools (AI, IoT)	7.2%	10.8%	15.6%	48.0%	55.0%	62.0%
Intermediate Tools (ERP, CRM)	22.5%	29.6%	34.5%	65.0%	71.0%	78.0%
Basic Tools (Email, Cloud Storage)	55.3%	61.2%	67.6%	87.0%	89.0%	92.0%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]
Note: ERP, enterprise resource planning

In the realm of advanced technologies such as AI and IoT, the divide is particularly striking. While SMEs have shown progress, increasing their adoption rates from 7.2% in 2021 to 15.6% in 2023, large enterprises maintained a commanding lead with adoption rates soaring from 48.0% to 62.0% during the same period. This pattern reveals a persistent technology gap of over 46 percentage points by 2023, highlighting the significant challenges SMEs face in implementing cutting-edge digital solutions.

The adoption of intermediate tools, including enterprise resource planning (ERP) and CRM systems, presents a similar though slightly less pronounced divide. SMEs demonstrated steady growth in this category, with adoption rates rising from 22.5% to 34.5% over the three-year period. However, large enterprises maintained substantially higher adoption rates, increasing from 65.0% to 78.0%. Even in basic digital tools such as email and cloud storage, where SMEs show their highest adoption rates reaching 67.6% by 2023, they still lag behind large enterprises' near-universal adoption rate of 92.0%.

Despite these challenges, there are encouraging signs of progress. SMEs have shown consistent growth across all tool categories, with advanced tool adoption more than doubling and intermediate tool usage increasing by 12 percentage points over the study period. This growth suggests that government initiatives, particularly the Small and Medium Manufacturing Enterprise Digital Transformation Project, are having a positive impact. The project's comprehensive approach, combining financial subsidies with technical workshops, directly addresses both the financial and knowledge barriers that typically impede SME digital transformation.

The data underscores the importance of continued government support in bridging the digital divide. While the growth trends are promising, the persistent gaps in adoption rates between SMEs and large enterprises highlight the need for sustained effort in supporting smaller businesses through their digital transformation journey. The government's targeted approach, focusing specifically on advanced tool adoption where SMEs show the lowest rates, demonstrates a strategic understanding of where intervention is most needed.

Risk Management Challenges

The evolution of risk management adoption across ROC businesses from 2021 to 2023 reveals significant gaps between SMEs and large enterprises, particularly in their approach to digital security and system integration. This disparity highlights both the challenges faced by SMEs and the targeted responses developed by the government (Table 29).

In the realm of information security, while SMEs have shown notable improvement, increasing from 65.3% to 79.0% adoption over the three-year period, they still trail behind large enterprises' near-universal adoption rate of 92.0% by 2023. This gap, though narrowing, indicates that approximately one in five SMEs still lacks the basic information security measures, potentially exposing them to significant cyber risks.

TABLE 29

RISK MANAGEMENT AREA FOCUS, 2021–2023

Risk Management Area	SMEs (%)			Large Enterprises (%)		
	2021	2022	2023	2021	2022	2023
Information Security	65.3%	72.5%	79.0%	88.0%	90.5%	92.0%
Data Protection	51.2%	58.0%	66.6%	78.0%	82.0%	85.0%
System Integration	15.0%	18.6%	21.5%	63.5%	67.0%	71.0%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

Data protection presents a similar pattern but with a wider gap. SME adoption rates increased from 51.2% to 66.6%, showing growing awareness of data protection importance. However, large enterprises maintained substantially higher rates, reaching 85.0% by 2023. This 18.4 percentage point gap suggests that many SMEs may not be fully prepared for increasingly stringent data protection requirements and potential threats.

The most concerning disparity appears in system integration risk management, where SMEs significantly lag behind larger counterparts. Despite modest growth from 15.0% to 21.5%, SMEs fall nearly 50 percentage points behind large enterprises' 71.0% adoption rate in 2023. This substantial gap in system integration risk management could leave SMEs vulnerable to complex technical challenges and integration failures.

To address these vulnerabilities, the government has implemented a multi-faceted support strategy. The provision of cybersecurity tools and workshops directly targets the knowledge gap that often prevents SMEs from implementing comprehensive risk management frameworks. Furthermore, the government's subsidies for risk management software and strategic partnerships with cybersecurity firms create accessible pathways for SMEs to build more robust security infrastructures, demonstrating a practical approach to addressing these critical gaps in the SME sector's risk management capabilities..

Summary of Government Solutions

The government's multi-pronged approach to addressing SME challenges has centered on three key pillars:

1. Financial Support: Subsidies, grants, and marketplace platforms to reduce cost barriers.
2. Skill Development: Training programs and partnerships to bridge the digital skills gap.
3. Localized Empowerment: Targeted initiatives for underserved regions and sectors.

These solutions aim to create a more inclusive digital ecosystem, enabling SMEs to overcome barriers and contribute to ROC's broader economic goals. The next section will explore sector-specific impacts and the comparative outcomes of these transformation strategies.

Sectoral Impacts and Differences

ROC's digital transformation initiatives have produced varying impacts across different sectors, highlighting the unique challenges and opportunities faced by SMEs in industries such as manufacturing, retail, and services. While government policies have provided substantial support, the extent of digital adoption and transformation outcomes reflects differences in sectoral needs, resource availability, and technological priorities. This section examines these sectoral dynamics in detail, emphasizing the comparative progress of SMEs and large enterprises.

Manufacturing Sector

The manufacturing sector in ROC, a cornerstone of the national economy, exhibits a pronounced digital divide between SMEs and large enterprises. Table 30 reveals striking disparities in the adoption of critical digital technologies, highlighting the challenges SMEs face in their digital transformation journey.

TABLE 30

TOOL TYPE ADOPTION RATES FOR MANUFACTURING SECTOR, 2021–2023

Tool Type	SME Adoption Rate			Large Enterprise Adoption Rate		
	2021	2022	2023	2021	2022	2023
Production Management Systems	22.5%	27.4%	31.2%	75.6%	78.9%	82.3%
Quality Management Systems	30.8%	35.5%	40.2%	70.2%	72.6%	75.4%
Data Analytics Platforms	12.0%	15.5%	18.7%	58.5%	63.2%	68.8%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

The data demonstrates a consistent but significant gap across all tool types. Production management systems, fundamental to modern manufacturing operations, show a stark contrast: while large enterprises achieved an impressive 82.3% adoption rate by 2023, SMEs reached only 31.2%, despite showing steady growth from 22.5% in 2021. Similarly, quality management systems implementation among SMEs, though increasing from 30.8% to 40.2% over the three-year period, still falls considerably short of large enterprises' 75.4% adoption rate in 2023.

Perhaps the most telling is the adoption rate of data analytics platforms, where the disparity is most pronounced. SMEs' adoption rate of 18.7% in 2023, while showing improvement from 12.0% in 2021, remains significantly behind large enterprises' 68.8%. This gap in data analytics capability could potentially impact SMEs' competitiveness in an increasingly data-driven manufacturing environment.

To address these disparities, the Small and Medium Manufacturing Enterprise Digital Transformation Project has implemented targeted interventions focusing on three key areas: supply chain digitalization to enhance operational resilience, AI and IoT integration through subsidized smart manufacturing systems, and workforce upskilling programs specifically designed for manufacturing hubs in Central and Southern ROC. These initiatives aim to accelerate digital tool adoption among SMEs, who often face challenges such as supply chain disruptions, aging workforces, and high upfront costs for technology integration.

The year-over-year increases across all categories for SMEs, though modest, suggest that these government initiatives are making steady progress in narrowing the digital divide. However, the persistent gaps highlighted in Table 30 underscore the need for continued and perhaps intensified support to accelerate SMEs' digital transformation in ROC's manufacturing sector.

Retail and Service Sectors

The retail and service sectors in ROC demonstrate a clear digital adoption gap between SMEs and large enterprises, though data from 2021-2023 shows encouraging progress in SMEs' digital transformation journey. Table 31 reveals significant growth patterns across all digital tool categories, while highlighting persistent disparities between business sizes.

TABLE 31

DIGITAL TOOL ADOPTION IN RETAIL AND SERVICE SECTORS, 2021–2023

Tool Type	SME Adoption Rate			Large Enterprise Adoption Rate		
	2021	2022	2023	2021	2022	2023
CRM Systems	38.0%	45.0%	51.7%	78.0%	81.5%	85.2%
Digital Marketing Tools	30.5%	37.2%	42.8%	70.8%	74.6%	78.9%
Analytics Platforms	25.6%	31.5%	39.1%	65.0%	68.7%	72.4%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

CRM systems have seen the most substantial adoption increase among SMEs, rising from 38.0% in 2021 to 51.7% in 2023, marking a notable 13.7 percentage point improvement. However, this still trails behind large enterprises' 85.2% adoption rate in 2023, indicating a considerable gap in customer data management capabilities.

Digital marketing tools show a similar trend, with SMEs increasing their adoption from 30.5% to 42.8% over the three-year period. While the 12.3 percentage point growth is significant, it remains well below large enterprises' 78.9% adoption rate in 2023. This disparity suggests that many SMEs still face challenges in effectively reaching and engaging customers through digital channels.

Analytics platforms represent the area where SMEs have made their most dramatic progress, with adoption rates rising from 25.6% to 39.1%, a 13.5 percentage point increase. However, the gap remains substantial when compared to large enterprises' 72.4% adoption rate in 2023, potentially limiting SMEs' ability to make data-driven business decisions.

To address these disparities, the government has implemented targeted support measures, including the Data Sharing Innovation Service Project, which provides TWD30,000 subsidies for digital marketing and e-commerce solutions. This initiative, combined with localized training programs and community-based projects in shopping districts, aims to overcome common barriers such as insufficient marketing technology budgets, limited digital literacy, and e-commerce adoption resistance.

The consistent upward trends across all three categories suggest that these government initiatives are having a positive impact, though the persistent gaps highlighted in Table 31 indicate the need for continued support to accelerate digital transformation among retail and service sector SMEs.

Cross-Sectoral Insights

A comparison between high-performing and standard SMEs reveals distinct patterns in their digital transformation priorities and achievements. Table 32 illustrates significant disparities in three key focus areas, highlighting how strategic approaches to digital adoption correlate with business performance.

TABLE 32

FOCUS AREAS FOR HIGH-PERFORMING VS. STANDARD SMES, 2021–2023

Focus Area	High-Performing SMEs			Standard SMEs		
	2021	2022	2023	2021	2022	2023
Customer Experience Improvement	38.7%	45.2%	51.1%	20.0%	22.5%	25.4%
Operational Efficiency	36.5%	40.1%	45.3%	35.2%	38.7%	42.1%
Market Growth Initiatives	48.5%	54.3%	58.1%	32.8%	36.5%	40.5%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

Customer experience improvement shows the most striking contrast between the two groups. High-performing SMEs have dramatically increased their focus in this area from 38.7% to 51.1% between 2021 and 2023, while standard SMEs made more modest progress from 20.0% to 25.4%. This 25.7 percentage point gap in 2023 suggests that high-performing SMEs place substantially greater emphasis on customer-centric digital solutions.

Interestingly, operational efficiency presents the smallest gap between the two groups. While high-performing SMEs reached 45.3% in 2023 from 36.5% in 2021, standard SMEs achieved similar growth from 35.2% to 42.1%. This relatively narrow margin of 3.2 percentage points in 2023 indicates that operational efficiency is a shared priority across all SMEs, regardless of their performance level.

Market growth initiatives demonstrate another significant disparity, with high-performing SMEs increasing their focus from 48.5% to 58.1% over the three-year period, compared to standard SMEs' growth from 32.8% to 40.5%. The resulting 17.6 percentage point gap in 2023 reflects high-performing SMEs' stronger emphasis on expansion and market development strategies.

These patterns across sectors highlight how high-performing SMEs pursue a more comprehensive digital transformation strategy, balancing customer experience, operational efficiency, and market growth. Meanwhile, standard SMEs tend to focus more narrowly on operational improvements, suggesting a need for enhanced support to help them develop more balanced digital transformation strategies.

As ROC continues to support its SME ecosystem, these insights from high-performing SMEs provide valuable guidance for policy development and support programs. The next section will explore future directions and policy recommendations for sustaining and enhancing these transformation efforts, with particular attention to closing the performance gap between high-performing and standard SMEs.

Future Directions and Policy Recommendations

ROC's efforts to digitally transform its SME ecosystem have achieved significant progress, yet challenges persist, particularly in addressing financial constraints, skill gaps, technological disparities, and regional imbalances. To sustain and enhance the impact of these initiatives, future policies must build upon existing programs while introducing targeted strategies that promote inclusivity, innovation, and resilience. This section outlines future directions and policy recommendations to bridge the remaining digital divide and position ROC's SMEs as global leaders in digital competitiveness.

Financial Support

Financial support mechanisms for SMEs' digital transformation have shown steady growth from 2021 to 2023, yet data suggests significant opportunities for expansion and refinement. According to Table 33, subsidies and grants have seen the highest utilization rate, increasing from 35.7% in 2021 to 48.2% in 2023. The recommended evolution of these subsidies has progressed from supporting basic tool adoption to enabling more sophisticated technologies, particularly advanced tech implementation by 2023 (Table 33).

Expert guidance services have demonstrated consistent growth in utilization, rising from 25.0% to 32.1% over the three-year period. The recommendations for this support mechanism have evolved strategically, beginning with generic digital strategy assistance in 2021, advancing to data-driven tool guidance in 2022, and culminating in specialized AI and IoT coaching by 2023.

TABLE 33

FINANCIAL SUPPORT MECHANISMS FOR SMES, 2021–2023

	2021		2022		2023	
Financial Support Mechanism	Current Utilization	Recommended Expansion	Current Utilization	Recommended Expansion	Current Utilization	Recommended Expansion
Subsidies and Grants	35.7%	Broaden access for basic tools	42.5%	Support ERP/ CRM adoption	48.2%	Increase coverage for advanced tech
Expert Guidance	25.0%	Develop generic digital strategy help	28.7%	Provide guidance on data-driven tools	32.1%	Offer targeted AI and IoT coaching
Training Program Subsidies	20.5%	Focus on foundational skill-building	23.8%	Expand programs for mid-level skills	25.0%	Expand sector-specific programs
Micro-loans	N/A	Not proposed	N/A	Suggested to improve capital access	N/A	Launch for underserved SMEs

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]Training program subsidies, while showing modest growth from 20.5% to 25.0%, reveal a systematic progression in recommended focus areas. The evolution from foundational skill-building in 2021 to mid-level skills in 2022, and finally to sector-specific programs in 2023, reflects an increasingly sophisticated approach to workforce development.

Notably, micro-loans represent an untapped opportunity in the support ecosystem. While not implemented during the 2021-2023 period, recommendations have evolved from no initial proposal to a recognized need for improving capital access, ultimately leading to specific recommendations for launching programs targeting underserved SMEs by 2023.

Looking forward, policy priorities should focus on three key areas: scaling subsidies for advanced technologies like AI and IoT to encourage broader adoption, implementing the recommended micro-loan programs with particular attention to high-risk sectors and micro-enterprises, and introducing performance-based incentives that reward measurable improvements in productivity, revenue, or environmental sustainability through digital adoption. These recommendations align with the observed trends in support mechanism utilization and the increasingly sophisticated needs of SMEs in their digital transformation journey.

Bridging the Skill Gap

Table 34 reveals evolving priorities and initiatives in digital skill development among SMEs from 2021 to 2023, highlighting both progress and emerging needs. Data analysis and database management have consistently remained the highest priority skill area, showing steady growth from 21.5% to 27.0% over the three-year period. The proposed initiatives in this area have evolved from basic analytics workshops to more comprehensive certification programs and internships, reflecting the increasing sophistication of SMEs' data needs.

TABLE 34

SKILL DEVELOPMENT PRIORITIES AND INITIATIVES FOR SMES, 2021–2023

	2021		2022		2023	
Skill Area	Current SME Priority	Proposed Initiative	Current SME Priority	Proposed Initiative	Current SME Priority	Proposed Initiative
Data Analysis & Database Management	21.5%	Basic analytics workshops	24.3%	Expand access to hands-on training	27.0%	Certification programs and internships
Digital Project Management	15.0%	Foundational leadership programs	18.5%	Mentorship with experienced managers	20.0%	Subsidized training courses
System Integration	12.8%	Pilot technical integration bootcamps	15.7%	Partner with industry for on-the-job learning	18.0%	Government-sponsored workshops
Cybersecurity	N/A	Not identified as a priority	N/A	Emerging focus area	N/A	New focus area for workforce development

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

Digital project management has emerged as the second most prioritized skill area, increasing from 15.0% to 20.0%. The progression of proposed initiatives from foundational leadership programs in 2021 to subsidized training courses in 2023, with an intermediate focus on mentorship programs in 2022, demonstrates a structured approach to building project management capabilities within SMEs.

System integration skills have shown consistent growth in priority, rising from 12.8% to 18.0%. The evolution of initiatives from pilot technical integration bootcamps to government-sponsored workshops, with industry partnerships for on-the-job learning in between, indicates a growing recognition of the importance of practical, hands-on experience in this area.

Notably, cybersecurity emerged as a new focus area by 2023, despite not being identified as a priority in 2021 and 2022. This addition to the skill development landscape reflects the growing awareness of digital security threats and the need for workforce development in this critical area.

To address these evolving skill needs, a comprehensive approach is recommended, incorporating three key strategies: First, developing partnerships with academic institutions and private training providers to deliver certification programs in high-demand areas, particularly in data analytics and cybersecurity where skill gaps are evident. Second, implementing incentive programs such as tax breaks or grants for SMEs that hire certified digital professionals, helping address the immediate talent shortage. Finally, fostering industry-academia collaborations that enable on-the-job training, particularly in areas like system integration where practical experience is crucial for skill development.

Promoting Ecosystem Collaboration

Building a robust digital ecosystem for SMEs requires strategic collaboration across multiple stakeholders, as evidenced by the different models and their potential benefits outlined in Table 35. The data reveals three distinct collaboration approaches, each offering unique advantages for SME digital transformation.

TABLE 35

COLLABORATION MODELS FOR SMES AND THEIR POTENTIAL BENEFITS, 2023

Collaboration Model	Potential Benefits
Public-Private Partnerships	Resource sharing, mentorship opportunities
Industry Consortia	Tailored solutions for sectoral challenges
Global Partnerships	Access to advanced technologies

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

Public-private partnerships emerge as a fundamental collaboration model, offering dual benefits of resource sharing and mentorship opportunities. This approach enables SMEs to leverage the expertise and resources of larger enterprises while benefiting from government support frameworks. The combination of private sector experience and public sector facilitation creates a supportive environment for digital growth.

Industry consortia represent another crucial collaboration model, specifically designed to address sector-specific challenges. These consortia prove particularly valuable in developing tailored solutions for sectoral challenges, such as managing supply chain disruptions in manufacturing or implementing customer analytics in retail. The focused nature of these collaborations enables more efficient problem-solving and resource allocation within specific industry contexts.

Global partnerships complete the collaboration framework, providing SMEs with access to advanced technologies that might otherwise be beyond their reach. These international connections facilitate knowledge transfer and expose ROC SMEs to the best global practices and cutting-edge digital solutions. Such partnerships are essential for maintaining competitiveness in an increasingly interconnected global economy.

By implementing these complementary collaboration models, ROC can foster an SME ecosystem that effectively balances innovation with inclusivity and resilience. The combination of local support through public-private partnerships, sector-specific solutions through industry consortia, and international exposure through global partnerships creates a comprehensive framework for digital transformation. These strategic collaborations will ensure that SMEs continue to drive economic growth while successfully adapting to the evolving demands of the digital economy, ultimately supporting the development of a more competitive and sustainable business environment.

Progress Assessment and Future Vision for SME Digital Transformation

ROC's journey toward digitally transforming its SMEs underscores the critical role these enterprises play in driving economic resilience and innovation. From 2021 to 2023, government-led initiatives have addressed key barriers, including financial constraints, skill gaps, and regional disparities, to empower SMEs to compete in a technology-driven global market. While progress has been significant, persistent challenges highlight the need for a sustained and strategic focus on inclusive and sustainable digital transformation.

Key Achievements

The evolution of digital tool adoption among ROC SMEs reveals a fascinating maturation pattern in their digital transformation journey. The data presents three distinct but interrelated trends that collectively suggest a strategic shift in how SMEs approach technology adoption. The most striking trend appears in basic digital tools (email and cloud storage), where adoption rates show an unexpected decline from 73.3% to 67.6% over the three-year period. Rather than indicating a retreat from digital solutions, this decline likely represents a strategic shift as businesses mature beyond basic digital infrastructure. This interpretation is strengthened when viewed alongside the growth patterns in more sophisticated tools, suggesting SMEs are reallocating resources toward more advanced digital solutions (Table 36).

TABLE 36

TOOL CATEGORY ADOPTION RATES FOR SMES, 2021–2023

Tool Category	2021	2022	2023
Basic Tools (Email, Cloud Storage)	73.3%	70.2%	67.6%
Intermediate Tools (ERP, CRM)	29.2%	31.8%	34.5%
Advanced Tools (AI, IoT)	11.2%	13.4%	15.6%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

In the intermediate technology category, encompassing ERP and CRM systems, the steady increase from 29.2% to 34.5% demonstrates growing confidence among SMEs in adopting more complex business management solutions. This 5.3 percentage point improvement aligns with the objectives of government initiatives like the Tcloud Marketplace and the Small and Medium Manufacturing Enterprise Digital Transformation Project. The consistent growth in this category suggests these programs are successfully encouraging SMEs to enhance their operational capabilities through more sophisticated digital tools.

Perhaps the most encouraging trend appears in advanced technology adoption, where the integration of AI and IoT technologies shows remarkable relative growth. While the absolute increase from 11.2% to 15.6% might seem modest, the 39.3% relative growth over three years signals a significant shift in SMEs' willingness to embrace cutting-edge technologies. This trend becomes particularly meaningful when coupled with the increased utilization of government subsidies, which rose from 29% to 48.2% during the same period.

The overall pattern suggests a strategic evolution in how SMEs approach digital transformation. Rather than simply accumulating various digital tools, businesses appear to be making more sophisticated choices about their technology investments, potentially focusing on solutions that offer the highest strategic value for their specific operational needs. This maturation in digital strategy, supported by increased utilization of government resources, indicates a growing understanding among SMEs of how to leverage digital technologies for enhanced competitiveness and operational efficiency.

Persistent Challenges

Table 37 reveals persistent disparities between SMEs and large enterprises in their digital transformation challenges from 2021 to 2023, though the data shows gradual improvement across all metrics. The gap between SMEs and large enterprises remains significant, even as both groups show a declining impact from various challenges.

TABLE 37

CHALLENGES FACED BY SMES AND LARGE ENTERPRISES, 2021–2023

Challenge	SME Impact			Large Enterprise Impact		
	2021	2022	2023	2021	2022	2023
Financial Constraints	40.5%	37.1%	35.6%	15.0%	13.8%	12.3%
ROI Concerns	42.0%	39.0%	37.2%	18.5%	17.2%	15.7%
Skill Gaps	30.2%	28.5%	27.0%	12.8%	11.2%	10.0%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]
Note: ROI, return on investment

Financial constraints continue to be a major hurdle for SMEs, though showing improvement from 40.5% to 35.6% over the three-year period. This contrasts sharply with large enterprises, where financial constraints affect only 12.3% of businesses in 2023, creating a 23.3 percentage point gap that highlights the ongoing resource disparity between SMEs and their larger counterparts.

ROI concerns emerge as the most significant challenge for SMEs, affecting 37.2% of businesses in 2023, despite decreasing from 42.0% in 2021. Large enterprises demonstrate much lower concern levels at 15.7% in 2023, suggesting better capacity to evaluate and realize returns on digital investments. The 21.5 percentage point gap in 2023 indicates that SMEs continue to struggle with justifying digital investments.

Skill gaps show a similar pattern, with SME impact decreasing from 30.2% to 27.0%, while large enterprises report only 10.0% impact in 2023. This 17-percentage point difference suggests that large enterprises have better access to or resources for acquiring digital talent.

These persistent gaps are reflected in broader trends: nearly half of SMEs (48.5%) invest less than TWD500,000 annually in digital transformation, while most large enterprises invest over TWD1 million. Regional disparities compound these challenges, with Northern ROC's SMEs showing significantly higher digital adoption rates (54.3%) compared to Southern (33.5%) and Eastern (21.9%) regions. Addressing these multifaceted challenges remains crucial for ensuring equitable digital transformation across ROC's business landscape, particularly in supporting SMEs across all sectors and regions.

Vision for a Resilient SME Ecosystem

Table 38 reveals ambitious digital transformation goals for ROC's SMEs through 2026, with significant planned increases across all tool categories. The data demonstrates both current progress and future aspirations in the government's vision for SME digitalization.

TABLE 38

TOOL ADOPTION GOALS AND TARGETS FOR SMES, 2021–2026

Adoption Goal	2021 Current Rate	2023 Current Rate	2026 Target
Advanced Tools (AI, IoT)	11.2%	15.6%	40.0%
Intermediate Tools (ERP, CRM)	29.2%	34.5%	60.0%
Basic Tools (Email, Cloud Storage)	73.3%	67.6%	80.0%

Source: Reproduced with permission from PricewaterhouseCoopers Taiwan [20-22]

For advanced tools incorporating AI and IoT, the government has set an ambitious target of 40.0% adoption by 2026. This represents a substantial leap from the current rate of 15.6% in 2023, which itself showed improvement from 11.2% in 2021. Achieving this goal would require accelerating the current adoption rate by nearly threefold over the next three years.

Intermediate tools such as ERP and CRM systems show a similarly ambitious trajectory. Starting from 29.2% in 2021 and reaching 34.5% in 2023, the target of 60.0% adoption by 2026 would require nearly doubling the current rate. This goal reflects the government's commitment to helping SMEs adopt more sophisticated business management solutions.

Interestingly, while basic tools like email and cloud storage showed a slight decline from 73.3% in 2021 to 67.6% in 2023, the government has set an optimistic target of 80.0% adoption by 2026. This goal suggests a renewed focus on ensuring comprehensive digital literacy across the SME sector, even as more advanced technologies are promoted.

These targets reflect the government's vision of positioning ROC's SMEs as agile, innovative participants in the global digital economy. Achieving these ambitious goals will require sustained policy support and strategic initiatives to ensure SMEs remain competitive, environmentally conscious, and deeply integrated into ROC's broader economic strategy.

Empowering Transformation: The Impact of Policy Support on Taiwan Lung Meng Advanced Composite Materials' Digital Revolution

Introduction to Taiwan Lung Meng Advanced Composite Materials

Taiwan Lung Meng Advanced Composite Materials, officially established in 1998, has emerged as a trailblazer in the manufacturing of environmentally friendly paper products. The company's flagship innovation, "stone paper," is a revolutionary alternative to traditional wood pulp paper, designed to address global concerns about deforestation, resource depletion, and environmental degradation. Stone paper is composed predominantly of inorganic mineral powder (commonly referred to as stone powder) combined with a small percentage of non-toxic resin. This unique composition imparts a range of desirable characteristics to the product, including waterproofing, oil resistance, and remarkable durability, making it suitable for a variety of applications such as packaging, notebooks, and advertising materials.

The production of stone paper stands out for its minimal environmental footprint. Unlike conventional paper manufacturing, which requires tree cutting, extensive water usage, and chemical treatments, Lung Meng's process avoids these environmentally harmful practices. By utilizing stone powder—a byproduct of construction materials—the company upcycles waste materials into valuable paper products. Additionally, the manufacturing process does not produce wastewater or emit significant levels of greenhouse gases, aligning with global sustainability goals and earning Lung Meng widespread acclaim for its eco-conscious practices.

One of Lung Meng's key strengths lies in its vertically integrated production model, which encompasses the entire lifecycle of stone paper—from raw material refinement and manufacturing to product design and marketing. This end-to-end control enables the company to maintain consistent quality, optimize costs, and rapidly adapt to market demands. The company markets its products under the proprietary brand "imSTONE," which has gained traction in global markets, including Europe, North America, and Asia. Lung Meng's products cater to diverse consumer needs, with applications ranging from eco-friendly packaging materials to durable, aesthetic stationery items.

Over the years, Lung Meng has garnered significant international recognition for its innovation and contributions to sustainable manufacturing. The company has secured multiple patents for its proprietary production techniques and product designs, underscoring its commitment to research and development. Among its accolades are the prestigious ROC Excellence Award and the Red Dot Design Award, which highlight Lung Meng's excellence in product quality and design innovation.

These achievements have solidified Lung Meng's reputation as a pioneer in sustainable materials and have positioned the company as a leader in ROC's manufacturing sector. Its groundbreaking approach to stone paper production serves as a model for how technological innovation can intersect with environmental stewardship to create commercially viable and ecologically responsible solutions.

Taiwan Lung Meng Advanced Composite Materials exemplifies how an innovative SME can transform an industry through sustainable practices and advanced manufacturing techniques. By addressing critical environmental challenges and delivering high-quality, versatile products, Lung Meng has established itself as a global leader in the eco-friendly materials space. The company's achievements are a testament to the potential of aligning business strategies with sustainability, setting a benchmark for other enterprises striving to make a positive environmental impact.

Motivation for Digital Transformation at Taiwan Lung Meng Advanced Composite Materials

Taiwan Lung Meng Advanced Composite Materials' journey toward digital transformation was primarily driven by external and internal challenges that compelled the company to modernize its operations. These challenges were rooted in environmental concerns, economic pressures, evolving market demands, and unprecedented disruptions caused by the COVID-19 pandemic.

The global shift towards sustainable practices significantly influenced Lung Meng's decision to pursue digital transformation. Traditional wood pulp paper production is notorious for its environmental footprint, involving deforestation, high energy consumption, and extensive water usage. In contrast, Lung Meng's "stone paper," made from mineral powders and non-toxic resin, is an environmentally friendly alternative that does not require tree cutting, water bleaching, or acid/alkaline treatments. However, as the market increasingly prioritized green solutions, Lung Meng needed to improve its production efficiency and scalability to meet growing demand for sustainable products.

By adopting digital technologies, the company aimed to align its production processes with eco-conscious market trends. This not only reinforced Lung Meng's positioning as a sustainability leader but also provided a competitive edge in a market increasingly regulated by environmental policies.

Economic factors such as fluctuating raw material prices added further pressure. The traditional wood pulp market is heavily influenced by supply chain volatility, particularly for SMEs with limited resources to absorb cost fluctuations. While Lung Meng's stone paper had the advantage of lower material costs compared to wood pulp-based paper, its production processes initially suffered from inefficiencies that inflated operational costs and hindered scalability.

To address these issues, Lung Meng sought to optimize its production processes through automation and AI-driven manufacturing. These technologies allowed the company to reduce waste, improve resource utilization, and enhance cost predictability, ensuring financial stability in the face of raw material price volatility.

As consumer preferences shifted toward personalized and high-quality products, Lung Meng recognized the limitations of its traditional manufacturing methods. The company's original production setup was optimized for bulk manufacturing, but it lacked the flexibility to accommodate customized, small-batch orders efficiently. For instance, clients in Europe and North America sought bespoke stone paper products for specific applications such as notebook covers, packaging, and advertising materials.

Digital transformation enabled Lung Meng to implement IoT-based monitoring systems and AI-driven parameter optimization, which enhanced production agility and quality control. This allowed the company to meet diverse customer needs without compromising efficiency or increasing costs. By investing in these technologies, Lung Meng strengthened its ability to offer tailored solutions that catered to varying market demands.

The COVID-19 pandemic exposed vulnerabilities in global supply chains and amplified the need for operational resilience. Lockdowns, transportation disruptions, and shifting consumer behaviors created an urgent demand for more robust and agile manufacturing processes. Lung Meng faced a surge in orders for packaging materials, driven by the rise of e-commerce and home delivery services during the pandemic.

These disruptions underscored the importance of real-time data integration and supply chain visibility. Lung Meng's adoption of digital tools, such as a web-based platform for customer order tracking and supplier coordination, ensured continuity in operations despite external uncertainties. This strategic shift not only mitigated the immediate impact of the pandemic but also positioned the company for long-term resilience in a dynamic market environment.

Lung Meng's motivation to embrace digital transformation stemmed from a combination of environmental, economic, and market-driven factors, as well as the acute challenges posed by the COVID-19 pandemic. By addressing these issues with forward-thinking digital strategies, Lung Meng was able to evolve into a more agile, sustainable, and customer-centric organization. This transformation reflects the broader necessity for SMEs to leverage technology in order to thrive in an increasingly complex and environmentally conscious global market.

Process and Outcomes of Digital Transformation at Taiwan Lung Meng Advanced Composite Materials
The digital transformation of Taiwan Lung Meng Advanced Composite Materials was a comprehensive endeavor that integrated cutting-edge technologies into the company's manufacturing and supply chain processes. This initiative aimed to enhance efficiency, address market demands, and strengthen Lung Meng's competitive position. The process unfolded in several key phases, each yielding significant outcomes.

The first step in Lung Meng's digital transformation was the establishment of an IoT infrastructure. By equipping the factory with IoT-enabled devices, the company automated data collection and monitoring across its production lines. Sensors captured critical parameters such as machine performance, production speed, and quality metrics, consolidating this data into a centralized system accessible through a real-time dashboard.

This upgrade reduced the reliance on manual monitoring, which was prone to delays and errors. For example, pre-digital processes require hours or even days to diagnose issues on the production line. The new system allowed immediate detection of anomalies, significantly improving response times. Lead time for issue identification and resolution decreased from 24–48 hours to under 30 minutes, enabling the company to prevent costly downtime and minimize waste.

Lung Meng incorporated AI to analyze the data collected by IoT devices. AI algorithms identified patterns and trends, enabling predictive maintenance and process optimization. One key application was the use of AI in refining production parameters. Previously, developing a new product required extensive trial-and-error adjustments, consuming substantial time and resources. AI-driven models allowed the company to simulate and fine-tune production parameters virtually, accelerating product development cycles and ensuring consistent quality.

The outcomes of this AI integration were transformative. Product development timelines shortened significantly, and the production process became more adaptable to custom orders. These advancements allowed Lung Meng to cater to diverse customer needs while maintaining high standards of quality, a critical factor in the premium markets it serves.

As part of the government-supported "Smart Machinery and Supply Chain Digital Integration" initiative, Lung Meng implemented smart manufacturing technologies. These included automated process controls and advanced planning systems that synchronized production schedules with raw material availability and customer order timelines. The Manufacturing Execution System (MES) provided end-to-end visibility of production stages, enhancing decision-making and coordination.

The transition to smart manufacturing resulted in a significant boost in production efficiency. Monthly production capacity increased from 230 tons to 500 tons, while production cycle times dropped from 56 days to 30 days. The ability to produce wider sheets of stone paper (up to 5,000 mm) opened new opportunities in markets such as construction and packaging.

To streamline its supply chain, Lung Meng developed a digital platform that connected suppliers, production units, and customers. This platform allowed customers to track order progress in real time, while Lung Meng could monitor raw material stock levels and supplier performance. This transparency ensured timely delivery of products and reduced the risk of supply chain disruptions.

For suppliers, the platform facilitated better coordination by providing forecasts and enabling proactive inventory management. For Lung Meng's customers, it enhanced satisfaction by offering instant updates on order status and delivery schedules. These improvements were particularly valuable during the COVID-19 pandemic, when logistical disruptions and increased demand for packaging materials put immense pressure on supply chains.

For measurable outcomes and strategic benefits, the outcomes of Lung Meng's digital transformation were multifaceted:

1. Enhanced Productivity: Monthly production capacity more than doubled, enabling Lung Meng to meet growing market demands.
2. Improved Efficiency: Automation reduced production lead times and waste, cutting operational costs significantly.
3. Market Expansion: The ability to produce larger, customized sheets allowed Lung Meng to enter new markets, including construction and specialty packaging.
4. Environmental Gains: Digital tools optimized resource use, reinforcing Lung Meng's commitment to sustainability and aligning with global environmental standards.
5. Customer Satisfaction: Real-time data sharing improved trust and communication with clients, strengthening relationships and brand loyalty.

Lung Meng's digital transformation journey demonstrates the power of strategic technology adoption in addressing modern business challenges. By integrating IoT, AI, and smart manufacturing systems, the company not only enhanced operational efficiency but also aligned itself with evolving market trends and environmental priorities. The measurable improvements in production capacity, product quality, and customer engagement underscore the transformative impact of these efforts, establishing Lung Meng as a leading example of successful digitalization in the manufacturing sector.

Impact of Government Policy Support on Lung Meng's Digital Transformation

The success of Taiwan Lung Meng Advanced Composite Materials' digital transformation was significantly influenced by robust support from government policies and initiatives. This support played a crucial role in reducing barriers to innovation, providing financial and technical assistance, and creating a collaborative ecosystem for digital advancements. The alignment of Lung Meng's goals with government programs highlights the potential of public-private partnerships in driving industrial transformation.

Lung Meng's participation in the MOEA' "Smart Machinery and Supply Chain Digital Integration with AI Applications" initiative was instrumental in funding its digital transformation efforts. This initiative, designed to support SMEs in adopting advanced manufacturing technologies, provided Lung Meng with financial subsidies that offset the high costs of implementing cutting-edge systems.

For example, the company utilized the funding to integrate IoT-enabled devices across its production lines, automate data collection, and implement AI-driven process optimization. These technologies required substantial initial investments in hardware, software, and training. The government's financial aid not only reduced Lung Meng's risk but also allowed the company to expedite its technology adoption and focus on innovation rather than cost containment.

Government programs offered more than just financial backing; they also provided access to technical expertise and best practices in smart manufacturing. Lung Meng leveraged the expertise of research institutions and technology providers, which were part of the government's collaborative network. For instance, partnerships with organizations such as MIRDC helped Lung Meng tailor its digital systems to its unique production requirements.

This technical support was crucial in overcoming initial challenges, such as optimizing production parameters for stone paper manufacturing and implementing real-time monitoring systems. The knowledge-sharing component of government programs facilitated the adoption of industry standards and best practices, ensuring the sustainability and scalability of Lung Meng's digital transformation efforts.

The government's policy framework encouraged collaboration between Lung Meng and other industry stakeholders. As part of the initiative, Lung Meng worked closely with system integrators, equipment suppliers, and technology consultants to design and implement its smart manufacturing solutions. These partnerships fostered innovation and allowed the company to access specialized knowledge and advanced technologies that would have been difficult to develop independently.

The collaborative nature of these programs extended to Lung Meng's supply chain as well. By incorporating both upstream and downstream partners into its digital platform, the company improved coordination and transparency, significantly enhancing supply chain efficiency and resilience. This seamless integration was largely facilitated by the government's focus on collective innovation and ecosystem development.

Government support not only facilitated Lung Meng's digital transformation but also positioned the company as a pioneer in sustainable and smart manufacturing. The credibility gained from participating in a national initiative helped Lung Meng secure additional recognition, such as industry awards and certifications. These accolades strengthened its reputation in international markets, opening doors to high-value export opportunities in Europe, North America, and Asia.

Furthermore, the improved production capacity and efficiency achieved through digitalization enabled Lung Meng to better align with global sustainability goals and regulatory standards. This alignment enhanced its competitive edge in environmentally conscious markets, where demand for sustainable products continues to grow.

The impact of government policy support extended beyond Lung Meng to the broader paper and manufacturing industries in ROC. The company's success demonstrated the feasibility and benefits of adopting smart manufacturing technologies, serving as a model for other SMEs. By showcasing how digital transformation can lead to increased efficiency, cost savings, and market expansion, Lung Meng inspired similar efforts across the sector.

The government's focus on fostering a sustainable manufacturing ecosystem through digitalization also contributed to ROC's industrial competitiveness on a global scale. The success of companies like Lung Meng underscored the effectiveness of targeted policy interventions in accelerating technological innovation and addressing systemic challenges.

Government policy support was a cornerstone of Lung Meng's digital transformation, providing essential resources and fostering an environment conducive to innovation. Financial subsidies alleviated cost barriers, technical assistance ensured the effective implementation of advanced systems, and collaboration initiatives promoted knowledge exchange and ecosystem development. These efforts not only accelerated Lung Meng's transformation but also reinforced ROC's position as a leader in sustainable and smart manufacturing. The case of Lung Meng exemplifies how well-designed government programs can empower SMEs to achieve significant technological and competitive advancements.

Conclusion: Insights and Lessons Learned on Policy Effectiveness

The case of Taiwan Lung Meng Advanced Composite Materials underscores the transformative potential of well-designed and effectively implemented government policies in facilitating industrial innovation and digital transformation. The success of Lung Meng's transition to a digital and sustainable business model provides valuable lessons for policymakers, industry leaders, and SMEs seeking to navigate the complexities of modernization.

The government's proactive support through the "Smart Machinery and Supply Chain Digital Integration with AI Applications" initiative demonstrates the pivotal role of public policy in reducing barriers to technological adoption. Financial subsidies helped mitigate the substantial upfront costs of digitalization, enabling Lung Meng to invest in cutting-edge technologies such as IoT and AI. Moreover, technical guidance and collaboration with research institutions empowered the company to tailor these technologies to its unique needs, ensuring a smoother and more effective transition. This highlights that strategic policy interventions can act as catalysts for innovation, especially in resource-constrained SMEs.

Lung Meng's experience illustrates the importance of fostering ecosystems that encourage collaboration between businesses, research institutions, and technology providers. The government's emphasis on partnerships facilitated knowledge sharing and resource optimization, allowing Lung Meng to achieve outcomes that might have been unattainable through isolated efforts. This collaborative approach can serve as a model for future policies, emphasizing the value of collective innovation over individual enterprise.

By aligning policy objectives with global trends in sustainability and digitalization, the government enabled Lung Meng to enhance its competitiveness in international markets. The company's ability to meet the growing demand for eco-friendly products while improving operational efficiency demonstrates that policies designed with long-term environmental and economic goals can deliver impactful results. Policymakers can draw inspiration from this case to design frameworks that simultaneously promote sustainable development and industrial competitiveness.

Lung Meng's success is a testament to the effectiveness of targeted policy measures aimed at SMEs. As smaller enterprises often face disproportionate challenges in adopting advanced technologies, dedicated support mechanisms such as those provided to Lung Meng are crucial. This case emphasizes the need for governments to identify and address the specific barriers faced by SMEs, providing them with the tools and resources needed to thrive in a rapidly evolving market landscape.

The experience of Taiwan Lung Meng Advanced Composite Materials showcases how government policies, when thoughtfully crafted and executed, can unlock the potential of businesses to innovate, adapt, and grow sustainably. It highlights the importance of aligning policy initiatives with the needs of industries, fostering collaboration, and prioritizing long-term goals. These insights provide a roadmap for enhancing the effectiveness of future policies aimed at driving industrial transformation and sustainability in the global economy.

Concluding Remarks

Building on current progress, future strategies must focus on inclusivity, innovation, and sustainability. Achieving these goals will require stronger public-private collaboration, with large enterprises, academic institutions, and technology providers playing pivotal roles in mentoring, training, and co-developing solutions with SMEs.

ROC's experience offers valuable lessons for fostering SME digital transformation in other economies. By addressing financial, technical, and regional disparities through targeted and inclusive policies, ROC demonstrates how governments can empower small businesses to overcome barriers and embrace digital opportunities. Moving forward, a focus on sustainability, advanced technology adoption, and collaborative ecosystems will be pivotal in solidifying the role of SMEs as drivers of economic growth and innovation.

CONCLUSION AND POLICY RECOMMENDATIONS

Research Summary and Key Findings

This study offers a comprehensive evaluation of ROC's SMEs during the period from 2021 to 2023, focusing on innovation capabilities, digital transformation, and policy impacts. The findings highlight significant advancements alongside persistent challenges requiring strategic intervention.

SMEs' Innovation and R&D Investment

ROC SMEs have demonstrated remarkable resilience in maintaining R&D investments despite the global economic uncertainties and challenges posed by the COVID-19 pandemic. By 2022, R&D intensity among SMEs reached 1.09%, reflecting their steadfast commitment to innovation amidst resource constraints. Key sectors, including electronics, machinery, and biotechnology, have emerged as leaders in driving technological advancements and adapting to evolving market demands. These industries not only fuel ROC's export growth but also highlight the pivotal role of SMEs in sustaining the nation's global competitiveness.

However, disparities in innovation capacity between SMEs and larger enterprises remain a significant challenge. While large firms benefit from robust infrastructure, substantial budgets, and specialized R&D teams, SMEs often face financial constraints and limited access to technical expertise. These challenges hinder SMEs' ability to pursue large-scale innovation, potentially exacerbating the gap between SMEs and larger firms.

Government programs such as the SBIR program and the ITDP have been critical in addressing these disparities. The SBIR program empowers SMEs by supporting the development of innovative technologies, business models, and applications through financial assistance and technical guidance. Meanwhile, the A+ ITDP—an evolved and strategically focused successor of the ITDP—places greater emphasis on fostering forward-looking technologies, international R&D partnerships, and interdisciplinary collaboration. With its priority areas such as artificial intelligence, green

energy, and biotechnology, the A+ ITDP has enhanced ROC's ability to align its innovation ecosystem with global trends and market demands. Initiatives such as the IC Design Summit Subsidy Program underscore the program's strategic focus on high-value sectors, further solidifying ROC's position as a global innovation leader.

Insights from the Community Innovation Survey (CIS) reveal that ROC SMEs adopt a dual focus on product and process innovation. Product innovation, exemplified by SMEs in the electronics sector, involves creating new or significantly improved goods and services to meet international demand. Process innovation emphasizes operational efficiency and productivity through technologies like automation and digital supply chains. This agility enables SMEs to respond swiftly to market shifts, making them integral contributors to economic resilience.

Despite these achievements, challenges persist. The share of SMEs in overall corporate R&D expenditure has declined, pointing to the increasing dominance of larger firms in ROC's innovation landscape. Resource allocation pressures also compel many SMEs to prioritize short-term survival over long-term R&D investments. These trends underscore the need for a more inclusive innovation ecosystem that addresses structural imbalances and strengthens SME capabilities.

To bridge these gaps, the government must expand programs like SBIR and A+ ITDP with higher funding tiers for high-impact and transformative innovations. Enhanced incentives for critical sectors, such as biotechnology, renewable energy, and semiconductors, can drive growth in areas with the greatest strategic value. Strengthening regional innovation clusters through initiatives like the LIIEP and fostering deeper collaborations between SMEs and GSRIs are essential to amplifying SME access to cutting-edge resources and technical expertise.

By addressing these challenges and optimizing its systemic innovation policies, ROC can cultivate a more equitable and dynamic innovation ecosystem. Empowered with comprehensive support and strategic resources, ROC SMEs will be well-positioned to thrive alongside larger enterprises, reinforcing their role as key drivers of sustainable economic growth and technological advancement.

Digital Technology Adoption Patterns

The digital transformation of ROC SMEs has seen notable progress in recent years, reflecting their growing recognition of technology as a critical enabler of competitiveness and resilience. Between 2021 and 2023, SMEs increasingly pivoted from basic digital tools, such as email and office software, toward more advanced solutions. While basic tool usage declined from 73.3% to 67.6%, adoption rates for intermediate systems, including ERP and CRM, rose to 34.5%. The most significant growth was observed in advanced technologies like AI and the IoT, which, although still limited to 15.6% of SMEs, exhibited a remarkable 39.3% growth rate over the period.

These trends, however, underscore persistent disparities in digital technology adoption across sectors and regions. Manufacturing SMEs have primarily focused on supply chain digitalization and automation to optimize production efficiency and address the challenges of a globalized market. In contrast, service-oriented SMEs have prioritized tools for enhancing customer engagement, such as CRM systems, delivering personalized services and improving client retention. Geographically, northern ROC emerged as a leader in digital adoption, achieving a 54.3% rate, far exceeding 33.5% in southern ROC and 21.9% in eastern ROC. Such disparities highlight the uneven pace of digital transformation and the need for policies tailored to the unique needs of specific industries and underrepresented regions.

The transformative potential of digital adoption is exemplified in the case of Taiwan Lung Meng Advanced Composite Materials, a leader in sustainable paper manufacturing. The company implemented IoT devices to enable real-time monitoring across production lines, drastically reducing issue resolution times from 48 hours to under 30 minutes. AI-driven process optimization further enhanced production efficiency and enabled greater customization to meet diverse market demands. Additionally, Lung Meng's integration of a digital supply chain platform improved operational resilience, ensuring continuity during disruptions caused by the COVID-19 pandemic. These advancements doubled the company's monthly production capacity while halving production cycles, showcasing the immense benefits of advanced digital tools.

Lung Meng's success also demonstrates the role of government-supported initiatives in driving SME digital transformation. Programs like "Smart Machinery and Supply Chain Digital Integration with AI Applications" provided financial subsidies, technical guidance, and partnerships with research institutions to mitigate the costs and complexities of implementing advanced technologies. This holistic support highlights the importance of targeted government interventions in scaling such success stories across other SMEs and sectors.

To address regional and sectoral disparities, future policies must focus on bridging the digital divide. Expanding access to digital transformation funding in southern and eastern ROC, coupled with the establishment of regional innovation hubs, can empower SMEs in these areas to adopt advanced technologies. Sector-specific programs should be designed to support unique priorities, such as customer-facing tools for services and automation for manufacturing. By aligning policy interventions with SME needs, ROC can foster an inclusive and competitive digital economy, ensuring that SMEs across all regions and sectors are equipped to thrive in an increasingly technology-driven global landscape.

Policy Implementation Outcomes

Government policy mechanisms have been instrumental in supporting the innovation capacity and development of ROC SMEs, though their outcomes have varied. Supply-side initiatives such as the SBIR program and the A+ Industrial Technology Development Program (A+ ITDP) have proven particularly effective in fostering innovation. These programs prioritize collaborative R&D and provide financial subsidies, enabling SMEs to adopt advanced technologies and access new markets. Notably, the SBIR program has facilitated industry-academia partnerships, empowering SMEs to leverage external expertise and resources to strengthen their innovation capabilities and competitiveness.

The SME Credit Guarantee Fund (SMEG) has emerged as another cornerstone of government support, facilitating substantial financing for SMEs. By 2022, SMEG had supported TWD22.6417 trillion in loans across 8.28 million cases, ensuring that SMEs could access the capital necessary to maintain operations, invest in innovation, and navigate economic uncertainties. The Fund's role during the COVID-19 pandemic was especially critical, providing lifelines to businesses facing liquidity constraints and helping them weather unprecedented disruptions.

Despite these successes, the report identifies significant disparities in policy outcomes. Larger firms and SMEs in well-developed regions, such as northern ROC, have disproportionately benefited from government programs. These entities often possess the administrative capacity, technical expertise, and established networks needed to navigate application processes and capitalize on available resources. In contrast, smaller SMEs and businesses in underdeveloped

areas, such as southern and eastern ROC, have faced considerable barriers in accessing support. Limited awareness of programs, inadequate infrastructure, and a lack of tailored initiatives for regional challenges have contributed to these inequities.

These findings underscore the need for enhanced targeting and customization of policies to ensure more equitable outcomes. Expanding outreach and awareness campaigns in underrepresented regions can improve access to existing programs. Additionally, implementing region-specific adaptations, such as higher subsidy rates or simplified application processes for SMEs in underserved areas, can address structural barriers. Sectoral variations also call for tailored interventions, with priority given to industries that are less integrated into the innovation ecosystem or face unique operational challenges.

By addressing these disparities, the government can create a more inclusive policy framework that enables all SMEs—regardless of size, sector, or location—to thrive. Such an approach not only strengthens the overall SME ecosystem but also ensures balanced economic growth across ROC's regions and industries.

Key Challenges and Opportunities

Despite notable achievements in productivity, innovation, and digital transformation, ROC's SMEs face persistent challenges that could constrain their long-term growth and competitiveness. A critical issue is the lack of sufficient financial and human capital, which limits SMEs' ability to scale innovation efforts and adopt advanced technologies. Many SMEs operate with tight budgets and minimal R&D capacity, making it difficult to compete with larger firms that benefit from extensive resources and infrastructure. Additionally, the shortage of skilled labor, particularly in areas such as digital technologies and green innovation, further impedes SMEs' ability to modernize and innovate effectively.

Geographic disparities represent another significant hurdle to balanced growth. SMEs in northern ROC benefit from better infrastructure, greater access to government programs, and proximity to innovation hubs. In contrast, businesses in southern and eastern ROC often struggle with limited resources, reduced access to policy support, and inadequate digital infrastructure. These disparities not only hinder regional development but also exacerbate inequalities within the SME ecosystem, limiting the sector's overall contribution to national economic growth.

The global push toward sustainability and regulatory compliance adds another layer of complexity for SMEs. With increasing emphasis on green practices, circular economy models, and carbon neutrality, SMEs must invest in significant adaptation efforts to align with evolving regulations and market expectations. For resource-constrained firms, meeting these demands can be a daunting task, requiring both financial investment and strategic capacity building.

However, these challenges also present substantial opportunities. ROC's robust policy frameworks, exemplified by programs such as the SBIR initiative and SME Credit Guarantee Fund, provide a strong foundation for addressing structural gaps. The rising momentum in digital transformation and sustainable practices offers avenues for SMEs to enhance their competitiveness, diversify into emerging markets, and strengthen their resilience against global economic uncertainties. Advanced technologies such as AI, IoT, and blockchain can help SMEs optimize operations, reduce costs, and meet green standards, while collaboration with academic institutions and research organizations can accelerate innovation.

By strategically addressing existing gaps in financial and human capital, regional development, and sustainability readiness, ROC can position its SME sector as a resilient and globally competitive force. Initiatives such as regionally focused innovation hubs, targeted skills development programs, and incentives for green technology adoption can ensure that SMEs are equipped to navigate future challenges while seizing opportunities in a rapidly evolving global landscape.

Findings from the Summary Table of SME Policy Measures

The analysis of ROC's technology policy framework demonstrates a sophisticated approach to fostering SME development through integrated demand-side, supply-side, and systemic measures. Each category serves distinct but complementary functions in supporting innovation, regional development, and global competitiveness.

TABLE 39

SUMMARY OF POLICY MEASURES SUPPORTING SMES IN ROC

Policy Type	Program Title	Years of Operation	Main Objectives	Responsible Agency
Supply-Side	ROC SBIR	1998–Present	- Support R&D in new ideas, concepts, and technologies - Enable novel applications of existing technologies - Implement new technologies in existing applications - Enhance existing technologies/products	MOEA
	Local SBIR	2008–Present	- Support R&D projects focused on local characteristic industries - Coordinate between central and local governments - Promote regional development	MOEA with Local Governments
	A+ ITDP	2014–present	- Foster forward-looking technologies (e.g., AI, green energy, biotechnology). - Enhance industry-academia collaboration and international R&D partnerships. - Promote cross-sectoral integration to build comprehensive industrial ecosystems. - Strengthen ROC's industrial competitiveness and global market integration.	DOIT, MOEA
	SMEG	1974–Present	- Provide credit guarantees to SMEs - Address collateral challenges - Facilitate access to institutional funding - Support SME development	Small and Medium Enterprise Administration (SMEA), MOEA
Demand-Side	ROC Startup Procurement Program	2018–Present	- Create pathways for startups in public procurement - Address unmet government needs - Stimulate innovation among local startups - Support innovative solutions	SMEA, MOEA
	Mature Support Program	2018–Present	- Support municipal and county governments in procurement - Encourage procurement of innovative products/services - Streamline procurement procedures	SMEA, MOEA
	R&D Support Program	2018–Present	- Fund startups developing innovative solutions - Address specific market needs - Enable prototyping and validation	SMEA, MOEA

Policy Type	Program Title	Years of Operation	Main Objectives	Responsible Agency
Systemic	LIIEP	2014–being replaced	- Organize R&D alliances in less-developed regions - Strengthen innovation capabilities of industrial clusters - Balance regional development - Scale up innovation alliances	DOIT, MOEA
	Regional Innovation and Research Parks/ Centers Program	2016–Present	- Foster industrial innovation - Create specialized innovation clusters - Promote balanced regional development - Support traditional industry transformation	DOIT, MOEA
	Creative Life Industry Development Program	2003–Present	- Integrate cultural elements into businesses - Enhance customer experience - Strengthen regional brands - Support cultural industries	MOEA
	Digital Innovation and International Linkage Initiatives	2019–Present	- Support digital tool adoption - Foster cross-border collaborations - Expedite international market expansion - Enhance SME competitiveness	MOEA

Source: This study.

The demand-side policies, anchored by the ROC's Startup Procurement Program (2018-present), create direct market opportunities through public procurement. This program, operating through its Mature Support Program and R&D Support Program components, provides subsidies ranging from 70% to 90% for municipal governments and up to TWD1 million for startups. These initiatives effectively implement the "Government Poses the Challenge, Startups Solve It" model, creating pathways for innovative solutions to enter public sector markets.

Supply-side measures form the cornerstone of ROC's innovation support system. The SBIR program (1998–present) operates through dual tracks—national and local—providing up to 50% subsidy coverage for R&D costs, thereby enabling SMEs to explore innovative technologies and business models. A+ ITDP (2014–present) builds on the legacy of its predecessor (1999–2009) by focusing on forward-looking technologies such as AI, green energy, and biotechnology. It fosters cross-sectoral collaboration, international partnerships, and comprehensive industrial ecosystems, aligning ROC's innovation agenda with global trends. SMEG (1974–present) has been instrumental in facilitating access to institutional funding, with 48.90% of all listed companies in ROC having utilized SMEG guarantees during their SME stage, underscoring its pivotal role in supporting enterprise growth and economic resilience.

The systemic policy framework emphasizes comprehensive ecosystem development, with the Regional Innovation and Research Parks/Centers Program (2016–present) serving as a cornerstone initiative. Launched under the "5+2 Industrial Innovation Plan," this program has established specialized innovation clusters across ROC, including the Miaoli Industrial Innovation Promotion Center, Central ROC Innovation Campus, Chiayi Industry Innovation and Research Center, and Southern ROC Innovation and Research Park. Each center focuses on specific industrial strengths - for instance, Miaoli specializes in powder metallurgy and high-value ceramics, while the Central ROC center emphasizes smart machinery and advanced greenhouse systems. This network of innovation centers creates an interconnected "Industrial Innovation Corridor" that promotes balanced regional development while fostering cross-disciplinary collaboration between academia, research institutions, and industry.

Supporting this regional innovation framework, the Local Industrial Innovation Engine Program (2014–present) organizes R&D alliances in less-developed regions, while the Creative Life Industry Development Program (2003–present) integrates cultural elements into business innovation. The Digital Innovation and International Linkage Initiatives (2019–present) complete the ecosystem by supporting digital transformation and global market access.

These policies demonstrate several key strengths:

1. **Integrated Support Structure:** ROC's innovation framework provides end-to-end support, addressing critical needs such as R&D funding, capacity building, market access, and international collaboration. Clear coordination between programs like the SBIR program, A+ ITDP, and SMEG ensures that resources are deployed efficiently and gaps in the innovation ecosystem are minimized. This holistic design enables enterprises to seamlessly transition from ideation to commercialization.
2. **Regional Balance:** The **Regional Innovation and Research Parks/Centers Program** strategically allocates innovation resources across ROC, fostering geographically balanced industrial growth. By creating specialized clusters that leverage local industrial strengths—such as precision machinery in Miaoli or health and biotechnology in Chiayi—the program not only addresses regional disparities but also enhances the competitiveness of ROC's diverse economic landscape. These efforts align regional development with national priorities, ensuring inclusivity in economic progress.
3. **Cross-sector Integration:** ROC's innovation policies actively facilitate collaboration across academia, research institutions, and industry, bridging the gap between theoretical research and practical application. Initiatives like **LIIEP** promote R&D alliances and foster knowledge transfer, enabling industries to benefit from cutting-edge research and technological advancements. This collaborative ecosystem accelerates innovation diffusion, drives industrial upgrading, and enhances the overall efficiency of resource utilization.
4. **Sustainable Development:** The framework underscores environmental sustainability as a cornerstone of industrial advancement. Facilities such as **CIIRC** exemplify this focus, with eco-friendly green infrastructure and sustainable practices integrated into their design and operation. The inclusion of green energy, circular economy initiatives, and low-carbon technologies within the broader policy framework reflects ROC's commitment to aligning economic growth with global environmental goals.

Future policy developments should focus on enhancing the connectivity between these innovation centers, expanding their reach to more traditional industries, and strengthening their role in driving digital transformation across ROC's SME sector. The success of this integrated approach provides valuable lessons for other economies seeking to develop comprehensive innovation support systems.

Strategic Policy Recommendations

ROC's journey in fostering economic resilience and innovation offers valuable lessons for developing economies aiming to strengthen their SMEs. As the backbone of ROC's economy, SMEs account for 98% of all businesses, employ 80% of the workforce, and contribute over 50% of market value. This dominance has been supported by a series of well-crafted policies that have enabled technological innovation, digital transformation, and global competitiveness, despite challenges like the COVID-19 pandemic and global supply chain disruptions.

ROC's experiences highlight the critical importance of adaptive policy frameworks, targeted financial support, and robust innovation ecosystems. By systematically addressing regional disparities, fostering digital adoption, and encouraging green technology integration, ROC has established itself as a model for inclusive and sustainable SME development.

For developing economies, the replication and adaptation of these strategies can catalyze their own economic transformation. This document presents a series of strategic policy recommendations derived from ROC's experience, focusing on actionable insights tailored to the unique challenges and opportunities in emerging markets.

Modifications to Existing Policies

Enhancing Innovation Support Mechanisms The SBIR program has been a cornerstone of ROC's strategy to foster SME innovation. To maximize its impact, the program should increase subsidy rates for high-risk, breakthrough innovation projects from the current 50% to 70%. This enhanced support would significantly reduce the financial burden on SMEs engaging in transformative research and development.

Priority should be given to strategic sectors such as semiconductors and biotechnology, which are crucial for driving industrial advancement and maintaining global competitiveness. These adjustments aim to streamline the innovation-to-commercialization process, ensuring that groundbreaking technologies reach the market more efficiently and contribute to broader economic growth.

For developing economies, adopting a similar approach could foster technological breakthroughs in sectors aligned with their unique industrial priorities, laying the foundation for sustainable economic development.

Strengthening Financial Support Addressing regional disparities in financial access is critical for fostering balanced economic development. SMEG can be reformed to raise guarantee coverage to 90% for underserved areas, such as rural or economically disadvantaged regions. This adjustment would mitigate the risks faced by financial institutions when lending to SMEs in these areas, encouraging broader financial inclusion.

Additionally, region-specific credit assessment standards should be implemented to better reflect the economic conditions and business environments of various localities. These tailored criteria will ensure equitable distribution of financial resources and enable SMEs in less developed areas to access the capital needed for growth and innovation.

Optimizing Digital Transformation Policies To accelerate SME adoption of advanced digital technologies, a targeted voucher system can be introduced. This system would provide financial incentives specifically for technologies that enhance productivity, such as AI, IoT, and ERP systems.

Furthermore, the establishment of regional digital transformation demonstration centers is essential. These centers would serve as hubs for hands-on training, technical support, and resource-sharing, enabling SMEs to acquire the necessary skills and expertise to implement digital solutions effectively. By bridging the digital divide, these initiatives would empower SMEs across diverse regions to thrive in an increasingly digital economy.

For developing economies, these measures could address structural imbalances and lay the groundwork for inclusive growth, ensuring that technological advancements benefit businesses across all regions.

New Policy Initiatives

To address existing gaps and enhance SME development, ROC proposes several new policy initiatives aimed at fostering innovation, sustainability, and global competitiveness. The Regional Innovation Hub Network seeks to bridge regional disparities by establishing physical centers in underserved areas, equipped with advanced manufacturing tools and staffed with rotating industry specialists. These hubs will foster collaboration among SMEs, research institutions, and industry experts, creating localized ecosystems to accelerate technology adoption and innovation. For developing economies, such hubs could provide the foundation for balanced growth, enabling SMEs in remote areas to compete in global markets.

The Green Technology Transition Fund focuses on promoting sustainability by offering subsidies of up to 70% to assist SMEs in adopting environmentally friendly technologies, including energy-efficient systems and waste reduction processes. This fund reduces the financial burden of transitioning to green practices, aligning SME operations with global climate goals while enhancing competitiveness. Similarly, the Cross-Border SME Innovation Alliance Program aims to establish international collaboration networks, enabling SMEs to access advanced technologies, talent, and global markets. By fostering joint ventures, research projects, and market entry strategies, this initiative strengthens SMEs' global presence and competitiveness. For developing economies, these programs collectively address key structural barriers, fostering sustainable industrial growth, international connectivity, and resilience in a competitive global landscape.

Resolving Institutional Obstacles

Improving Interdepartmental Coordination To address overlapping responsibilities and fragmented approaches among government agencies, a Digital Economy Coordination Committee should be established. This high-level body would bring together representatives from relevant ministries to develop cohesive strategies, standardize evaluation criteria, and streamline decision-making processes.

By ensuring interdepartmental alignment, the committee would enhance the efficiency of resource allocation for digital transformation initiatives. It would also minimize duplication of efforts and improve the coordination of programs aimed at fostering innovation, sustainability, and competitiveness among SMEs.

Regional Digital Innovation Councils Regional Digital Innovation Councils should be formed to address the specific challenges and opportunities unique to different geographic areas. These localized councils would work closely with SMEs, local governments, and industry stakeholders to design and implement tailored strategies that reduce the digital divide and foster inclusivity in digital adoption.

By focusing on the needs of underserved regions, these councils would play a critical role in ensuring that digital transformation efforts are equitable and regionally balanced, ultimately contributing to national economic cohesion.

Unified Digital Service Platform A centralized, unified digital service platform is essential to streamline the application processes for financial and technological support programs. This platform would serve as a one-stop portal where SMEs can access comprehensive information, apply for various government resources, and track their application status in real time.

By reducing administrative complexity and improving accessibility, the platform would significantly enhance SMEs' ability to leverage available support efficiently. For developing economies, such a system could democratize access to critical resources, empowering SMEs to innovate and grow regardless of their location or size.

Policy Goals and Feasibility
The strategic recommendations aim to achieve three overarching goals:

1. Bridging Urban-Rural Divides: By addressing regional disparities in financial access, digital transformation, and innovation support, the policies aim to create balanced economic opportunities across all regions.
2. Enhancing Digital and Green Transformation: Encouraging SMEs to adopt advanced digital tools and environmentally friendly technologies is essential for future-proofing their operations and aligning with global sustainability standards.
3. Strengthening Global Competitiveness: By facilitating international collaboration and market integration, the policies empower SMEs to compete effectively on a global stage.

Feasibility Assessment:
These recommendations leverage ROC's proven policy frameworks, adapting them to the needs of developing economies with flexibility and scalability. Implementation requires:

- Clear prioritization of sectors and regions to maximize early impacts.
- Collaboration with international development agencies and stakeholders to mobilize resources and expertise.
- Political commitment to institutional reforms and long-term economic development goals.

Through phased implementation and strategic alignment, these recommendations provide a practical and sustainable roadmap for fostering SME innovation, competitiveness, and inclusive economic growth.

REFERENCES

Czarnitzki, D., Ebersberger, B., & Fier, A. (2007) The relationship between R&D collaboration, subsidies and R&D performance: empirical evidence from Finland and Germany. *Journal of applied econometrics*; 22(7): 1347–1366.

Directorate-General of Budget, Accounting and Statistics (DGBAS) (2021–2022) *Manpower Survey data*.

Dodgson, M. (2009) Asia's national innovation systems: Institutional adaptability and rigidity in the face of global innovation challenges. *Asia Pacific Journal of Management*; 26: 589–609.

Economic Daily News. (2021) *July 2021 survey*. https://paper.udn.com/udnpaper/PID0008/366758/web/#2L-19591094L, accessed on 2 April 2025.

Edler, J., & Georghiou, L. (2007) Public procurement and innovation—Resurrecting the demand side. *Research Policy*; 36(7): 949–963.

Fiscal Information Agency, Ministry of Finance (2021–2022) *Value-Added Business Tax (VAT) data*.

The Industrial Technology Development Program. (n.d.) https://www.moea.gov.tw/MNS/doit_e/content/Content.aspx?menu_id=5442, accessed on 29 November 2024.

Li, Y., Ribeiro, C. G., Rauen, A. T., & Júnior, E. I. (2020) Buying to develop: the experience of Brazil and China in using public procurement to drive innovation. *International Journal of Innovation and Technology Management*; 17(03): 2050021.

Liu, M.-C. (2015) Manufacturing servitization and revitalizing industrial clusters: a case study of Taiwan's LIIEP. *Journal of the Asia Pacific Economy*; 20(3): 423–443.

Kleer, R. (2010) Government R&D subsidies as a signal for private investors. *Research Policy*; 39(10): 1361–1374.

Knoll, N. (2003) Business R&D and the role of public policies for innovation support: a qualitative approach. *WIFO Studies*; number 24268.

Kundu, O., James, A. D., Rigby, J. (2020) Public procurement and innovation: a systematic literature review. *Science and Public Policy*; 47(4): 490–502.

Ministry of Economic Affairs (n.d.a) *Factory Operation Census* https://dmz26.moea.gov.tw/GMWeb/investigate/InvestigateG.aspx, accessed on 29 November 2024.

National Science and Technology Council (2022, December). Indicators of Science and Technology Taiwan 2022. *White Paper on Small and Medium Enterprises*

PricewaterhouseCoopers Taiwan (PwC Taiwan) (2021) *Taiwan SME digital transformation survey*. Retrieved from https://www.pwc.tw/zh/publications/topic-report/sme-digitalisation-survey-2021.html, accessed on 29 November 2024.

PricewaterhouseCoopers Taiwan (PwC Taiwan) (2022) *Taiwan SME digital transformation survey*. PwC Taiwan. Retrieved from https://www.pwc.tw/zh/publications/topic-report/sme-digitalisation-survey-2022.html, accessed on 29 November 2024.

PricewaterhouseCoopers Taiwan (PwC Taiwan) (2023) *Taiwan enterprise transformation status and needs survey*. Retrieved from https://www.pwc.tw/zh/publications/topic-report/sme-digitalisation-survey.html, accessed on 29 November 2024.

Rolfstam, M. (2013) *Public procurement and innovation*. Edward Elgar Publishing.

Rolfstam, M. (2009) Public procurement as an innovation policy tool: the role of institutions. *Science and public policy*; 36(5): 349–360.

Small and Medium Enterprise and Startup Administration (Taiwan SMEA) (2021–2023) *White Paper on Small and Medium Enterprises in Taiwan*, https://www.sme.gov.tw/list-en-2572, accessed on 29 November 2024.

Small and Medium Enterprise and Startup Administration, Ministry of Economic Affairs. Taiwan SBIR. (n.d.) https://www.sbir.org.tw/, accessed on 29 November 2024.

Small and Medium Enterprise Administration (SMEA), Ministry of Economic Affairs (n.d.b.) Public Procurement for Startups. https://www.spp.org.tw/spp/sppnews, accessed on 29 November 2024.

Wu Se-hua. (n.d.) The Third Industrial Innovation Survey in Taiwan Area (E99035) [data file]. Available from Survey Research Data Archive 2013, *Academia Sinica*. https://doi.org/10.6141/TW-SRDA-E99035-1

APPENDIX TABLE PROGRAM CATEGORIES AND PERFORMANCE METRICS OF ROC'S A+ INDUSTRIAL INNOVATION R&D PROGRAM (2014-2024)

(Unit: thousands TWD)

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forward-looking Technology R&D Program	# of Projects	6	10	11	10	14	8	5	11	27	17	22
	# of Firms	6	14	14	10	17	16	8	14	45	26	45
	Approved Budget	1,185,890	1,566,500	1,598,660	742,130	5,630,068	1,253,388	1,017,486	1,918,280	7,062,558	8,771,418	5,495,058
	Approved Grant Amount	501,610	655,030	640,464	305,950	1,564,954	501,351	377,000	615,290	1,966,728	3,668,815	1,817,183
Integrated R&D Program	# of Projects	10	16	11	11	14	11	15	7	1	0	0
	# of Firms	42	56	49	39	47	34	47	23	3	0	0
	Approved Budget	2,528,611	2,204,560	2,095,638	2,077,260	1,944,398	1,807,195	2,200,210	993,709	262,600	0	0
	Approved Grant Amount	1,109,689	911,708	848,090	870,580	811,180	732,100	849,165	306,250	80,000	0	0
Domestic R&D Center Program	# of Projects	13	24	11	16	11	13	6	13	7	7	0
	# of Firms	13	24	11	16	11	13	6	13	7	7	0
	Approved Budget	525,970	892,565	397,193	624,016	399,255	494,480	266,740	447,692	336,135	263,698	0
	Approved Grant Amount	196,196	332,123	164,338	233,191	154,386	198,042	95,000	159,752	118,283	106,467	0
Project-based Program	# of Projects	20	14	13	16	11	15	12	13	14	28	26
	# of Firms	24	14	13	16	12	16	14	14	16	29	32
	Approved Budget	1,274,390	616,609	1,023,274	942,388	1,375,529	1,039,500	1,804,146	1,088,216	607,392	1,701,300	1,376,900
	Approved Grant Amount	493,124	234,990	298,155	278,437	277,330	243,078	304,899	191,828	168,725	593,449	555,868
Global R&D Innovation Partnership Program	# of Projects	0	0	1	2	4	2	2	2	2	3	2
	# of Firms	0	0	1	2	4	4	2	2	2	3	2
	Approved Budget	0	0	212,219	780,000	1,507,839	990,000	620,000	515,000	1,600,000	2,550,000	9,840,000
	Approved Grant Amount	0	0	89,132	264,000	630,000	415,000	250,000	170,000	620,000	861,000	3,790,000
Others	# of Projects	2	0	0	0	0	0	0	0	0	7	23
	# of Firms	2	0	0	0	0	0	0	0	0	11	35
	Approved Budget	478810	0	0	0	0	0	0	0	0	170961	22696860
	Approved Grant Amount	162590	0	0	0	0	0	0	0	0	72500	6047700

Source: The Industrial Technology Development Program [9]

JAPAN

INTRODUCTION

SMEs in Japan are important in Japan. They occupy 99.7% of all enterprises in Japan as of June 1, 2021 (Table 1). Approximately 33.1 million people are employed by SMEs as a whole according to 2021 Economic Census, which means that approximately 70% of Japan's employees are employed by SMEs.

TABLE 1

NUMBER OF SMES AS OF 1 JUNE 2021

Category	# of enterprises (thousand enterprises)	Ratios (%)
SMEs	3,364,891	99.7
of which, small enterprises	2,853,356	84.5
Large enterprises	10,364	0.3
Total	3,375,255	100.0

Source: The author tabulated using the data from Chuushoukigyouchou SME Agency (2023d)

TABLE 2

DEFINITION OF SMES IN JAPAN

Industry	SMEs		Small enterprises
	Capital	Employees	Employees
Manufacturing and other industries	Up to JPY300 million	Up to 300	Up to 20
Wholesale	Up to JPY100 million	Up to 100	Up to 5
Service	Up to JPY50 million	Up to 100	Up to 5
Retail	Up to JPY50 million	Up to 50	Up to 5

Source: The author tabulated this data based on Cuushoukigyou kihon hou (METI, n.d.)

In Japan, SMEs are defined by the Small and Medium-sized Enterprise Basic Act. The Act defines them by the amount of capital and the number of employees (Table 2). Small enterprises, however, are defined by the number of employees only.

Although the importance of all SMEs remains the same, the recognition of SMEs in SME Basic Act changed radically in 1999 (Table 3). In the prior standing Act of 1963, SMEs were uniformly recognized as weak entities. The policy philosophy was to correct the disparity with large companies. The policy intended to assist all SMEs. Whereas in the Act of 1999, SMEs are recognized as the source of growth and development. The new Act focuses on SMEs that have the will and ability to grow and improve themselves in providing various assistances.

TABLE 3

CHANGES OF SME POLICY

	SME Basic Act in 1999	SME Basic Act in 1963
Recognition	The players who form the foundation of Japan's economy by conducting distinctive business activities in a variety of business fields, providing diverse employment opportunities, and offering individuals the opportunity to carry out their business while demonstrating their capabilities.	The Weak (uniformly)
Policy Philosophy	Growth and development of diverse and vibrant SMEs	Correcting the gap with large companies
Roles	(1) Creation of new industries, (2) increased employment opportunities, (3) promotion of competition in the market, and (4) revitalization of the local economy.	—
Policy Goals	(1) Promoting business innovation and business start-ups, (2) strengthening business foundations, and (3) facilitating adaptation to changes in the economic and social environment.	(1) Productivity Improvement and (2) trade condition Improvement

Source: The author tabulated this data based on 2020 Cuushoukigyou Hakusho (SME Agency, 2020)

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

Productivity

Total Factor Productivity

Japan shows unremarkable TFP growth from the period 2000–2019. It was 0.6% in the latter half of the 2010s and was 1.5% in the former half of the 2010s (Table 4). Moreover, SME TFP growth in Japan for the period 2003–2013 is even worse, with rates around 2010 at only 0.17% (Table 5).

TABLE 4

JAPAN'S TFP GROWTH

Period	TFP Growth Rates (%)
2000–2004	1.2
2005–2009	-0.1
2010–2014	1.5
2015–2019	0.6

Source: The author tabulated using the data from Japan Productivity Center's website (n.d.).

TABLE 5

JAPAN'S SME TFP GROWTH

Period	SME TFP Growth Rates (%)
2003–2007	0.48
2007–2009	-1.01
2009–2013	0.17

Source: The author tabulated using the data from the website of Council on Economic and Fiscal Policy (2016)

Labor Productivity

Labor productivity fluctuated to some extent in Japan between 2003–2020 (Table 6). The labor productivity of SMEs was less than half of that of large enterprises (LEs) in both manufacturing and non-manufacturing. The rate of SME manufacturing productivity to SME non-manufacturing productivity varies from year to year.

TABLE 6

LABOR PRODUCTIVITY IN JAPAN (UNIT: JPY10,000)

Year	SME Manufacturing	SME Non-manufacturing	LE Manufacturing	LE Non-manufacturing
2003	517	547	1,301	1,247
2004	557	524	1,365	1,264
2005	533	509	1,418	1,270
2006	518	525	1,456	1,283
2007	552	523	1,460	1,285
2008	536	503	1,044	1,150
2009	501	521	999	1,080
2010	524	522	1,172	1,186
2011	524	534	1,134	1,111
2012	516	529	1,140	1,160
2013	524	535	1,305	1,181
2014	525	546	1,330	1,212
2015	549	558	1,307	1,296
2016	549	558	1,320	1,327
2017	556	563	1,403	1,325
2018	554	543	1,367	1,394
2019	535	534	1,238	1,363
2020	520	520	1,180	1,267

Note: SME, enterprises with capital less than JPY100 million; LE, enterprises with capital equal to JPY1 billion or more.
Source: The author tabulated using the data from 2022 Chuushoukigyou Hakusho (SME Agency, 2022a).

R&D and Innovation

Now we look at innovation and research and development (R&D) that is largely related to innovation.

R&D and Patenting

First, R&D expenditure as a percentage of sales is examined. SMEs spent considerably less in R&D than LEs in 2020 (Table 7).

TABLE 7

R&D EXPENDITURE AS A PERCENTAGE OF SALES BY COMPANY SIZE, 2020

Company size and industry sector	R&D expenditure as a percentage of sales (%)
SMEs	
Manufacturing	0.9
Non-manufacturing	0.1
Large enterprises	
Manufacturing	5.9
Non-manufacturing	0.8

Source: The author tabulated using the data from 2023 Cuushoukigyou Hakusho (SME Agency, 2023a).

One of the direct results of R&D is patenting. In 2022, the total number of patent applications was 219 thousand in Japan (Japan Patent Office, 2023) and SMEs constituted about 40 thousand applications, or 18.1%. This is the reflection of the fact that SMEs do not spend much on R&D. The number of SME patent applicants for the same year was 10,767, or 64.7%. This indicates that the number of patent applications made by SMEs per company is smaller than that by large enterprises. However, the situation was improving. The ratio of the number of patent applications by SMEs increased from 14.9% in 2018 to 18.1% in 2022. The ratio of SME patent applicants increased from 62.3% in 2018 to 64.7% in 2022.

Innovation Activities

Regarding the innovation activities in Japan, a larger enterprise size is correlated with a more rigorous innovation activity in the period from 2019 to 2021 (NISTEP, 2023) (Table 8). On the whole, innovation activities became more active from the former period from 2015 to 2017. The ratio of the enterprises that conducted innovation increases in all size categories of enterprises.

TABLE 8

INNOVATION ACTIVITIES, 2019–2021

Enterprises by Size	Conducted (%)	Not conducted (%)
Small	49 (36)	51 (64)
Medium	57 (47)	43 (53)
Large	69 (60)	31 (40)
Total	51 (38)	49 (62)

Note: The numbers in brackets show the data of the period of 2015–2017.
Source: The author tabulated using the data from NISTEP (2023).

Both in manufacturing and service sectors, the ratio of enterprises that conducted innovation increased as the size of enterprises became larger. However, there were some industry sector differences. On one hand, the ratio of enterprises that conducted innovation was larger in manufacturing in the categories of medium-size enterprises and large enterprises. On the other hand, the situation was opposite in the category of small enterprises (Table 9). The ratio of enterprises that conducted innovation increased more largely in the service sector than in the manufacturing sector from the period between 2015 and 2017 to the period between 2019 and 2021.

TABLE 9

INNOVATION ACTIVITIES BY INDUSTRY, 2019–2021

(a) Manufacturing

Enterprises by Size	Conducted (%)	Not conducted (%)
Small	48 (42)	52 (58)
Medium	63 (60)	37 (40)
Large	80 (76)	20 (24)
Total	53 (47)	47 (53)

(b) Service

Enterprises by Size	Conducted (%)	Not conducted (%)
Small	51 (35)	49 (63)
Medium	55 (41)	45 (59)
Large	64 (53)	36 (47)
Total	52 (37)	48 (63)

Note: The numbers in brackets show the data of the period of 2015–2017.
Source: The author tabulated using the data from NISTEP (2023).

Positive Effects and Obstacles

SMEs obtain some positive effects from innovation activities. For SMEs whose innovative activities have been innovative, the top three positive effects are "differentiation from the competitors," "expanding sales channels (domestic and overseas)," and "improvement of customer satisfaction" (Table 10). For SMEs whose innovative activities have not been very innovative, the top three positive effects are "improving efficiency of existing operations," "differentiation from the competitors," and "expanding sales channels (domestic and overseas)." The ratio of SMEs recognizing these positive effects is higher among those with highly innovative activities compared to those with less innovative activities.

TABLE 10

TOP 3 POSITIVE EFFECTS OF INNOVATION ACTIVITIES FOR SMES

Ranking	Innovation Activities	
	Innovative	Not Innovative
1	Differentiation from the competitors (58.2%)	Improving efficiency of existing operations (36.7%)
2	Expanding sales channels (domestic and overseas) (49.5%)	Differentiation from the competitors (32.3%)
3	Improvement of customer satisfaction (34.8%)	Expanding sales channels (domestic and overseas) (30.6%)

Source: The author tabulated using the data from 2023 Chuushoukigyouhakusho (SME Agency, 2023b)

For LEs, innovative R&D shows better corporate performance in terms of sales growth and profitability compared to incremental R&D (Kondo, 1996). However, only 29.5% of LEs conduct mainly innovative R&D. The remainder, 70.5%, conduct mainly incremental R&D.

Since SMEs only have limited resources, they encounter various problems in conducting innovation. At the R&D stage, the most serious problem is "human resources" (Table 11). Likewise, at the later stages of sales, initiating service, and business expansion of innovated goods and services, the most serious problem is also "human resources."

TABLE 11

OBSTACLES TO CONDUCTING INNOVATION FOR SMES

(a) R&D stage

(Unit: %)

Problems	Magnitude		
	Large	Rather large	Total
Human resources	46.6	40.1	86.6
Funds	20.0	29.8	49.8
Information	19.1	44.7	63.8

(b) The stages of sales, initiating service, and business expansion of innovated goods and service

(Unit: %)

Problems	Magnitude		
	Large	Rather large	Total
Human resources	48.9	37.1	86.0
Funds	21.2	28.7	49.9
Information	20.7	41.2	61.9

Source: The author tabulated using the data from 2023 Chuushoukigyouhakusho (SME Agency, 2023c)

Collaboration on innovation activities - "Open Innovation"

Since SMEs have limited resources to conduct innovation, they need to collaborate with others. Unexpectedly, the smaller the size of an enterprise, the less it collaborates with others on innovation (Table 12). This is the same for both R&D-related and non-R&D-related collaboration. SMEs tend to collaborate with others for non-R&D-related collaboration more than R&D-related collaboration, unlike large enterprises.

TABLE 12

COLLABORATION ON INNOVATION ACTIVITIES, 2019–2021 (%)

Enterprises by Size	Collaboration on innovation activities	R&D related	Non-R&D related
Small	9	5	6
Medium	17	8	11
Large	34	24	22
Total	12	6	8

Source: The author tabulated using the data from NISTEP (2023).

By industry, enterprises in the manufacturing sector are more active in collaboration with others than those in the service sector (Table 13). In the manufacturing sector, R&D-related collaboration is more rigorous than non-R&D related collaboration. In the service sector, non-R&D-related collaboration is more rigorous than R&D-related collaboration.

TABLE 13

COLLABORATION ON INNOVATION ACTIVITIES BY INDUSTRY, 2019–2021 (%)

(a) Manufacturing

Enterprises by Size	Collaboration on innovation activities	R&D related	Non-R&D related
Small	19	12	11
Medium	22	15	11
Large	52	45	30
Total	22	15	12

(b) Service

Enterprises by Size	Collaboration on innovation activities	R&D related	Non-R&D related
Small	7	2	6
Medium	14	5	12
Large	23	12	18
Total	9	3	7

Source: The author tabulated using the data from NISTEP (2023).

Real development of new products depends on the size of enterprises. For SMEs, their products are "developed by others" most (41%), followed by developed by "own company only" (36%), developed through "collaboration with others" (20%), and by "conversion or modification of the products developed by others" (17%). They ask others to develop their products rather than collaborate with others. For large enterprises, their products are developed through "collaboration with others" (53%), followed by developed by "own company only" (50%), "developed by others" (26%), and by "conversion or modification of the products developed by others" (20%).

TABLE 14

PRODUCT DEVELOPMENT BY ORGANIZATION, 2019-2021
RATIOS OF THE COMPANIES THAT REALIZED PRODUCT INNOVATION AGAINST ALL COMPANIES (%)

Developing organizations	Own company only	Collaboration with others	Conversion or modification of the products developed by others	Developed by others
Small	36	20	17	41
Medium	36	34	18	32
Large	50	53	20	26
Total	37	25	17	39

Source: The author tabulated using the data from NISTEP (2023).

By industry, in the manufacturing sector, products are developed by "own company only" most for any size of enterprise, followed by developed through "collaboration with others" (Table 15). In the service sector, for SMEs, their products are "developed by others" most. For large enterprises, their products are most often developed through "collaboration with others".

TABLE 15

ORGANIZATION THAT DEVELOPED THE PRODUCT BY INDUSTRY, 2019–2021
RATIOS OF THE COMPANIES THAT REALIZED PRODUCT INNOVATION AGAINST ALL COMPANIES (%)

(a) Manufacturing

Developing organizations	Own company only	Collaboration with others	Conversion or modification of the products developed by others	Developed by others
Small	56	36	12	13
Medium	55	37	13	17
Large	71	61	15	13
Total	57	39	12	14

(b) Service

Developing organizations	Own company only	Collaboration with others	Conversion or modification of the products developed by others	Developed by others
Small	31	14	14	54
Medium	30	32	22	37
Large	35	45	23	35
Total	31	19	16	50

Source: The author tabulated using the data from NISTEP (2023).

POLICIES FOR ENHANCING PRODUCTIVITY AND INNOVATION CAPABILITIES OF SMES

This section discusses the major policies implemented in the 2022 fiscal year, as outlined in Section 1 "Enhancing Productivity and Strengthening Technological Capabilities," of Chapter 3 "Growth Promotion through Productivity Enhancement" in the White Paper on SMEs in Japan 2023.

SME Productivity Revolution Promotion Program

Under this program, Organization for Small & Medium Enterprises and Regional Innovation, JAPAN (SME Support, JAPAN) provides the following supports to SMEs:

- Support for equipment introduction, IT introduction, market development, business succession and so on,
- collection of advanced cases and wide dissemination of those information along with various support measures, and
- expert support for system changes such as tax systems and business expansion both domestically and internationally.

The size of the budget for this program was JPY200.1 billion (as FY 2021 Supplementary Budget).

Under this program, the following subsidies are available (SME Support, JAPAN, website).

Manufacturing/Commerce/Service Subsidy
This subsidy applies to capital investments or system development to develop innovative products or services, or to introduce labor-saving production processes. The subsidy rate is 1/2 (2/3 for DX: Digital Transformation or GX: Green Transformation). The secretariat is the National Federation of Small Business Associations.

IT Implementation Subsidy
This subsidy applies to IT tool (software or service) Implementation. The subsidy rate is 1/2 (2/3 for invoice taxation system changes). The secretariat is TOPPAN Co.

Sustainability Subsidy for SEs
This subsidy applies to market development based on own business plan with the supports from chambers of commerce and industry. The subsidy rate is 2/3. The secretariat is the Central Federation of Societies of Commerce and Industry.

Business Succession Subsidy
This subsidy applies to business succession, M&A (merger and acquisition), management reform after group formation, and expert cost at the time of M&A. The subsidy rate is 1/2 or 2/3. The secretariat is the Central Federation of Societies of Commerce and Industry.

An overall evaluation will be conducted after completion, but since the program is currently ongoing, there is no overall evaluation as of yet. However, there are some other evaluations from the SME Agency (2022b). For Manufacturing Subsidy within Manufacturing/Commerce/Service Subsidy, its outcome was as follows at the end of September 2022. The commercialization rate was 68.6%. The added value growth rate was -0.6%. It is thought that several more years will be required for added value to increase.

For the IT Implementation Subsidy, a certain degree of progress had been achieved with labor productivity growth by 3.4%.

Go-Tech Program (R&D Support Program for Growing SMEs)

History
The Go-Tech Program (R&D Support Program for Growing SMEs) started as the Supporting Industry Program (Support Program for Upgrading Strategic Fundamental Technology) in 2006. In 2022, the program merged with the Supporting Service Industry Program (Commerce and Service Industry Competitiveness Enhancement and Collaboration Support Program), which had started in 2018, and became the Go-Tech Program in 2022 (Keieisha Konekuto, 2024).

Content
This program supports a project from R&D through market development for up to three years. The amount of the subsidy is up to JPY97,50 million. The subsidy rate for SMEs is 2/3 or less. The budget for FY 2022 was JPY10.49 billion (SME Agency, 2023e).

Requirement
An SME, or SMEs, alone cannot apply for the program. They need to form a ‘consortium’ with universities, research institutions, and a project management organization. A matching navigation site for project management organizations exists and the other site for R&D organizations such as universities and public research institutes exists as well (Keieisha Konekuto, 2024).

Process

Applicants apply electronically through e-Rad (the Cross-Ministerial Research and Development Management System). After receiving proposals, the SME Agency asks a Selection Committee, consisting of external experts, to select proposals. Based on the decision of the Committee, the SME Agency notifies the adoption to the applicants (Figure 1) (Keieisha Konekuto, 2024).

Achievements

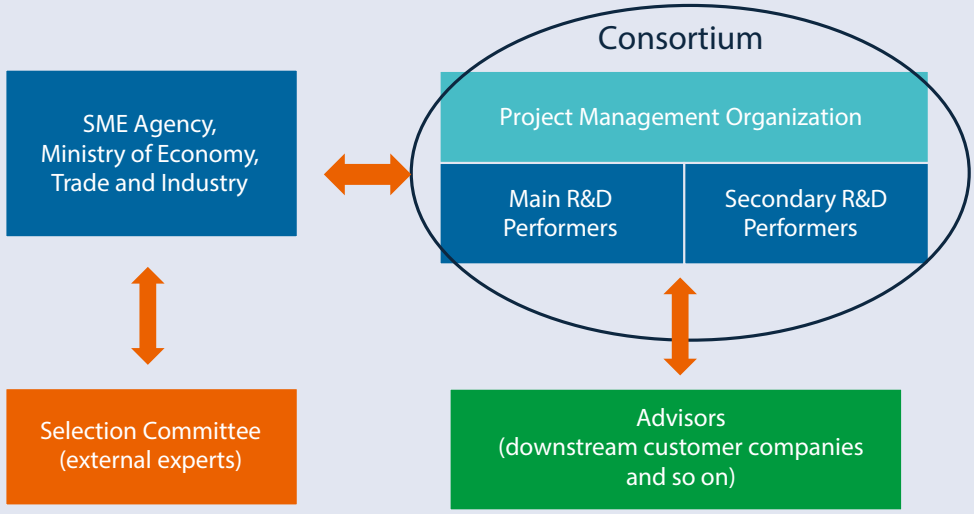
The achievements from FY 2006 through FY 2016 can be found on the SME Agency website. For example, an SME developed a new "fishing ground information quick report system" collaborating with a university and a prefectural public research institute as R&D partners and with a public-purpose foundation as a consortium management agency. This system is used by fish finder device manufacturers and fishing ground information distribution companies.

Outcome

Though the commercialization rate was 21% in the project final year, it increased to 40% a year after the project was finished and to 67% nine years after. It was statistically confirmed that selected companies for the program would see a sales increase of approximately JPY2 billion and added-value increase of approximately JPY300 million after six to eight years compared to unselected companies (Mitsubishi UFJ Research & Consulting, 2018).

FIGURE 1

SCHEME OF GO-TECH PROGRAM



Source: The author created based on the picture at SME Agency website (n.d.a).

Advanced Collaboration and Business Restructuring Promotion Program for Manufacturing (Monozukuri)

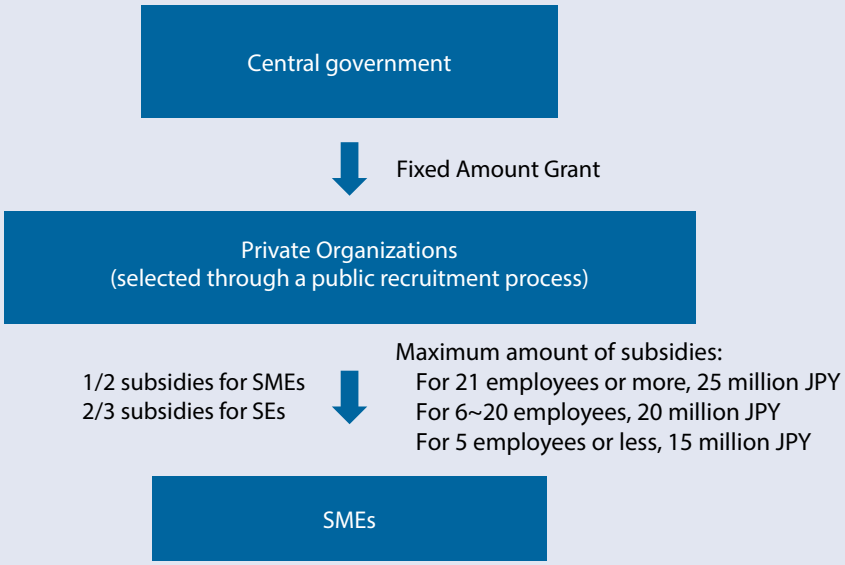
This Program supports capital investment and other expenses required for projects in new fields, business transformation, development of innovative products and services, and improvement of production processes, etc. in order to improve productivity of multiple SMEs working together as a whole.

The operation is conducted by a private organization selected through a public recruitment process (Figure 2).

The budge was JPY1.02 billion in FY 2022. In FY 2022, 28 groups (61 companies) were selected. (SME Agency, 2023). The secretariat is the Green Investment Promotion Organization.

FIGURE 2

SCHEME OF ADVANCED COLLABORATION AND BUSINESS RESTRUCTURING PROMOTION PROGRAM FOR MANUFACTURING



Source: The author created based on the information at SME Agency website (n.d.b).

According to the Self Review of the executing section of Program was that the Program accurately reflected the needs of the people and society. However, no specific figures were given. The Review Team within METI stated that in order to achieve program objectives, the executing section needs to set appropriate goals and strive to execute budgets efficiently and effectively (METI, 2021).

Bridging AIST and Medium-size Enterprises and SMEs

This policy intends to bridge AIST (The National Institute of Advanced Industrial Science and Technology under METI (Ministry of Economy, Trade and Industry)) technology seeds and the needs of Medium-size Enterprises and SMEs through 189 coordinators (as of January 2023). The size of its budget was a part of JPY62.06 billion for FY 2022.

Under this scheme, the coordinators introduce experts to companies. In addition, for R&D themes that cannot be conducted by the company alone, AIST conducts joint R&D with that company, or it conducts the R&D contracted by that company. There are many cases of using this scheme. For example, an electronic blood strip for an arm is developed. This strip improves a needle stick success rate in blood sampling (AIST 2024).

Medical-Engineering Collaborative Innovation Promotion Program

Content

This program started in 2015 and supports the following three activities:
[1] product development and commercialization,
[2] product development and commercialization (start-ups) and
[3] self-supporting regional collaboration center promotion.

For the activities [1] and [2], an applicant must be a consortium consisting of manufacturing SMEs for product/ process development and part supply, manufacturing/sales companies for final product production, IPR management and sales, medical institutions, and universities/research institutes (optional). For a start-up, it can be a member of such a consortium and it could also apply for education and support program.

For the activity [3], an applicant must be a researcher in semi-public organizations whose mission is to support medical device development and commercialization.

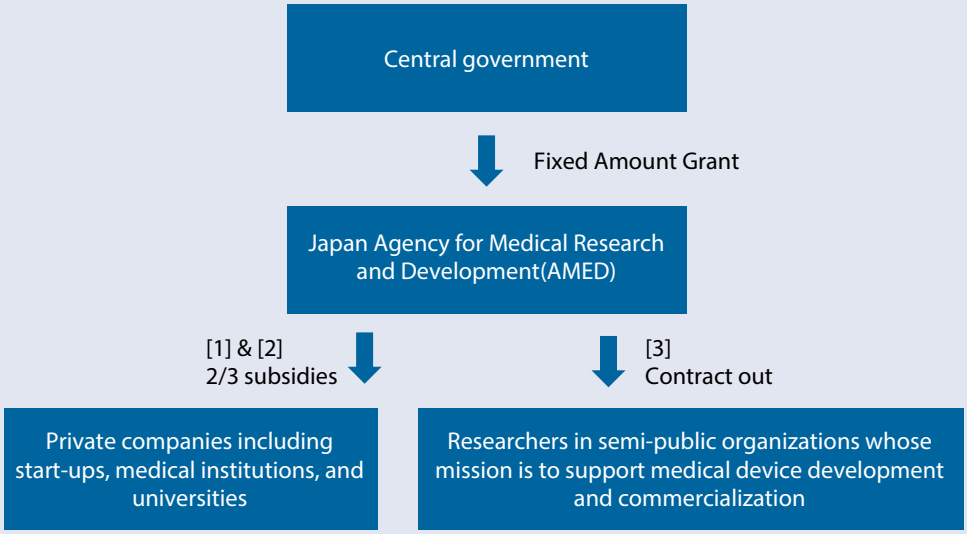
For FY 2022, the budget was JPY1.92 billion for and the number of projects selected was 9.

Scheme

Japan Agency for Medical Research and Development (AMED) manages the program using the grant from the government (Figure 3). AMED was established in 2015. The Ministers in charge are Prime Minister, Minister of Education, Culture, Sports, Science and Technology, Minister of Health, Labor and Welfare, and Minister of Economy, Trade and Industry.

FIGURE 3

SCHEME OF MEDICAL-ENGINEERING COLLABORATIVE INNOVATION PROMOTION PROGRAM



Source: The author created based on the information at AMED website (n.d.).

Outcome:

The number of products commercialized was 112 and the accumulated amount of sales was 14.1 billion JPY (SME Agency, 2023e). Detailed outcomes up to 2019 are found in the guidebook of the Program (MEDIC, 2024). Common misconceptions and mistakes are also explained in the guidebook.

Japanese SBIR Program

Japanese Version of Small Business Innovation Research (SBIR) Program started in 1999, with reference to the United States' SBIR Program. The name was changed to Small/Startup Business Innovation Research Program in 2023. The size of the budget increased from JPY11 billion in FY 1999 to JPY46 billion in FY 2019 (Nihonnnbann SBIR seido no minaoshi ni muketa kentoukai, 2019)

The program is not an existing independent program. The central government designates the subsidies that fulfil certain conditions as specific new technology subsidies and prepares annual spending targets for SMEs every fiscal year. The SMEs (start-ups) that receive the specific subsidies are eligible for special loans from Japan Finance Corporation (JFC) and so on in commercializing their R&D results. The Go-Tech Program is designated as one of the SBIR programs.

This program was well used by 94 thousand companies (SME Agency, 2019). However, there were several problems as follows (SME Agency, 2019; and Cabinet Office, 2021).

- There are not many SME recipients;
- The support in the early stages of Feasible Study and Proof of Concept is weak;
- There is no unified operation;
- There are no program managers to support appropriate target setting and practical application; and
- It is not linked to innovations that are used in society.

R&D Tax Incentive

This tax incentive scheme is very popular. For general type, 12–17% of R&D expenditure increase is deducted from tax payment for SMEs and 2–14% for large enterprises. For open innovation type, 20–30% of R&D expenditure for collaboration with others or contracting out to others is deducted. The procedure is simple. Tax authorities check annual financial statements of the companies. According to an executive of a high-tech startup in the semiconductor industry, the company enjoys this R&D Tax Incentive although it does not apply for any public subsidies.

This tax incentive is widely used by both SME's and large enterprises. The utilization of this R&D tax incentive in FY 2022 was as follows. For the general type, the amount of deducted tax was JPY749.5 billion in 13,650 cases. For the open innovation type, the amount of deducted tax was JPY14.1 billion in 2,752 cases (METI, 2024a).

Agriculture, Commerce, and Industry Cooperation Program

This program is not listed in Section 1 "Enhancing Productivity and Strengthening Technological Capabilities," of Chapter 3 "Growth Promotion through Productivity Enhancement" in the White Paper on SMEs in Japan 2023. However, this program is a good example of joint efforts of two ministries, MAFF (Ministry of Agriculture, Forestry and Fisheries) and METI (Ministry of Economy, Trade and Industry). This program is executed based on the law of NouShouKoutou Renkei Suishinhou (Agriculture, Commerce and Industry Cooperation Promotion Law) effective from July 21, 2008.

Outline

In the case where SMEs of commerce and manufacturing and agricultural, forestry and fishing industry workers collaborate to develop new products or new services making use of resources of each member, they receive comprehensive support. This program is to realize a 6th stage of industrialization since primary industry (agricultural, forestry and fishing industry) (1) x secondary industry (manufacturing) (2) x tertiary industry (commerce) (3) equals six.

Support Content

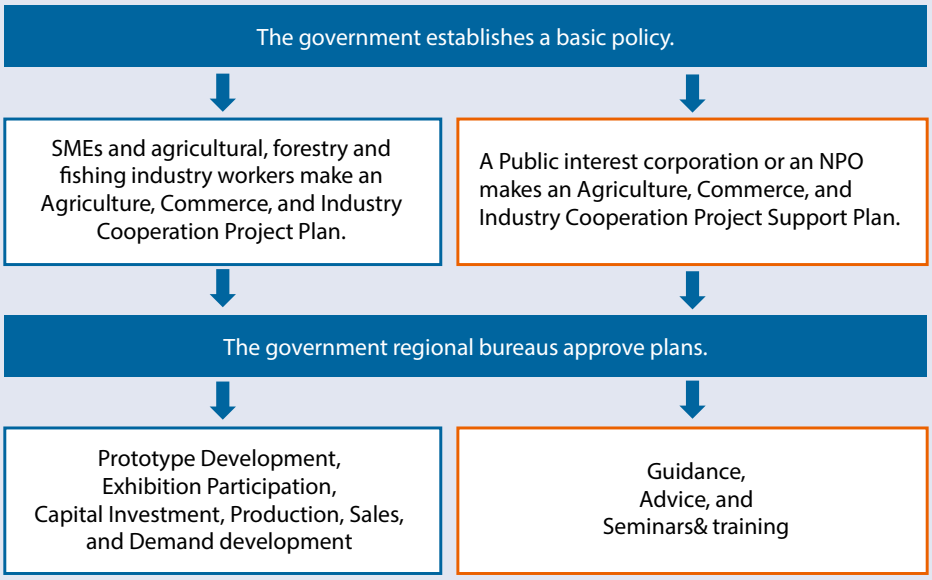
For Agriculture, Commerce, and Industry Cooperation Projects to develop new goods/services, the following supports are provided:

- subsidies,
- low-interest loans,
- Interest-free loans,
- investment tax breaks, and
- expanded lines of credit guarantees.

For Agriculture, Commerce, and Industry Cooperation Support Projects, subsidies and credit guarantees are provided.

FIGURE 4

SCHEME OF AGRICULTURE, COMMERCE, AND INDUSTRY COOPERATION PROGRAM



Source: Hokkaido Bureau of Economy, Trade and Industry website (n.d.).

Output and Outcome

Many products have been produced (MAFF, 2008, and MAFF and METI, 2008).

Case: The Development of High-Quality Noodles "Ebetsu Wheat Noodles"

One of the examples of the Agriculture, Commerce, and Industry Cooperation Program is "Developing high-quality noodles using locally grown wheat in Ebetsu Region." The participants were farmers, a flour miller, a noodle maker, a university, and a public research institute.

Wheat farmers introduced "early winter sow" method for "Haruyutaka (a special kind of wheat)" which is difficult to grow. A flour miller built a milling system for small batches. A noodle maker built a handmade workshop to develop high quality noodles. A university and a public research institute cooperated in cultivation techniques, quality assurance, and component analysis. These activities were part of the Ebetsu Economic Network activities. A regional network is well used as will be explained in the section of "Institutions".

The outcome is interesting. The number of annual sales of this noodle was 2.6 million servings as the regional brand "Ebetsu Wheat Noodles." The amount of sales in 2006 was approximately JPY300 million (MAFF and METI, 2008).

Public Financial Assistance

Although the problem of human resources is the greatest in conducting innovation for SMEs, public financial assistance is very helpful. The ratio of recipients of public financial assistance or tax deduction is the same for medium and large enterprises (Table 16). The ratio is a little higher for small enterprises, especially financial assistance from the central government. For financial assistance, the assistance from the central government is more used than the assistance from the local governments. For tax deduction, the situation is opposite. The ratio is a little lower for small enterprises compared to medium- and large enterprises.

TABLE 16

PUBLIC FINANCIAL ASSISTANCE, 2019–2021

(Unit: ratios of recipients, %)

Enterprises by Size	Public financial assistance/ Tax deduction	Public financial assistance		Tax deduction
		Local gov't	Central gov't	
Small	32	18	22	11
Medium	31	17	19	12
Large	31	17	19	12
Total	32	18	21	11

Source: The author tabulated using the data from NISTEP (2023).

By industry, the enterprises in the manufacturing sector use public financial assistance or tax deduction more extensively than those in the service sector (Table 17). In the manufacturing sector, on one hand, smaller enterprises are more likely to use public financial assistance. On the other hand, larger enterprises are more likely to use tax deduction. In the service sector, smaller enterprises are more likely to use public financial assistance or tax deduction. Small enterprises use tax deduction most extensively unlike the case of the manufacturing sector.

TABLE 17

PUBLIC FINANCIAL ASSISTANCE BY INDUSTRY, 2019–2021

(Unit: ratios of recipients, %)

(a) Manufacturing

Enterprises by Size	Public financial assistance/ Tax deduction	Public financial assistance		Tax deduction
		Local gov't	Central gov't	
Small	39	23	27	18
Medium	39	23	22	23
Large	39	20	22	24
Total	39	21	25	19

(b) Service

Enterprises by Size	Public financial assistance/ Tax deduction	Public financial assistance		Tax deduction
		Local gov't	Central gov't	
Small	32	17	23	11
Medium	27	17	17	7
Large	21	10	12	9
Total	31	17	21	10

Source: The author tabulated using the data from NISTEP (2023).

DEMAND SIDE POLICIES

Public Procurement

In general, bidding for public procurement is not easy. A bidder must be qualified in two aspects. One is delivery record. The other is management performance, which is evaluated by:

- Average annual production and sales (average actual production and sales of the previous two years),
- total equity,
- current ratio,
- number of years in business, and
- amount of equipment (only for goods manufactures).

Therefore, it is very hard for an SME that developed a new product without a good track record and good financial conditions to bid for public procurement.

For SBIR output product, special measures are taken. Provided that an SME is approved as a technologically capable holder, that SME can bid for public procurement without good track record or good management performance (METI, 2024b). This was decided by the Cabinet on 10 October 2000.

Still, the government did not procure many SBIR products and projected its own infallibility. However, since the government started SBIR Phase 3 program in 2023, if the R&D topic in this Phase 3 is in line with government procurement needs, a commitment to government procurement is required (METI, 2024c).

Regional Branding

A Regional Collective Trademark is a trademark which consists of a region's name and that of goods or services. This Trademark is widely used as regional branding in Japan (Japan Patent Office, 2024). Its three major merits are:

1. An exclusive right is assured to use the trademark all over Japan.
2. It becomes possible to prevent others from using the trademark.
3. It becomes possible to extend the trademark's right almost eternally.

They claim that it is the most effective tool to make a brand popular among people.

This scheme is well-used. Many examples can be found at the Patent Agency website (https://www.jpo.go.jp/system/trademark/gaiyo/chidan/katsuyo-jire.html).

Case: Imabari Towel and Senshu Towel

Imabari Towel and Senshu Towel are the two most famous towels produced in Japan. Both the Imabari Towel Industrial Association for Imabari Towel and the Osaka Towel Industrial Association for Senshu Towel adopted a branding strategy using the Regional Collective Trademark. Both were selected for METI's Japan Brand Development Support Projects in 2006. However, their strategies differed from each other.

The Imabari Towel Industrial Association registered "Imabari Taoru" (in Japanese) [Imabari Towel] as a Regional Collective Trademark in 2007. The association established "Imabari Towel" as a unified name in English to seek a global market and created a logo mark. The association urges all member companies to maintain good quality by adhering to the specification set by the association. Thus, there is only one high-quality level for Imabari Towels. The association is very active in attending international product fairs.

The Imabari Towel Industrial Association was established on 1 November 1952, though towel production in Imabari district started in 1894. Its capital is JPY101,486 thousand and has eight staff (Imabari Towel Industrial Association 2024). The revenue was JPY560 million in 2022. The association has 79 member companies. These member companies have 1,894 employees in total. That is, a member company averagely hires 24.0 employees. They produced 7,612 tons of towels in 2023.

The Osaka Towel Industrial Association registered "Senshu Kodawari Taoru" (in Japanese) [Senshu Carefully Crafted Towel] as a Trademark with its logo in 2005 and "Senshu Taoru" (in Japanese) [Senshu Towel] as a Regional Collective Trademark in 2007. The association maintains high quality standards for "Senshu Kodawari Taoru" products. The level is as good as that of Imabari Towels. However, the association maintains the quality standard for "Senshu Taoru" products at the level of the Japan Towel Industry Association. Therefore, there exist two quality standards for Senshu Towel products.

The Osaka Towel Industrial Association was established in 1952 though towel production in this district started in 1887 for the first time in Japan (Osaka Towel Industrial Association 2024). It had 83 member companies in 2019. They produced 7,503 tons of towels in 2019.

As a result, Imabari Towel is successful because of good global orientation and strict control of its one quality standard; and Senshu Towel is less successful due to weak global orientation and its two standards of quality. Consumers prefer Imabari Towel to Senshu Towel (Nakajima, 2017). From 2005 to 2017, Imabari region reduced its towel production from 13,643 tons to 11,468 tons (16% decrease), while Senshu region reduced its towel production from 11,491 tons to 8,443 tons (27% decrease) (Shibata, 2018).

Good Design Award and G Mark

The GOOD DESIGN AWARD is an only comprehensive design evaluation and promotion mechanism in Japan. Together with G Mark, it has been recognized by a wide range of people for more than 60 years since 1957, Its awardee can use G Mark for their products. As the effects of winning the award, 72.2% of awardees felt the increase of the popularity (Japan Institute of Design Promotion, 2024). This Award was started as "Good Design Product Goods Selection System" established by METI in 1957.

ORGANIZATIONS AFFECTING POLICY EFFECTIVENESS

Because of the social, economic and political importance of SMEs, there are many organizations for SMEs at both national and regional levels.

National Level

At the national level, the following public organizations for SMEs exist:

- SME Agency under Ministry of Economics, Trade and Industry (METI)
- Organization for Small & Medium Enterprises and Regional Innovation, JAPAN (SME Support, JAPAN), which is an Independent Administrative Agency, and
- Government Research Institutes (not only for SMEs).

The SME Agency is the most important public organization to formulate and execute SME policies in Japan. Although it is under METI, it covers all industry sectors. SME Support, JAPAN, is also an important semi-public organization to assist SME Agency at the implementation stage. As far as technological aspect concerns, government research institutes are important though they do not function only for SMEs. AIST is one of them in the manufacturing sector.

There are also national level organizations of SMEs. They are:

- The Japan Chamber of Commerce and Industry [Shokokaigisho],
- Central Federation of Societies of Commerce and Industry [Shokoukai],
- National Federation of Small Business Associations,
- Japan Junior Chamber, and
- The National Conference of the Association of Small Business Entrepreneurs.

Regional Level

There are regional level public organizations for SMEs as well. They are:

- Regional branches of METI and SME Support, JAPAN,
- SME sections of regional governments,
- SME Assistance Centers (which have close relations with regional governments), which are Public Interest Incorporated Foundations, and
- Public Research Institutes – [Kosetsushi].

A Regional Platform is organized in each region. This is a coalition of local SME support organizations and regional governments to support SMEs. This Platform is promoted by the SME Agency.

There are regional-level organizations of SMEs as well corresponding to national level organizations of SMEs. They are:

- Regional Chambers of Commerce and Industry [Shokokaigisho],
- Regional Societies of Commerce and Industry [Shokoukai],
- Regional Small Business Associations,
- Regional Junior Chambers, and
- Regional Associations of Small Business Entrepreneurs.

Financial Institutions for SMEs

Since financial assistance is very important for SMEs, there are several types of public/semi-public financial institutions for SMEs as follows:

- SME Unit, Japan Finance Corporation (JFC),
- The Shoko Chukin Bank, Ltd.,
- Small and Medium Business Investment & Consultation Co., Ltd. (Tokyo, Osaka, and Nagoya), and
- Credit Guarantee Corporations (51 corporations).

SME Unit, JFC, provides low interest loans to SMEs, LEs, and agriculture, forestry and fisheries workers. The Shoko Chukin Bank, Ltd. provides low interest loans to SME Cooperatives and other organizations whose members are mainly SMEs and their members. Small and Medium Business Investment & Consultation Co., Ltd. (Tokyo, Osaka, and Nagoya) makes investment in SMEs and investment funds. Credit Guarantee Corporations (51 corporations) provide credit guarantees. They have reinsurance agreement (SME credit insurance) with JFC (Japan Federation of Credit Guarantee Corporations, 2024).

There are also private financial institutions for SMEs according to Financial Service Agency (2024). They are:

- Shinkin banks (254 banks) and
- Credit unions (146 unions).

Credit unions are cooperative regional financial institutions serving small and medium enterprises and local residents. Shinkin banks serve some of the same functions as credit unions but can accept deposits from non-members inside and outside their regions and can extend loans to the former members who have grown beyond the membership qualifications.

Start-up-related organizations

Venture capital companies exist as well in Japan. There were 202 companies in 2018 (Paradigm Shift, 2024). There are also accelerators and incubators. There were 180 incubators in 2006 (METI, 2007). Japan Business Incubation Association (JBIA) was established in 2008. Japan Business Incubation Association (JANBO) fostered incubation managers (IMs), who were important for incubator tenants, and it existed from 1999 to 2008.

INSTITUTIONS AFFECTING POLICY EFFECTIVENESS

Policy Implementation

The SME Agency is responsible for policy making. However, the Agency does not have enough capacity to implement policies. Thus, the combination of the SME Agency and SME Support, JAPAN, which is an effective arm of policy implementation, is good. SME Agency regional offices are co-located with SME Support, JAPAN regional offices. These regional offices also have good contacts with SME divisions of local governments. Each SME division of a local government also has an implementation organization. In most cases those organizations are foundations supervised by local governments.

Policy information Diffusion and Collection

Regarding policy information diffusion, regional level SME organizations, such as Chambers of Commerce and Industry [Shokokaigisho], Regional Societies of Commerce and Industry [Shokoukai], Regional Small Business Associations, Regional Junior Chambers, and Regional Associations of Small Business Entrepreneurs are very helpful. They even provide policy consultancy services to their member SMEs. They are also functional to collect policy requests from their member SMEs. These requests are organized at their national level organizations and will be conveyed to the government.

Regional Political Economic System

In Japan, regional governments operate their universities and research institutes. They are called public universities [Koritsudaigaku] and public research institutes [Kosetsushi]. Many of regional parliament members have patrons who are SME owners. Some of them are SME owners themselves. Thus, regional governments pay attention to these SME owners. Both public universities and public research institutes are helpful to them through collaborative R&D or contracted R&D. In some cases, a public university professor or a public research institute researcher fills out an application form of government R&D subsidies together with a regional SME owner.

Regional SME Study Groups

SME owners often organize study groups within the regional level SME organizations. These study groups invite public university professors, public research institute researchers, and other experts. Attending these study groups is also a good occasion to drink. A famous one is “Cross-Industry Exchange Plaza” [Igyoshukoryu Puraza] activities. This group allows only one member from the same industry sector. That is, there are no competitors in the same group. Out of these activities, new products are developed, and even joint venture companies are established on some occasions.

CONCLUSION AND POLICY RECOMMENDATIONS

Economic environment for Japanese SMEs is changing. Keiretsu (long-term reliable business relations) has been weakened. This change is partly caused by the change of product configuration. Product configuration is shifting from an integral type to a modular type. Therefore, SMEs need to find their own ways. Some are successful such as Global Niche Top (GNT) companies. “Global Niche Top (GNT) Companies Selection 100” Program conducted by METI in 2013 showed that 69 out of 100 GNT companies were SMEs. They were globally performing well.

Collaboration is one of the key factors required for SMEs to conduct innovation since the resources of SMEs are limited. The other key factor is targeting a niche market since its technological capacity is limited. However, this niche market should also be a global niche market to increase its sales amount.

Thus, one of the policies which should be pursued is the promotion of international collaboration. That is the collaboration between a Japanese SME and a foreign company who is knowledgeable about foreign markets. This policy caters for both supply side and demand side. For supply side, although domestic collaboration of SMEs with other SMEs, large companies, universities, and public institutes is more important and easier. International collaboration would add new factors. For demand side, international collaboration is very important. Japanese public organization basically take the position of "Infallibility." They are reluctant to procure new products which have no good track records though some policies encourage them to do so. Their tendency towards SMEs and startups is stronger than towards large companies. Japanese large companies share this kind of tendency with public organizations. It is hard for SMEs and startups to sell their new products to public organizations and large companies. Thus, the foreign market is important as the first market for newly developed innovative products for SMEs and startups. Recent Japanese yen depreciation against various currencies is favorable for Japanese companies to export their products.

Bureaucrats in Japan are knowledgeable and capable. Thus, if somebody proposes a new policy, such policy already exists in many cases. If asked, is that policy effective? Yes, it is effective and has resulted in some concrete outcomes in a limited scale. The issue is how large the industrial or social impact is. In reality, many intermediating activities are being conducted by semi-public organizations such as Japan External Trade Organization (JETRO), Osaka Business Development Agency (OBDA), Osaka Chamber of Commerce and Industry (OCCI) and so on. However, these kinds of activities are not enough to create large impacts yet.

The other policy is to create Japanese versions of GAFAM (Google, Amazon, Facebook, Apple, and Microsoft). Some lacking elements required to nurture SMEs that could be Japan's future global giants might be:

- strategic managers (who create new business models), and
- entrepreneurs born globally.

These talented people could be trained through practical training such as assistants to globally active managers. The government could assist ambitious English-speaking people to find such opportunities. As a global institutional system, organizing global networks accommodating Japanese researchers, entrepreneurs, businessmen residing in both in Japan and overseas is needed. One example of such movements is the establishment of World Association of Overseas Japanese Entrepreneurs (WAOJE) whose headquarters is located in Tokyo.

The other aspect is targeting the products that do not require large-scale production capacities. For example, the ICT industry does not need large-scale production facilities. Once their product is developed, its production is basically just copying. The semiconductor design industry is another industry that does not require large-scale production capacities. Once the design is completed, they can outsource production to large foundries. Biotech startups are similar. They can outsource production to large pharmaceutical companies.

REFERENCES

AIST (2024) *Sansoken: chuushokigyou-chukenkigyou tono renkeijirei no shoukai* [Examples of Bridging AIST and Medium-size Enterprises and SMEs] https://www.aist.go.jp/aist_j/business/alliance/reg_innovation/outcome/, accessed on 22 July 2024.

AMED (n.d.) https://www.amed.go.jp/program/list/12/01/007.html, accessed on July 19, 2024

Cabinet Office (2021) *Nihon-ban SBIR Seido no minaoshi* [Review of the Japanese SBIR program] February 2021. https://www8.cao.go.jp/cstp/openinnovation/sbir/sbir_r3_02.pdf, accessed on 12 December 2024.

Council on Economic and Fiscal Policy (2016) *Sentakusuru Mirai* 2.0 [Choosing the Future 2.0]. https://www5.cao.go.jp/keizai2/keizai-syakai/future2/saishu-sankou.pdf, accessed on 4 July 2024.

Financial Service Agency (2024) *Chusho-Tiiki Kinyukikan Johoitiran* [List of SME Regional Financial Institutions] https://www.fsa.go.jp/policy/chusho/shihyou.html, accessed on 26 July 2024.

Hokkaido Bureau of Economy, Trade and Industry (n.d.) https://www.hkd.meti.go.jp/information/chusho/shinjigyo/noushoukou.htm, accessed on August 28, 2024

Imabari Towel Industrial Association (2024) https://itia.or.jp/info.html, accessed on 10 December 2024.

Japan Federation of Credit Guarantee Corporations (2024) https://www.zenshinhoren.or.jp/, accessed on 26 July 2024.

Japan Institute of Design Promotion (2024) GOOD DESIGN AWARD https://www.g-mark.org/en/learn/what-is-gda, accessed on 8 October 2024.

Japan Productivity Center (n.d.) https://www.jpc-net.jp/research/assets/pdf/JAMP01_2022.pdf, accessed on 4 July 2024.

Japan Patent Office (2023) *Tokkyo Gyousei Nenjihoukokusho 2023* [Japan Patent Office Annual Report 2023].

Japan Patent Office (2024) *Chiikidantai Shohyou Seido* [Regional Collective Trademark System] https://www.jpo.go.jp/e/system/trademark/gaiyo/chidan/index.html, accessed on 8 October 2024.

Keieisha Konekuto (Corporate Manager Connect) (2024), *Sapoin Jigyo toha?* [What is Supporting Industry Program?], https://keieisha-connect.com/2021/01/27/sapoin/, accessed on 12 July 2024.

Kondo, M. (1996) "R&D Management for Better Corporate Performance - Lessons from Japanese Manufacturing Firms," *Journal of Science Policy and Research Management*, Vol.11, No.1/2, 106–123.

MAFF (2008) *Noushoukourenkei Jireishu Dai1kainintei* [Case Collections of Agriculture, Commerce, and Industry Cooperation Program – the 1st Certification], September 2009. https://www.maff.go.jp/j/shokusan/sanki/nosyoko/attach/pdf/index-34.pdf, accessed on 13 December 2024.

MAFF and METI (2008) *Noushoukourenkei 88 sen* [88 selections of Agriculture, Commerce, and Industry Cooperation Program], 4 April 2008. https://www.chusho.meti.go.jp/shogyo/noushoko/2008/download/08040402_88.pdf, accessed on 13 December 2024.

MEDIC (2024) *Ikourenkei niyoru iryoukikijigyouka gaidobuuku 2020nen 3gatu ban* [Guidebook for Medical Device Commercialization through Medical-Industrial Collaboration, March 2020 Edition]. https://www.med-device.jp/pdf/repository/guidebook20200521v2.pdf, accessed on 2 September 2024.

METI (2007) *Heisei 18nenndo Bijinesu Inkyube-ta kisochousa houkokusho siryohen* [FY 2006 Business Incubator Basic Study (Data Section)].

METI (2021) FY 2021 *Gyouseijigyo Revu Shiito* [Administrative Projects Review Sheet] Project No. 2021-METI-New22-0008. https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.meti.go.jp%2Finformation_2%2Fpublicoffer%2Freview2021%2Fsaisyu%2F040008METI.xlsx&wdOrigin=BROWSELINK, accessed on 21 December 2024.

METI (2024a), *Kenkyuukaihatsuzeisei no Gaiyou to reiwa 5-6 nenndo no zeiseikaisei ni tsuite* [Overview of the R&D Tax Incentive System and Tax Reforms for FY 2023 and FY 2024] https://www.meti.go.jp/policy/tech_promotion/tax/R6gaiyou_set.pdf, accessed on 16 July 2024.

METI (2024b) *Gijuturyokuaru Chuushoukigyoutou no Nyuusatsusannkakikai no Kakudai nituite* [Expanding bidding opportunities for technically capable SMEs] https://www.meti.go.jp/information_2/publicoffer/sanka_shikaku/gijyuturyoku_chusyo.html accessed on 8 October 2024.

METI (2024c) *Chushokigyou Inobe-shon soushutujigyou (SBIR fe-zu3 jigyou) no shikoku nituite* [Expanding bidding opportunities for technically capable small and medium-sized enterprises] https://www.meti.go.jp/information_2/publicoffer/sanka_shikaku/gijyuturyoku_chusyo.html, accessed on 8 October 2024.

METI (n.d.) *Cuushoukigyou kihon hou* [the Small and Medium-sized Enterprise Basic Act]. https://www.chusho.meti.go.jp/koukai/hourei/kihonhou/, accessed on 27 July 2024.

Mitsubishi UFJ Research & Consulting (2018) Heisei 29 *nenndo senryakutekikibangijutu koudokasiennjigyou no koukasokutei ni kannsuru chousajigyohoukokusho* [FY 2017 Report on the Outcome Measurement of Go-Tech Program], February 2018. (Its summary can be found at SME Agency website: https://www.chusho.meti.go.jp/sapoin/index.php/about/business/)

Nakajima Eiji (2017) *Chiho no Sangyokurasuta- niokeru Hukkatuyouin no Kosatsu – ImabariTaoru to Senshu Taoru nniokeru Yoinbunseki* [Consideration of revival factors in local industrial clusters - Factor analysis of Imabari Towel and Senshu Towel] https://core.ac.uk/download/pdf/185702893.pdf, accessed on 14 October 2024.

Nihonnnbann SBIR seido no minaoshi ni muketa kentoukai (2019), *Nihonbann SBIR seido no Minaoshi no houkousei* [Direction of Japanese SBIR Program Review, Interim report, November 7, 2019]. https://www.chusho.meti.go.jp/koukai/kenkyukai/sbir/2019/191107sbir.pdf, accessed on 24 July 2024.

NISTEP (2023) "全国イノベーション調査2022年調査統計報告" [Report on the Japanese National Innovation Survey 2022 (J-NIS 2022),] NISTEP REPORT No. 200.

Osaka Towel Industrial Association (2024) https://os-towel.or.jp/kingdom/data/, accessed on 10 December 2024.

Paradigm Shift (2024) *Achievements of GO-tech Program*, https://paradigm-shift.co.jp/column/134/detail

SHIBATA, Hirotoshi (2018) "Senshu Taoru Sangyo no Seisui to Genkyo" [The rise, fall and current status of the Senshu towel industry], *The Monthly Bulletin of the Institute for Social Science Senshu University*, No.661-662, July–August 2018, 60–75. doi.org/10.34360/00009133

SME Agency (2019) *Chuushoukigyou Gijutukakushinseido Kaikakupuran Soan* [Japanese SBIR Program Reform Plan Draft], 3 October 2019. https://www.chusho.meti.go.jp/koukai/kenkyukai/sbir/2019/191003sbir03.pdf, accessed on 12 December 2024.

SME Agency (2020) *Chuushoukigyou Hakusho* [2020 White Paper on SMEs] Part I, Chapter 1, Section 1.

SME Agency (2022a) *Chuushoukigyou Hakusho* [2022 White Paper on SMEs] https://www.chusho.meti.go.jp/pamflet/hakusyo/2022/chusho/b1_1_6.html, accessed on 25 June 2024.

SME Agency (2022b) *Chushoukigyou Seisanseikakumei Suishin Jigyo ni tsuite* [About SME Productivity Revolution Promotion Program], 8 November 2022. https://www.gyoukaku.go.jp/review/aki/R04/img/4_2_1_keisan.pdf, accessed on 21 December 2024.

SME Agency (2023a) *Chuushoukigyou Hakusho* [2023 White Paper on SMEs]. Part I, Chapter 4.

SME Agency (2023b) *Chuushoukigyou Hakusho* [2023 White Paper on SMEs]. p. I-113.

SME Agency (2023c) *Chuushoukigyou Hakusho* [2023 White Paper on SMEs]. pp. I-114.

SME Agency (2023d) *Chuushoukigyoucho*. https://www.chusho.meti.go.jp/koukai/chousa/chu_kigyocnt/2023/231213chukigyocnt.html#:~:text=%E4%B8%AD%E5%B0%8F%E4%BC%81%E6%A5%AD,380.9%E4%B8%87%E8%80%85, accessed on 26 June 2024.

SME Agency (2023e) *Chuushoukigyou Hakusho* [2023 White Paper on SMEs].

SME Agency (n.d.a) https://www.shusho.meti.go.jp/sapoin/index.php/application/guide, accessed on July 12, 2024.

SME Agency (n.d.b) http://www.meti.go.jp/main/yosangaisan/fy2023/pr/ip/chuki_18.pdf, accessed on July 24, 2024.

SME Support, JAPAN (n.d.) https://seisansei.smrj.go.jp/#anchor-contents01, accessed on 25 July 2024.

MONGOLIA

INTRODUCTION

Mongolia has been included in the Global Competitiveness Report since 2015. In 2015, Mongolia was ranked 57th out of 61 countries surveyed in terms of competitiveness, and by 2023, it ranked 62nd out of 64 countries. A study of the competitiveness reports shows that in order to increase our competitiveness, Mongolia needs to establish a good innovation and productivity system and improve its contribution to economic and social development. The relatively low level of innovation development in Mongolia leads to low company productivity. During the above period, the share of mining and extractive industries in the structure of Mongolia's total industrial production sector remained dominant, while the share of processing industries, electric and thermal power generation, and water supply generally tended to decrease. In other words, it can be said that there have been almost no positive changes in the structure of Mongolian economy during the period. This indicates that there is insufficient investment in the establishment of small and medium-sized enterprises with modern technology, the creation of new jobs and the development of processing industries (Asian Development Bank Institute, 2019).

Also, since 1990, there has been no significant change in the share and structure of the main products exported by Mongolia in total exports in the last 30 years, indicating that the structural change of the economy has been very slow. For example, when considering the 5 types of products that account for the largest share in our country's exports during the above period, the following 4 types of products have consistently had a high share: mineral products; textiles and woven products; raw and processed leather, hides, and fur; livestock and their products. In 2018 and 2022, there were no significant changes in these five product categories, and only a slight change in their relative weight . These main export products are mainly primary processed mining and agricultural raw materials (International Finance Corporation, 2015). Therefore, our country urgently needs to take measures to develop the production of final products that are produced using modern technology, have high intellectual capacity, and are competitive in the global market.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

Small and medium industry is an important sector of business, and governments of countries assume the direction of supporting and expanding small and medium businesses in their national strategic programs. According to the World Trade Organization, 90% of entrepreneurs in developed economies, 60 to 70% of employment, and 55% of GDP are small and medium enterprises.

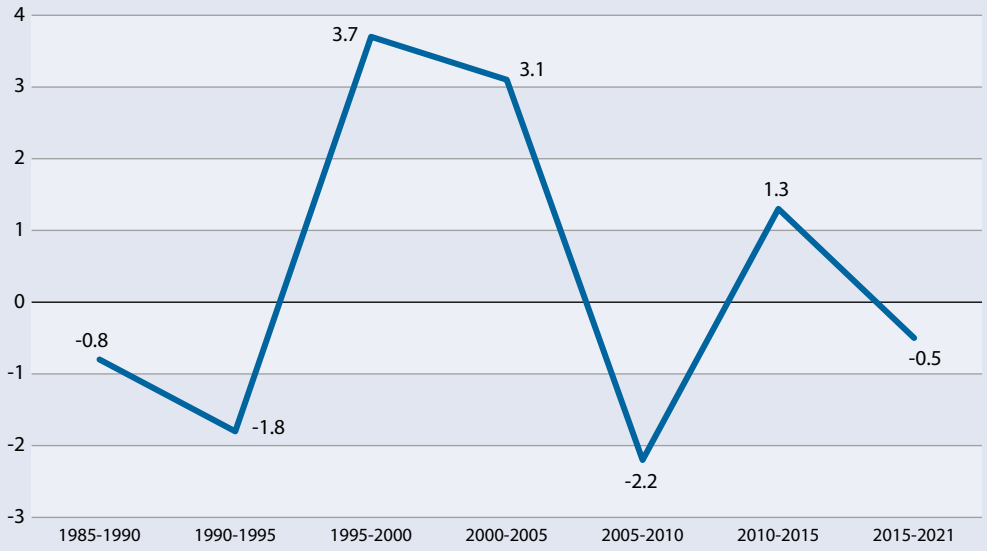
The National Statistics Office of Mongolia determines the number and data of enterprises engaged as small and medium-sized enterprises and services based on the articles of 4.1.1, 5.1, and 7.1 of the Law of Mongolia on Support of Small and Medium-sized Enterprises and Services from the statistical business register database. As of the end of 2022, there are 91.8 thousand legal entities operating in the database of the Business Register, of which 69.5 thousand (75.7%) are small and medium enterprises, 75.4% are micro enterprises, 2.5% are small enterprises, 0.1% are medium enterprises, and one is a service provider. Also, as of 2022, SMEs provided 80% of total employment, made up 5.5% of GDP, account for 2.1% of total exports and 8.9% of imports. The number of enterprises engaged in small and medium industries and services has increased by 19.9% from

2021. Although SMEs are important in many ways, such as with the competition they bring to the market, the unique and innovative solutions, economic growth, employment, etc., in reality, SMEs face many challenges in growing, expanding, and sustaining their activities. Small businesses have a relatively simple structure, enabling them to react quickly and use their resources efficiently, which boosts their productivity. In contrast, medium-sized businesses tend to have a more complex structure with a variety of activities, which can reduce operational speed and flexibility. The success of small businesses largely depends on their ability to remain flexible, rapidly innovate products and services, and respond quickly to risks.

The change in total factor productivity, a key indicator of the competitiveness of Mongolia's SMEs in the economy, has varied over the past 25 years. In other words, there has been a decline of 0.8–1.8% in the first 10 years, an increase of 3.1–3.7% in the middle 10 years, a decrease in 2005–2010 (-2.2%), an increase of 1.3% in 2010–2015, and a decrease in 2015–2021 (-0.5%).

FIGURE 1

SOURCES OF ECONOMIC GROWTH BY COUNTRY AND REGION, 1985–2021

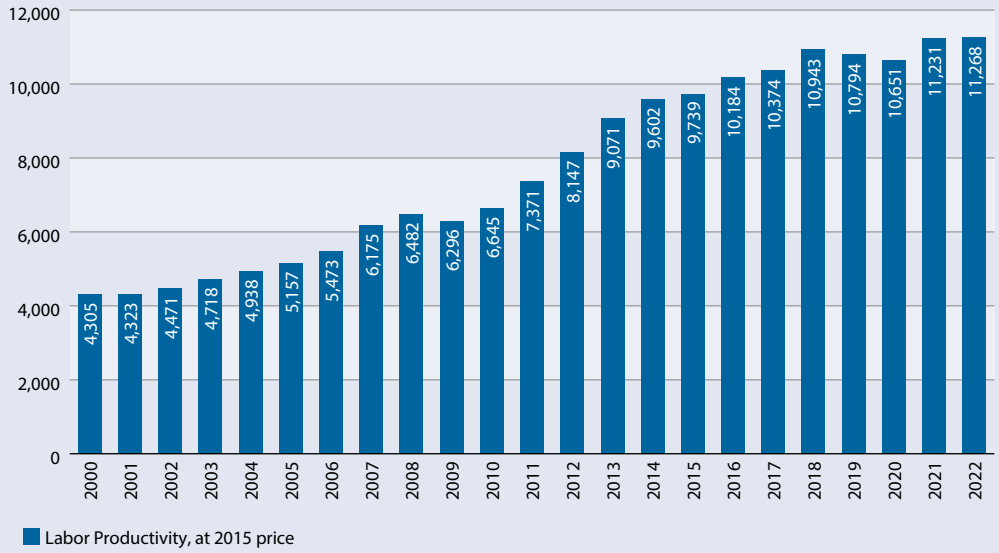


Source: (APO, 2023)

Mongolian labor productivity has a tendency to increase, as indicated by the graph below (Figure 1).

FIGURE 2

LABOR PRODUCTIVITY OF MONGOLIA (USD)



Source: (APO, 2023)

However, when compared internationally, it is relatively low. For instance, from 2000 to 2022 the average labor productivity in Mongolia was USD6.8 thousand. When compared to high-income countries (USD85.5 thousand) 12.5 times lower, 3.2 times lower than upper-middle-income countries (USD21.6 thousand), and 1.7 times lower than middle-income countries (USD12.0 thousand). In contrast, it is 1.6 times higher than lower-middle-income countries (USD4.2 thousand) and 5.7 times higher than low-income countries (USD1.2 thousand).

TABLE 1

LOANS ISSUED BY THE SMALL AND MEDIUM ENTERPRISES DEPARTMENT

Year	Amount of loan (USD)	Number of borrowers	Created workplace	Funding spent to create per workplace (USD)
2019	17,809,829	451	2,963	6,010.7
2020	8,109,543	249	1,689	4,801.4
2021	284,281	12	74	3,841.6
2022	6,099,476	156	1,002	6,087.3
2023	10,224,664	265	1,302	7,853.0
2024	6,099,528	140	639	9,545.4
Total	**48,627,320**	**1,273**	**7,669**	**6,356.6**

Source: Report of SME Department (2022)

In the last five years, the SME Department has provided loans USD48.6 billion to 1,273 manufacturers, creating 7,669 jobs, which is equivalent to one job created by USD6.3 thousand for every borrower.

According to the Bank of Mongolia survey, 45.1% of SMEs use 81–100% of their capacity, 30.6% use 61–80%, and 24.3% use less than 60%. In addition, 28.7% use their full production capacity (100%), while 8.1% use less than 40% of their capacity (MongolBank, 2022b). This low capacity utilization is common in micro businesses

TABLE 2

SMES INDUSTRY EFFICIENCY (%)

Indicators	Total (n=703)	Business scale			Administration gender	
		Micro (n=407)	Small (n=165)	Medium (n=131)	Male (n=404)	Female (n=299)
Capacity utility						
Average %	78.3	74.9	82.8	83.1	78.3	78.2
under 40%	8.1	10.3	4.8	4.7	7.9	8.4
41–60%	16.2	21.6	10.9	6.2	15.8	16.7
61–80%	30.6	28,0	32.1	35.2	31.4	29.4
81–100%	45.1	40,0	52.1	54.1	44.8	45.5
Profitability						
Exceeded the planned profit	9,0	6.1	10.3	16.7	9.2	8.7
Earned the planned profit	46.1	40.3	59.4	48.6	43.3	49.8
Earned less profit than planned	23.3	27.8	18.2	15.4	24.3	22.1
Null profit	14.2	17,0	7.3	13.2	13.9	14.7
Loss	7.4	8.8	4.8	6.2	9.4	4.7
Labor productivity						
Average (million MNT)	28.2	19.2	48.2	32.1	26.8	30,0
Maximum (million MNT)	156.2	120.0	133.0	156.2	135.0	156.2
Minimum (million MNT)	0.04	0.36	1.0	0.04	0.04	0.05

Source: (MongolBank, 2022b)

Labor productivity is calculated as the annual sales revenue per employee, it was MNT28.2 million in 2022, and 65.7% of all SMEs have below average labor productivity (Figure 2). Considering the size of the sector's business, the labor productivity of micro-businesses is significantly lower, on average MNT19.2 million. Interestingly, small businesses are more productive than medium businesses by MNT16.1 million (Table 1).

Therefore, in order to increase the efficiency of operations, which is the main indicator of the competitiveness of SMEs, it is necessary to give priority attention to increasing labor productivity, and further to increasing profitability.

FIGURE 3

SMES' LABOR PRODUCTIVITY, BY NORMAL DISTRIBUTION

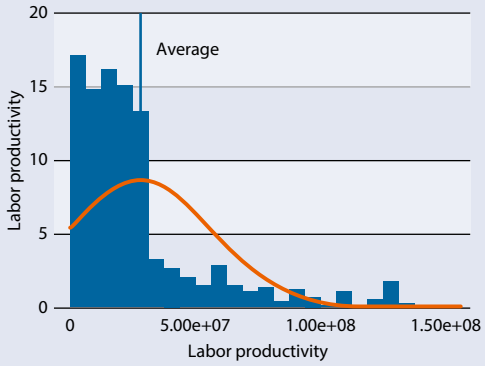
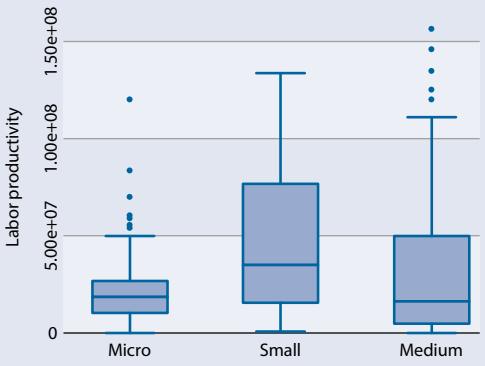


FIGURE 4

SMES' LABOR PRODUCTIVITY, BY BUSINESS SCALE



Source: (USAID, 2024)

Although many SMEs are making some effort to develop new products and services, the number of patents for new products and services is low. Thirty-five point-seven percent of surveyed SMEs invest in equipment required for new product and service development, 21.5% have a new product and service development team, and 12.7% budget specific costs for research and development (Table 3). In addition, 7% combine the development of these new products and services (USAID, 2024). On the other hand, 30.2% do not make any effort to develop new products and services, which is more noticeable in micro, small and female-led businesses. Eleven point-seven percent of the surveyed enterprises have patents for new products and services. Fifteen point-three of medium-sized businesses, 13.9% of small businesses, and 9.6% of micro-businesses have patents.

TABLE 3

SMES INNOVATION EFFORTS AND PATENTS (%)

Indicators	Total (n=703)	Business scale			Administration gender	
		Micro (n=407)	Small (n=165)	Medium (n=13)	Micro (n=407)	Small (n=165)
Efforts to develop new products and services						
Budget specific costs for research and development	12.7	10.6	12.1	19.8	12.4	13
Has team for new product and service development	21.5	18.7	23.6	27.5	21.8	21.1
Investing in equipment required for new product and service development	35.7	37.6	32.7	33.6	38.1	32.4
No efforts	30.2	33.2	31.5	19.1	27.7	33.4
Number of patents for new products and services						
Share of total patents	11.7	9.6	13.9	15.3	12.1	11,0
Patents number, average	6.2	2.6	5.9	13.5	6.4	5.9
Patents number, maximum	55	13	20	55	55	50

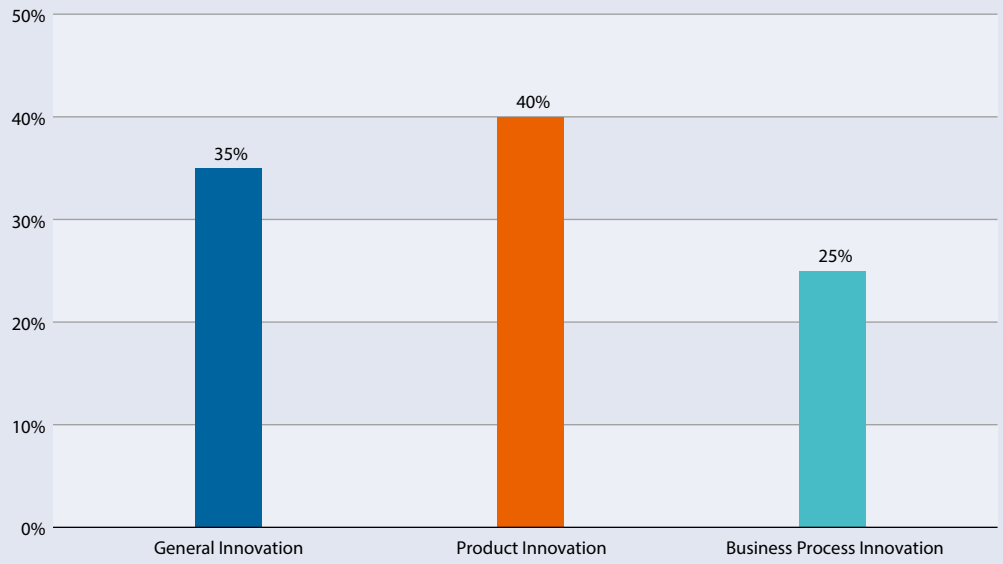
Source: (MongolBank, 2022b)

Since 2015, the main trends of newly established Mongolia SMEs have the following innovation structure:

- **General innovation:** 35% focused on new initiatives, innovation in new business structures and operations.
- **Product innovation:** 40% is focused on new product development and new product introduction.
- **Business process innovation:** 25% were innovations focused on process improvement, introduction of automation and digitization.

FIGURE 5

FOCUS OF INNOVATION IN NEW COMPANIES (SINCE 2015)



Source: (MongolBank, 2022b)

Over the past 10 years (2013–2023), Mongolia has focused on improving the productivity of SMEs, supporting public-private sector collaboration in innovation activities, and introducing new technologies and products.

TABLE 4

RESULTS OF SME PRODUCTIVITY AND INNOVATION ACTIVITIES

No.	Indicators	Difference	Explanation
1. Growth of SMEs' productivity			
1.1	Production volume	5–7%	Increased
1.2	Production efficiency	20–35%	Grew
1.3	Technological innovation	30–40%	New technologies and equipment introduced
2. Government supports and programs for SMEs			
2.1	Supporting financing	20–24 million USD	Financing for SMEs increased
2.2	Supporting programs	480 thousand USD	MNT1.2 billion allocated for innovation and development programs
2.3	SME Development Fund	1.2–2.0 million USD	MNT3–5 billion allocated to support SMEs in 2015–2020 years
3. Innovation activities and new products			
3.1	Organic products	15–20%	The number of SMEs producing organic food increased to 100–150 in 2020, and total production increased
3.2	New product innovation	20–30%	Developed new product and service innovations
4. Digitalization and e-commerce			
4.1	E-commerce	15–20%	Using an e-commerce platforms
4.2	Digitalization	200+	Using electronic payment systems and online shopping platforms
5. Green technology and sustainable production			
5.1	Green technology	15–20%	Solar energy and waste recycling technology have begun to be used.
5.2	Sustainable production	15–20%	We have moved towards producing environmentally friendly products and ecologically efficient production.
6. Growth of Export			
6.1	Export growth	20–25%	Organic food and innovative products from processing industries account for most of the export growth in 2020–2023
7. Workforce skills and productivity			
7.1	Workforce skills	1,000+	Over 1,000 SMEs participated in training to improve management and technical skills from 2015–2023
7.2	Workforce productivity	15–25%	As a result of the training, the productivity of the workforce of SMEs has increased.

Source: Reports of SME Department of Ministry of Industry and Trade; SME Development Fund of Ministry of Food, Agriculture and Light Industry (MOFALI); National Statistics Committee; Mongolian E-commerce Association; Mongolian Green Development Center, Ministry of Nature, Environment and Tourism; Mongolian Chamber of Commerce and Industry; General Department of Customs; Mongolian Business Development Center, Ministry of Labor.

POLICY INSTRUMENTS FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION OF SMES

Legal and Regulatory Environment for SMEs

"Vision 2050," Mongolia's long-term development policy document, has set Information Technology and Creative Production as one of the priority economic sectors and stated to support and to increase their contribution to the economy. Current policies and regulations are geared towards innovation and science technology research development with limited benefits for tech-based startups.

There are a number of laws in Mongolia regulating the operational environment for SMEs. Some laws have a direct impact on the business environment for SMEs and some others like the introduced Law on Investment (2013) seem to be of greater relevance for large corporate companies and/or foreign investors. Still, SMEs are indirectly impacted by changes in the business environment for large corporations as they are usually important buyers for SMEs. The following provides an overview of legislation directly and indirectly affecting SMEs:

TABLE 5

POLICY INSTRUMENTS TO SUPPORT ON SMES

Programs and laws	Ministry and Duration	Third parties	Policy type	Objectives and highlights
National program for supporting small and medium-sized enterprises and services	MOFALI 2022–2026	Fair Competition and Consumer Protection Department	supply-side	Clustering of SMEs and alignment with international standards. Support SMEs based on innovation and technology • Development of export-oriented SMEs in line with regional development. • Development of SMEs using advanced technology to replace imports by exports.
Cashmere Program	MOFALI 2018–2021	Ministry of Finance	supply-side	Improving the competitiveness of Mongolian cashmere products
National Innovation Program	MOECS, MOIT 2018–2025	Ministry of Finance	supply-side	Increase the competitiveness of SMEs by introducing innovative products and technologies. • Investing in research and development and expanding international cooperation.
Green Production Support Program	MOET 2023–2030	Eco-Business Development Center	demand-side	Supporting environmentally friendly and sustainable production
Law on Support of Small and Medium Enterprises	Since 2013	Government of Mongolia	systemic	Financial support for SMEs and improvement of competitiveness.
Law on Small and Medium Enterprises and Services Development Fund	Since 2014	Government of Mongolia	systemic	Providing financial support to SMEs.
Mongolian Law of Tax (revised)	Since 2019	Government of Mongolia	systemic	Provide tax relief to SMEs.

Note: MOECS, Ministry of Education, Culture and Science; MOET, Ministry of Environment and Tourism; MOIT, Ministry of Industry and Trade; MOFALI, Ministry of Food, Agriculture and Light Industry

The main government policy document for SME-related activities is the Law on Innovation (revised in 2019).

According to the Law, the Government has following duties:

- Develop and approve state policy and legislation on innovation,
- Approve innovation directions,
- Develop national innovation system and innovate, approve, and enforce laws and regulations,
- Approve and implement state budget investment and finances, and issue grants,
- Approve and implement regulation on park activities.

According to the Law on Innovation, the state's central administrative body in charge of high technology and national innovation development has following duties:

- Implement a policy to develop national innovation system;
- Develop a proposal on program, planning and finances to develop innovation priorities and national innovation system, submit it to the Government;
- Provide ministry, agency, province and capital city governor's office activities with general management;
- Implement a policy to provide correlation of stakeholders' partnership and operations in developing the innovation system;

An Overview of the National Program "Supporting Small and Medium Enterprises"

The Program aims to increase productivity by supporting small and medium-sized enterprises and increase jobs by improving competitiveness in the market, and it was approved by Government Resolution No. 156 of 2019. The implementation of the Program was organized at the national level through the "Supporting Small and Medium Enterprises" sub-program. During the implementation of the Program, the performance of monitoring and evaluation is 94.3% (SMEO, 2021).

According to the indicators and results of the Program, there are many positive outcomes such as the number of SMEs increasing by 11.5% compared to 2018, SMEs enrolling in incubators and support centers increasing by 61.0%, SMEs attending in training and seminars increasing by 22.0%, and branded products and services increasing four fold. Despite the positive outcomes, compared to the target level, the performance of new jobs created in the SME sector was 20.8% only, and the share of SMEs in exports was planned to be 5.3%, but with 2.5% as performance. The highlighted outcome of the Program was the increase of 20 enterprises that introduced innovative and environmentally friendly advanced techniques and new technologies.

Due to the poor coordination of scientific institutions, universities, and the private sector, the possibility of successfully engaging in production, trade, and services is limited. A few number of small and medium-sized enterprises meet quality and safety standards and produce internationally recognized products, but their competitiveness in international and regional markets is still weak.

TABLE 6

NATIONAL PROGRAM "SUPPORTING SMALL AND MEDIUM-SIZED ENTERPRISES" CRITERIA AND PERFORMANCE

No.	Indicators	Unit of measure	Basic level 2018	Target level 2020	Target level 2022	Performance	Percent
1	Active small and medium enterprises	number	62,330	64,900	67,600	69,500	100.0
2	Employee of small and medium industry sector (jobs to be created)	number	3,360	16,500	32,900	6,099	20.8
3	A small and medium-sized business owner enrolled in an incubator and support center	number	200	260	280	322	100
4	A small and medium-sized enterprise owner who attended training and seminars	number	9,527	10,400	11,600	11,689	100
5	Share of exports of small and medium enterprises	%	2,3	3,5	5,3	2,5	16.7
6	Branded products and services (locally created)	number	6	15	30	32	100
7	An enterprise that has introduced innovative and environmentally friendly advanced techniques and new technologies	%	0	5	20	20	100
8	Introduced international standard	ТОО	42	50	60	42	0
	Average						**58.8**

Note: ТОО, a Mongolian limited liability partnership

According to the observational study conducted by the MOFALI in the sector of small and medium-sized enterprises and the "Study on the Financing of Small and Medium-sized Enterprises" by the Bank of Mongolia, small and medium-sized enterprises considered that there is a need to improve public services, to create a favorable tax environment, to protect production, and to create a stable source of financing.

The "National program for supporting small and medium-sized enterprises" (hereinafter referred to as "the Program") was developed based on the Action Plan for the Implementation of the "2016–2020 Program of the Government of Mongolia," Section 2.48.3, "Revised the Implementation of the National Program to Support Small and Medium Enterprises," and "Law on Small and Medium Enterprises," Article 21.1, which state that "the program for supporting small and medium-sized enterprises shall be developed by the central administrative organization in charge of small and medium-sized enterprises and submitted to the Government for approval in accordance with the appropriate procedure."

Objectives of the Program

The goal of the Program is to increase productivity by supporting small and medium-sized enterprises and increase employment by improving market competitiveness. The following objectives will be implemented within the scope of the goal of the Program:

- To improve the legal environment for small and medium-sized enterprises;
- By improving financial and investment policies, reducing the interest rate and extending the term of loans granted to small and medium-sized enterprises, and increasing access to favorable financial conditions;
- To develop of the consulting services sector;
- By introducing intensive innovation and environmentally friendly techniques and technologies, increasing the productions that meet standard requirements, and improving competitiveness;
- Expanding market and supporting sales for small and medium-sized enterprises;
- To organize the "One Settlement-One Product" campaign, develop locally branded products, and increase the independence and creativity of small and medium-sized enterprises.

From the conclusions of the 2022 Report on the monitoring and evaluation conducted during the implementation of the Program

The implementation of activities included in the Program has created an economic and market environment for small and medium enterprises, improved the legal environment for providing finance, investment, consulting services, training, and increased the number of branded products and services that meet standard requirements.

The overall performance of the objectives and activities of the Program have been evaluated at 94.3% as of the third year. This is an increase of 4.3% compared to last year's evaluation. In the future, it is necessary to increase the funding of the Program and intensify the work specified within several objectives. In particular, the funding for activities aimed at implementing the national program of the MOFALI is very low.

The Program is in its third year of implementation and the target level of performance needs to be more than 70%. However, the indicators such as "Active small and medium enterprises," "Employees in the small and medium enterprise sector (new jobs created)," and "Share of small and medium enterprise exports" have been assessed as 16.7–33.0% insufficiently implemented, and have not reached the planned level. And the number of newly introduced international standards has not increased from the baseline, and have been evaluated as a zero score. It is advisable to improve these unimplemented and insufficiently implemented indicators, make planning activities, and calculate the indicators of the sub-plans, performance plans, and activities of the national program implementation.

The Program Implementation and Results

Introduction of Tumen shuvuut Joint Stock Company (JSC) involved to the National program to support SMEs

Tumen shuvuut JSC first started its operations in 2004. Since this time, the company has been engaged in poultry farming and supplying more than 30% of domestic egg production in Mongolia. In order to meet the needs of the poultry industry, the company is expanding its activities by engaging in the production of egg nests and animal feed with 100% investment from Mongolia, aiming to improve the quality of life with healthy ecological products.

Its poultry farming is located in its former Poultry Factory, and it owns a total of 18 hectares of land, has industrial buildings with an area of 13,000 m^2, and has a total of 350,000 egg-laying chickens, an incubator workshop with a capacity of raising 80,000 chicks at a time, brooding 153,600 eggs, and producing and selling 200,000 eggs per day. The company introduced modern technology, and it is a factory with fully automated equipment.

The company's work is characterized by the fact that 19 types of "Tumen" products prepared and supplied by its poultry farm are liked by consumers, in high demand, and reach consumers as fresh.

TABLE 7

DEVELOPMENT OF TUMEN SHUVUUT JSC

Year	Development
2004	Established and started
2013	Best of the country and Asia Pacific
2015	"Agro Feed" feed factory was established (MNT4.2 billion)
2017	Manufacturer of user-friendly products
2017	The Award "Best Product Manufacturer"
2019	Became an open joint-stock company
2022	Expanded feed mills with soft loans (MNT4.0 billion)
2023	Net profit increased by 58%

► **Feed production:**

In 2015 to meet the needs of poultry farming, the fully automatic "Agro Feed" feed factory equipped with equipment from the world's leading American "FAMSUN" group, with the capacity to produce 100 tons of complete ingredients per day for chickens and animals, with an investment of MNT4.2 billion soft loans was commissioned.

As a result, the company produces not only chicken feed based on scientific achievements, but also horse power feed and animal mineral supplements adapted to the characteristics of own country's livestock.

The feed plant has an accredited laboratory for analyzing the quality of raw materials and feed, 90% of its operations are automated, and it has a storage and bunker capacity to store 8,000 tons of feed and raw materials according to its procedures, and it is fully equipped with central energy.

The "Agro Feed" complete feed plant has the advantage of having the technology of mixing animal feed with full automatic adjustment and precision of thousandths.

The factory imports the main feed raw materials such as wheat, barley, bran, nettle, grass flour, rapeseed oil, vegetable oil, salt, and corn, soybeans, essential amino acids, and vitamin supplements from abroad. Five types of feed for young birds and laying hens, and six types of animal feed have been successfully introduced to the market.

► Edible egg production

- **Nursing eggs:** According to the MNS 92-77 standard (Mongolian National Standard), the eggs used for food within seven days after laying eggs are called "Nursing eggs." Because it is used as a fresh food, nursing fresh eggs are 96% absorbed by the human body.
- **Health Package:** Special feature eggs with iodine, selenium, and Omega-3, that are made by adding these elements to the feed of laying hens and increasing the content in the eggs. These eggs help compensate for the lack of iodine, selenium, and Omega-3 in the diet of Mongolians.
- **Eggs for breakfast:** The researchers concluded that the best starting point for a day's meal for the human body is to consume protein foods. For a healthy start to the morning, it's heavier than a standard egg, has more protein, and typically has two yolks.

► Fertilizer production

Using its bird droppings composition (pH: 6.0–7.5%, Phosphorus: 2.5–4.0%, Nitrogen: 2.5–4.2%, Potassium: 2.5–3.0%), Mongolian quality and 100% Japanese-standard compostable organic product was produced at the Fertilizer Factory of Tumen Shuvuut JSC by Japanese technology.

Capital growth and efficiency of Tumen Shuvuut JSC

- In the first IPO of 2019 on the Mongolian Stock Exchange, Tumen Shuvuut JSC offered 25% of the total shares or 50,000,000 shares to the public.
- 2,991 individuals and companies participated in the initial market order of shares offered to the public by Tumen Suvuut JSC, and a total of 54,575,195 purchase orders were submitted, which exceeded the amount offered to the public by 9.1%.
- For Tumen Shuvuut JSC, the net profit at the end of 2023 reached MNT11.7 billion, an increase of 58% compared to the previous year, while the sales revenue increased by 37% or MNT16.9 billion from the previous year.
- The return on equity increased by six points and the share price decreased by four points.
- On average, 32% of net profit is distributed annually as dividends.
- Total assets increased by 30% and reached MNT68.3 billion, and 68% of the total assets are equity and 32% are liabilities.
- As the accumulated profit increased by 1.4 times, the amount of equity reached MNT46.2 billion, growth of 25%.

An Overview of the Cashmere Program

According to the 2017 data of the National Statistics Committee, 12% of the total cashmere stock is fully processed, and the production of this sector accounts for 2.3% of the industry, 7% of the processing industry, and 55% of the light industry. In 2017, 5,409.7 tons of washed cashmere, 571.4 tons of combed cashmere, and 915.6 thousand pieces of knitted clothes were produced. Ninety percent of the total raw material resources are processed in primary form, and 10% are manufactured into final products such as textiles and knitwear, which are exported domestically and abroad.

During the raw material preparation season, i.e. in March and April of each year, when cashmere end-product factories lack working capital to purchase raw materials, foreign traders come to our country to buy good quality raw materials in cash, pay very low taxes, and export raw materials without export taxes. More than 80% is still being exported without adding any value. Due to this, domestic industries are running out of raw materials and are using only 40–60% of their installed capacity, which affects the wages of employees, and the number of students in the field tends to decrease year by year. Today, there is a need for more than 1,000 engineers, technicians and 3,000 specialized employees in the cashmere industry of our country, but in the last five years, on average, 40–50 engineers and less than 10 specialized employees have been trained annually.

The Cashmere Program was developed in order to solve the above-mentioned problems, to develop cashmere production techniques and technologies, to increase the variety and production of final products, and to support exports.

Objectives of the Cashmere Program:
The aim is to increase the level of complete processing of cashmere to 60%, increase the production and export of environmentally friendly final products, and improve the international competitiveness of cashmere products.

TABLE 8

THE OBJECTIVES AND RESULTS OF THE CASHMERE PROGRAM

Objectives of the program	Results of program implementation
Creating a favorable and stable legal, investment and tax environment necessary to increase the production and export of final products;	- Conditions for soft loans and investment support for the cashmere sector have improved - The range of services provided by professional associations has increased.
Improving a breeding of goats and preparation of raw materials, and the quality of cashmere;	It has an internationally recognized testing and research institute.
Step-by-step improvement of the full processing level of cashmere and increase the production and export of products;	The level of complete processing of raw materials will be increased to 60% by providing optimal tax and financial support to enterprises producing final products.
Introduce environmentally friendly advanced techniques and technologies into production and develop friendly and competitive products targeted at the market segments;	- The production of spun yarn will increase by 3–3.5 times - "Mongoliin Khaan Shirkhegt," a quality mark, has created environmentally friendly and competitive products with a quality certificate and introduced them to the domestic and foreign markets.
Increase production productivity by training and specializing the human resources of the industry based on demand and requirements.	More than 5,000 jobs in the cashmere sector have been stably preserved, more than 3,600 new jobs have been created, and the production and export of final products has increased 5.7 times.

TABLE 9

PROGRAM IMPLEMENTATION AND INDICATORS

No.	Indicator	Unit of measure	Baseline (2017)	Target level (2021)	Level achieved	Performance
1.	Export of washed cashmere	ton	5,409.7	2,632	6,026.8	111%*
2.	Export of combed cashmere	ton	571.4	1,579	424.0	27%
3.	In the production of knitwear	thous.	915.6	2,200	1,285.0	58%
4.	Number of jobs (permanent)	person	5,582	9,110	10,055	110%

Note: * The export of washed cashew was set to decrease by 46%, but it increased by 111%. Thous., thousands.

From the conclusions of the 2022 Report on the monitoring and evaluation conducted during the implementation of the Cashmere Program

The overall average of the performance assessment of the Cashmere Program was 83.4%, or "Achieved significant results." The implementation of the national program's results, criteria, and monitoring results was 32.2%, or insufficient. While the volume of washed cashmere was planned to be reduced two fold, the export volume increased by the end of the program. However, the volume of combed cashmere exports was planned to increase four fold, but it decreased from the baseline. The production of knitted products reached 28.8% of the target level, and the number of new permanent jobs created under the program reached 10,055, fully meeting the target level. With the policy support of the Ministry of Food, Agriculture and Light Industry and the signing of an agreement with the Mongolian Development Bank which provided MNT103.9 billion of interest-free loans to 44 enterprises for cashmere processing in 2020. Within the framework of the "10-Year Comprehensive Plan to Protect Health and Revitalize the Economy," MNT94.9 billion worth of loans was provided to 38 enterprises for cashmere processing in 2021. The level of complete processing of raw materials in the cashmere processing sector (measured by spinning capacity) increased by 36.5% compared to the base year to 2,628 tons. The following tangible supports were also provided.

- SMEs were supported through training in order to meet quality standards and improve raw material processing efficiency.
- In cooperation with herders, recommendations were made to improve the quality of cashmere and a sustainable supply chain was established.
- A campaign was launched to promote Mongolian cashmere products in the international market, and the export volume of the products was increased.
- The sustainable development of the cashmere industry has been supported by the introduction of environmentally friendly and low-waste production methods.
- The products produced by SMEs were joined into the sales chain of Evseg LLC and allowed to enter the market.

Cashmere Program Implementation and Results

Introduction of Evseg Cashmere LLC, involved in the Cashmere Program

> We continue to aim to create the best wool cashmere brand in Mongolia and to introduce Mongolian cashmere to the world market, and today we have expanded to become the second-ranked company in the sector in Mongolia. In terms of history, it has been 40 years since our foundation, and 20 years since Evseg brand products have been on the market. Currently, Evseg LLC has more than 800 employees, 70–80% of whom are women. The most important value of Evseg is that the company's shares are owned by its own employees, it is a domestic company without foreign investment. In other words, employees invest in themselves. The advantage of the company's policy is to increase labor productivity by supporting and training the young people working in-house rather than hiring new people from outside. It is also the company's value and pride that when the factory was forced to shut down during the pandemic, it was aware of its responsibility to ensure the livelihood of its employees and provided them with regular wages. Evseg colleagues have the right attitude, there are people who want to work hard and live by their own power. I personally believe that success will come if you are dedicated to the work you have started. Our employees also believe in labor.
>
> From the interview of Mr. Bayarbat.N, CEO of Evseg LLC

Evseg LLC opened and operated "Evseg factory store" in 2005 in cooperation with the German architectural team in order to provide its customers with the opportunity to choose the color and style of products in a comfortable environment. expanding to local chain stores and reaching consumers. Evseg brand products have gained a reputation as 100% Mongolian cashmere products and "organic" products.

Since 49% of the company's shares are owned by the company's employees, the company's team is expanding its activities and working with one goal to improve results, making construction with its own resources, and its success is increasing.

The feature of the product that is expected to be appreciated by the consumers is that Mongolian goat cashmere and camel wool, which are raw materials of the homeland, are processed with high-quality European auxiliary materials and sophisticated technology, and are created by highly professional workers, engineers and designers.

The company supplies a variety of sewn, woven and knitted products made in Mongolia with Mongolian goat cashmere and camel wool. Growing into a major national company in the wool cashmere industry.

The team of Evseg LLC, with the mission "We will fully process Mongolian goat cashmere and camel wool, the precious raw materials of our country, and by constantly improving our techniques and technology, we will produce competitive and value-added products in the foreign and domestic markets, and contribute to the development and progress of our country by increasing the profit and income of our community." In 2018, the company inaugurated a new Evseg brand knitting factory.

TABLE 10

DEVELOPMENT OF EVSEG LLC

Year	Development history
1981	A spinning mill was established
2000	Evseg LLC was established
2000	A program to introduce environmentally friendly production was implemented
2005	International ISO 9001 quality management system has been implemented
2005	Evseg factory store was opened
2010	Awarded as the "Best Exporting Organization of Mongolia."
2015	Successfully introduced the product to the European market
2017	A new knitting factory of the Evseg brand was opened
2018	Received the GRAND PRIX award of the "Goyol" festival
2019	"Mongoliin Khaan Shirkhegt" a quality mark indicating that the quality standards of knitted and woven products have been accepted
2020	Awarded the "Best National Manufacturer" award.
2022	Technological innovation and production of cashmere products have been expanded
2023	Established new partnerships and increased sales in the Asian market

Note: ISO, International Standard Organization

The factory which is equipped with more than 300 pieces of equipment, including the latest fully automatic knitting and sock knitting machines from Germany's "Stoll" and Japan's "Shima-Seiki" and high productivity Italian "Conti complett" sewing machines, has the capacity to produce 530,000 pieces of knitted products per year and manufactures products that meet the needs of consumers. After the factory was put into operation, the Evseg brand doubled its knitting capacity and increased its processing capacity by 2.4 times, creating more than 300 new jobs.

In connection with the installation of new equipment and technology, the company's programmers, designers, and technologists were qualified in Japan and Germany, and 11 employees were educated at universities with the company's support.

In this way, building a new factory and increasing the capacity of the factory can be considered as a major investment in the knitting industry based on obtaining working capital loans and increasing profits within the framework of the Cashmere Program implemented by the Government of Mongolia.

In addition to putting the new factory into operation, the shop next to the factory has been expanded twice as the area of 1,500 m^2 to provide a comfortable and wide selection environment for the customers. Also, in 2018, by installing embroidery and printing equipment, we started to produce knitted, stitched, printed shawls and knitted products with classic and avant-garde patterns and embroidery.

In addition to supplying the domestic market, company's products are sold in Russia, Italy, Switzerland, Germany, England, Japan, and Kazakhstan, and every year, taxes of at least MNT2.5 billion are collected in the state budget.

As a result of the work of designers and tailors of the brand, they participated in international fashion exhibitions and fashion shows in Italy, Japan, and China.

THE EFFECT OF POLICIES TO IMPROVE THE COMPANY'S TECHNOLOGICAL CAPABILITIES

The two selected companies were surveyed in the form of questionnaires and interviews about how they improved their productivity and quality by introducing innovations and new technologies by taking soft loans under the Program and the Cashmere Program. Government policies have a relatively positive effect on improving the innovation capabilities of these companies. However, when examining the policy impact on improving firms' technological capabilities and innovation-related activities is different (Table 11)

The impact assessment of the government's policies, the Program and the Cashmere Program was clearly answered by the administration of Tumen Shuvuut and Evseg LLC in question 8 of the "Survey on the Technological Capability and Productivity of SMEs": "If you have participated in any of the above supports, how do you think it has affected your company's productivity, efficiency, research, and innovation activities?"

TABLE 11

TECHNOLOGICAL CAPABILITIES OF COMPANIES IMPACT OF POLICY ON IMPROVEMENT

Influence	Tumen Shuvuut JSC	Evseg LLC
Increase investment in R&D	**	**
Product innovation	***	***
Business process renew and innovation	***	**
Improving the management system by introducing R&D or innovation	**	***
Update product production inputs and resources	***	**
Export existing products to more demanding/profitable markets	*	***
New product diversification	**	**
New market segments	**	***
Improving the position in the value chain	***	**
A matter of technological sophistication	***	**

Source: Author
Note: In terms of impact level:*-weak degree of influence, **-moderate degree, ***-good influence are indicated by symbols. R&D, research and development.

The survey results obtained from SMEs

A total of 17, hereof small (6), medium (8), and micro (3) enterprises were not very satisfied with the support provided by the government regarding how government policies and support affected companies' strategy, research and development, innovation, and productivity improvement activities. (Table 12.)

TABLE 12

COMPANIES SURVEYED ABOUT GOVERNMENT POLICIES

No.	Companies	Employees number	Year established	Sector of production	Type
1	Uransentii LLC	4	2015	Light	Micro
2	Huchu Agro LLC	7	2017	Food	Small
3	Organic Food Trade LLC	8	2013	Food	Small
4	Teneger Altan toosgo LLC	25	2011	Light	Medium
5	Bayan Harzag LLC	10	2011	Agriculture	Small
6	Shine Ajin LLC	2	2015	Agriculture	Micro
7	Azkhuu LLC	5	2005	Agriculture	Medium
8	Top car LLC	6	2023	Light	Micro
9	Ensada Traktron LLC	37	2010	Agriculture	Medium
10	Uguuj flour LLC	65	1997	Food	Medium
11	Evseg Cashmere LLC	800	1981	Light	Medium
12	Tumen Shuvuut LLC	290	2004	Food	Medium
13	Chanadman Shireet LLC	10	2008	Agriculture	Medium
14	APU JSC	650	1924	Food	Medium
15	Mongolian Ecological Fertilizer LLC	8	2013	Agriculture	Small
16	Nomadic felting LLC	5	2015	Light	Small
17	LISH LLC	3	2000	Light	Small

FIGURE 6

SECTORS OF ACTIVITY OF COMPANIES

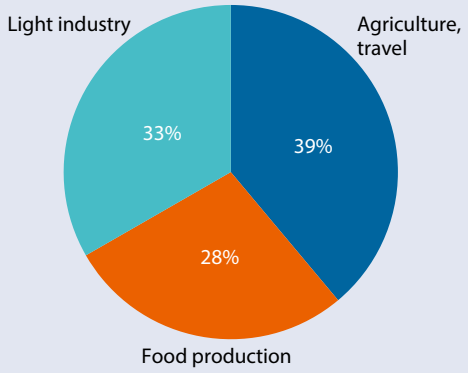
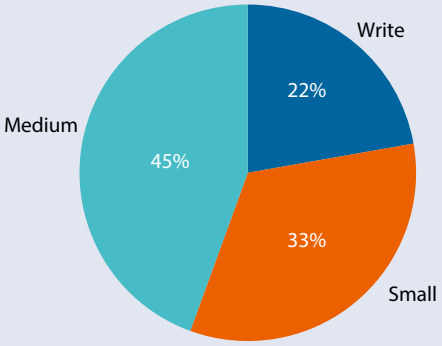


FIGURE 7

TYPE OF COMPANIES SMES



The respondents expressed doubts about whether the productivity of SMEs receiving financial support and soft loans from the government is improving in all aspects, and they especially disagree with the assumption that there is improving on the progress in research, development, and innovation activities. The number of specialized personnel is not increasing as a result of the policies and support implemented by the government. In other words, the human resources such as specialized technicians, engineers, researchers, technologists, designers, etc. that can create innovations, conduct research and development, increase technological capabilities, and improve labor productivity are not being created.

TABLE 13

SMES' ASSESSMENT OF GOVERNMENT POLICY SUPPORT

No.	Indicator	Evaluation	Meaning
1	The productivity of the company has improved in all aspects	3.07	Doubtful
2	The company's labor productivity has improved	2.83	Doubtful
3	The company's technological capabilities have improved	3.00	Doubtful
4	The company's financial resources and capabilities have improved	2.83	Doubtful
5	Research and innovation activities have progressed	1.78	Disagree
6	Increased investment in research, development and innovation	1.71	Disagree
7	A management team and system with the ability to make research-based decisions has been formed	2.22	Disagree
7.1	As a result of the policy support implemented by the government, the number of specialized personnel has been increased	2.11	Disagree
7.2	The number of specialized technicians and engineers has increased	2.35	Disagree
7.3	Professional researchers and experts were hired	1.77	Disagree
8	Professional technologists and designers were hired	2.00	Disagree
8	As a result of state support, training for specialists was organized on a larger scale than before	1.93	Disagree
9	Labor productivity improved by organizing training	2.40	Disagree
10	They are satisfied with the support provided by the government	2.50	Disagree

Note: Rating: "1- Do not agree at all, 2- Disagree, 3- Doubt, 4- Agree, 5- Agree very well"

In order to evaluate the national policy implemented to improve the technological capabilities and productivity of SMEs and its outcomes, a survey consisting of 12 main and 10 sub-questions was conducted with 17 enterprises and manufacturers. Question 8 of this survey asked, "How do you think the government support has affected your company's productivity, efficiency, research and innovation activities?" and asked for an assessment of 10 indicators. (Table 13)

According to the survey results of the SMEs and enterprises that participated in the survey, the average score of the above 10 indicators was 2.3 points, or disagreement. This indicates that they disagree that the company's productivity and technological capabilities have improved, and they especially disagree that there has been progress in research, development and innovation activities. As an example, the results of a detailed study and interview on the impact of government policies on the technological capabilities of Tumen Shuvuut JSC and Evseg LLC, which were included in the study, were found to have a "moderate" impact. (Table 11)

The impact of government policies on the above two enterprises, which are leading SMEs operating in Mongolia to a certain extent, is "moderate," which confirms that the results of government support for other normally operating SMEs are not sufficiently satisfactory.

The responses of the enterprises participating in the survey to question 12 "Please share your opinions on what policies and regulations the government should implement to improve the technological capabilities and productivity of SMEs" are summarized as follows:

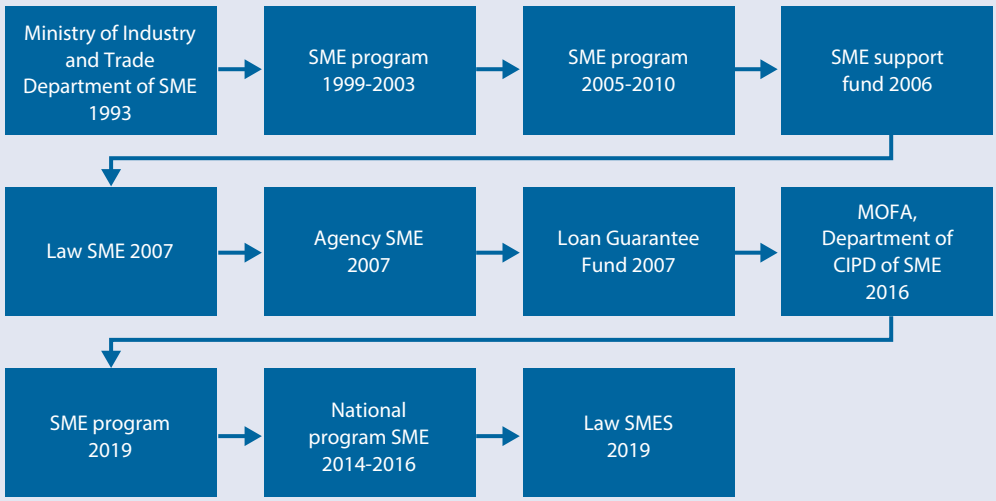
- Providing tax and value added tax (VAT) relief, financing support for purchase of working capital and equipment;
- Training of qualified professional staff/providing conditions for education and training of specialized staff, foreign and domestic professional development, improvement of university curriculum, preparation of new graduates for jobs
- To support the introduction of new technologies with expert consulting services, and to have integrated information on human resources
- Implementation of optimal subsidy policy in the agricultural sector, sales support (export).
- An enterprise that is starting a startup business loses a lot of opportunities due to lack of collateral when applying for a loan.

INSTITUTIONS AFFECTING EFFECTIVENESS OF POLICIES

In Mongolia, the SME Department was first established in 1993 under the Ministry of Production and Trade, and since then, the SME support program has been implemented since 1999. However, in 2007, the Law on Small and Medium Enterprises was approved, and policies and main directions for SMEs were established. In 2008, the Government's implementing agency, the Department of Small and Medium Enterprises, was established, and the Small and Medium Enterprises Development Fund was established in 2009. The government approved the "Program for supporting small and medium industries (2014–2016)" in 2014. Within the framework of the Program, 2016 was declared as the "Year of Supporting Domestic Production and Sales," and certain policies and activities were implemented to improve the competitiveness of SMEs and increase employment. The Government Resolution No. 156 approved the "National Program for Small and Medium Enterprises Support 2019–2022" in 2019 (MongolBank, 2018)

FIGURE 8

DEVELOPMENT OF SMALL AND MEDIUM INDUSTRY



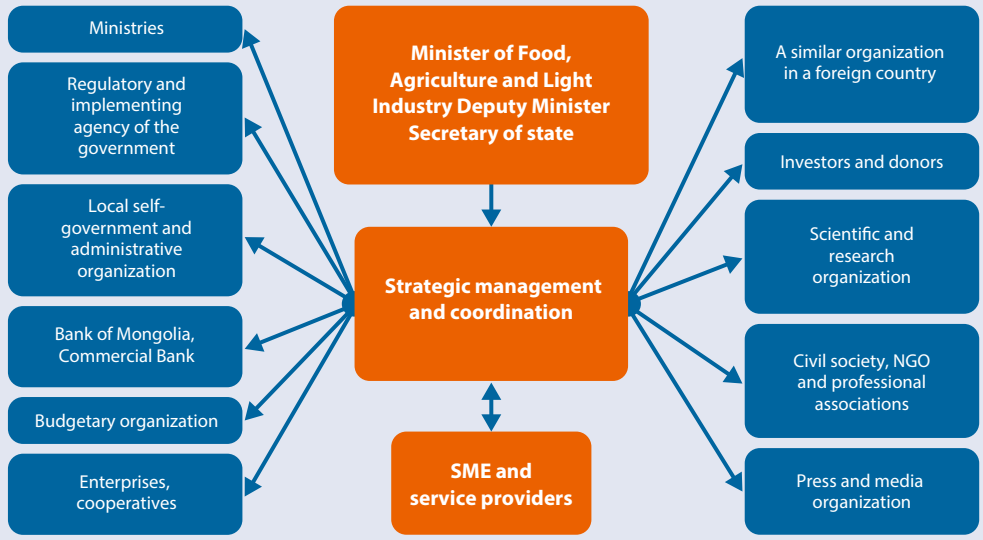
Source: (Asian Development Bank Institute, 2016)

The two main programs, the National Program for Supporting SMEs and the National Innovation Program, are aimed at increasing the capacity of enterprises to improve productivity, innovation, and technology in the SME sector of Mongolia. These supply-side policy documents aim to support innovation and new technology investment by reducing the costs of enterprises. The fact that these two programs are emphasized in the policy documents in this research report is that, among the many policy documents implemented in Mongolia, they are more closely related to the sector and their results can be measured in terms of SME development indicators. They are also emphasized in the report because the Law on Supporting Small and Medium Enterprises, the Law on Innovation, and the Law on Taxation regulate legal relations at the system level. Although the SME sector is operating within the framework of the above policy and legal documents, there is still no clear progress in the development level of the economy, society, labor market, and enterprises.

The strategic management and regulation of small and medium-sized enterprises is aimed at the implementation of various types of relationships related to meeting the above-mentioned needs and requirements and the demands of the main customers or consumers within the framework of relevant laws and regulations. The scope, type and form of services to meet the needs of strategic management and regulation of small and medium-sized enterprises have been determined for each need and requirement, and have been implemented in the operational strategies of the organizational structural units of the department and the job descriptions of employees, respectively (Figure 9).

FIGURE 9

STRATEGIC MANAGEMENT AND COORDINATION OF SMES



The main department that ensures the implementation of SME development policies through cross-sectoral coordination is the Small and Medium Enterprises Agency. The agency works in line with the policies of the MOFALI to ensure the implementation of sector development policies, conduct research and analysis, create jobs for medium-sized enterprises and service providers, provide soft loans and financial support aimed at replacing imports and increasing exports, provide technical assistance, provide consulting services, support the development of new products and services based on innovation in clusters, properly manage, organize and spend the funds of the Small and Medium Enterprises Development Fund, implement internal control over operations, and support the expansion of foreign cooperation.

The policies and programs are too government-regulated or dominated by supply-side policies, so the effort and initiative and collective participation of enterprises is weak. Therefore, the enterprises participating in the study expressed the need to implement national programs and projects with demand-side policies in the field of SMEs. In the future, it is necessary to have enterprises evaluate national programs and legal documents, and have external evaluations of monitoring, analysis, and evaluation (M&E) activities.

The effort and initiative of stakeholders (Figure 10) to provide strategic guidance and build relationships with SMEs is crucial. This requires a more transparent and SME-friendly governance system that involves collaboration between government ministries and agencies, local authorities, commercial banks, and budgetary institutions. The majority of SMEs surveyed are in need of financial support and loans, but they face obstacles ranging from unclear government agencies to commercial bank eligibility requirements. The common problem faced by the enterprises participating in the study and the Tumen Shuvuut and Evseg LLCs that received adequate support from the SME Fund is that the research and development capacity or human resources to ensure sustainable development of investments in innovation and new technologies are still insufficient, so they refuse to invest in this area.

The institutional framework governing SME support in Mongolia is characterized by fragmentation and inefficiencies. Multiple agencies with overlapping mandates lead to a lack of coordinated policy implementation. Additionally, inconsistent regulatory environments and weak enforcement mechanisms create uncertainties (International Finance Corporation, 2015). Moreover, the absence of a unified database on SMEs results in inconsistent and fragmented statistics, complicating policy formulation and the provision of targeted support. This data deficiency hampers the government's ability to design effective interventions to bolster the SME sector (Asian Development Bank Institute, 2019).

In recent years, the implementation of government policies and programs to support business such as the Food Revolution, the White Revolution, the New Cooperative Movement, and the Billion Tree National Movement has stimulated enterprises, but has also created negative consequences for their ability to develop according to the principles of market competition and has led to a shift towards excessive social assistance. The following section will clearly outline suggestions for improving the productivity of SMEs on how to avoid this.

CONCLUSION AND POLICY RECOMMENDATIONS

General Recommendation

In Mongolia, SMEs provide 80% of the total employment and 5.5% of the GDP, which means that the sector's economic efficiency, labor productivity, technology and innovation are insufficient. The government approved many policies and legal documents to improve the competitiveness and productivity of SMEs, but the monitoring and evaluation system that creates a policy feedback loop does not meet the requirements of developing a balanced policy.

In order to increase the productivity of SMEs, it is believed that (i) introducing policy reforms and innovations aimed at increasing the productivity of low-productivity sectors such as agriculture and the public sector, (ii) making structural changes in information and communication technology and similar sectors that can create high productivity as below.

1. Adjust the supply and demand of labor to reach conditions for the creation of many highly productive jobs for the young and educated workforce, and on the other hand, increase the capacity of human resources by improving the skills of workers in those sectors;
2. Resolve barriers to structural reform and innovation, such as inadequacy of infrastructure and unequal taxation, through direct investment, grants, and tax incentives, and increase investment in research and scientific sector.
3. In cases where the cost of creating new innovations is high, it is possible to take actions to import foreign advanced technologies to Mongolia and introduce their techniques and experiences.

A comprehensive policy approach is needed to increase the competitiveness of SMEs, human resources development, science parks, business incubators, technology acquisition, information and communication technology needs.

The Mongolian small and medium industry is lagging other countries in the world in terms of research and technological capabilities, and further improvement is effective. The following policy recommendations are proposed based on the institutional issues and policy recommendations for solving the problems faced by the SME sector in Asia and the Pacific and the results of this research. It includes:

1) Adopting a comprehensive science and technology development policy to support innovation;
2) Providing financial support from the government to SMEs, as well as other key stakeholders such as science, research, technology transfer and commercialization;
3) Development of institutional network, coordination, capacity and infrastructure (science and technology park), national innovation system;
4) Supporting open market policy to increase access to finance or technology outsourcing and technology transfer for SMEs;
5) Improving the capacity of human resources by organizing training by establishing business and technology incubation centers.

Recommendations from governors within the framework of the national program to support SMEs

The SME support programs of the major national manufacturers in the light and food industry of Mongolia are important for supporting the sustainable development of the food, agriculture and light industry sectors. In order to further increase access, improving the policy based on the suggestions of the participants will help the growth of SMEs.

- The financing for the implementation of the national program "Supporting Small and Medium Enterprises" needs to be increased on state and local budget.
- The MOFALI and the Department of SMEs need to cooperate with relevant organizations to include the investment of the SME Development Fund and the Cooperative Development Fund in the establishment of factories for small and medium enterprises, the establishment of innovation-based technologies, and the development of clusters in preferential loan support and provide a policy for training qualified personnel who will work supporting small and medium enterprises.
- The support of the Department of SMEs is required to encourage private investment by introducing advanced techniques and technologies, develop sales and transport and logistics networks, and to intensify the work of including SME products by category in official statistical data and creating a unified electronic database.
- When reporting the results of the national program by "aimag" (Province) and "soum" (Sub-Province), the clarification by local and special funds, private sector, and project financing is needed. It is necessary to clearly report the results of the activities implemented and the reasons for the activities not implemented.

Suggestions and recommendations from entrepreneurs in the SME sector

- Since the SMEs support program is not accessible, bring it closer to the rural and local communities, constantly evaluate the effectiveness, and make reforms based on the opinions and needs of the participants during the implementation process.
- Create a one-stop place for manufacturing consulting services and technology solutions for SMEs through the implementation of a business incubator program.
- Strengthen cooperation with herders and farmers and support the supply of raw materials and infrastructure needed by SMEs.
- Ease loan requirements and guarantee conditions for SMEs, set up guarantee funds and provide access to loans to a wider range of manufacturers
- Provide interest rate concessions for loans to SMEs, especially more support for producers from vulnerable groups.
- Establish a loan repayment schedule suitable for agricultural and seasonal activities.
- Provide financing for the modernization of equipment and machinery for SMEs operating in rural areas.
- Actively participate in the expansion of domestic and foreign markets for the sale of SME products, and open additional sales channels.
- Develop an online platform for SMEs and help them market their products.
- Improve cooperation with the Development Bank and organize activities to provide working capital loan support to producers before the cashmere preparation period;
- Work with the National Statistics Committee to obtain real statistical information and establish a unified database on the small and medium industry;

REFERENCES

Asian Development Bank Institute (2016) *Technology and Innovation Policies for Small and Medium-Sized Enterprises*. Tokyo: Asian Development Bank Institute.

Asian Development Bank Institute (2019) *LEVERAGING SME FINANCE THROUGH VALUE CHAINS IN THE CAREC LANDLOCKED ECONOMIES: CASE OF MONGOLIA*. Tokyo: Asian Development Bank Institute.

APO (2023) *Productivity Databook*. Tokyo: Keio University Press.

International Finance Corporation (2015) *SMEs and Women-owned SMEs in Mongolia*. Washington: International Finance Corporation.

MongolBank (2018) *The proceeding of research works*. Ulaanbaatar.

MongolBank (2022a) *Proceedings: Small and Medium Industry Development and Financial Conditions*. Ulaanbaatar.

MongolBank (2022b) *The development and financing of SME*. Ulaanbaatar.

SME Department (2022) *MONITORING-ANALYSIS AND EVALUATION REPORT OF THE IMPLEMENTATION PROCESS OF THE NATIONAL PROGRAM TO SUPPORT SMALL AND MEDIUM INDUSTRIES*. Ulaanbaatar: MOFALI.

Small and Medium Enterprises Agency (2021) "*National program Small and Medium Industry*." Ulaanbaatar: MOFALI.

State Great Khural (2016) *CURRENT STATUS OF POLICY AND LEGISLATION OF SMALL AND MEDIUM INDUSTRY DEVELOPMENT IN MONGOLIA: CHALLENGES AND PROBLEMS*. Ulaanbaatar.

USAID (2024) *Mongolian SMEs competitiveness survey*. Ulaanbaatar: Development Solution NGO.

APPENDIX 1

LIST OF ORGANIZATIONS AND COMPANIES INTERVIEWED

Organizations and Companies	Interviewed person and Date	Staff number	Interviewed issues
Policy Coordination Department of the SME Department	Head Gerelzaya, A. 15 Oct 2024	12	Policies and results implemented by the SME Department
Huchu Agro LLC	Bartsadgui, S. Director 26 Dec 2024	7	Regarding the availability of projects and programs to support SMEs
Organic Food Trade LLC	Director 23 Oct 2024	8	Benefits and results of soft loans
Ensada Traktron LLC	Boldsaikhan, U. Director 28 Oct 2024	37	SME support policies and implementation
Ugуuj flour LLC	Khulan, B. Director of Sales 30 Nov 2024	65	Benefits and results of soft loans
Evseg Cashmere LLC	Bayarbat, N., CEO 29 Nov 2024	800	Brand development, soft loan results of the Cashmere Program
Tumen Shuvuut LLC	Erkhembayar, L. Chairman of the Board of Directors 20 Nov 2024	290	Expanded feed mills with soft loans (MNT4.0 billion)
Nomadic felting LLC	Aldarmaa, Z. Director 30 Oct 2024	5	Benefits and results of soft loans of SME supporting fund

PAKISTAN

INTRODUCTION

Economies that implement policies supporting technology, R&D, and innovation experience higher productivity. In Pakistan many SMEs are working to adopt new technologies, improve processes, and innovate to stay competitive in the markets, but the overall pace and depth of technological advancement are varied across sectors and regions. The three highest sectors that have adopted technology are textiles & apparel,[1] agriculture & food processing[2] and light engineering & manufacturing.[3] The export-oriented SMEs are increasingly engaged in product and process innovations by developing unique and high-quality products e.g., organic textiles, premium leather goods, and advanced sports equipment. However, the level of innovation varies, with limited R&D capacity among many SMEs due to high costs and lack of technical expertise. Additionally, there is a rising trend in digital adoption of urban areas SMEs especially after COVID-19, e.g., e-commerce, digital marketing and online business management, but again these SMEs face challenges like low digital literacy, lack of infrastructure, limited internet access especially in remote areas, access to affordable financing, high-interest rates and limited funding options prevent many from upgrading their machinery or investing in new software (Ali, 2018; Raza et al., 2018; and Aftab et al., 2021).[4]

The government of Pakistan, primarily through Public Sector Development Programme (PSDP) initiatives, has established Common Facility Centers (CFCs) across various sectors by involving organizations such as the Small and Medium Enterprise Development Authority (SMEDA)[5] and the Technology Upgradation and Skill Development Company (TUSDEC).[6] These centers provide SMEs with access to shared resources like modern machinery and training. Moreover, the following organizations (1 till 7), through public-private partnerships and international collaborations, play a critical role in supporting SMEs by fostering innovation, facilitating technology adoption, and driving value addition in various industries (See Table A of appendix).

1. Ministry of Science and Technology (MoST)
2. Ministry of Industries and Production (MoIP)
3. Pakistan Academy of Sciences
4. Pakistan Council for Science and Technology
5. Pakistan Innovation Foundation
6. Pakistan Industrial Technical Assistance Center
7. Pakistan Technical and Educational Council

1 Such as investing in automated weaving, stitching, and dyeing equipment to meet international quality standards. Yet, some segments, particularly smaller businesses, still rely on manual processes.
2 There is growing use of mechanized farming, greenhouse technology, and modern packaging methods. However, limited access to advanced machinery and tech tool remains a barrier for many SMEs, particularly in rural areas.
3 Such as surgical instruments, sports goods, and automotive parts which have shown improved technological capabilities. For example, many surgical instrument manufacturers in Sialkot use precision engineering equipment, and some have implemented enterprise resource planning (ERP) systems for inventory and process management. But, due to resource constraints, many SMEs in this sector still lag in adopting advanced manufacturing technologies like CNC (computer numerical control) machines and 3D printing.
4 Other than literature review information has been provided by some stakeholders during interviews.
5 https://smeda.org/
6 https://tusdec.org.pk/

All of these organizations have implemented a range of projects for key industrial sectors supported by the government of Pakistan, national and international donors. Their key roles include promoting R&D, providing access to technology, establishing technology incubators and parks, facilitating standards and certifications, supporting value addition, financing and policy support, digital transformation, networking and market linkages, knowledge dissemination and awareness and finally fostering industry-academia linkages etc.

In Pakistan, the number of SMEs and their breakdown of economic contribution data can be compared in 2007 and 2021. For details see Table 1.

TABLE 1

KEY CONTRIBUTION OF PAKISTANI SMES

SMEs of Pakistan	2007	2021
Total number of SMEs	3.2 million	5.2 million
As percentage of total businesses	99%	90%
share in industrial employment	78%	80%
share in value addition	28%	35%
manufacturing exports earning	25%	25%
contribution to GDP	over 30%	40%
exports value	PKR140 Billion	30% of total exports value
Employment Status	87% employee less than 5 people & 98% employ less than 10 people	

Source: 2007 and 2021 SME Policy of Pakistan (Ministry of Industries & Production, 2021, 2007)

The global economy has significantly transformed due to technological advancements. Pakistan, during its technological transformation journey foster the startup ecosystem and for that the incubation centers (ICs) have played a pivotal role. Although the startup ecosystem of Pakistan is relatively young, it holds great promise. Despite facing resource constraints, startups are making profits, showcasing the potential of Pakistan's entrepreneurial talent, particularly among its large youth population. The primary objective of these incubation centers is to drive economic development through job creation, fostering innovation, encouraging a risk-taking mindset and empowering female entrepreneurs. The ICs in Pakistan provide crucial support to startups such as office space, mentorship, access to funding, networking opportunities, business training and services. However, ICs in Pakistan face some major challenges such as limited funding, lack of quality mentorship from experienced industry professionals, bureaucratic hurdles in government led initiatives and low commercialization of research ideas. By addressing these challenges, the effectiveness of ICs in Pakistan could be enhanced to foster a more vigorous startup ecosystem (Mahmood et al., 2017; Hafeez et al., 2021).

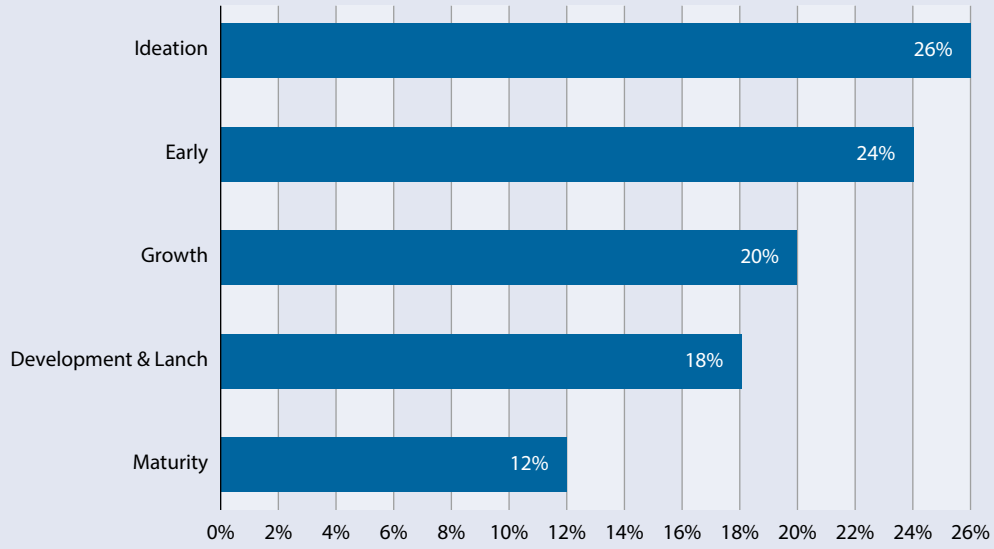
The support infrastructure for startups has been evolving since 2000 but got power in 2012 when the government started funding for incubation programs and the Punjab Information Technology Board (PITB) launched Plan9 (first major startup incubator) and this growth accelerated in 2016 with the launch of National Incubation Centers (NICs) under national ICT R&D fund now named "Ignite – National Technology Fund which was established in 2006" work under Ministry of

Information Technology and Telecommunication (MoITT). To promote entrepreneurship further the Higher Education Commission (HEC) established the Office of Research Innovation and Commercialization (ORIC) and Business Incubation Centers (BICs) in 2010 within universities that have strong ORIC under the framework of BIC Policy 2021. Furthermore, in 2024, National Incubation Center for Aerospace (NICAT) hosted first ever Meta LIama Pitchathan in the Asia Pacific region showcasing AI innovation. Collectively these startups have created more than 126,000 jobs, upraised USD79 million, revenue produced around USD50 million. The most prominent accelerator of Jazz company, i.e., xIr8, has mentored over 25 startups and enabled PKR1.4 billion in investment and PRK543 million in revenues. Likewise, Telenor Velocity by Telenor company has graduated 42 startups securing investments of USD44,000 and raised USD6.5 million. From the viewpoint of private and philanthropic organizations like Azad Chaiwala and Saylani International Welfare Trust also focusing on skill development in demanding areas like programming, digital marketing and graphic designing in order to empower freelancers. Pakistani freelancers generated USD350 million in 2023–24 making 40% year on year increase. Finally, from the perspective of global support, Facebook and WhatsApp connected with State Bank of Pakistan (SBP) to empower 500 women entrepreneurs via the "SheMeansBusiness" program launched in 2018. So far, this initiative has trained around 9000 women for digital economy. Likewise, Google maintained a strong presence in Pakistan via Google Developer Groups and developer student clubs, offering courses, events and talks on technological development. So far, over one hundred thousand developers in Pakistan benefited from these programs (UNDP, 2024).

Figure 1 shows the contribution of incubation centers (ICs) during the life stages of startups. It is evident that both ideation and early-stage startups benefited more from the support of ICs.

FIGURE 1

STARTUP LIFECYCLE STAGES SUPPORTED BY ICS



Source: PSER 2024, ESO Survey (Invest2Innovate, 2024)

Broadly speaking there are six different types of incubation centers (ICs) in Pakistan as shown in Table 2.

TABLE 2

CATEGORIES OF ICS IN PAKISTAN

1	University-Based Incubation Centers known as Business Incubation Centers (BICs)	The Higher Education Commission (HEC) provide funds for the creation of BICs in public sector universities to offer basic infrastructure and associated facilities for students and faculty interested in developing early-stage business ventures.
2	Government-Led Incubation Centers known as National Incubation Centers (NICs)	NICs are supported by Ignite and MoITT to promote economic growth across Pakistan. There are eight NICs all over Pakistan. NICs supported more than 1300 startups and more than 600 graduated. Plan9 got 4000 startup applications and successfully incubated 130 ventures.
3	Private Sector and Corporate Incubation Centers	These are established by companies and private sector organizations to promote innovation align with their business goals such as Jazz xlr8 (Jazz Pakistan) and Telenor Velocity (Telenor Pakistan).
4	Technology and Industry-Specific Incubation Centers	These ICs focus only on specific sector startups such as IT, agriculture, or fintech e.g., NIC Karachi (focus on Fintech and IoT) and Arfa Software Technology Park in Lahore.
5	NGO-Driven Incubation Centers	Such ICs are run by non-governmental organizations in order to encourage entrepreneurship of underserved areas or to create social impact e.g., Karandaaz Pakistan who focus on financial inclusion of females and conduct women entrepreneurship development program.
6	Accelerators and Hybrid Models	This model offers very fast tract programs for startups to grow in a short period by combining incubation and acceleration elements such as Nest I/O (Karachi) and LUMS center for entrepreneurship (LCE), Lahore.

Source: Author compilation from data provided by ICs.

With the consistent efforts of all types of ICs by now there exits a nation-wide network of innovation hubs. The overall aim of ICs is to provide jobs for graduates instead of job seekers. The process of selection in ICs start with application submission from entrepreneurs or startups. On average, out of 800 applications, around 40 startups get shortlisted and 50% shortlisted for BICs get admitted in NICs. The application includes information details about the business idea, team, market potential, revenue model, and scalability. After an initial screening from a committee of ICs to ensure the incubation center's need, the pitching session is conducted by ICs. Later on, evaluation and assessment by an evaluation panel is completed. And then, based on one-on-one interviews, final selection is done. Startups sign an agreement with the ICs for one year. They are provided with resources, including office space, mentorship, networking opportunities, and rarely access to funding, depending on the center's offerings. Startup progress is monitored through periodic reviews and evaluations. Most famous ICs of Pakistan in terms of productivity are National Incubation Centers, Plan9, LUMS Centre for Entrepreneurship, Invest2Innovate, Jumpstart Pakistan and The Foundation and P@sha Technology incubation center. The progress of BICs established by HEC can be seen in Table 3.

TABLE 3

PROGRESS OF HEC INITIATIVES FOR STARTUPS – 2024 DATA

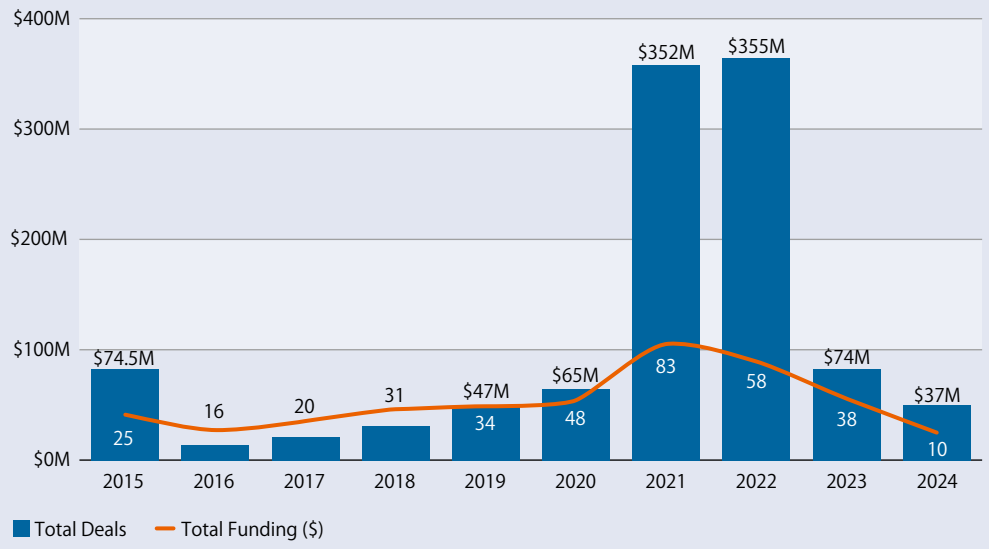
No. of ORIC	89
No. of BICs	41
No. of startups incubated	573
Faculty startups as spin offs	160
Students/Alumni startups	881
Funding secured for faculty/student/alumni startup by BIC	186
Funding secured by faculty/student/alumni startup	211
Venture capitalist/Angel investment/seed funding secured by startups	172
Availability of seed funding opportunities for startups	222
Incubations training programs/course for startups	352
Industries/stakeholders/mentors/corporate partners for startups	573
Professional links (MOU) by BIC/startup	845
No. of University awareness seminars	571
No. of participation of faculty in training workshops	538
No. of trainings/workshops/seminars	553
Entrepreneurial course for startups/ university students	181

Source: HEC (n.d.)
Note: MOU; memorandum of understanding.

Figure 2 shows the trend of startup funding in Pakistan. The key fund-raising barrier for startups is the lack of providing the necessary information (UNDP, 2024).

FIGURE 2

TOTAL STARTUP FUNDING IN PAKISTAN, 2014–2024

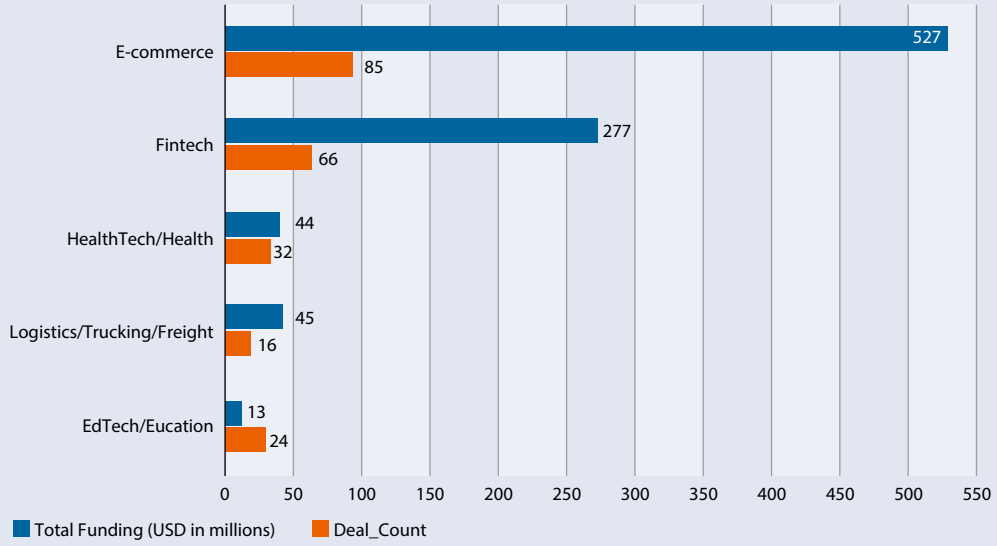


Source: Invest2Innovate (2021, 2022, 2024b)

The major decline in startups funding during 2023 onward is associated with the Pakistan's ongoing challenges such as political instability, high inflation, currency devaluation, high policy rate etc. The major sectors of showing growth among startups include e-commerce (revenue expected to reach USD6.7 billion by 2029), logistics and mobility as shown in Figure 3.

FIGURE 3

TOP FUNDED SECTORS, 2014–2024



Source: Deal Flow Tracker (Invest2Innovate, 2024b)

First Industrial National Innovation Survey 2024

The First Industrial National Innovation Survey 2024 conducted by the Pakistan Council for Science and Technology (PCST) during 2021–2022 covering the three-year period, i.e., 2018–2020, shows the current state of innovation within Pakistan's industrial sector such as information about innovative practices, challenges, and opportunities confronted by Pakistani industries presenting the role of R&D, technology adoption, and policy agendas in motivating industrial growth. This is the first-ever national-level industrial innovation survey in Pakistan. The sample of this survey includes 5000 manufacturing units of Pakistan. All given figures (Fig 4 till Fig 14 have been directly taken from this innovation survey).

The innovation rate has been calculated using given formula.

FIGURE A

FORMULA OF INNOVATION RATE

$$\text{Innovation rate} = \frac{\text{Number of innovation–active firms in a group (industry size/province/sector etc.)}}{\text{Total number of surveyed firms in the concerned group (industry size/province/sector etc.)}} * 100$$

Out of the total population of 20,752 large size manufacturing industrial units across four provinces and capital of Pakistan, the sample of 5000 units included in the survey and considers only those units with 10 or more employees (see below for details).

FIGURE 4-1

NUMBER OF INDUSTRIES

Province/ Territory	Total Manufacturing Units
Punjab	14,309
Sindh	4,421
KPK	1,592
Balochistan	162
Islamabad	268
Total Industries	20,752

FIGURE 4-2

NUMBER OF EMPLOYEES

Industry Size	Number of Employees
Small	10 to 50
Medium	51 to 250
Large	Above 250

FIGURE 4-3

IMPACT OF INNOVATION ON FIRM PERFORMANCE

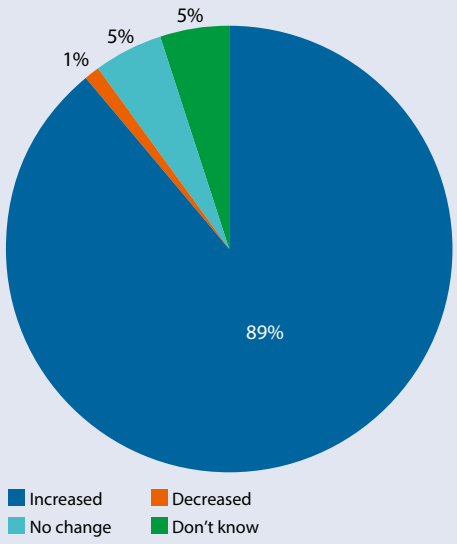


FIGURE 5

TYPE OF INNOVATION ACTIVITY

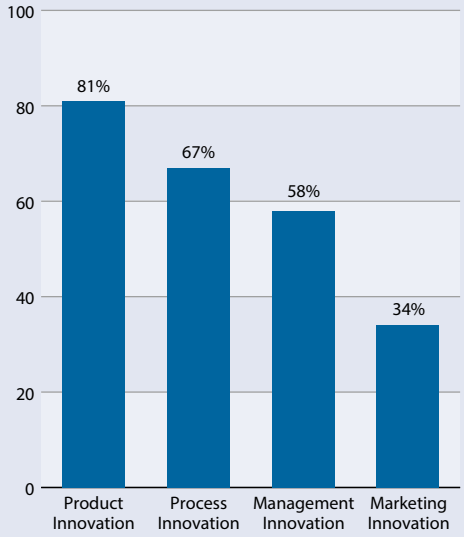


FIGURE 6

UTILIZATION OF VARIOUS SOURCES OF INFORMATION FOR INNOVATION

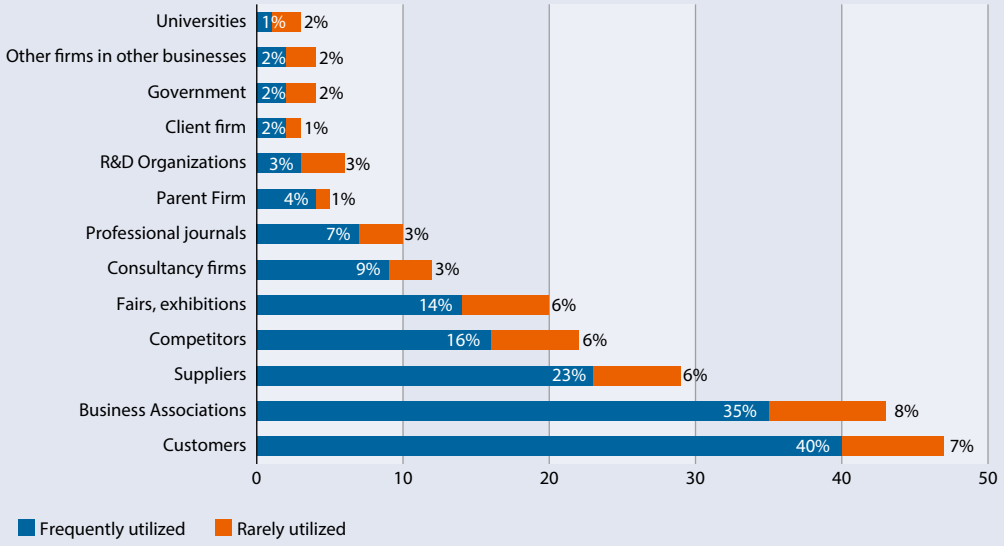


FIGURE 7

FIRMS USING COLLABORATION FOR INNOVATION

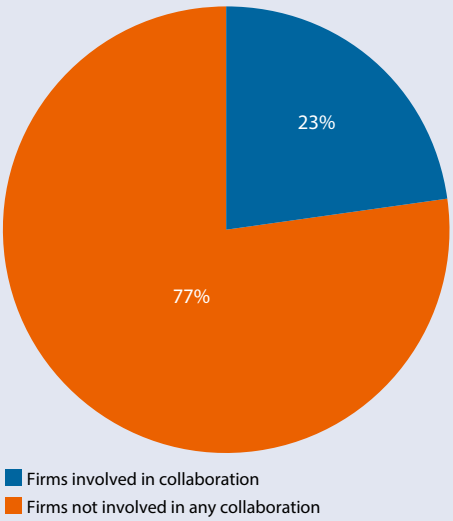


FIGURE 8

FIRMS HAVING R&D UNIT

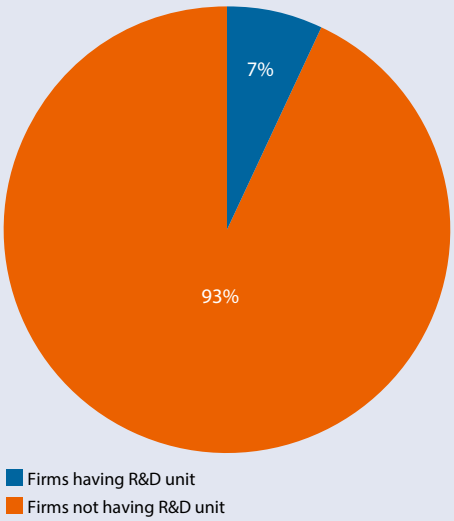


FIGURE 9

MOTIVATION FOR UNDERTAKING INNOVATION BY FIRMS

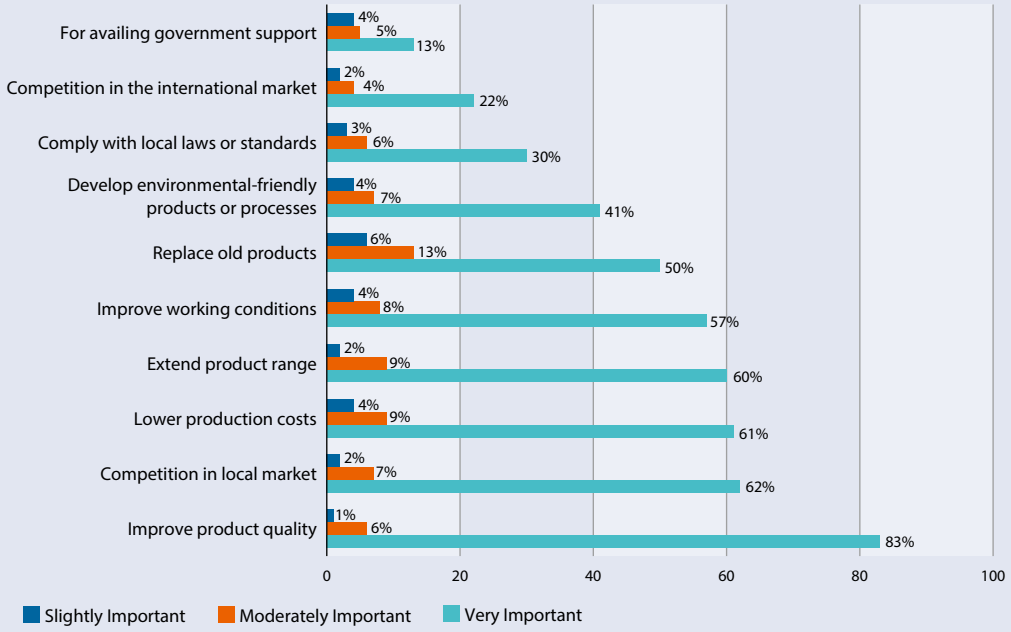


FIGURE 10

NUMBER OF FIRMS SPENDING ON R&D

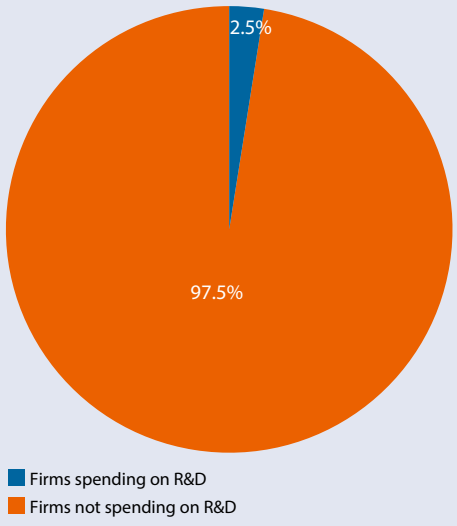


FIGURE 11

NUMBER OF FIRMS HIRING SCIENTISTS/ ENGINEERS

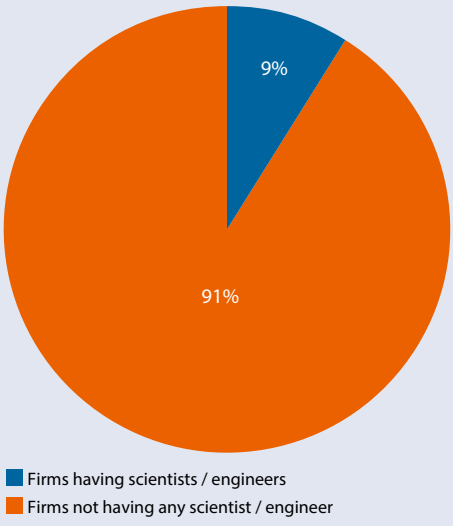


FIGURE 12
BARRIERS TO INNOVATION

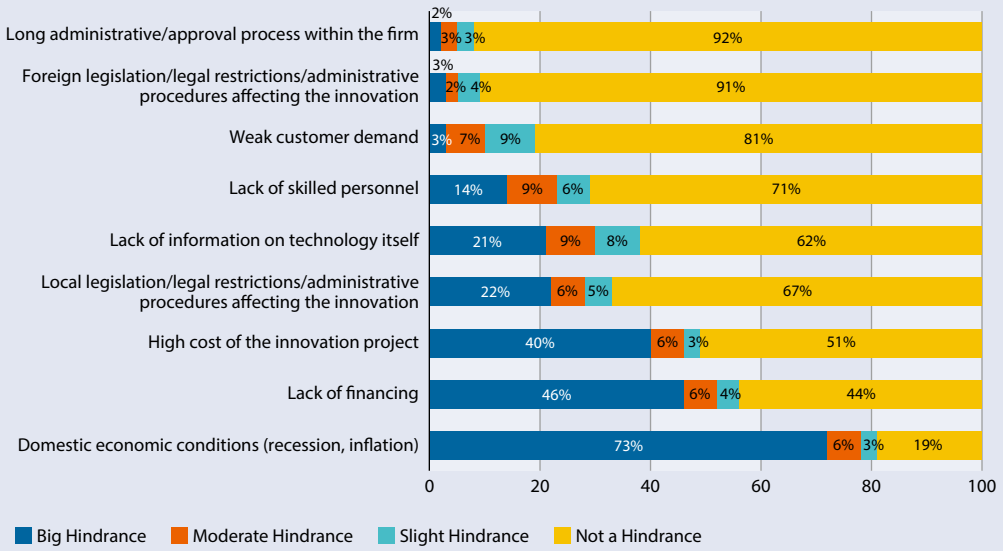


FIGURE 13
GOVERNMENT SUPPORT FOR INNOVATION

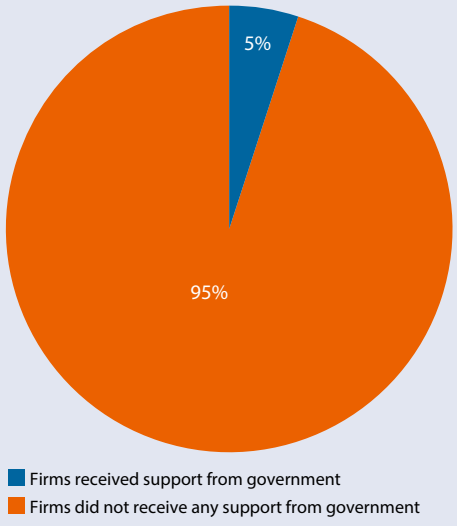
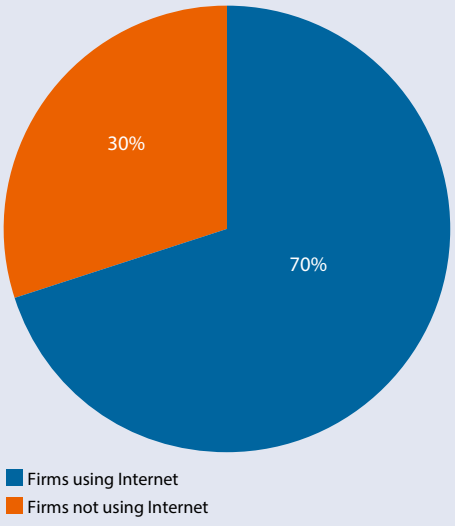


FIGURE 14
USE OF INTERNET



Following Table 4 provides a summary of key findings.

TABLE 4

KEY FINDINGS OF THE PCST INNOVATION SURVEY 2024

- Twenty-seven percent, i.e., 1352 firms out of 5000, found to be active in innovation.
- Public Listed Companies has the highest innovation rate (81%), followed by Public Unlisted Companies (58%), Private Limited Companies (43%) and Partnerships (21%). The lowest level of innovation rate (16%) was observed in the firms with Individual Ownership.
- Higher innovation rate was observed in the older firms as compared to younger firms.
- Islamabad Capital Territory was the forerunner with respect to rate of innovation activities (70%), followed by Sindh (40%), Balochistan (26%), Punjab (25%) and Khyber Pakhtunkhwa (7%).
- Large sized firms have the highest innovation rate (85%) as compared to medium (50%) and small sized firms (13%).
- Firms operating in international markets were more engaged in innovation activities as compared to firms focusing on domestic market.
- Transport Equipment (75%), Pharmaceuticals, Tobacco, Wearing Apparel, Motor Vehicles sectors were relatively more innovation active while, Repair & Installation of Machinery was the least active sector in innovation (30%).
- The most important factor for innovation is product quality (83%) followed by competition in local markets (62%), lower production costs (61%), extended product range (60%), improving working conditions (57%) and the least important factor is availing government support which is 13%.
- The highest barrier for innovation is domestic economic conditions (recession, inflation) reported by 73%, followed by lack of financing (46%), high cost of innovation projects (40%), while long administrative/approval process within the firm (3%) is the least impeding barrier for innovation.
- Firms operating at international level see more innovation (42%) than the ones operating at national level (25%).
- Large firms were slightly more focused on process innovation (30%) than product innovation (28%). While medium and small firms active in innovation were relatively more focused on product innovation than process innovation.
- Public Ltd Companies (listed) have process innovation as the top priority while firms with the other forms of ownership were more focused on product innovation.
- Marketing innovation was the lowest priority of firms across provinces, industry sizes, industrial sectors and of varying ownership status
- Among the firms which undertook innovation activities in collaboration with other stakeholders, most collaborated with the Suppliers, followed by Consulting & Marketing Firms and Customers.
- Customers was the most preferred choice as collaborator for the small sized firms, followed by Suppliers and Consulting & Marketing Firms.
- In general, a higher percentage of older firms had R&D units than the younger firms.
- Firms located in Islamabad Capital Territory have the highest percentage of firms with R&D units, followed by Sindh, Punjab, Khyber Pakhtunkhwa and Balochistan.
- Pharmaceuticals, Medicinal Chemical & Botanical Products sector was the most R&D intensive sector with about 57% firms having R&D units, followed by Tobacco Products and Chemicals & Chemical Products sectors.
- A much higher percentage (23%) of large firms had employed scientists / engineers than the medium sized firms and small sized firms, where 11% and 7%, firms, respectively, had employed scientists / engineers.
- In general, 'subsidies' and 'tax rebates' were the first and second most frequently received form of government support for innovation across firm sizes, legal status of ownership and various industrial sectors.
- A vast majority of the Internet-using firms (i.e., more than 88%), were using it to access Social Media applications, closely followed by Email (87%) and Web Searching (83%). Internet-use was very low for the purposes of Advertising (33%) and Marketing (35%).
- Higher percentage of innovation-active firms (42%) were engaged in export than innovation inactive firms (25%).

Regulations Overview

Overall, the innovation sector of Pakistan operates under multi-layered regulatory framework which causes added challenges. MoITT provides policy direction and oversees its initiatives (e.g., MoITT spent PKR18.718 billion to establish two major IT parks) and is currently working to introduce 5G technology in Pakistan. Furthermore, MoITT introduced the Pakistan Cloud First Policy (PCFP) in 2022 in collaboration with Amazon and Google to transition all federal public sector entities to cloud-based digital services and data management. It mandates a cloud-first approach for new technology investment to improve efficiency and modernization. The Security and Exchange Commission of Pakistan (SECP) provide a legal framework for technology startups and has made numerous amendments in its 2017 Companies Act to support startups. SECP also put forward guidelines for corporate cloud adoption. The State Bank of Pakistan (SBP) manages policies affecting foreign investment and fund repatriation in the tech sector. Moreover, SBP engages in initiatives towards the digital financial services space during 2019, facilitating fintech startups through electronic money institution licenses distribution in 2019, followed by payment system operator (PSO) licenses, the Instant Payment System (RASST) launched in 2021, digital retail banking licensing and extension of RAAST from person-to-merchant transactions as notable initiatives. In early 2022, a digital banking framework was announced to foster innovation in financial technologies. The Federal Board of Revenue (FBR) administers technology-specific tax regulations. Digital infrastructure and services are managed by the National Database and Registration Authority (NADRA) and Pakistan Telecommunication Authority (PTA). The Ministry of Commerce (MOC) introduced the E-commerce policy in 2019 to accelerate e-commerce growth which resulted in 910 e-commerce entities registered in 2023. New registration has doubled from 14 thousand in 2018 to 17 thousand in 2023. The IT and software development sector are the forefront, contributing more than 3600 new registrations in 2023. Moreover, seven new funds under venture capital (VC) regulations in 2022 managing PKR8.4 billion in assets indicating a growing maturity of Pakistan's startup investment landscape (UNDP, 2024).

Pakistan investment framework permits profits and capital repatriation through formal banking channels but practical implementation remains tough involving cumbersome approval that delays repatriations especially during periods of economic uncertainty. The Board of Investment (BOI) offers tax incentives and special economic zones. The disconnect between policy intent and actual investment flows highlights deeper structural issues including bureaucratic inefficiencies, political instability and need for streamlined mechanisms to facilitate capital movement. VC companies and funds enjoy tax exemptions till June 30, 2025. Certified startups also receive a 100% tax credit under the income tax ordinance for the year of their approval and the following two years. Also, VC funds benefit from a decade-long tax exemption on dividend income and long-term capital gains from investments in designated zone enterprises. Startups operating as zone enterprises are also eligible for a ten-year tax exemption from the date of their license approval. SECP issues guidelines for digital investment platforms for licensed investment and securities advisors. Insufficient institutional capacity to uphold civil rights, e.g., IPR laws, exist in Pakistan but low public awareness and inadequate execution of intellectual property rights (IPR) are the main hindrances (UNDP, 2024).

From above discussion it can be concluded that there have been several efforts in terms of policies and laws introduced for digital adoption in Pakistan by federal government and provincial governments for the different federating units of Pakistan. The list of laws, policies, and regulations introduced by the Pakistan

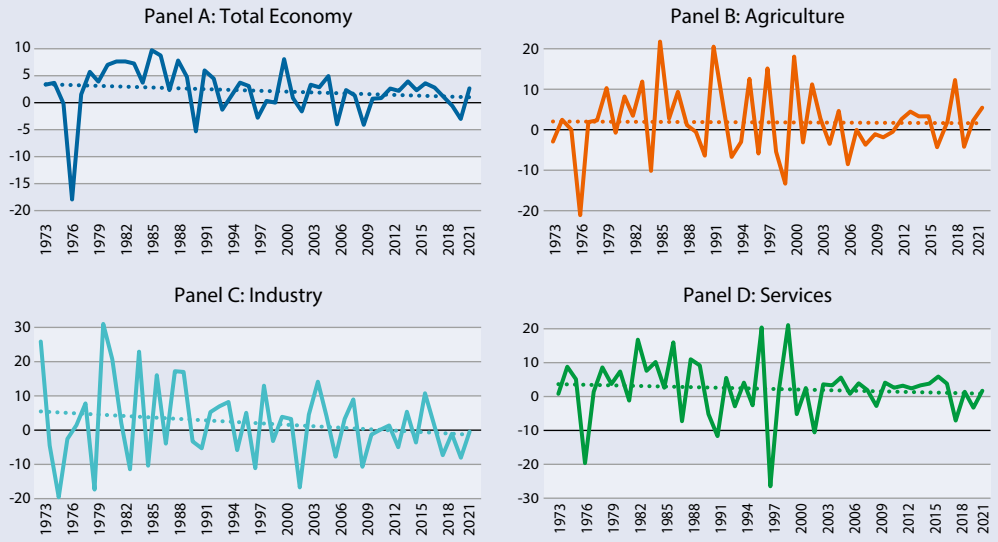
government to enhance/streamline digitalization in the country over the last three decades starting from 1991 to 2024 is given in Appendix Table A.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION

Pakistan faces a scarcity of skilled labor, largely due to limitations in technical and vocational education. These include outdated curricula, insufficient capacity in training institutions, a lack of relevant courses, and a disconnect between education and job market needs. While many firms offer in-house training to apprentices, workers often leave for better-paying opportunities once their training is complete. Pakistan predominantly relies on outdated technology across various sectors. In the manufacturing sector, a major user of technology, productivity is declining due to very slow adoption of modern technologies, which is largely attributed to ineffective management practices (APO, 2023).

FIGURE 15

LABOR PRODUCTIVITY GROWTH BASED ON EMPLOYMENT (%)



Source: Reproduced from APO study for Pakistan (APO, 2023)

Figure 15 illustrates a downward trend in employment-based LP growth from 1972 to 2021 across the overall economy and both in industrial and services sectors. However, the agriculture sector depicts a flat trend indicating the lowest average employment-based LP growth, at just 2%. The findings suggest that in Pakistan, the decline in LP was not driven by reduced working hours or a drop in employment but rather by diminished demand, which caused GDP growth to decline. Figure 15 shows LP estimated as output per unit of employed labor, whereas Table 5 shows LP estimated as output per hour worked.

TABLE 5

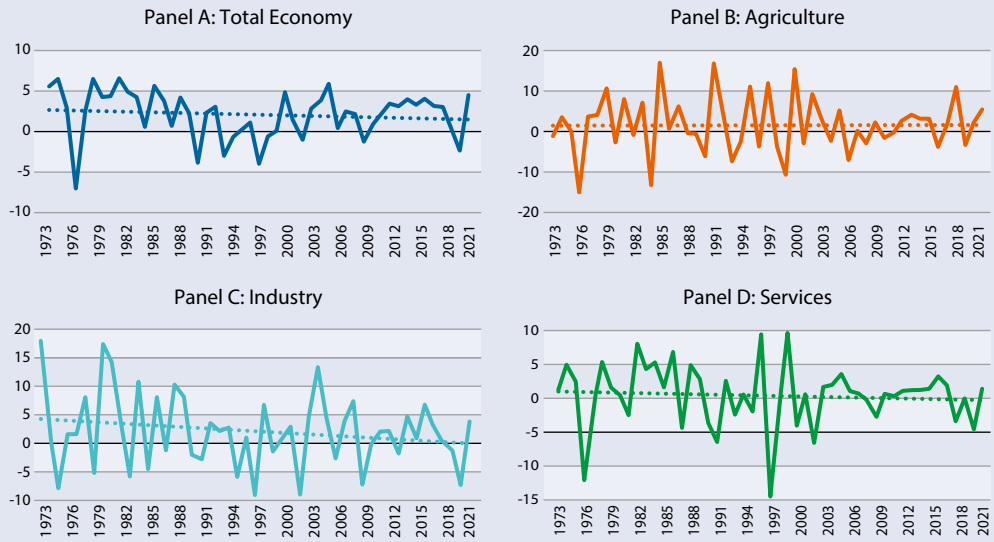
LABOR PRODUCTIVITY BASED ON HOURS WORKED (PKR/LABOR HOUR WORKED)

Sectors	2015	2018	2021
Agriculture	141.81	175.63	170.03
Services	316.01	388.21	413.57
Industry	199.19	240.07	224.00
Total Economy	221.68	277.10	277.62

Source: Reproduced from APO study for Pakistan (APO, 2023)

FIGURE 16

TOTAL FACTOR PRODUCTIVITY GROWTH (%)



Source: Reproduced from APO study for Pakistan (APO, 2023)

The trend in TFP growth mirrors that of LP growth, as shown in Figure 15. TFP growth exhibits a downward trend across the overall economy, as well as in the industrial and services sectors, while remaining flat in the agricultural sector. Like LP growth, TFP growth also declined in 2020, highlighting a drop in productivity and overall economic growth in Pakistan.

Pakistan ranks 91st among the 133 economies according to its innovation capabilities (WIPO, 2024) while its ranks was 87 out of 132 countries during 2022 and 69 out of 131 during 2007–08. The main reason behind low innovation is that innovation and risk taking have traditionally been restrained in Pakistan due to the invasive role of government in the marketplace. This caused the business sector to develop by exploiting rent-seeking rather than entrepreneurship (Nouman et al., 2009).

R&D expenditure in Pakistan remains significantly low, accounting for just 0.2% of GDP in 2019 (lowest among its comparator countries). Key factors contributing to this low R&D and innovation include policy inefficiencies, weak academia-industry collaboration, and inadequate protection of intellectual property rights, among other challenges (WIPO, 2024). The following Table 6 gives information on the parameters of Global Competitiveness Index (GCI) of Pakistan in comparison with other countries.

TABLE 6

COMPARING GCI PARAMETERS, 2014–15

Parameters	GCI 2015-15 Score (Scale of 1-7, 1 = very poor, 7 = very good)							
	Pakistan	PRC	India	ROK	Malaysia	Turkiye	USA	UK
Technological readiness	2.8	3.5	2.8	5.4	4.2	4.3	5.8	6.3
Capacity for innovation	4	4.2	4	4.7	5.2	3.7	5.9	5.3
Higher education and training	2.8	4.4	3.9	5.4	4.8	4.7	5.8	5.5
Availability of scientists and engineers	4.3	4.4	4.4	4.4	5.2	4.2	5.3	5.2
University and industry collaboration in R&D	3.2	4.4	3.9	4.6	5.3	3.7	5.8	5.7
Company spending on R&D	2.9	4.3	3.8	4.5	4.9	2.9	5.5	4.8
Quality of scientific research institutions	3.4	4.3	4	5	5.2	3.9	6.1	6.3
Overall ranking	129	28	71	26	20	45	3	9

Source: World Economic Forum (2014)

Evaluation of Policy Effectiveness in Enhancing SMEs' Productivity and Innovation

In Pakistan, a holistic approach has been used while making most of the policies to stimulate SMEs productivity and innovation meaning these policies are the combination of demand-side and supply-side policies as well as covering systematic policy measures by adopting the approach of thematic areas.[7] Therefore, under one policy, the focus on the following has been adopted: supply-side measures (i.e., capacity building, access to finance, regulatory reforms, infrastructure support and technology & innovation improvement etc.); demand-side measures (i.e., business development services, market Linkages and export promotion etc.); and systematic measures (i.e., formation of coordination committees). In this regard the two key policies regarding SMEs are given in Table 7. However, other than SMEs 2007 and 2021 policies, a few other very important supply-side polices have also been mentioned in given table.

7 For example, the SME Policy 2007 covers a few thematic areas that are related to supply-side measures and a few demand-side measures as well as formation of coronation committees, indicating the systematic measures.

TABLE 7

KEY POLICY MEASURES AND THEIR PARAMETERS

Supply-Side Policies					
Policy Name	**Policy Focus**	**Year**	**Responsible Agency**	**Targeted Sector/Technology**	**Evaluation**
SME Policy	Access to finance, improving infrastructure, technology transfer, and regulatory reforms.	2007	SMEDA	High-potential and labor-intensive industries such as Textiles & Apparel, Leather & Footwear, Light Engineering & Auto Parts, Agro-based Industries & Food Processing, Gems & Jewelry, IT & Software Development, Handicrafts & Cottage Industries.	Theoretically, the SME Policy 2007 was a good framework to boost productivity and innovation but its impact was limited due to weak implementation, financial constraints, and lack of innovation-focused incentives. Most importantly, the policy required a detailed implementation roadmap with specific timelines to tract its progress.
Credit Guarantee Scheme for Small and Rural Enterprises	Banks offered government credit guarantee loans to rural SMEs.	2010	SBP	AgriTech, Manufacturing Technology, FinTech and E-commerce & IT Solutions	Most of the rural SMEs were ignorant of the scheme. Many faced difficulties in applying due to complicated bank requirements. So, it can be said that providing credit alone cannot augment SME productivity rather technical support, training, and infrastructure development should be the main focus of such policies to get more positive outcome of these interventions. Moreover, due to absence of tracking system some SMEs misused loans for personal consumption.
Prime Minister's Youth Business Loan Scheme	Provision of financial assistance to young entrepreneurs to start or expand the their business.	2013	Ministry of Youth Affairs	E-commerce, IT, and service sector businesses.	Although this scheme provided the easy access to finance. However, challenges like lack of business training, loan recovery issues, and improper fund utilization affected its overall impact.
Strategic Trade Policy Framework (STPF)	To promote SMEs exports and enhance the competitiveness of Pakistani products in the global market,	2015–2018	Ministry of Commerce	Various SMEs sectors such as Textile, leather, sports goods, surgical instruments, and agriculture.	The set export target of USD35 billion by 2018 of this policy through the diversification of export products and markets was not achieved. Also, the plan to establish an export-import bank for trade finance faced delays or remained incomplete. While regarding technology upgradation, it lacked clear plans/approaches and suitable funding to promote R&D or support technological innovation in priority sectors.
Ease of Doing Business Reforms	Facilitate SMEs to start and run businesses in Pakistan.	2018–21	BOI	SMEs	These reforms of BOI contributed a lot to improve business environment in Pakistan such as introduction of the One-Window Operation and e-registration system etc. However, still bureaucratic inadequacies, inconsistent application of laws, and sluggish regulatory reforms continue to hinder the overall ease of doing business improvements in Pakistan.

Supply-Side Policies					
Policy Name	**Policy Focus**	**Year**	**Responsible Agency**	**Targeted Sector/Technology**	**Evaluation**
Digital Pakistan Policy	To promote digitalization across various sectors of SMEs.	2018	MoITT	Various SMEs sectors	This policy provided key support to the overall startup ecosystem by boosting the creation of tech hubs, incubators, and accelerators to foster innovation and entrepreneurship. However, more successful implementation in future will depend on dealing with issues like skill development, infrastructure gaps and policy coordination.
Kamyaab Jawan Program	To encourage young entrepreneurs via financial assistance, training, and business development services.	2020	Prime Minister's Youth Affairs Wing, SMEDA, HEC, Chamber of Commerce & Private Sector Partners	Open to all businesses, including agriculture, manufacturing, services, IT, and trade.	Factors such as slow disbursement of loans due to bureaucratic delays, limited rural areas outreach and high rejection rate of loan applicants due to strict banking criteria made this program not of much success.
National SME Policy	Infrastructure development, access to finance, regulatory reforms and digital transformation.	2021	SMEDA	SMEs	Out of 167 proposed reforms 112 implemented to date. The major focus of the policy on skill development and innovation was admirable. However, the effectiveness of the proposed initiatives has been constrained by limited resources especially in terms of insufficient infrastructure e.g., a lot of SMEs could not adopt new technologies and practices because of the lack of financial and technical barriers.*
Demand-Side Policies					
SME Policy	Business development services (BDS), human resource development, market development and export promotion.	2007	SMEDA	High-potential and labor-intensive industries such as Textiles & Apparel, Leather & Footwear, Light Engineering & Auto Parts, Agro-based Industries & Food Processing, Gems & Jewelry, IT & Software Development, Handicrafts & Cottage Industries.	Some SMEs got better exposure to international markets due to arranged trade fairs and business linkages by SMEDA for them. Similarly, some SMEs benefited SMEDA programs of technology adoption programs leading to process improvement. However, the incentives for technology adoption were insufficient and mechanisms to fulfill funding needs of SMEs remained underdeveloped. Training programs often were not aligned with needs of industries. Moreover, due to weak implementation of the set goals, created less impact to bring major shift in productivity and innovation of SMEs.

Supply-Side Policies					
Policy Name	**Policy Focus**	**Year**	**Responsible Agency**	**Targeted Sector/Technology**	**Evaluation**
Systematic-Policy Measures					
SME 2007 and National SME 2021 policy	For effective policy implementation various coordination committees (such as inter-ministerial coordination committee, SMEs development working groups, provincial and regional coordination committees and national coordination committees were formed under both 2007 and 2021 SMEs policies of Pakistan.	2007 & 2021	SMEDA	Various sectors of SMEs	The coordination committees of 2007 played a fundamental role in developing effective policy implementation strategy but its execution showed gaps due to weak inter-agency coordination, lack of enforcement and limited private sector participation. Later on, National SME Policy 2021 aimed to ensure better coordination for SME growth with a central governance structure, more distinct and clearer roles for stakeholders, and better inter-institutional communication. However, by increasing transparency and accountability via regular audits and reporting systems, the outcome of coordination committees can be tracked. Most importantly, there is a dire need to develop a stronger and consistent partnership with private sector using these committees in order to make sure that SME policies are market oriented and demand driven.

Source: *UNDP (2024)

CASE STUDIES TO ASSESS TECHNOLOGICAL CAPABILITIES AND INNOVATION IN PAKISTANI COMPANIES

For the case studies, I have selected the companies under the support of incubation centers of Pakistan and interviewed their CEOs. Table 8 shows the list of the selected 6 companies/startups that fall under three main sectors i.e., Education, Environment, and IT. More successful startups (small size) are on growth stage while less successful startups (micro size) are on breakeven stage.

TABLE 8

LIST OF SELECTED COMPANIES

Sector	Sub- Sector	Company Name	Founder & CEO	Co. Status	Off shots
Education	Ed Tech	Red Marker Systems https://redmarker.io/	Ms. Gull Zeba	More Successful	NIC Islamabad
		STELALLIANCE https://www.linkedin.com/in/shameer-zeeshan/?originalSubdomain=pk	Mr. Shameer Zeeshan	Less Successful	NICAT
Environment	Clean Tech	Trash Bee https://tracxn.com/d/companies/trash-bee/__PQzYIpvm8QHyXRzNjZahwslLk-03DEynWvQC0nlBjEA#funding-and-investors	Mr. Arsalan Ayaz	More Successful	Regional Plan9
		Waste Hero https://www.f6s.com/company/wastehero#people	Mr. Raza Javed	Less Successful	NICAT
IT	Software App Development	Poultry Baba https://www.facebook.com/poultrybaba/	Ms. Javeria	More Successful	BIC
		The Tuitionist thetuitionist | Twitter, Instagram, Facebook | Linktree	Mr. Hanan Asif	Less Successful	NIC Islamabad

Source: List of companies obtained from National Incubation Center (NIC), Islamabad.

Red Marker Systems Pvt. Ltd.

Basic Information

I interviewed Ms. Gull Zeba, the founder & CEO of Red Marker Systems, a company established in 2019. This company is a leading assessment solution provider using innovative digital systems. Ms. Gull Zeba holds an MBA in Finance and an MS in Project Management, both earned in Pakistan. Since 2003, she has been actively involved in the education sector, working with both public and private institutions. Later on, during 2011–2015 she joined public education assessment sector and conducted assessments across Pakistan. Her portfolio includes serving as a chairperson of the education committee and executive member of Rawalpindi Chamber of Commerce and Industries (RCCI), a board member in various public and private companies and a part of multiple forums like SBP and ADB being a consultant. Basically, she has spent many years working in the field of assessment (e.g., paper checking, paper conduction and paper marking) with different assessment bodies across Pakistan. The deeper she explored into the assessment sector, the more she realized the underlying issues and their root causes. Eventually, she identified numerous shortcomings in this sector, recognizing how they were impacting the future of Pakistan and influencing students' results. However, on the other hand, there was a lack of checks and balances

to improve the existing system. She was kept on thinking that manual paper checking is too time consuming. A huge cost is involved in paper printing and checking. And on the top of that, there is no transparency in manual paper marking system. She realized that technology could bring much-needed transparency to Pakistan's education assessment sector. In 2016, Gull Zeba shared her concerns and ideas with her husband, the co-founder of Red Marker company. They both agreed on the need to take action to improve this sector. She was particularly disheartened by the fact that despite the government spending billions of PKR on examination processes in Pakistan, the outcomes remained unsatisfactory (e.g., many students are dissatisfied with the obtained marks, the elite class often uses bribery to influence outcomes at assessment centers, and no guarantee that a student scoring 95% actually deserves those marks). Driven by her passion, Ms. Gull Zeba hired two professionals to develop a technology-based product for exams evaluation. She later organized eight to ten focus group discussions with public and private assessment bodies to identify the key challenges in this sector. Based on the feedback, she validated her so far built technology product by conducting exams in several schools across different areas. After witnessing the success of her prototype, she officially launched and registered Red Marker Company in 2019. She began operations on a larger scale with 100% self-financing and from a few partners, starting with PKR7 million investment, a three-room office space, and a team of five employees. By now, the company has a team of 26 employees, including software engineers, data analysts, social media specialists, finance professionals, and project-based subject experts hired as per project requirements. Additionally, so far the company has engaged approximately 4,000 project-based employees and generated around 13,000 employment opportunities, with over 4,000 of these positions filled by women. At present the company is focused on serving the domestic market, but there are ongoing international discussions with representatives from Saudi Arabia, Algeria, and Egypt who have shown interest in purchasing Red Marker products. However, none of these deals have been finalized yet, as global expansion requires significant funding, which Red Marker is still working to secure. However, Zeba got multiple offers from international investors who are interested to invest in her business if she can move her business in Singapore, Saudi Arabia, etc. (i.e., open head office and company accounts in those countries), which Gull Zeba does not want due to her family and lifestyle constraints.

Innovation Strategies

As part of its business strategy to generate revenue, the company presents its business ideas to both local and international investors. In 2020, the company secured a project with the Punjab Examination Commission, which used Red Marker's EdTech product to compare manual and e-checking systems in terms of speed, efficiency, and marking differences. The commission's findings favored the company product, concluding that the e-marking system is superior. They recommended it for its ability to enhance quality, transparency, and speed, while also serving as a tool for cost-cutting and better data management in assessments. After this success, the company got a project from Peshawar board for 6 thousand papers e-checking in 2020 and later on 1.2 million papers checking. In 2021, the company did assessment of HEC, lawyer aptitude test and later on got four times the same order. Then it got Federal Public Services Commission (FPSC) professional tests assessment project. All these were paid projects and the company got these initial assignments based on linkages that Ms. Gull Zeba built during her assessment sector job.

With the social acceptance of the product the company has made another Tech related product. However, Covid was very unfortunate setback for the company as for the first time in history of Pakistan students were promoted to next grads without conduction of examinations. But the same Covid was a blessing in disguise for the company as Covid pushed the government and private

sector to adopt technology and they were searching for Tech base exam evaluation product. So that was the time people started to accept online solutions and mindset of people changed a lot.

In 2021 the company won USAID–SMEA grant of 8 million after facing tough competition from 400 Pakistani startups. The company used that grant to improve existing product features and also train teachers (how to use e-marking system) of five cities of Khyber Pakhtunkhwa province. Actually, the CEO wanted to know the feedback of teachers who will be the end user of her product. She found that teachers were very much receptive for her company's product. Even during second round of training the CEO was told by teachers that how by adding some other features she could enhance the product. Moreover, the chairman of Peshawar board told Gull Zeba that by using her product the participation of female markers raised from 2% to 22% in Peshawar city, and also, he has saved 30% marking cost. All this positive attitude of society towards the company's product was an added motivation for Gull Zeba. In 2022 the company raised angel investor investment to cover office overhead costs plus product development with equity share – for 8 months the company survived on this investment. After that the company got an offer for computer base testing from Institute of Chartered Accountants of Pakistan (ICAP) as a three-year contract. Before this the ICAP was using international product for its assessment purpose. To secure this offer the Red Marker company quickly developed its computer base testing product and successfully got this three-year contract. Later on, the company secured a USD1.5-million deal with a Netherlands-based company and again got this investment using linkages. The Netherlands company was interested in investing in Pakistan and by observing the Red Marker's operational excellence the deal matured. Furthermore, the company regularly gets orders for Central Superior Services (CSS) assessment, recently CASE university hired Gull Zeba for a third-party assessment of its 170-school chain. For that Red Marker has developed 300 indicators to check student, teachers, principal and school assessments and compared all of these across 170 schools of CASE. Based on the findings the company, Red Marker has provided a lot of recommendations to improve the loopholes in the 170 schools. With the help of these funds the Red Marker kept on developing two more products, that is, a computer-based testing product and a self-assessment product, and also expanded the building structure of the company. By now the company has four-floor building. The first floor is for data scanning and power room, the second floor is for marketing and social media management, the third floor is reserved for product development and operations while fourth floor is a testing center for 35 people for computer-based testing. Other than above mentioned funds, Zeba got many grants from Karandaz, USAID, standard Chartered Bank, US-Pak accelerator program etc. and all the grants she has spent on technology improvement, R&D and women's training. At that time entering the exports side was not her concern as local demand was quite high, but now she is looking for funds for global expansion.

During its early years, the company has hired two technical experts for business planning. Later on, after getting experience those two technical experts got very good job offers (salary double Red Marker's) so they quit the company. Now the founders and department heads together set the next six months' business targets. However, the company is still in touch with those experts.

The company has its own recruitment process through advertisement using various social media platforms and sometimes using newspaper. The company follows all processes and systems of ISO either hiring, policies and operations. The company does on-the-job training for fresh employees (at least once in a month) and for that use services of senior employees, i.e., peer learning basis and also offer off-job training (employees attend ongoing training in the company's network).

Red Marker has a complete in-house technology team of 18 people (for production, R&D, design and engineering) that has been formed with the help of investors. This technology team keeps in touch with Lahore office (subsidiary of Red Marker) team all the time. Moreover, the company has a team of four members for marketing and branding on social media.

All the retained earnings are reinvested in the company for capital injections mainly for technology development, and sometimes the company needs funds out of its retained earnings for a specific project, e.g., having to buy a scanner for a specific project. Therefore, during the digital transformation journey from manual assessment to digital assessment the Red Marker company has adopted both incremental product and business process innovation approaches.

As far innovation challenges are concerned, the biggest challenge of the Red Marker company during its early years was lack of digital mindset of people in Pakistan. Secondly, since examination marking is a secret process which is why company had to do a lot of effort to convince its investors to keep the secrecy upheld. Thirdly, during any project deal with government bodies if during the course of deal, the chairman, secretory or minister get changed/retired/transferred then the company has to start its effort from zero again. Fourthly, public sector bodies (i.e., public exam boards) staff think that technology means end of their jobs, feeling job insecurity due to technology intervention in assessment sector so they resist Zeba and were not willing to cooperate with her. Finally, the elite class and local union council's mafia try to kick out companies like Red Marker who can stop their corruption with the use of technology, and this mafia also blackmails the government officials to not support Zeba, even if some wanted to support her. After facing such type of issues Gull Zeba now has adopted the strategy to collaborate with private sector schools and has started training of teachers who later on speak in favor of her company because the use of EdTech products made their lives easy, e.g., it is easy for them to mark papers even at home just by sitting on their computer.

Finally, by now the Red Marker has 100% operational excellence, 100% transparency, especially financial transparency (all transactions are caseless), and is just in need of a big capital injection to scale up, especially in terms of launching its own board which will be the replication of the Cambridge system in Pakistan. That is why Pakistan can save trillions of dollars spent on O and A level assessment every year. This is the dream of Ms. Zeba for which she is struggling hard day and night.

Incubation Centers Role

Business incubation centers played no role in formation of company's business plans, recruitment policy, in-house production and did not provide funds in business development and expansion. They only facilitated in networking and sometimes arranged funded international trips (e.g.,

Gull Zeba attended the LEAP Tech Event with the help of an incubation center which she got after going through the competitive processes of an incubation center. So, indirectly from these expos sometimes she got orders so it can be said that incubation centers helped only in terms of business registration, branding, and positioning. Also, she was able to get many types of information like legal help from ICs.

Although ICs have created an enabling environment for startups and have built an ecosystem for them, most of the times ICs do not provide need-based training (e.g., the same training for pre-idea and matured-idea stage startups). Sometimes training instructors are fresh graduates who actually

know much less than the startups. Another problem is that almost 80% shortlisted startups of ICs have already been in business for few years. So, during the incubation period if those startups earn big profits that is because of their past establishment while ICs take credit for that. ICs can play much better role if they do groundwork on a one-on-one basis with registered startups, i.e., helping them in business plan development, team building, R&D and securing funding for them, especially for developing technology-related products. NICs' role should not be limited rather multiple as they have too much connectivity both at national and international levels.

Policy Measures

Red Marker got public procurement from government agencies by winning tenders and most of the time it was the only company in bidding process from the private sector because its competitors (i.e., IBA-sukur and the Federal Board don't use their Edtech product for commercial purposes). Gull Zeba strongly demanded collaboration with universities in terms of using her product at university assessments. Gull got a few tax rebates from government but those were not applicable after adoption of new processes (because government does not know about her adoption of new processes). Public research does not help the company much as the company does all its product development by self-learning and via focus group discussions. Moreover, sometimes the Government became a competitor with the private sector and so suppresses their innovation process.

So far Gull Zeba got no rebate nor subsidy incentive from the government. Some types of incentives like if she opens her office in a software technology park, then she can get plot of office at subsidized rates. But that does not suit her so she didn't opt this incentive. Moreover, she has applied for women-led loans (PKR50 million at 7% markup) but bank officials discouraged her from taking that loan. Other than this, she has applied for the Kamyab Jawan Prime Minister's loan scheme, but here the application process was too long that after one year she got answer of her application then she did not pursue it.

She is not aware of any government policy that can boost up her technological innovation abilities. She told me in Pakistan only linkages and self-help are the main things that can sustain a startup business. Institution support was a mix in her case. Institutes stimulate her innovation process (e.g., project related funds) and at the same time institutes obstruct her innovation (e.g., resistance from government boards as mentioned above).

Stelalliance Pvt. Ltd.

Basic Information

I interviewed Mr. Shameer, CEO of Stelalliance, launched his startup in 2023 with the mission of revitalizing interest in rocketry and space science in Pakistan. A graduate of UMT-Lahore with a degree in Computer Science, Shameer was inspired by Indian television series on rocketry and space exploration during 2015–16. During his research, he discovered that Pakistan initially outpaced India in space programs but eventually-lagged behind. Today, India holds a significant share—about 10%—of the USD1.8 trillion global rocket industry. This realization, coupled with Pakistan's lack of focus on space science, motivated Shameer to take action. Driven by his passion, he envisioned a platform to inspire school children to explore space science through science, technology, engineering and mathematics (STEM)-based educational games. His goal was to make space knowledge engaging and accessible to kids, fostering early interest in rocketry and exploration. For three years, he worked tirelessly, reading books, sending emails to experts worldwide, and expanding his knowledge to develop a game prototype. When it got ready, he registered Stelalliance as a software company.

Shameer strategically targeted schoolchildren rather than university students, recognizing that Pakistan's current job market does not support space science graduates. With only two institutions—Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) and National Aerospace Science and Technology Park (NASTP)—working on space initiatives at a slow pace, he decided to instill a foundation of space knowledge in younger generations. SUPARCO's 2023 space policy mentions plans for space education and infrastructure, aligning with Shameer's vision.

The games developed by Stelalliance teach children the fundamentals of space exploration. Features include simulations like landing on a planet, troubleshooting rocket crashes, and exploring alien terrains. A virtual lab allows kids to diagnose and fix issues, while integrated quizzes assess their learning. Starting with just one colleague, Stelalliance has grown into a team of 15, comprising software developers recruited for their passion and interest in the field. New hires undergo training and participate in workshops, often visiting schools to demonstrate the games to students. The company operates on a bootstrap model, funded by Shameer's personal savings from his other business ventures. To make the games widely accessible, company plans to implement a subscription model, offering reduced fees for government schools compared to private institutions. Despite the high cost of game development, Shameer leverages his expertise to minimize expenses. His ambition is to secure USD2.5 million in funding from a major investor to scale the business further. Through his efforts, CEO aims to rekindle Pakistan's legacy in space science, starting with the youngest generation and paving the way for a brighter future in rocketry and exploration.

Innovation Strategies

The CEO approached the Ministry of Education with his innovative idea of spreading space knowledge among primary school children through gamification. Impressed by the concept, the Education Minister immediately encouraged him to prepare a detailed implementation proposal. After reviewing the proposal, the minister approved its execution in 40 government schools. Following the approval, the CEO and his team visited these schools to demonstrate their prototype to students. Based on the feedback received—such as identifying areas where children faced difficulties or showed strong engagement—they began upgrading and enhancing the game to make it more engaging and educational. The goal was to spark students' interest in space science, potentially inspiring them to pursue it as a future career. In addition to the B2G (business-to-government) model, company is simultaneously targeting private schools under a B2B (business-to-business) strategy. This dual approach ensures that the company is actively creating a market for its product.

The CEO faced significant innovation challenges during the journey. His initial concern was whether there would be buyers for the product once it was complete. However, the ministry's approval and support provided him with the confidence to move forward. This experience also improved his perception of government bureaucracy, which he initially viewed as inefficient in Pakistan. Another major concern is the risk of idea replication due to weak patent protections in the country. Private schools could potentially mimic his concept without proper safeguards. Additionally, the broader challenge lies in societal awareness—convincing parents and educators that gamification can be a powerful tool for children's learning, especially in a niche field like space science. Despite these obstacles, the CEO remains committed to realizing his vision of making EdTech a transformative medium for teaching space science through gamification, driving both educational innovation and societal change.

Incubation Centers Role

IC helped him in terms of mentorship and networking.

Policy Measures

In government institutions, the success of a startup often hinges on the support of a single influential individual in a top position. If such a person is willing to champion the startup's cause, the path to market penetration becomes significantly smoother, and the future prospects of the business brighten considerably. Conversely, without their support, sustaining and growing a business in Pakistan can be extremely challenging. In this case, the company was fortunate to find an ally who supported their vision without relying on any formal connections or networks. This pivotal support proved instrumental in advancing their mission and overcoming initial barriers. Other than this kind of support the company has not received any incentive from government.

Trash Bee Pvt. Ltd.

Basic Information

I interviewed Mr. Arsalan, the CEO of Trash Bee, a waste management company founded in 2019 and officially registered in 2021. Along with his co-founder, Mr. Arsalan holds a master's degree in Material Science from the Institute of Space Technology (IST). His passion for environmental protection was sparked by attending various environment-focused events and conducting independent research online about the significance of sustainable practices. Trash Bee's innovative idea was shortlisted at the National Incubation Center (NIC), where Mr. Arsalan spent a year refining the concept. Subsequently, he joined another incubation center, Regional Plan9, for an additional year to further develop the business. Trash Bee specializes in extracting valuable materials such as plastics, metals, and paper from collected waste, reintroducing them into the production cycle. Additionally, the company develops eco-friendly products like compost from organic waste and recycled packaging, contributing to a circular economy and promoting sustainability. Trash Bee offers comprehensive waste management services to housing societies across three cities in Pakistan, with its head office in Rawalpindi and subsidiaries in Gujranwala and Lahore. Additionally, the company provides consultancy services by creating sustainability reports for export-oriented businesses, covering all scopes of emissions (Scope 1, 2, and 3). Trash Bee also produces eco-friendly products, such as bamboo cutlery, which significantly reduces carbon emissions compared to traditional materials. Starting with just two employees, Trash Bee has grown to a team of approximately 80 employees. This includes 10 university professors of IST who provide expertise, while the remaining workforce consists of workers who collect waste from designated locations. All workers wear proper company uniforms, and operations are managed through WhatsApp, with founders providing instructions via this platform. Currently operating under a B2B model, the company plans to expand into the B2C market in the future. Trash Bee is revolutionizing the waste management sector in Pakistan by formalizing and digitizing the supply chain. Through technology, the company optimizes resource utilization, ensuring maximum recycling and minimal waste. It follows the 3R strategy—reduce, reuse, and recycle—to promote a sustainable and healthier environment. To raise awareness, Trash Bee conducts campaigns emphasizing its use of waste materials for composting. Segregated waste is outsourced for recycling, and raw materials for plastic production are sourced externally. These efforts align with the company's mission to advance sustainability and create eco-friendly solutions. International deals, including ongoing negotiations with Saudi Arabia, reflect Trash Bee's ambition to expand its impact. All of the company's innovations focus on reducing carbon emissions while managing waste effectively.

Innovation Strategies

Trash Bee has established itself as a leader in addressing waste management challenges through innovative strategies. By leveraging technology, community engagement, and sustainable practices, the company is transforming how waste is handled and recycled. Currently, Trash Bee is generating substantial profits through waste collection services, recycling sales, and the production of upcycled goods. Its steady growth is driven by continuous enhancements to waste collection processes, recycling techniques, and user engagement models. The founders apply their academic knowledge extensively in business planning, using the labs at their alma mater, IST, to develop new products from collected waste materials. They remain closely connected with their university professors, who serve as invaluable mentors in providing business solutions. Trash Bee raised its initial funds through bootstrapping and now provides monthly services to clients such as DHL and housing societies in Rawalpindi, Gujranwala, and Lahore. The company is expanding its target audience to include universities and restaurants. One of the biggest challenges Trash Bee faces is changing the conventional mindset around waste management. The company is rebranding waste management as a symbol of environmental cleanliness. To address labor needs, it hires workers as unpaid interns for one month, offering salaries afterward. Senior employees easily train juniors within a month. Trash Bee adopts an incremental innovation approach. For example, the company uses IST labs to explore the production of tiles from textile waste with assistance from IST professors. They also hire R&D experts to design products like cutlery, conducting demand-side analyses to tailor products to market needs. The company reinvests over 20% of its annual profits into business development and allocates another 20% for R&D.

Incubation Centers Role

Plan9 played a significant role in supporting Trash Bee by providing access to highly qualified mentors and offering paid training programs. The mentors from Plan9 and other incubation centers have been instrumental in the company's growth, and the founders remain closely connected with them to this day.

Policy Measures

The founders have not sought government incentives, as their focus remains on managing operations. They are, however, keen to establish strong collaborations with other universities and engage in project-based partnerships. The founders have reported positive experiences with government institutions such as the FBR and SECP, praising their efficiency and transparency. Licenses were obtained without corruption, though they advocate for a reduction in license fees and call for the government to provide free licensing to support startups like Trash Bee. Also, the company demand the government implement Environmental Protection Agency (EPA) rules, and by using television media, the government should aware people about environment cleanliness.

Waste Hero Pvt. Ltd.

Basic information

I had the opportunity to interview Mr. Raza Javed, the CEO of Waste Hero, a startup dedicated to environmental conservation. Founded in 2019 and formally registered in 2023, Waste Hero is making steps in promoting sustainable practices and addressing climate change through circular economy principles. Raza holds a master's degree in Computer Science from National University of Modern Languages (NUML) University. After graduation, he co-founded a software house with his best friend. However, due to partnership issues, he eventually exited the business. He then transitioned into the Fast Moving Consumer Goods (FMCG) sector, joining Engro Olpers, a leading company in Pakistan, where he has been working in Sales Build-To-Order for the following five

years. In 2016–2017, Raza served as Vice President of the PYOUTH AID organization, actively engaging in social initiatives. One of their impactful projects involved teaching children in slum areas under the "1 Child, 1 Book" principle, funded by Army Medical College (AMC) doctors and international agencies. Despite the noble mission, the organization faced challenges in securing private sector funding for education, which eventually hindered its progress. However, during his time with PYOUTH AID, Raza spearheaded a program involving slum children in waste collection and segregation from specific areas, offering them financial compensation. This experience inspired him to launch Waste Hero. He refined the concept further through a one-year training program at NUML's BIC. Currently, Waste Hero targets universities, restaurants, and the corporate sector as its primary markets. The startup has a dedicated team of four core employees, 10 workers, and numerous volunteers. He also organizes skill development training programs for employees—mostly female university interns—on waste segregation, recycling, and technology utilization. Recruitment is primarily volunteer based. Raza frequently visits universities to conduct awareness sessions, encouraging students to join Waste Hero and participate in waste collection and segregation activities. The startup's involvement in social and creative incubation programs underscores its commitment to environmental conservation and sustainability. Waste Hero is not just a business; it is a vision for a cleaner, greener future, driven by innovation, education, and community engagement.

Innovation Strategies

The primary objective of Waste Hero is to progress toward a zero-waste society. Its business plan consists of three key steps: Education and Awareness: The startup organizes workshops and social media campaigns to educate communities about recycling and proper waste disposal. Awareness initiatives target households, schools, and businesses to inspire sustainable practices. Market Data Collection: Employees and interns visit restaurants, universities, and private companies to gather data about their waste management practices and assess their willingness to collaborate. This data is analyzed to inform strategic decisions. Smart Waste Collection System: The company has developed a mobile app that enables households and businesses to schedule waste pickups. Users can drop segregated waste at designated spots, which Waste Hero workers then collect. In return, participants earn redeemable points for discounts or vouchers from partner restaurants and shopping malls, funded through companies' CSR budgets. Currently, due to limited funds, this system is operational in a single sector but has plans for scaling up.

Additionally, Waste Hero engages in event waste management, using volunteers to clean up and segregate waste after events. The startup is currently at the breakeven point, reinvesting all profits into operations and development.

The CEO, Raza Javed, personally manages app development, market research, and operations. Despite financial and resource constraints, the company has validated its prototype in one sector of Islamabad. Raza has personally invested PKR2 million into the startup, relying on his savings from his job

Waste Hero conducts on-ground market surveys to measure waste production and identify recyclable materials. Doorstep segregation is encouraged, and the data collected informs research on potential uses for the recovered materials.

During early years, Raza has faced resistance from local trash pickers, including threats that sometimes necessitate police intervention. To address these challenges, he has revised the business

model to focus on partnerships with universities and the corporate sector, securing agreements for waste collection, segregation, and recycling. Collaborating with educational institutions also allows him to introduce students to sustainability concepts, fostering a generation more mindful of environmental practices.

Raising awareness about waste management and fostering sustainable habits remains the biggest challenge. To address this, the CEO has initiated awareness programs in schools, teaching students waste segregation and motivating them to spread this practice at home. Recently, prominent companies like Zong and Mobilink have approached Waste Hero to fund awareness initiatives through their CSR budgets. Despite these successes, the company faces resistance from local trash pickers and requires government support to scale operations. Moreover, initially, the startup faced misconceptions, with people equating it to garbage collection. However, partnerships with major corporations like Zong have helped reshape public perception, highlighting the societal value of the initiative.

The startup is in its incremental innovation stage. While the app is ready, it has not been launched yet, as the company focuses first on building awareness, creating goodwill, and refining its logistics system. Door-to-door awareness campaigns and social media efforts are key strategies, leveraging youth networks to promote waste segregation. Raza emphasizes that technology, such as app development, is manageable, but creating behavioral change among households is the real challenge.

Incubation Centers Role

The establishment of ICs has significantly contributed to raising awareness about startups among Pakistani students. Many students have now grasped the basics of startup concepts and are increasingly motivated to launch their own ventures. Previously, the prevailing mindset was that starting a business required substantial investment. However, ICs have played a pivotal role in shifting this perception, emphasizing that a business begins with a strong idea and strategic planning.

The CEO of Waste Hero effectively leverages the space and resources provided by ICs to conduct awareness sessions, finding this approach highly cost-efficient. However, there is still room for improvement. ICs should take more proactive measures to connect startups with other industries, facilitate partnerships, and negotiate deals on their behalf. Additionally, they should work toward securing funding opportunities for startups, enabling them to scale and thrive in a competitive market.

Policy Measures

The startup is still in its infancy and has not received any government incentives. However, the CEO strongly believes in the power of self-help and volunteer support to drive progress. He believes that startups should view competitors as collaborators to create a larger societal impact. Initially, Waste Hero approached Papu Recycle, a leading private waste management company in Pakistan, for a partnership. However, the collaboration did not materialize due to a lack of mutual recognition of passion and goals. If the two companies had joined forces, they could have significantly expanded their impact, combining Papu Recycle's focus on embassies with Waste Hero's work in universities and restaurants.

Raza emphasized the need for government agencies, particularly the government Capital Development Authority (CDA), to collaborate on a Public-Private Partnership (PPP) basis. He advocates for adopting proper waste management techniques such as collection, segregation, and recycling, rather than the current inefficient practice of indiscriminate dumping. By transitioning to formalized waste management systems, the government could create jobs and foster a circular economy. Currently, the CDA collects and dumps waste without exploring recycling or other sustainable options. The CEO firmly believes that partnering with Waste Hero could significantly improve efficiency and help transition toward a sustainable waste management model. He sees immense profit potential in waste management, referring to waste as "trash to cash." However, the lack of supportive policies and the resistance of government institutions to change from conventional methods hinder progress. Although initially obstructed by the CDA, the authority has recently acknowledged Waste Hero's efficient work model. The CEO remains optimistic about building a collaborative relationship with the CDA to scale the company's impact and revolutionize waste management in Pakistan.

The CEO strongly advocates for better policy implementation, using fines for littering as an example. While a penalty of PKR5000 exists for throwing garbage on roads, weak enforcement renders it ineffective, as waste continues to litter public spaces. Strengthening and enforcing policies is crucial to driving behavioral change. The CEO also raises concerns about the lack of enforcement of child labor laws. Local trash pickers often exploit children for waste collection, despite the visible and widespread nature of this issue. Furthermore, these trash pickers bribe CDA officials to circumvent policies, highlighting systemic inefficiencies. They even pay restaurants for waste collection, underscoring the profitability of informal waste management by these trash pickers.

Waste Hero seeks grants—local or international—rather than loans to avoid interest payments and ensure the business grows according to its own vision and proven strategies. While the CEO is open to profit-sharing with partners, he resists equity partnerships that could interfere with the company's planning and decision-making process.

Poultry Baba Pvt. Ltd.

Basic information

I interviewed Dr. Jaweria Kanwal, co-founder of Poultry Baba, a registered company established in 2019. She is an Assistant Professor in the Computer Science Department at NUML University and holds a Ph.D. in Computer Science. Since 2014, she and her colleague have been working on the idea of developing an app to connect buyers and sellers in the poultry industry, addressing a significant market gap. Her colleague's uncle, who is now the company's CEO, has been in the poultry business for over 20 years. Through his experience, they learned about the exploitation small farmers face at the hands of middlemen who sell their products in main markets. To combat this issue, Dr. Jaweria and her colleague devised a plan to eliminate the role of middlemen by connecting buyers and sellers directly through their app, charging a nominal commission for successful deals. They shared the idea with the uncle, who gave them the green light to proceed, recognizing the potential to scale his business. Leveraging the NUML-BIC platform, Dr. Jaweria applied for an HEC grant (funded by the World Bank through HEC). Despite tough competition, they secured the grant, worth PKR9.8 million.

Total number of employees' initial were three and now around eight, few software engineers, developers and marketing professionals. Besides this company hires consultants for specific task

and for short run. Poultry Baba's primary product is a software app targeting the poultry industry under a B2B model. Currently, the company operates in major poultry hubs in Pakistan, including Lahore, Faisalabad, Gujranwala, and Rawalpindi.

Innovation Strategies

The company develops its business strategy based on market needs and user feedback. Currently, a mature prototype of the app has been completed, and testing of its basic features is ongoing. Once the company receives the second tranche of funds from HEC, the app will be launched commercially. The profit margin is directly tied to the number of users. The company recruits employees based on their experience and expertise in developing various app features. Most of the technical work is handled by consultants, and experienced professionals are hired for both management and IT roles. As a joint venture between NUML-BIC and poultry industry experts, the company hires specialists for every task. The app prototype was developed by IT professionals with over a decade of experience. Marketing efforts are planned across multiple platforms. The company intends to host marketing events at NUML to build brand goodwill and trust among its users. Since the project is still in its early stages, significant sales have yet to be achieved. However, the company secured USD35,000 (equaling to PKR9.8 million) in Innovator Seed Fund (ISF) funding, allocating 60% to research and development and 40% to marketing.

Incubation Centers Role

The BIC played a crucial role in shaping and refining the company's business proposal. It provided valuable guidance in identifying target customers, optimizing budget utilization, determining valuation, and developing a solid future plan, which ultimately helped secure the HEC grant. For networking, the company effectively utilized the workspace provided by NUML-BIC. Leveraging the NUML (government) platform, the company is confident it will easily gain the trust of its users.

One of the biggest innovation challenges was taking the first-mover advantage in developing an app for the poultry industry, as no such app previously existed. This pioneering effort posed significant difficulties in designing the app's features, often requiring the company to discard prototypes and start over. Although the company envisions incorporating numerous features, it must keep the app as simple as possible to accommodate its market audience, which may not be highly educated. As of now, the company has not applied for any patents.

Policy Measures

Apart from the HEC grant, the company has not benefited from any additional government incentives. Through market surveys, the company discovered that many of its app's target users—small-scale poultry farmers—do not own Android phones. Providing these users with Android devices from government on installment plans under any government scheme could greatly enhance accessibility and adoption of the app. The company also urges the government to initiate awareness campaigns among its target audience, promoting the use of the app. This effort would not only foster trust and goodwill toward the company but also empower farmers to benefit from its services effectively eliminating exploitation in the process.

The Tuitionist Pvt. Ltd.

Basic information

I interviewed Mr. Hanan Asif, the founder and CEO of The Tuitionist, a startup established in 2022 and officially registered in 2023. Mr. Hanan holds a bachelor's degree in Computer Science from Capital University of Science & Technology (CUST), Pakistan. When he was graduating, he

launched The Tuitionist tutoring platform but later pivoted to The Tuitionist Lms, an idea that gained recognition at the NIC in Islamabad. Currently, Mr. Hanan also operates a software house and marketing agency. The Tuitionist addresses a significant gap in the Pakistani education sector: the limited adoption of modern technology in schools. The startup's flagship product is a multilingual School Management System (SMS), offered as Software as a Service (SaaS). It is designed to help schools to enhance their brand image while the company manages the backend services. Additionally, The Tuitionist is developing a Learning Management System (LMS). Unlike similar platforms in the government sector, The Tuitionist's solutions are user-friendly and accessible to teachers and parents. The company's products are cross-platform, cloud-based, end-to-end encrypted, and customizable for specific school needs. These features aim to ensure usability, affordability, and learning ease for schools while benefiting administrators, teachers, parents, and students. This also helps schools to become data-driven and make decisions to grow and optimize school processes. The primary end-users are parents, but the services cater to a wide range of stakeholders. Initially, the company consisted of Mr. Hanan and his UK-based co-founder. Today, The Tuitionist employs 15 professionals, including software engineers, developers, data analysts, and marketing and sales personnel. The startup has signed memorandum of Understanding (MOU) with several big private schools, both domestically and in the UK. While the company operates at a breakeven point, growth remains slow.

Innovation Strategies

Mr. Hanan oversees all company operations, effectively eliminating operational costs. The business strategy focuses on targeting specific market segments, starting with middle-tier and upper-lower-tier private schools that cannot afford or manage these expensive platforms. He visits schools to demonstrate the product, emphasizing how it enables data-driven decision-making and comprehensive analytics. Despite the innovative offering, the company faces challenges in product adoption. Many school principals resist change, fearing disruption to existing processes. There is also a societal reluctance, with some principals outright rejecting the product, fearing profit-sharing concerns. To combat this, The Tuitionist offers free one-month trials and charges PKR60–90 per student thereafter. International expansion presents further challenges. While The Tuitionist has an ongoing deal in the UK, Mr. Hanan is hesitant to relocate the office or register a company in the UK due to Pakistan's limited international banking infrastructure and high repatriation taxes.

To build his team, Mr. Hanan recruits through LinkedIn and conducts interviews with shortlisted candidates. The Tuitionist also offers paid summer internships to fresh graduates, with training provided by the CEO himself. Mr. Hanan adopts an incremental innovation approach, staying updated on market trends and implementing feasible technologies using existing resources. The current focus is on optimizing and selling the developed product, with revenue reinvested in product development and marketing. The Tuitionist is one of the few startups in Pakistan that is funded by Google as well as Microsoft for its services.

Incubation Centers Role

NIC has provided networking opportunities, training programs, and access to competent teams. Through the platform of NIC, Mr. Hanan has interacted with various founders and CEOs, gaining valuable insights. Occasionally, NIC funds attendance at technology conferences, which Mr. Hanan finds beneficial. With the assistance of NIC, The CEO got the chance to meet various founders and other CEOs of his area which he found very informative and helpful. NIC curriculum which they had of Founders Institute was one of the best programs for startups as it is from Silicon Valley. Mr. Hanan got connected with the senior manager of Sustainability & Innovation of Fauji Fertilizer

Company (FFC) (one of the biggest companies in Pakistan) as his mentor with the help of NIC but Hanan found him not of much help. However, he expressed dissatisfaction with NIC's inability to connect The Tuitionist with investors, a commitment they had made as they helped the startup get into the market. He also emphasized that NICs should focus on boosting sales for startups, as initial investments can be afforded by startups that way startups can manage to scale up by themselves.

Policy Measures

To date, The Tuitionist has not received government incentives. Although the general manager of projects Ignite promised to connect the company with investors or relevant potential leads, no concrete progress has been made as work is still progressing. Due to a lack of references, the company is eagerly looking for a point of contact to whom they can sell their products. The CEO is pitching his idea at various places but according to him due to a lack of strong references, he is not having much success in confirming his deals. He has spent years bringing digital transformation to Pakistan and finally made a product but there is no demand from the government for his product, therefore, he is strongly demanding government procurement of his products. The CEO strongly demands government to test his product at least once, even free of cost just to compare its quality with government-built similar products. The CEO claimed that the government built such products user interface is very difficult for parents and teachers. Moreover, the Government should arrange focus group discussions for him which is the way awareness and adaptation of the company product can be enhanced. Importing hardware from the USA or China incurs high taxes, making it difficult for the company to afford such imports. Furthermore, heavy taxes and blocked foreign accounts hinder the repatriation of profits, discouraging international expansion. Secondly, if the company opens its head office in the UK or registers in the UK then again government of Pakistan provides no option to startups to get back the profit, as foreign accounts get blocked. Also, due to heavy taxes, the profit margin shrinks. The CEO wanted the government to take some serious actions on these issues of startups. So far, the CEO is not aware of any government policy that can assist him in terms of rebate etc. The CEO has recently applied for the patent rights of its company logo.

Following Table 9 presents the comparison of successful startups (who are at growth stage) and less successful startups (who are at breakeven stage).

TABLE 9

COMPARISON OF SUCCESSFUL VS UNSUCCESSFUL COMPANIES

- The successful companies receive government support (winning government tenders) mainly due to their strong networking with government institutions which they have built in their career back, whereas, lack of networking creating a problem for less successful companies to scale up.
- Micro size companies want government support to create awareness of their innovative products in general public during early years of their business while small size companies want government financial support to scale up their businesses.
- Less successful companies are taking more benefit from ICs while more successful companies do not give much credit to ICs behind their success.
- Both type of companies strongly wants government procurement of their innovative products and changes in business policies in terms of ease in shifting profits back in Pakistan.
- Both types of companies are not so aware of government policies due to nonexistence of any such central platform. They don't even know to whom they should ask for any such polices. Moreover, they don't explore government policies keeping the belief that in Pakistan policies are of no use due to lack of their implementation, e.g., big companies can stop implementation using bribes.

INSTITUTIONS AFFECTING IMPLEMENTATION OF POLICIES

Government Agencies' Capacity and Interdepartmental Collaboration for SMEs' Innovation and Productivity Improvement:

Government agencies such as SMEDA, the Pakistan Industrial Development Corporation (PIDC), incubation centers, and various provincial bodies have been mandated to stimulate SME growth through policy formulation, financial assistance, capacity-building programs, and technology transfer. However, flaws exist in the policy-making stage. For instance, the National SME Policy 2021 provides a strategic vision to promote SME development through various government schemes such as training programs, grants, and the deployment of foreign machinery and plants to boost various sectors under PSDP projects, its implementation falls short because the policy did not provide the mechanism of comprehensive business development support to companies, and so these government organizations have largely (more than 80%) limited their capacity to providing training programs and little else. They must understand that training is just one component of the business development process.[8] As a result, startups, although motivated after receiving training, often fail to sustain their innovative businesses in the long run due to the absence of a fully developed ecosystem which should be provided by these organizations. On the other hand, it has been observed that government departments in Pakistan tend to work in silos due to several factors like bureaucracy discourages cross-departmental collaboration, departments focusing narrowly on its mandates only, ineffective communication channels among departments, and most importantly absence of technological integration among departments. Because of this lack of coordination, there exists delayed execution of policies and projects and duplication of efforts. Citizens also often face hurdles as they have to navigate disconnected government systems.

SME-Government Trust:

Firms have minimal trust in the government due to the frequent policy inconsistencies that arise with changes in political leadership. This lack of trust has led many SMEs to remain in the informal sector, as they are reluctant to integrate into the formal economy. The primary demand of SMEs is not financial assistance; rather, they seek an enabling environment where they can thrive. For example, SMEs often have to surrender a significant portion of their profits to various government organizations or political actors in order to operate, which led them to think that government is not playing it due role to support them and so their level of trust on government reduces further. The state must address this issue by eliminating corrupt practices and actors within society. Additionally, another critical reason for the distrust is the lack of transparency in government policies, as important information is often withheld from SMEs only big giants know all and in advance. The best way to publicize policy measures to businesses is via too much drum beating of success stories that originate out of some government schemes, e.g., if any firm after securing subsided loan from government has created a huge impact in society, that should be highlighted much in the media, so that more and more firms know about it, and that way trust level of firms will also increase. Moreover, government should publicize most of the content of its deals both national and international levels and then disclose where it will spend the amount of those deals, e.g., in a flood relief campaign government got a lot of funds, especially from international donors. Now government should publish how much it was, where it was spent, how much benefit it got after using those funds, etc. Moreover, trust can be enhanced if government keep itself out of the business sector. Their job is to make polices after consultation with all stakeholders then implementation and later on monitoring and evaluation (M&E) should be the role of government.

8 Keeping this in view the policies should be formed in a way to provide full fledge ecosystem to the companies not just one part of the ecosystem, otherwise wrong policies would yield wrong results meaning the objectives of sustainability and productivity improvements will never be achieved.

On the other hand, if government provides genuine help, e.g., as Ignite helped IT sector so much in terms of networking, provides options to attend funded conferences, and provides expert mentors, then startups will have built some trust with Ignite by now. Furthermore, trust can be enhanced with visibility as mentioned above and visibility can be enhanced with the use of technology, so government should speed up its efforts towards digitalization in its institutions.

Society Attitudes on Program Failures:
In general, the firms in Pakistan feel helpless once they come to know about the failure of government schemes/policies/projects. Most of them are not interested in taking any action as they have the mindset no positive outcome will be there. That's why they are not interested in wasting their time. And the few firms who wanted to take some action, don't even know where to lodge a complaint.

Citizens are of the view that government programs are poorly planned and implemented because they have consistently observed failures in delivering promised outcomes across almost all sectors, including education, healthcare, and infrastructure. This strengthens the perception that government initiatives are ineffective, leading to low levels of trust. Government failures are largely and frequently attributed to corruption, with widespread perceptions that funds are misappropriated by officials or influential individuals. This belief undermines confidence in the government's ability to execute programs effectively.

However, in a few cases, citizens have developed alternative coping mechanisms, such as relying on informal networks or private solutions to address needs that the government fails to meet. Likewise, in urban areas, people deeply affected by government failures often express their frustration through protests and on social media, which is less common in rural areas.

Opportunity-Based Entrepreneurs Availability:
To compare the status of opportunity-based and necessity-driven entrepreneurship in Pakistan, I have compared the literature of 2012 with 2024. A decade ago, Pakistan's entrepreneurial landscape was predominantly characterized by necessity-driven entrepreneurship, with individuals engaging in entrepreneurial activities out of economic compulsion rather than to seize opportunities (see GEM Global Entrepreneurship Monitor (GEM Consortium (2012)). In contrast, the situation in 2024 reflects significant advancements in the country's entrepreneurial ecosystem comparing to 2012 situation. Pakistan has witnessed notable progress, including the rise of startups, increased funding opportunities, IT penetration, the establishment of incubation centers, and the organization of entrepreneurship-focused events in public and private sectors. These developments indicate a shift towards opportunity-based entrepreneurship, where individuals pursue business ventures to capitalize on market opportunities rather than out of necessity (UNDP, 2024). Moreover, all stakeholders interviewed for this research study share a similar perspective, aligning with the findings of the UNDP report.

Finally, all the case studies mentioned in this report clearly indicate that recently Pakistani business ventures are initiated by those individuals who acted on a specific market opportunity out of their passion, introducing new products and services, taking calculated risk using networks, portfolio diversification and technology, aligned with market demands and trying hard to create market impact indicating the strong availability of opportunity-based entrepreneurs in the country, and for this both BICs as well as NICs[9] are playing their due role only to the extent of providing basic infrastructure.

9 The role of NICs is far more significant than BICs.

In Pakistan, most of the time the opportunity-based entrepreneurs replicate international ideas in their business venture. However, the sustainable startups are those who replicate international ideas after amending them with local context.

TABLE 10

SUMMARY OF POLICY SIDE MEASURES

Demand-Side Policy	Policy orientation toward incubation centers or innovation remains lacking in Pakistan. This is largely because innovation is often treated as a subset of broader economic or industrial policies rather than being prioritized as a standalone focus.
Supply-Side Policy	Pakistan lacks product policy support specifically targeted at innovation, as established industries such as banking, fertilizers, textiles, and chemicals dominate the market through subsidies, a practice commonly referred to as policy-driven rent seeking. The capacity of SMEDA is limited to functioning as a training institute rather than focusing on comprehensive business development. Additionally, its advocacy role remains minimal. Over the past decade, overall credit to the private sector has declined from 13% to 7%, while microfinance to SMEs has dropped from 5% to 3%, highlighting a significant failure in policy influence. Furthermore, the government allocates less than 1% of GDP to R&D, which severely hampers innovation and the growth of knowledge-based enterprises.
Systemic-policy measures	At present the existing incubation centers and innovation hubs in Pakistan lack adequate institutional support such as streamlined regulatory frameworks, mentorship programs, and technology transfer mechanisms because these centers operate in isolation, resulting in duplication of efforts and inefficiencies.

STAKEHOLDERS' ANALYSIS

Key challenges for Pakistani startups include the absence of indigenous literature, data, and case studies relevant to Pakistan, particularly in Urdu, which limits localized insights and inspiration for startups. Despite having 207 business schools and significant HEC funding for research on local challenges, these findings remain inaccessible and not of much value, leaving a gap in actionable resources. Research on local market needs and viable solutions is minimal, and incubation centers lack specialization, e.g., agriculture-focused universities neglecting agri-business startups. Additionally, the lack of strong partnerships with local and international industries further restricts their impact. On the other side, a burdensome business ecosystem that offers minimal ease of doing business. Technological startups struggle to connect with the physical market, while general startups struggle with intricate interactions involving local authorities, monopolistic businesses, and a very powerful informal sector. Technological grants often result in products with limited commercial success. While tech startups claim higher success rates, but they face significant challenges in scaling their businesses, such as launching IPOs on the PSX Main and Growth Enterprise Market (GEM) Boards. The extensive requirements for permits and approvals add further obstacles, making it particularly challenging for educated young graduates to establish and sustain their ventures in such a demanding environment.

In Pakistan, government interventions aimed at improving the performance of local companies often lack proper need assessments and a lack of effective monitoring and evaluation to measure their interventions impact. These efforts are frequently driven by a desire for political popularity and recognition rather than addressing the genuine needs of businesses. For example, few years back government announced a scheme of subsidized women's loans. Government made this policy

without knowing what women will do with this loan, if they have a mobile sim to apply for it, or if they will get permission to get these loans etc. On the other hand, women found the process very lengthy and difficult to obtain such loans and so very few applied for these loans. Therefore, the end result/benefit of such schemes is zero. There is a need to engage those stakeholders for whom the policy is going to be formed in order to match what they actually need and for that purpose civil society communities can play a role.

Mostly startups are not aware of government policies because they are extremely busy in business operations. So, policy makers should do a lot of drum beating of the polices made for startups so that they come to know automatically. Small companies have the mindset that government favors only big companies and small companies are not in the priority list of government. Therefore, they believe that all government policies are for big giants and in actual this happens as reported in Pakistan GEM Report 2012 (i.e., review of last six decades shows that Pakistan's government efforts clearly show a bias towards large scale industry and neglect of the small) that's why they don't bother to explore more on policy side. In Pakistan, government officials such as sectaries, ministers are not approachable for general public to share and address their grievances further reduces the trust level. Although all big companies are in good relations with bureaucracy. But bureaucracy uplifts only those companies who want dependence linked with political interest. On the other hand, the awareness level of big companies on government incentives is high due to linkages support in bureaucracy (giant companies even hire people only to get and analyze government incentives information). Since the big companies know in advance, and especially know the strategy in advance, so their productivity is higher than small firms.

Policy implementation is very weak in Pakistan mainly due to lack of implementation framework and timeline of activities, e.g., recently the IT minister said we have to raise IT exports up to USD25 billion from USD2 billion, but he has no clue how to do so. Although, at present, Pakistan's ICT services industry has been valued at USD2.6 billion in 2022, with the potential to grow to USD10 billion by 2025, but only if substantial support is provided at both market and governmental levels. The current support system such as the Special Investment Facilitation Council (SIFC), BICs, NICs fall short of building a prosperous startup ecosystem. Moreover, to unlock the full potential of Pakistan's ICT sector, the country must establish a more supportive, specialized, and accessible ecosystem tailored to local needs and industry-specific demands. This can be achieved through robust research and development initiatives, including comprehensive market needs assessments, local sourcing of materials, and strengthening connections within the local value chain. Sometimes policy implementation is weak due to existence of mafia/corrupt people, e.g., as per government digital policy, the government had downsize government employment (e.g., had to fire 300 out of 400 employees) in government institutes by adopting technology-related solutions. Later on, these 300 employees started protest against government digital policy and approached courts to get relief. Likewise, during last few years government spent trillions in education sector but the outcome is not there due to lack of third-party assessment of polices and very weak M&E of money spent on such education projects, e.g., government using these funds trained five teachers in each public school, then what happened, what kind of change they brought about etc. So, when there is no following evaluation and accountability system, implementation of such schemes will remain poor and no good results will be achieved. Another reason of weak implementation is lack of funds, e.g., sometimes government policies are tied up with donor funds. As long the funds are there, government will keep on working on that policy and after that no one bothers to check the status of policy, e.g., ADB wanted to make a women's entrepreneurship policy for Pakistan. It was made with the funds of ADB, then what. No one knows for whom this policy was nor what is its

current status etc. Furthermore, few years back MoITT made an app "Beti" meaning daughter, where all updated information regarding women's inheritance laws and women-related activities have been placed. Women found that app very useful. but now it's no longer there, because it was the initiative of previous government, and the current government neither had funds nor interest to continue that app. Another reason of weak implementation is firms please government offices by bribes to stop action against a particular policy. Moreover, the will of the executive body (bureaucracy) to get things completed also matters for the case of Pakistan. In short, there is a need to check that in last 10 years how many polices are formed and where do they stand now. This analysis will tell what happens with policies in Pakistan (i.e., they exist only on paper). Therefore, only after proper evaluation should old polices come to an end. Policy formation in Pakistan is fundamentally flawed, as most policies concentrate solely on providing basic infrastructure and management aspects. Addressing these gaps will require a holistic, stakeholder-driven approach to create policies that foster innovation and sustainability.

In Pakistan only a few of around six–seven venture capitalists are active (such as Sarmayacar, Faisal Aftab, Romana and Deosai) out of a list of around 500 venture capitalists. The problem is that local VC depends on the funding of international VC, which dried out in Pakistan a few years ago due to political instability. Rather, funding of international VC diverted to the real estate sector of Pakistan, which is less risky with huge capital gain margin. All this means that international VC instead of investing in startups are investing in real estate sector. ICs should play their due role here because their network is much stronger than startups and try to motivate international VC to fund startups rather than investing in the real estate sector. Hence, the prevailing "Seth" culture in the country along with angel investors and seed funders, hinders the growth of an entrepreneurial culture in Pakistan. For instance, within NICs, even successful tech startup products often lead to investors taking control and relegating the startup founders to the role of CEOs, effectively constraining entrepreneurial spirit and ownership.

Government must have in-depth, sector-wise start up data so that it can easily track their journey over their life. This way, it is easy to figure out how many startups have been sustained and why, and how many did not get sustained and why. This analysis will also help to strengthen existing policy for startups. At present there is no such tracking system in place. For that matter, Pakistan can just follow the startup polices of its neighbors like India and Bangladesh, where startup policies are very much startup facilitating due to deep analysis of startup data. Hence, there is no need to start from zero, what has worked in other similar countries should work here too.

To address the issue of policy mismatches, stakeholders must be actively involved in the policy development process. Regular feedback from stakeholders on existing policies should be collected, and revised versions of these policies should be published annually to ensure they remain relevant and effective.

The government should introduce seed funds, ranging from a minimum of PKR2 million for the idea stage to PKR5 million for the scale-up stage. This initiative aims to provide critical financial support to promising ventures during their formative phases. Startups applying for these funds must present unique and transformative solutions, with their business plans undergoing rigorous evaluation and endorsement by the respective ICs. Likewise, the financial resources of ICs should prioritize supporting startups rather than focusing solely on operational and establishment expenses. Greater investment should be directed toward enhancing entrepreneurs' business acumen, marketing expertise, and product development capabilities. Additionally, ICs should concentrate

on specialized fields aligned with their core competencies. For instance, agricultural universities could focus on agri-business, while NICAT could specialize in aerospace technology, rather than dispersing efforts across multiple domains. Moreover, ICs should also establish a collaborative network between universities and industries to improve backward and forward supply chains. Such a network would benefit startups by providing access to affordable raw materials and efficient distribution channels, enabling them to thrive in competitive markets. Given their geographic distribution, BICs and PITBs in peripheral and mainstream cities should focus on nurturing new startups, while NICs in major urban centers should support the growth of more advanced startups. The role of incubation centers should be to streamline to support the entrepreneurial journey of startups. Their responsibilities must be multidimensional and enhanced, as outlined above, to address the diverse needs of startups effectively.

At present there is a policy disconnect in Pakistan. Policies mainly focus on the training element[10] rather than innovation. Moreover, policies often overlook the specific needs of different regions or sectors, making it difficult to implement incubation programs tailored to local innovation challenges. Hence, establishing the regional innovation clusters that connect startups, universities, and businesses to create localized ecosystems that drive innovation is the solution of the problem.

CONCLUSION

The policy implementation process of government institutions is full of delays, and there is no intent of monitoring and evaluation of the policies once they are placed. The SME Policy 2007 laid a solid foundation for both supply-side and demand-side interventions but had little success in terms of enhancing productivity and innovation of SMEs, mainly due to lack of implementation of targeted goals. Therefore, most importantly, the policy of 2007 required a detailed implementation roadmap with specific timelines to track its progress. On the other hand, SME 2021 policy was an attempt to improve the shortcomings of 2007 policy especially in terms of implementation. And so the policy framework of the 2021 policy was quite comprehensive comparing to 2007. But here again execution of proposed goas was an issue. In short, it can be said that if properly executed SME Policy 2021 can bring greater productivity and innovation for Pakistani SMEs.

The coordination among government departments still is quite weak, despite the fact that under both SME policies (2007 & 2021) various coordination committees were formed. And this is the most important reason for weak policy implementation as well as creating a big trust deficit of companies/stakeholders of government initiatives. But they also feel helpless to complain against government program failures.

From the last ten years, startup culture is being groomed in Pakistan though with low pace. People's mind set has changed. And Covid played a positive role towards technology adoption in Pakistan. Although, there exists much opportunity based entrepreneurship in Pakistan, at present, all sectors of Pakistan are in great need of technology introduction to enhance their productivity via opportunity-based entrepreneurship.

The successful companies have around more than 20 years of experience, and relatively less successful companies have more than five years of experience before their affiliation with ICs. Most of these companies are on breakeven point or got low growth rate due to insufficiency of

10 Most of the government programs focus on short-term skills training over long-term innovation to provide startup with resources to scale up such procurement policies of innovative products.

required funds. And for that, they strongly demand government procurement of their innovative products, or at least, government should facilitate them to connect with investors to scale up their business via ICs. So, it can be inferred that technology acceptance and development will take some time in Pakistan, but if early-stage companies get the required amount of funds and support from government, this process can be speed up.

Companies don't bother to explore their sector-related policies, keeping the view that policies are of no use for them due to their poor experience of applying in government schemes to benefit their businesses. So, lack of awareness about existing polices and processes of businesses is a huge issue prevailing among companies in Pakistan. Sometimes, the small companies are not aware of government schemes as not properly marketed by government intentionally because government wants to offer tenders to the big companies as big companies are more credible than small companies. Raising awareness, engagement of right persons and then making the right polices—just a few good long-run polices are required but with strict implementation—all is done.

Finally, it can be said that Pakistani startups are developing promising products to revolutionize different sectors in Pakistan, but still technology adoption barriers, societal attitudes, and lack of government support pose significant challenges. Addressing these issues through new policy formations where there is a strong need to redefine the startup ecosystem and its support mechanism from all stakeholders, i.e., better incubation centers support and increased awareness by developing local data could help the companies to scale up and contribute to raise the productivity levels in the country.

RECOMMENDATIONS

Startup Ecosystem

The detailed investigation presented in this research report on Pakistan's startup ecosystem highlights that the fundamental infrastructure of existing incubation centers generally meets the required standards. These centers provide essential amenities such as well-equipped spaces, meeting rooms, offices, and free internet access. However, these efforts are primarily operational in nature, focusing on basic infrastructure while neglecting the development of a robust knowledge support system. Critical components such as local case studies, research on market dynamics, rigorous idea validation through contests, and specialized competencies in specific fields remain overlooked. Although, these centers organize training programs for capacity building, the content and quality of these sessions often fall short of expectations. They fail to effectively prepare startups, as the trainers themselves typically lack substantial industry experience and sufficient business acumen. Furthermore, the incubation centers are not adequately addressing the need to equip their startups with essential skills, such as obtaining loans from financial institutions or navigating the process of IPOs on the GEM Board. This skill gap significantly hampers startups' ability to secure critical financial resources necessary for scaling their ventures and achieving sustainable growth. Additionally, while some centers, such as NICs and Plan9, partially provide legal and auditing services, BICs completely lack such support. This shortfall further limits the startup's ability to address foundational business challenges, undermining their long-term success.

Now to address these critical weaknesses in existing startup ecosystem following steps are recommended.

1. The incubation centers should regularly provide more detailed and authentic local data across all cities of Pakistan for the benefit of startups so that they can conduct need base assessment easily and in advance to improve their business ideas. For this, organize dedicated news/views/ case studies/ journals/business magazine publications that capture local and international case studies (in Urdu as well) on startups along with video documentaries should be provided. This platform will offer aspiring entrepreneurs valuable insights into the opportunities, challenges, and issues dominant the business world.
2. A strategic emphasis should be placed on fostering robust partnerships with industry players, both locally and internationally, to provide valuable resources such as mentorship and market access for startups.
3. Implementing comprehensive training programs focused on enhancing financial literacy and entrepreneurial skills will empower startups to secure loans and explore opportunities for going public through IPOs.
4. Incubation centers should also provide essential business support services, including legal assistance, access to IT experts and technicians specializing in diverse fields, and support for developing prototypes for products, services, and websites. Additionally, offering accounting and auditing services will help create a sustainable foundation for startups.
5. Government in partnership with Ignite and HEC should adopt a strategic framework to optimize the effectiveness of BICs and PITB Incubation Centers. These centers should prioritize the incubation of early-stage entrepreneurs, offering specialized training and support during the stand-up phase (idea stage) of their ventures. Promising candidates from BICs and PITBs can then transition to accelerator programs at NICs i.e., aligning resources with areas of expertise and specialization.

Policy Formation

Policy formation in Pakistan faces fundamental challenges, as most policies primarily focus on providing basic infrastructure (e.g., covering only management aspects) without a forward-looking vision or a framework to ensure sustainable impact. Consequently, despite the abundance of policies, their implementation has failed to yield meaningful results. Moreover, policies are often crafted at the government level to align with the agendas of donor agencies or specific political parties, neglecting the active involvement of key stakeholders.

Following steps are recommended to make strong policies.

1. Adopting a stakeholder buy-in approach is essential to ensure the policies are practical, relevant, and widely supported.
2. The government should introduce a new policy "The Innovation Policy" to incentivize startups that demonstrate groundbreaking contributions to society. This policy should empower ICs to assess and measure the level of innovation brought by startups. Based on these evaluations, the government can offer substantial incentives, such as grants or zero/nominal-interest seed funds.
3. A "Policy Portal" should be established to consolidate and provide easy access to all sector-specific policies. This portal should serve as a centralized repository of information, ensuring that businesses are aware of existing policies. Regular updates and awareness campaigns should disseminate information about the portal. Additionally, company registration on this portal should be mandatory, promoting transparency and widespread awareness of government initiatives.

Policy Implementation

Policy implementation remains weak due to the flaws in policy formulation stage, as highlighted earlier.

1. The implementation framework of policies should be there at the time of policy formation and then evaluated by third parties. And those responsible for weak implementation should be accountable and should be penalized.
2. To make strong policy implementation, policies continuity must not depend on political party's continuity. Long run policies say a policy for next 15 years should be formed and their continuity should be independent from political parties. After making long-run policy, a few efficient officers from different ministries should be given additional charge to monitor its implementation, they should be accountable in case of failure of implementation.

Institutional Coordination

To enhance institutional coordination, the adoption of e-governance platforms is a viable solution. Startups often lack awareness of ongoing projects across various institutions, underscoring the need for a centralized system such as a "Ministries Portal." This platform would allow not only companies but also the general public to access information about the initiatives and activities of different institutions, fostering transparency and collaboration.

REFERENCES

Aftab, R., Naveed, M. and Hanif, S., (2021) An analysis of Covid-19 implications for SMEs in Pakistan. Journal of Chinese Economic and Foreign Trade Studies, 14(1), pp.74-88.

Ali, A., (2018) State of growth barriers of SMEs in Pakistan: A review based on empirical and theoretical models. NICE Research Journal, pp.158-182.

APO (2023) Productivity in Pakistan: Estimates, Bottlenecks and The Way Forward. https://www.apo-tokyo.org/wp-content/uploads/2023/07/Productivity-in-Pakistan.pdf

Bashir, T. (2024) First Industrial National Innovation Survey. Pakistan Council for Science and Technology, Ministry of Science and Technology, Government of Pakistan. https://www.pcst.org.pk/finis1.php

Invest2Innovate (2021) Pakistan Startup Ecosystem Report. https://invest2innovate.com/ecosystem-reports/

Invest2Innovate (2022) End of Year Report. https://invest2innovate.com/ecosystem-reports/

Invest2Innovate (2024a) Pakistan startup ecosystem report. https://invest2innovate.com/ecosystem-reports/

Invest2Innovate (2024b) Deal Flow Tracker. https://invest2innovate.com/ecosystem-reports/

Mahmood, N., Jamil, F., Munir, H., Yasir, N., & Jianfeng, C. (2017) Business incubators and challenges: Evidences from Pakistan. Advanced Science Letters, 23(9), 8479-8483.

Ministry of Industries & Production (2021) SME Policy, 2021. https://moip.gov.pk/SiteImage/Policy/1111.pdf

Ministry of Industries & Production (2007) SME Policy, 2007. ttps://moip.gov.pk/SiteImage/Policy/SME%20Policy%202007.pdf

Hafeez, S., Ali, Q., & Nawaz, M. A. (2021) Business Incubators in Pakistan: State of the Art and Future Outlook. Journal of Accounting and Finance in Emerging Economies, 7(4), 979-990.

HEC (n.d.) Business Incubation Center. https://rfi.hec.gov.pk/bic

Nouman, M., & Gul, S. (2009). Innovation in Pakistan's SMES: Making the case for coupling model and looking beyond. Business & Economic Review, 1(1), 20-25.

GEM Consortium (2012) Global Entrepreneurship Monitor Pakistan Report 2012. GEM Consortium. Retrieved from https://www.gemconsortium.org

Raza, S.A., Minai, M.S., Zain, A.Y.M., Tariq, T.A. and Khuwaja, F.M., (2018) Dissection of small businesses in Pakistan: Issues and directions. International Journal of Entrepreneurship.

UNDP (2024) State of Youth Entrepreneurship Ecosystem in Pakistan. https://www.undp.org/pakistan/publications/state-youth-entrepreneurship-ecosystem-pakistan

WIPO (2024) Global Innovation Index. https://www.wipo.int/gii-ranking/en/pakistan

World Economic Forum (2014) Global Competitiveness Index Report 2014–15. https://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

APPENDIX

TABLE A

TIMELINE OF POLICIES / LAWS / REGULATIONS FOR DIGITAL PRODUCTIVITY IN PAKISTAN

Year	Law/Regulation/Policy
1991	Pakistan Telecommunication Corporation (PTC) established. [10]
1993	Arrival of Internet and email through dial up connections in Pakistan
1994	Pakistan Telecommunication Authority Established through an Ordinance.
1995	Arrival of broadband in Pakistan.
1996	1. PTC dissolved and PTA established as a regulatory body. [11] 2. National Telecommunication Corporation established to providing telecom services and infrastructure to public and private entities.
1999	1. Punjab Information Technology Board Established. 2. 2nd generation mobile technology introduction by Mobilink
2000	1. Launch of National IT Policy and Action Plan 2. National Database and Registration Authority formed
2003	1. De-regulation Policy for the telecommunication sector. 2. Privatization of Pakistan Telecommunication Company Limited.
2004	Mobile Cellular and Broadband policy launched for increasing affordability.
2006	Establishment of Universal Service Fund for increasing outreach of internet to the underserved.
2011	Khyber Pakhtunkhwa Information Technology Board established.
2012	NADRA introduces computerized smart national identity cards (SNIC).
2014	Planning Ministry launches Pakistan vision 2025 anticipating that digitalization is critical to human development and SDGs.
2015	Telecommunication Policy introduced which was the first holistic legislation to harness Pakistan's digital ecosystem.
2016	1. The Prevention of Electronic Crimes Act 2016 introduced. 2. IGNITE-National Technology Fund Setup to support digital skills and technology startups. 3. IGNITE launches first incubation centers in Lahore and Peshawar.
2018	1. Punjab IT Policy Launched 2. KP IT Policy Launched 3. IGNITE launches incubation center in Quetta. 4. Ministry of IT launches digital Pakistan Policy which focused on digital strategy on emerging technology, entrepreneurship, innovation and youth. 5. IGNITE launces largest online digital skills program for youth increasing outreach to 300000.
2022	1. Sindh Digital Technology Board formed 2. IGNITE launches incubation centers in Hyderabad and Faisalabad. 3. State Bank of Pakistan (SBP) launches the RAAST payment system to enable real-time payments. 4. Ministry of IT introduces National Data Protection Regulations policy setting framework for data protection and privacy. 5. Ministry of IT moves government services to the cloud under the Cloud First Policy
2024	NADRA launces national digital Wallet.

TABLE B

LIST OF STARTUPS INTERVIEWED

S.No	Startups	Interview Date & Mode
1	Ms. Gull Zeba Red Marker Systems Pvt. Ltd.	December 11, 2024 (In Person)
2	Mr. Shameer Zeeshan Stelalliance Pvt. Ltd.	December 12, 2024 (In Person)
3	Mr. Arsalan Ayaz Trash Bee Pvt. Ltd.	December 19, 2024 (Telephone)
4	Mr. Raza Javed Waste Hero Pvt. Ltd.	December 13, 2024 (In person)
5	Ms. Javeria Kanwal Poultry Baba Pvt. Ltd.	December 24, 2024 (Google Meet)
6	Mr. Hanan Asif The Tuitionist Pvt. Ltd.	December 20, 2024 (Google Meet)

TABLE C

LIST OF STAKEHOLDERS INTERVIEWED

S.No	Startups	Interview Date & Mode
1	Dr. Ata Ullah Associate Professor / Director ITCON & BICON BIC – NUML Islamabad	December 10, 2024 (In Person)
2	Mr. Babar Mustaq Startup Growth Manager NIC - Islamabad	December 10, 2024 (In Person)
3	Mr. Anwar Haq Manager RegionalPlan9 - Islamabad	December 19, 2024 (In person)
4	Eng. Talha Sarwar Senior Cloud Data Engineer IBA – Karachi	December 25, 2024 (Telephone)
6	Mr. Javed Afzal Provincial Chief (Punjab) SMEDA, Lahore head office	January 7, 2025 January 31, 2025 Multiple times (Telephone)
7	Mr. Shakeel Ahmed Secretary Pakistan Council for Science and Technology (PCST), Islamabad	January 10, 2025 (Telephone)
8	Ms. Noshaba Awais Director ORIC Head of BICs, HEC, Islamabad	January 13, 2025 (In Person)
9	Dr. Abdul Wahid Assistant Professor, NUML, Islamabad Winner of RAASTA grant of ministry of planning commission to assess BIC performance	January 14, 2025 January 31, 2025 Multiple times (In Person)
10	Mr. Muhammad Ijlal Head of Policy & Planning Division SMEDA	January 28, 2025 Multiple times (Telephone)

INDIA

INTRODUCTION

India is aiming to achieve the vision of a USD5-trillion economy that relates to a strong, innovation-led productivity-based concept which would result in a circular economy. The governments around the globe are exploring great opportunities in business through SMEs after the crisis created by COVID-19. India is highly utilizing these unwavering opportunities on online platforms (ease-of-doing business) to enhance its innovative capabilities thereby developing a voice for local products through micro, small & medium enterprises (MSMEs) and large firms to fetch future global market demands by delivering a wide spectrum of innovation models, frameworks, and customer-led approaches.

Innovation and technological capabilities are key growth drivers for India's economic advancement that facilitate manufacturing industries to cater for local and global customers, and the economy. In financial terms, the country's innovation and productivity defines the product, process development, technological enhancements, and application of India's visions to stand as a product economy, to excel in manufacturing goods and services, or to be flexible to make their productivity more robust. India is spearheading to an innovation-led powerhouse economy because of frugal inventions achieved through new business project ideas. Based on problem statements thereby, it caters to the demands of regional and global markets. This leads to producing more vital technological outputs with the same manufacturing productivity inputs. This approach would result in achieving good results in making products and goods in a better manner, boosting quality and profitability in business for Indian MSME industries especially.

India fosters MSMEs in product design and process of springboard innovation by executing a framework of structured local and global standards, such as improved budget spending on research and development, funding in education and skill development, and most importantly, facilitating entrepreneurs led by vibrant startups and micro, small and medium industries to initiate an enterprise more efficiently, and also for promoting failed businesses to retire from the market more quickly through simplified schemes and process. Indian policies and schemes are carrying its intricacy to its benefit by utilizing the extensive and heterogeneous market segments in India that are keen on exploring new innovative solutions to their unmet needs through Indian MSMEs. The combination of strong capabilities and mature varieties of MSME schemes offered by different ministries makes India a strong productive innovation base.

MSMEs have been enormously contributing to the expansion of entrepreneurial endeavors through product, process, and business innovations. MSMEs in India are significantly widening their domain across different sectors of the economy through different clusters, producing a diverse range of local products and services to meet demands of domestic as well as worldwide markets. The MSME area is actively involved in different innovative activities through various implementing schemes and policies which function as growth drivers to achieve the USD5-trillion global economy through strong industrialization.

MSME INNOVATION AND PRODUCTIVITY

MSMEs are significant contributors to India's economic landscape. They play a vital and key role in fostering frugal innovations thereby promoting and facilitating entrepreneurship, generating enormous employment opportunities, thereby driving a culture of innovations and productivity in India. Indian MSMEs occupy a wide spectrum of different sectors, such as auto components, machine tools, pharmaceuticals/bulk drugs, foundry, agriculture, food & leather products, silk, coir & coir products, rubber products, toys, hosiery, hand tools, confectionary, chemicals, and textile machinery.

The innovation and productivity in large firms and MSME are discussed below.

Innovation in large firms and MSMEs in India

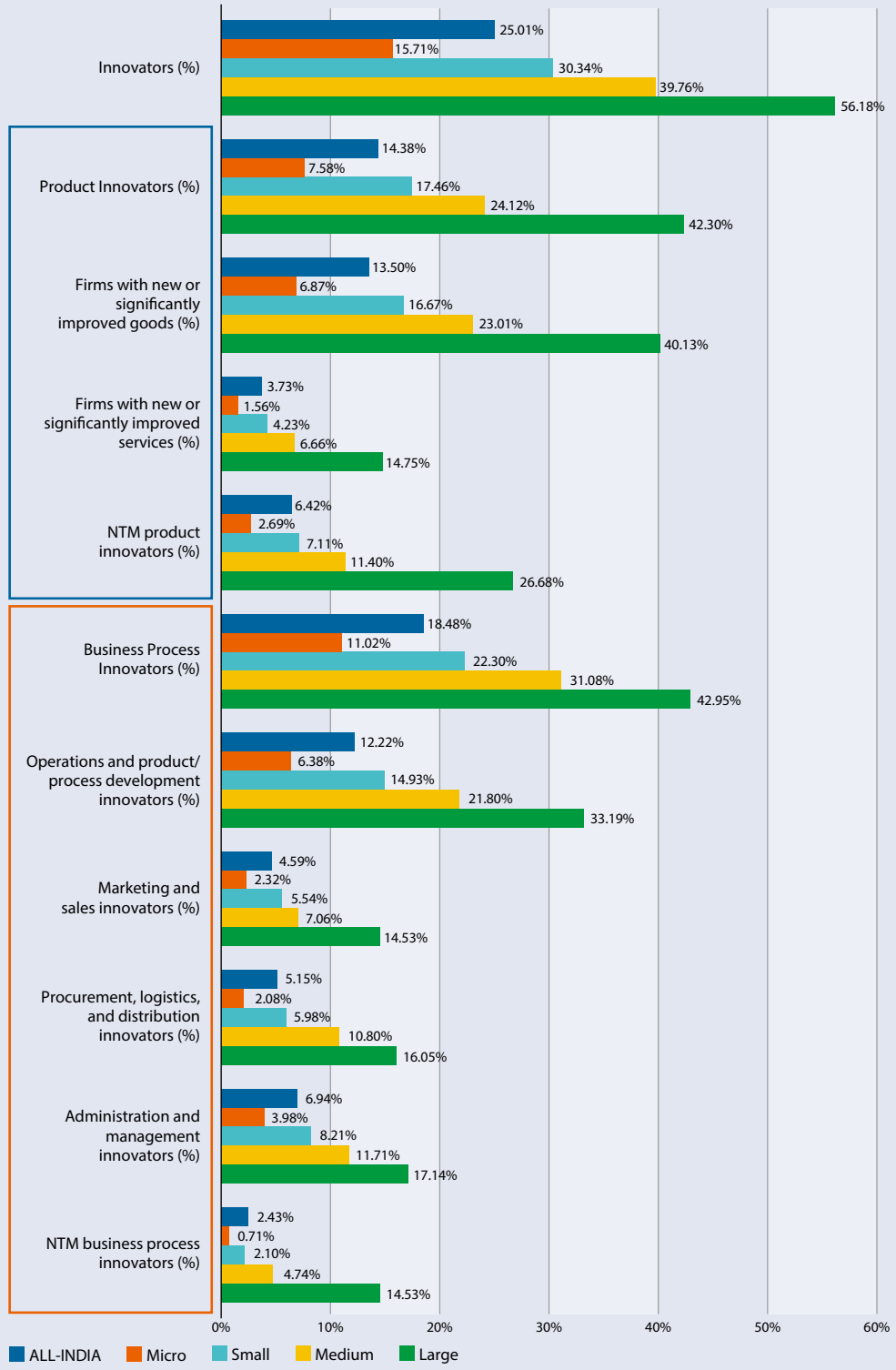
The National Manufacturing Survey 2021–22 (UNIDO, 2023) reported that micro and small enterprises, including start-ups, do indeed succeed in delivering new-to-market (NTM) innovations, responding to their requirement of immediate markets demands (Aggarwal & Joshi, 2024; Prihadyantil, 2024; Department of Science and Technology, 2020; Upadhyaya, 2021). Figure 1 and Figure 2 show that the share of innovative firms in different categories, such as product, process innovations, administrative and management innovators is comparatively highest among large firms, followed by medium, small and micro enterprises. Even though this is evident across all types and characteristics of innovations, such as product innovations, business innovations, product and process development innovations, and marketing and sales innovations, it is evident to see mostly the product innovators and business process innovators are prominent for their percentage share of firms compared to NTM and business process innovation (BPI). NTM product innovators—which clearly proves that micro and small enterprises, including start-ups, certainly have proven that they achieve success across different domains to deliver NTM innovations, responding to their innovations and immediate business markets.

The impact of barriers on innovation input activities in the manufacturing sectors is measured in the National Manufacturing Survey. It shows the share of firms in two categories. One is the low-to-severe impact of each barrier (represented as Frequency) which is examined against the second category which mentions the share of firms that reported each barrier and the firms which failed to innovate (Criticality) (Figure 3). The share of firms that reported low-to-severe impact of a particular barrier to innovation (input) activities is indicated by the frequency of a barrier. Whereas Criticality is a subset of such firms, that is, it provides the share of firms that were noninnovative (not successful in introducing innovations) out of the firms that reported the impact of a barrier (frequency). As seen in Figure 4, the barriers in innovations of the firms are categorized into five ways.

The National Manufacturing Survey indicates that more than 45% of firms reported that the most frequent barrier was the lack of funds within the firm or group, followed by high innovation costs (40.30%) and the lack of finance from external sources (39.52%). On the other hand, the most critical barriers were low demand for innovations in the market (71.23%) and organizational rigidities within the firms, lack of funds within the firm or group (69.28%), and lack of finance from external sources (68.38%).

FIGURE 1

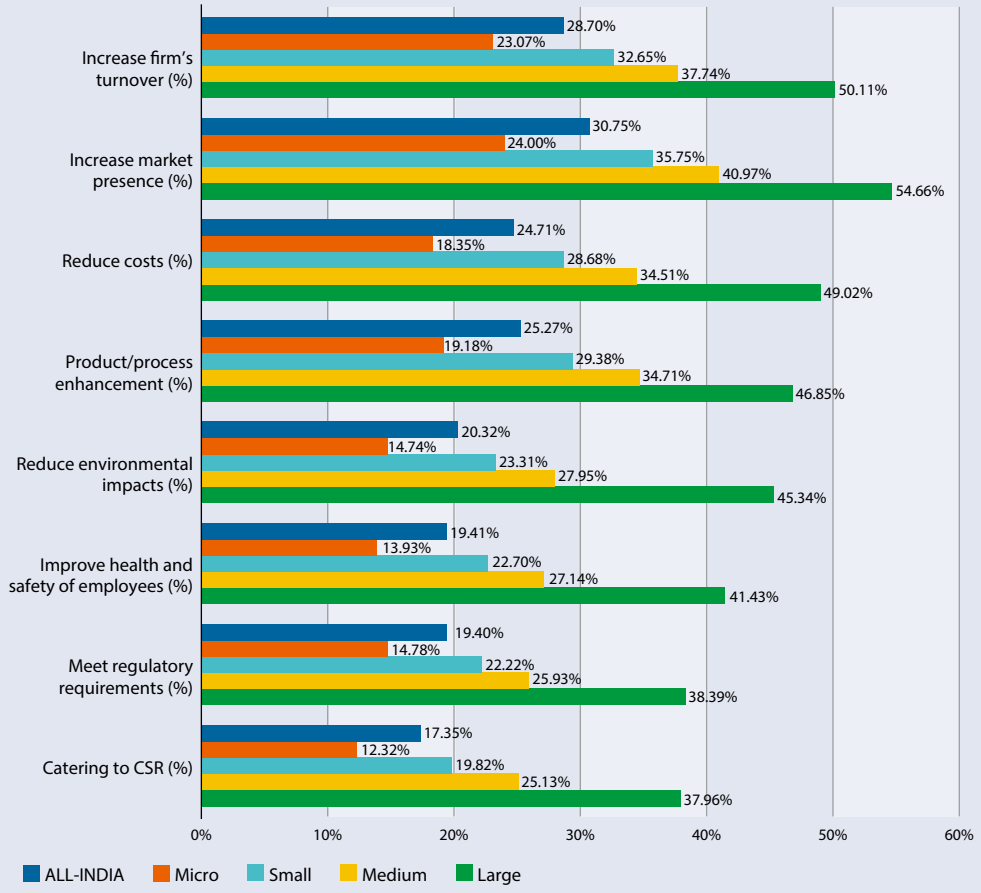
SHARE OF INNOVATIVE FIRMS BY CATEGORY (PRODUCT, PROCESS INNOVATIONS, ADMINISTRATIVE AND MANAGEMENT INNOVATORS)



Source: UNIDO (2023)

FIGURE 2

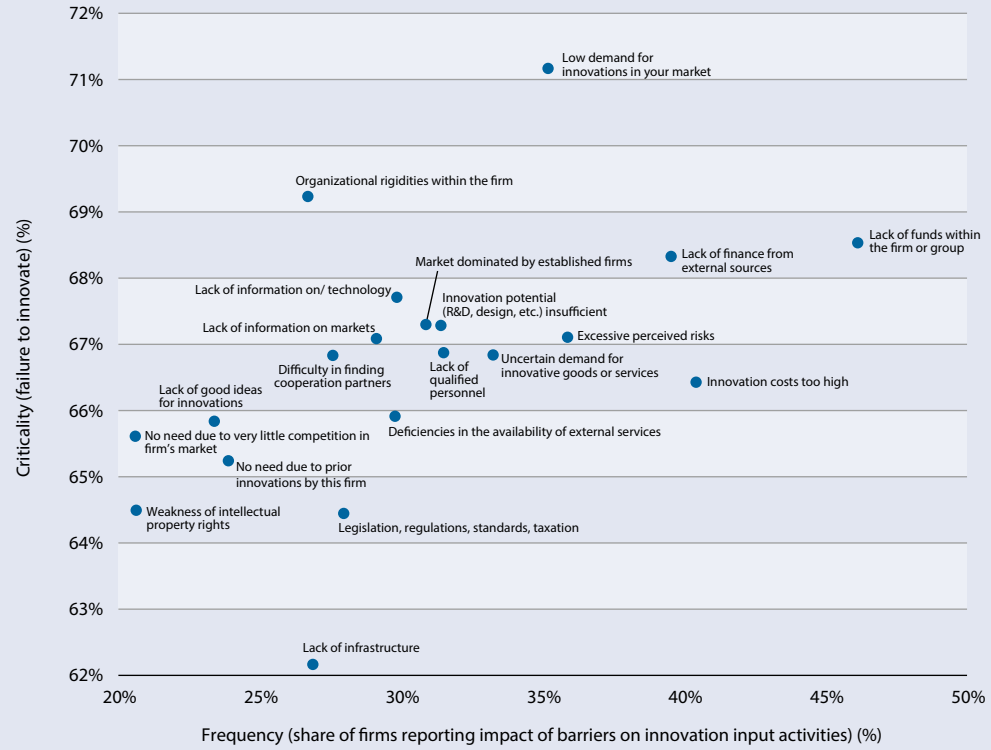
LARGE FIRMS AND MSMES SHARE IN TERMS OF INNOVATIONS, PRODUCTS, AND PROCESS ENHANCEMENTS, REDUCE ENVIRONMENT ETC.



Source: UNIDO (2023)

FIGURE 3

BARRIERS OF INNOVATION IN FIRMS REPRESENTED BY FREQUENCY AND CRITICALITY



Source: UNIDO (2023)

FIGURE 4-1

FIVE DIFFERENT BARRIERS FOR INNOVATION IN MANUFACTURING INDUSTRIES (LARGE AND MSME)

Key findings of the innovation survey

Innovations like purchasing new machinery were mentioned by 70% of innovative firms, and 40% mentioned activities related to quality and standards. Of the firms, 34% claimed process innovations and 32% indicated product innovations. In terms of more products, higher standards of quality, increased production capacity, and less environmental impact, 45% of innovative businesses were on par with their rivals. One of the main outside funding sources was domestic financial institutions. Scientists and engineers were employed by 8% of companies with new product innovations, but 53% of innovative firms lacked them. The size of the company affected the amount of R&D activity; both internally and externally-funded R&D activities were uncommon. The number of skilled workers and staff training was proportionate to the size of the company, and large firms used to obtain information and knowledge from outside sources. Information and communication technology (ICT) was utilized for technology management and research and development by 20% of businesses of all sizes. Enterprise resource planning (ERP) usage is higher in companies that have innovative products and processes. When it came to NTM product/process innovations, 36–90% of innovative firms had a formal R&D setup, whereas non-R&D firms gave priority to "new to firm." Fifty-nine to eighty-nine percent of innovative firms implemented non-technological innovations, with 46–48% implementing marketing innovations and 43–09% implementing organizational innovations. Internal resources are a significant obstacle to all forms of innovation, with 70% citing the cost of innovation for "product" and "process."

Collaboration for innovation:

Innovation in India has been fueled through universities, institutions research laboratories such as Defence Research and Development Organisation, and Council of Scientific & Industrial Research (CSIR), Central Scientific Instruments Organisation (CSIO). Indian MSME has been collaborating with universities through MSME incubation centres, Atal Incubation Centres and state incubation centres supported by state startup policies and Startup India schemes. MSMEs and large firms have been utilizing the schemes of central and state government to promote the innovation and enhance the productivities of the organizations.

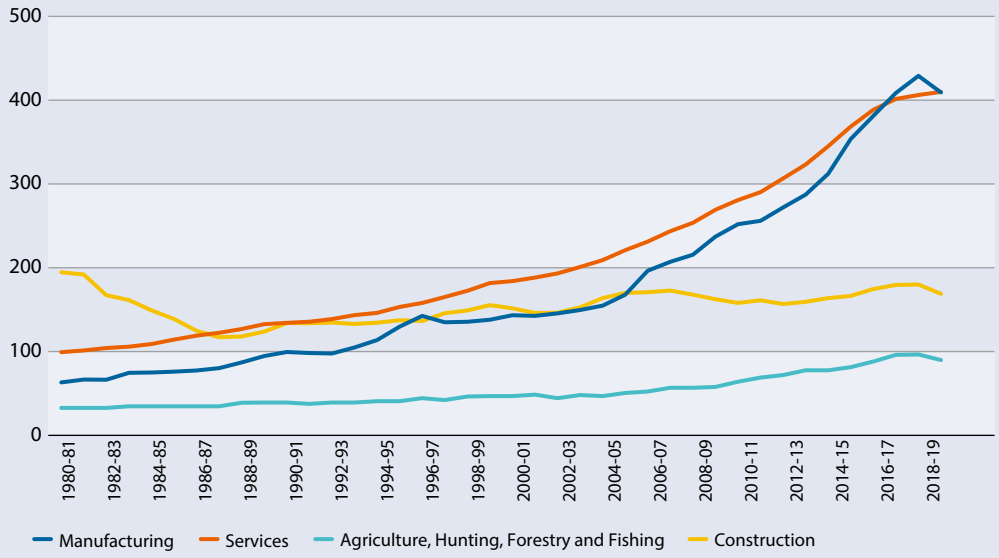
Productivity in Indian MSMEs and large firms

Labor productivity

MSMEs are an important sector in India, second only to agriculture, because they generate a lot of jobs at low capital costs. In India, they stimulate innovation, job creation, and economic expansion. India has a high employment base and a low value-added share. Since 1980, labor productivity in the construction and agriculture sectors has increased more slowly than in other sectors. In contrast, workers in manufacturing and services produced more than four to five times as much in 2019–20 as those in agriculture. Given that more than half of Indian workers are low-productivity workers in the construction and agricultural industries, there is a great chance to accelerate growth by implementing reforms that increase productivity in these industries and allow workers to shift to other, more productive industries. (see Figure 4.2)

FIGURE 4-2

LABOR PRODUCTIVITY BY INDUSTRY



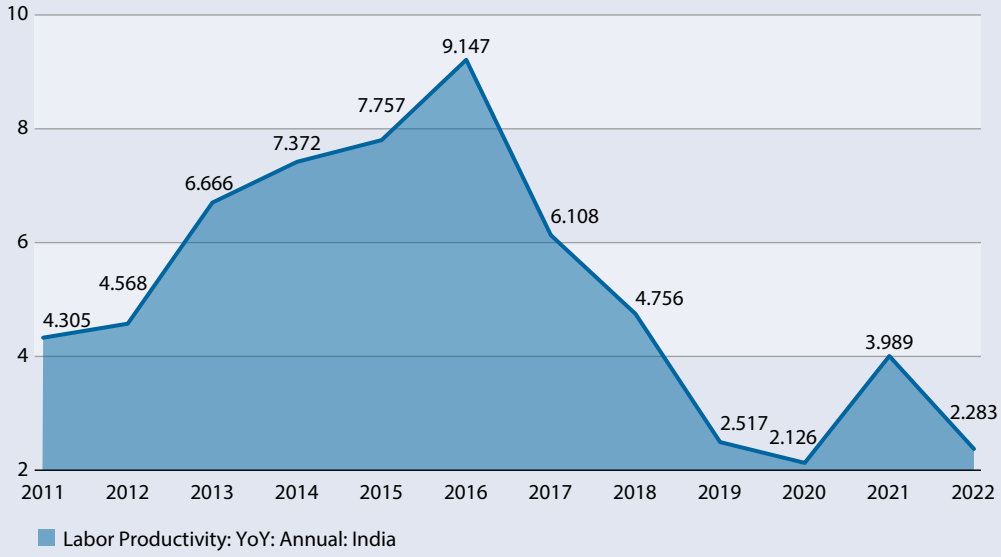
Source: India capital, labor, energy, materials and services (KLEMS) and IMF staff estimates (CEIC n.d.).

Key information about India Labor Productivity Growth

In December 2022, India's labor productivity fell 2.38% year over year, after increasing 3.99% the year before. Annually updated data on India's labor productivity growth is available from December 1992 to December 2022, with an average of 4.31% (see Figure 6). The data peaked at 9.15% in December 2016 and fell to a record low of 0.74% in December 2000. (Figure 4.3)

FIGURE 4-3

LABOR PRODUCTIVITY YOY ANNUALLY IN INDIA.



Source: CEIC Data (n.d.)

Over the past ten years, the government has worked to improve MSMEs' access to financing, improve their technological capabilities, create market connections, and address structural issues. In 2023, the government, working with Small Industries Development Bank of India (SIDBI), launched the Udyam Assist Platform (UAP) to formalize unofficial microbusinesses. Through the platform, more than 23.9 million informal microbusinesses have been formally recognized. Additionally, the Micro and Small Enterprises-Cluster Development Program (MSE-CDP) is being implemented country-wide by the government. To address common issues like improving technology, skills, quality, etc., Common Facility Centers (CFCs) are created. According to the findings of the National Productivity Council's evaluation study of MSE-CDP, the program has been successful in increasing the value chain efficiency of the units within the cluster, leading to a growth in turnover of 20–30% and an overall productivity increase of about 10–15%. The steps being taken by the government to further enhance labor productivity in the unincorporated non-agricultural sector are the following: (a) a 5.6% increase in gross value added (GVA) per worker in 2023–24; (b) the way government plans to sustain the observed growth in the GVA of the unincorporated sector, which recorded a 16.5% increase in 2023–24; and (c) the specific measures taken to enhance the skills of workers in the unincorporated sector, particularly in high-growth areas.

In India, enhancement of labor productivity and skills of workers is continuous and dynamic process. The government is implementing various skill enhancement schemes like the National Apprenticeship Promotion Scheme (NAPS), Deen Dayal Antyodaya Yojana - National Urban Livelihoods Mission (DAY-NULM), Rural Self Employment and Training Institutes (RSETIs), and Future Skills PRIME etc. Pradhan Mantri Kaushal Vikas Yojana (PMKVY) is being implemented by the Ministry of Skill Development and Entrepreneurship (MSDE) since 2015 for imparting skill development training through Short-Term Training (STT) and up skilling and re-skilling through Recognition of Prior Learning (RPL) to youth across the country. Further, the Government has announced in Budget 2024–25, the Prime Minister's package of five schemes and initiatives to facilitate employment, skilling, and other opportunities for 41 million youth across the country over a five-year period with a central outlay of INR2 trillion. Measures announced in the Budget 2025–26 include setting up of five National Centres of Excellence for skilling with global expertise and partnerships to equip youth with the skills required for "Make for India, Make for the World" manufacturing; expansion of capacity of Indian Institutes of Technology (IIT), and setting up a Centre of Excellence in Artificial Intelligence for education with a total outlay of INR5 billion. The Employment Linked Incentive (ELI) scheme announced in Budget 2024–25, with an outlay of INR107 billion aims at job creation and formalization of workforce, enhancing employability and incentivizing additional employment generation through incentives to employees and employers.

Total Factor Productivity (TFP)

The various literature studies conducted in India mentioned that a slow or negative growth in TFP in various manufacturing sector during 1951–1979. The post-reform studies are inconclusive about improvement in the TFP growth in the Indian manufacturing sector. In the Indian context as well, there is no definite conclusion on the effect of firm size on productivity. The studies conducted by Mazumdar (1991) (Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023), suggested taking sales as proxy for firm size, found larger firms to be less productive. On the other hand, researchers found a positive association between firm size and productivity in the Indian informal sector by taking employee count as the indicator of firm size.

The study conducted by various researchers has taken 23 manufacturing groups across different sectors in India (Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023). It was observed that large firms in the sample were concentrated in industries such as basic metals, chemicals, machinery, and motor vehicles groups. The study mentioned that the industries of printing and reproduction of media, wood products, and leather products comprised less than 1% each of the total sample, while there was no large firm engaged in furniture manufacturing. In fact, the Indian MSMEs were concentrated particularly in chemicals, machinery, textiles, and basic metals. The industries of printing and reproduction of media, furniture, tobacco products, coke, petroleum, and other transport comprised less than 1% of the total MSMEs (Figure 5-1). The results investigated from the research studies suggest that the productivity was comparable for large firms and MSME firms, with the larger firms performing better from 2011 to 2021 (Figure 5-2); the difference was tending to narrow in 2013–14 and rose marginally thereafter (Figure 5-2a). The growth in productivity stagnated in large firms till 2014–15 and increased until 2018–19.

In 2019–20, various manufacturing sectors saw a sharp decline in productivity. The movement in GVA manufacturing, which shrank by 3% in 2019–20, is consistent with this. Likewise, according to KLEMS data, manufacturing TFP shrank by 7.8% in 2019–20. Productivity for MSMEs in India was almost constant throughout and decreased in 2019–20. Both large and MSMEs saw a dramatic recovery in productivity growth after that, with MSMEs eventually overtaking large firms in terms

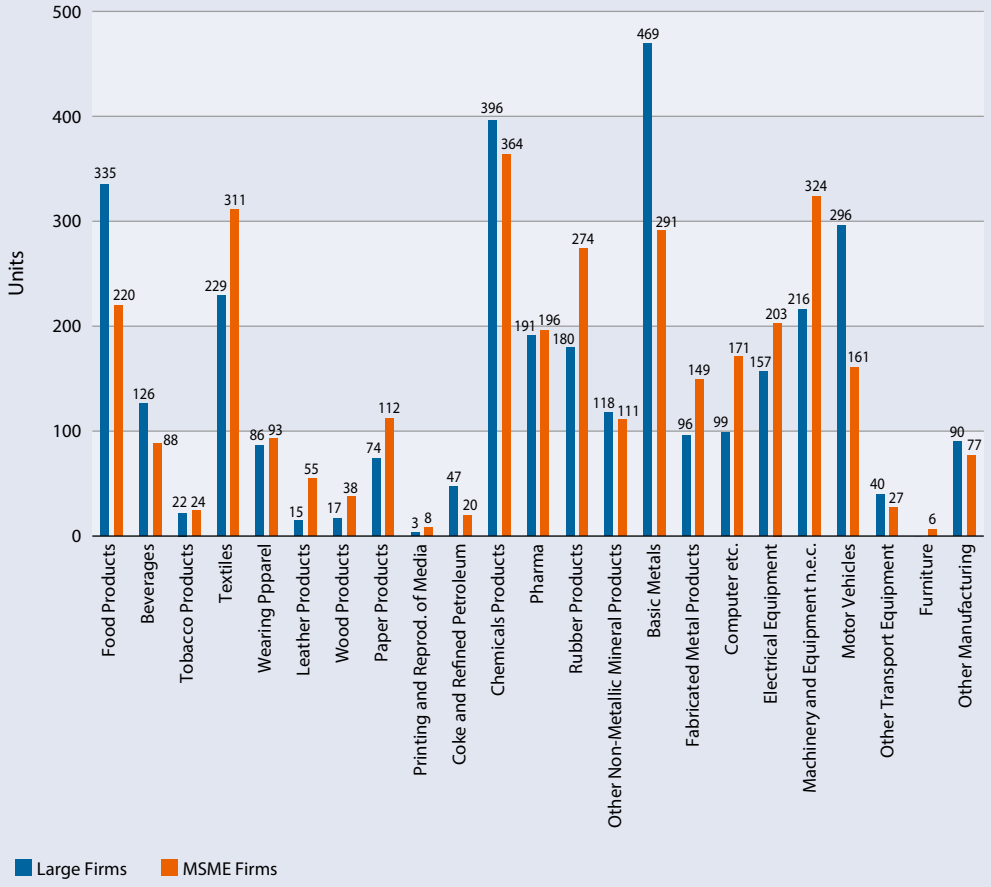
of growth (Figure 5-2b and Figure 5-2c). It was found that the recovery in the MSME sector might be due to funds aided by government initiatives like the Emergency Credit Line Guarantee Scheme (ECLGS) scheme. Furthermore, the average TFP levels indicated that, in the majority of manufacturing sectors—with the exception of paper and paper products, where MSMEs were found to be more productive—large firms were marginally more productive. In industries like tobacco, coke, petroleum, and food products, large corporations in the manufacturing sector were found to be more productive than their MSME counterparts (Chart 3).

The micro subsector in the Indian MSME sector makes up 99% of the entire industry. According to our analysis, 45.2% of all businesses are in the micro sector, 51.1% are small businesses, and the remaining 3.7% are medium-sized businesses (Chart 4). Prior to the pandemic, productivity growth in all subsectors stalled. Alongside a drop in manufacturing GVA, the micro sector's productivity fell sharply by 20.9% in 2019–20. In 2021–2022, post-pandemic microbusinesses showed the strongest recovery, followed by small and medium-sized businesses (Chart 5).

The average TFP growth from 2012–13 to 2019–20 was compared with the average TFP growth from 2020–21 to 2021–22 in the study of productivity growth in India's manufacturing industries before and after the COVID-19 pandemic for MSMEs and large firms (Chart 6). At the two-digit NIC level, the average productivity growth in MSMEs during the pre-pandemic period varied by industry. Most labor-intensive industries as well as the transportation, machinery, and automobile sectors saw a decline in productivity. Productivity rose in all industries after the pandemic, with printing media, coke, and petroleum showing only slight increases. Furniture, wood products, and paper products saw the biggest increases in productivity (Chart 6a). TFP growth for big businesses was found to be positive but modest (between 0.5 and 1%) for most sectors prior to COVID-19. While the industries producing tobacco and printed media saw a decline in productivity, the coke and petroleum sectors saw greater growth, at 2%. Productivity rose in all industries between 2020–21 and 2021–22, with the largest increases seen in computers, transportation equipment, and paper goods (Chart 6b).

FIGURE 5-1

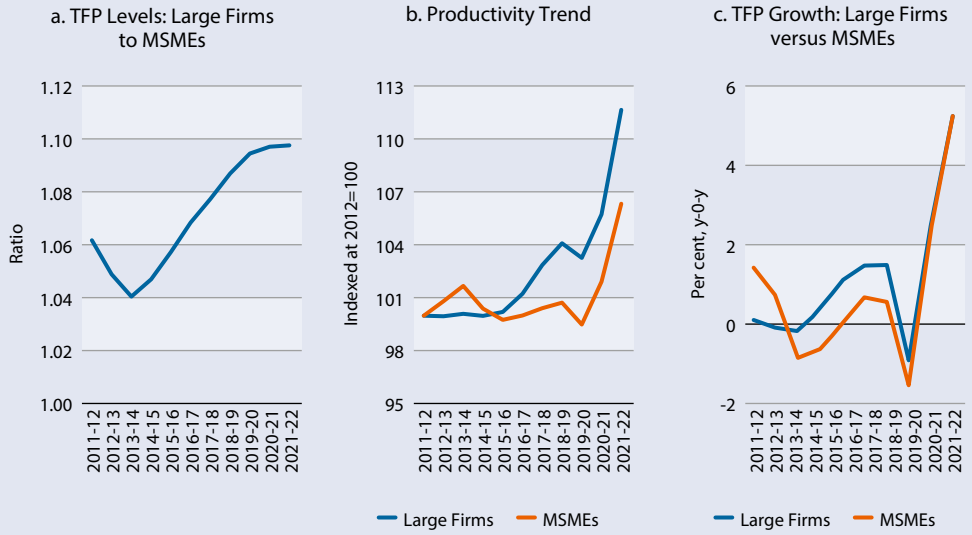
COUNT OF COMPANIES BY INDUSTRY



Source: CMIE Prowess (n.d.); Schwabe, (2021); Peres et al. (2010); Shukla et al. (2023); Suwanda & Caloffi, (2023); and Authors' estimates

FIGURE 5-2

TFP IN MANUFACTURING SECTOR

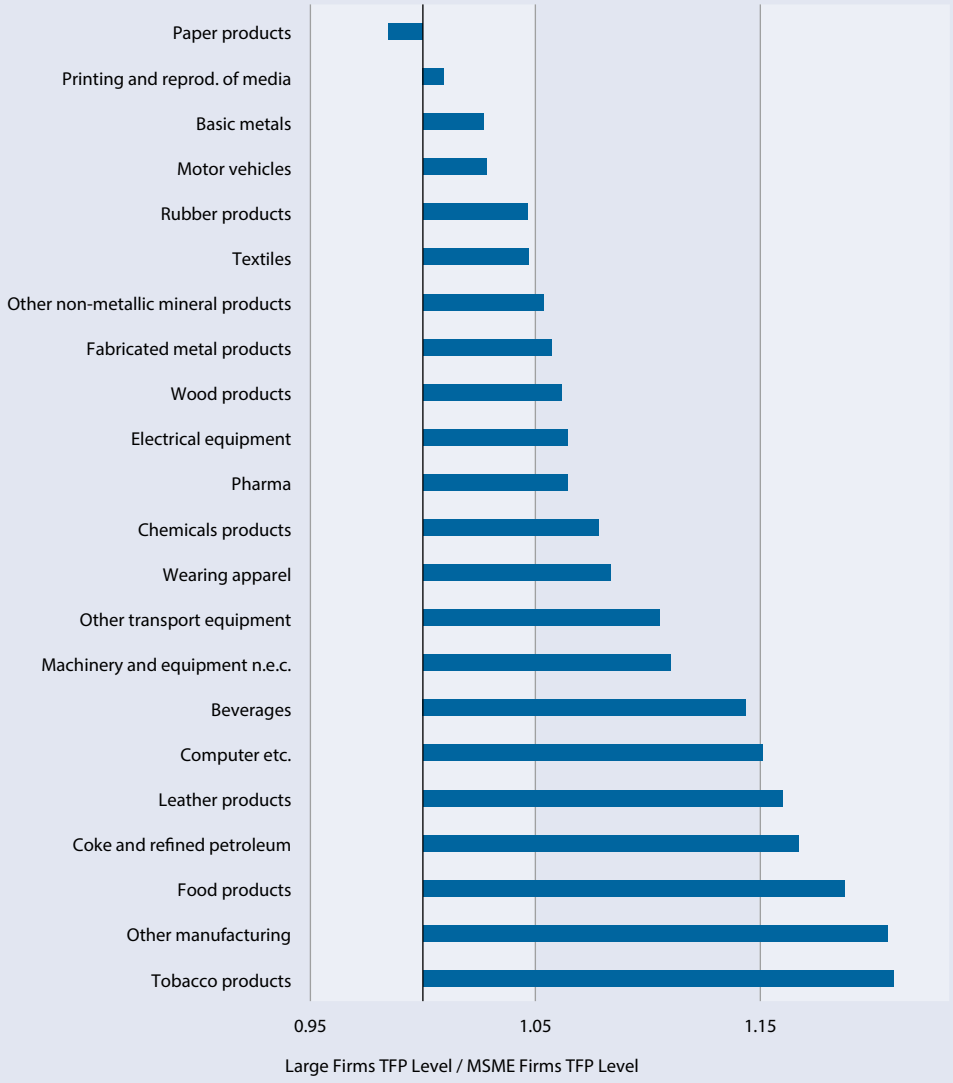


Source: Reserve Bank of India Occasional Papers (CMIE Prowess n.d.; Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023); and Authors' estimates.

Figure 5-1 shows the printing and reproduction of media, furniture, tobacco products, coke and petroleum and other transport comprises less than 1% of the total MSMEs. Figure 5-2 illustrates the productivity and total factor productivity of large firms and MSMEs.

FIGURE 6

PRODUCTIVITY WITHIN MANUFACTURING INDUSTRY (NIC 2-DIGIT)



Source: Reserve Bank of India Occasional Papers (CMIE Prowess n.d.; Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023) and Authors' estimates.

Figure 6 shows the comparison of productivity of large firms and MSMEs in India.

FIGURE 7-1

MSME COMPOSITION (%)

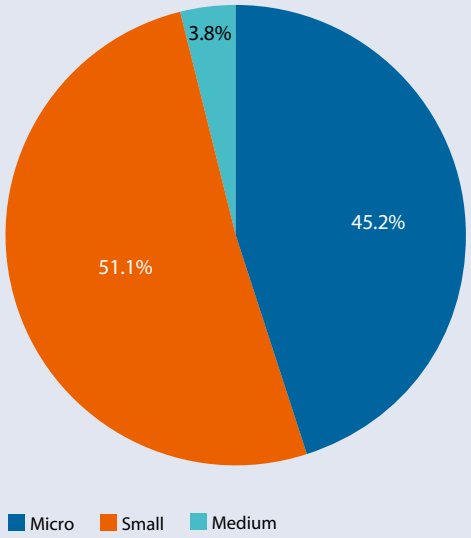
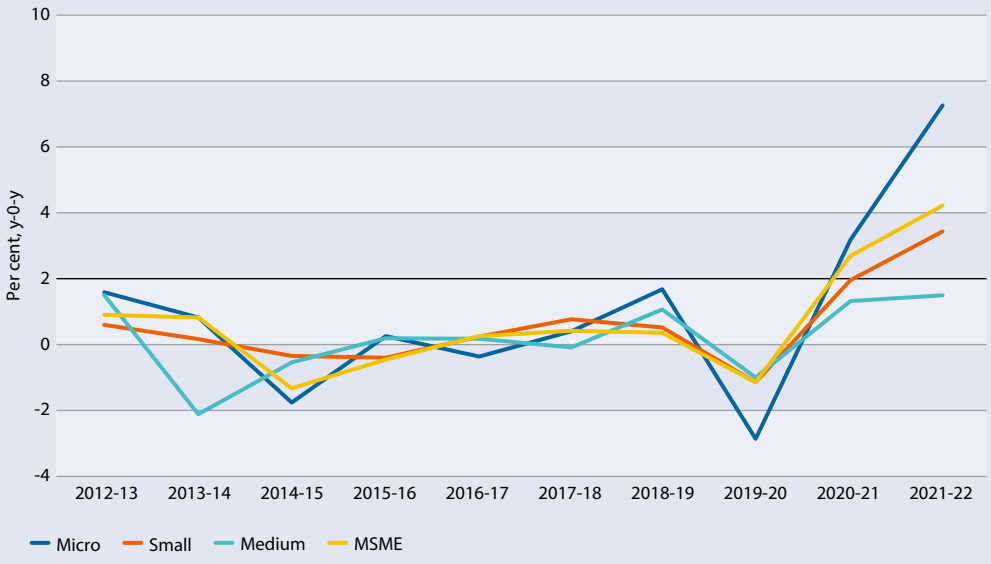


FIGURE 7-2

DISAGGREGATED TFP GROWTH WITHIN MSMES



Source: Reserve Bank of India Occasional Papers (CMIE Prowess n.d.; Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023) and Authors' estimates.

Figure 7-1 shows composition of MSMEs. Figure 7-2 shows the Total Factor Productivity of MSMEs pre and post pandemic in India.

FIGURE 8-1

MSME FIRMS' TFP

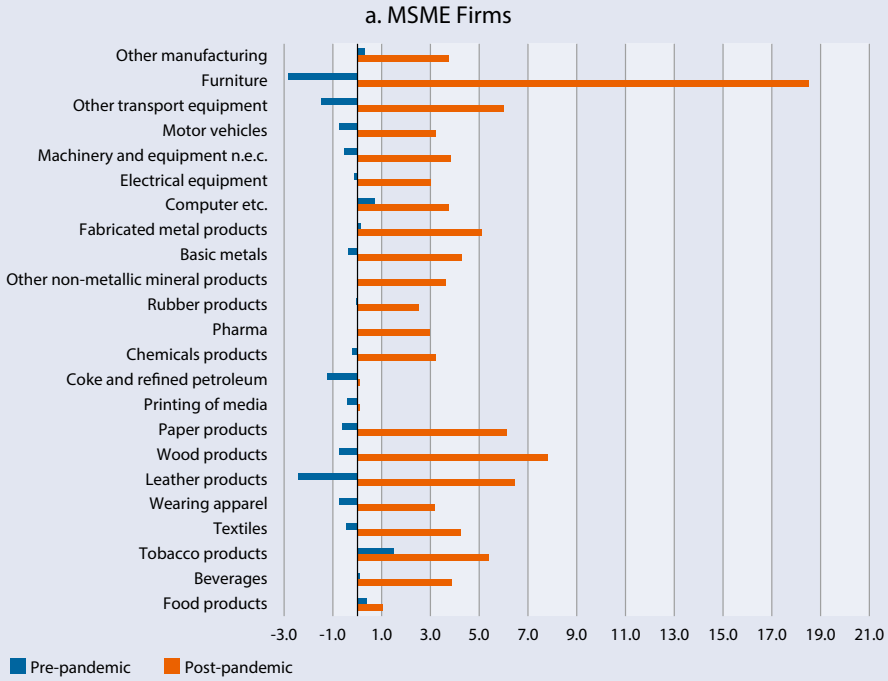
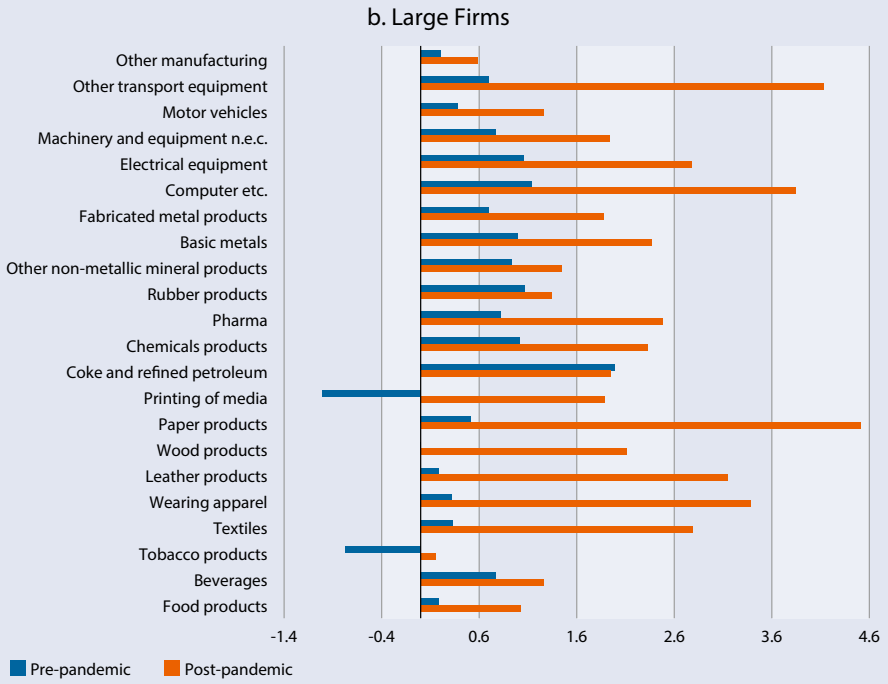


FIGURE 8-2

LARGE FIRMS' TFP



Source: Reserve Bank of India Occasional Papers (CMIE Prowess n.d.; Schwabe, 2021; Peres et al. 2010; Shukla et al. 2023; Suwanda & Caloffi, 2023)

Figure 8-1 illustrates the Total Factor Productivity gains of MSME of different industries such as furniture, motor vehicles, food products etc. and Figure 8-2 shows the TFP gains of large firms in India for the same industries.

INDIAN POLICY MEASURES (SUPPLY-SIDE) TO PROMOTE MSME INNOVATION, PRODUCTIVITY, AND TECHNOLOGICAL CAPABILITIES.

MSMEs are the strong backbone of India's economic landscape, pivotal in employment generation, entrepreneurship promotion, and economic development [9]. MSMEs are completely resilient, perform frugal innovation, and are more adaptable to market demands, thereby consistently driving the economy's growth, providing job opportunities to millions of youths, and leading to foster inclusive development. The Indian economy is constantly striving to position itself as a global economic powerhouse leader. The different sectors of MSME undoubtedly plays a pivotal role, fostering innovation and productivity, generating employment opportunities in different sectors, and enhancing the global export competitiveness. The Indian MSMEs enormously contribute nearly one-third to India's GDP, and are one of the important key pillars of the government's mission policies such as Make in India and Digital India. The government of India's continued efforts to formalize the MSMEs is furthering the important credit penetration in the manufacturing sector. Figure 7 shows different policy measures for facilitating innovation, productivity and technological capabilities offered through schemes by different ministries of the government of India for Indian MSMEs. The classification of Indian MSMEs is illustrated in (Box 1).

BOX 1

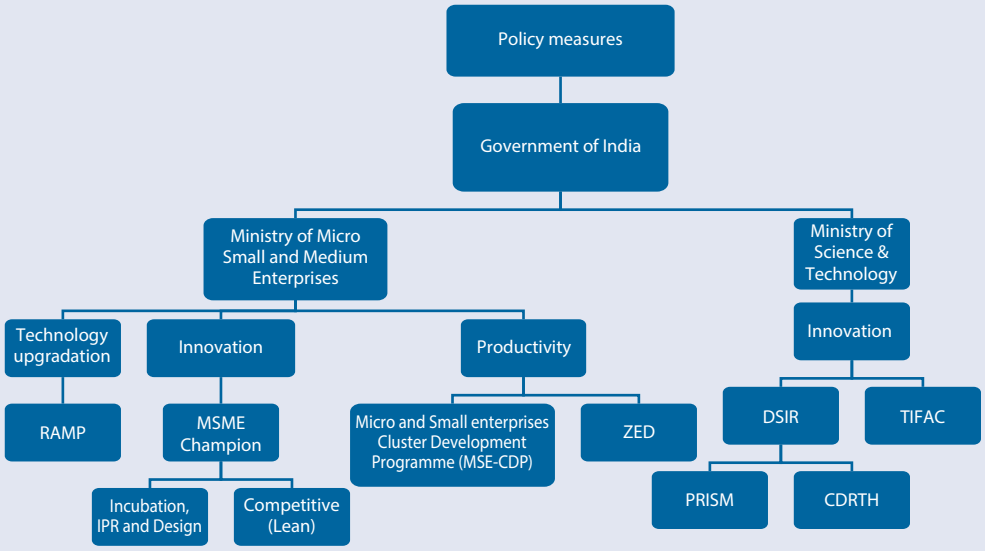
THE BROAD CLASSIFICATION OF DIFFERENT SECTORS OF INDIAN MSMES

In accordance with the Revised Classification as applicable with effect from 1st of July 2020, Indian MSMEs are broadly categorized as follows:

- **Micro Enterprise:** The enterprises where the investment in plant and machinery or manufacturing equipment would not formally exceed INR10 million and further the annual turnover does not wholly exceed **INR50 million**.
- **Small Enterprise:** The enterprises where the investment in plant and industrial machinery or manufacturing equipment does not fully exceed INR100 million and whole annual turnover does not wholly exceed **INR500 million**.
- **Medium Enterprise:** The classified enterprise where the investment of the enterprise in plant and industrial machinery or equipment does not exceed INR500 million and whole annual turnover does not fully exceed **INR2.5 billion**.

FIGURE 9

POLICY MEASURES BY THE GOVERNMENT OF INDIA FOR FACILITATING THE INNOVATION, PRODUCTIVITY, AND TECHNOLOGICAL UPGRADATION OF INDIAN MSMES.



Note: RAMP, Raising and Accelerating MSME Performance; IPR, intellectual property rights; ZED, Zero Defect Zero Effect; DSIR, Department of Scientific and Industrial Research; TIFAC, Technology Think Tank for Government of India; PRISM, Promoting Innovations in Individuals, Start-ups and MSMEs; CDRTH, Common Research and Technology Development Hub.

Government of India schemes

Ministry of Micro Small and Medium Enterprises

Ministry of Micro, Small & Medium Enterprises (M/o MSME) envisions a progressive growth of the MSME sector in different manufacturing engineering domains by smartly promoting growth and inclusive development of the various manufacturing sectors through frugal innovation, technological upgradation and productivity of Khadi products, rural villages and coir manufacturing industries, in collaboration with different inter and intra ministries/departments, state governments and different stakeholders, such as large firms, by providing technological, financial, research, public infrastructure resources and support to present enterprises, and also adopting state of the art disruptive tools and techniques of digital manufacturing transformations of Industry 4.0, thereby encouraging creation of new MSME enterprises.

Policy measures for Technology upgradation

Scheme 1: Raising and Accelerating MSME Performance (RAMP)

Objectives and policy content:

RAMP, a World Bank-backed Central Sector Scheme, aims to increase MSME access to markets, financing, and technological advancements by strengthening the current M/o MSME schemes through outreach initiatives.

Increasing the efficiency of current M/o MSME schemes for technology upgrades, strengthening the MSME Receivable Financing Market,

Increasing the effectiveness of Credit Guarantee Trust for Micro & Small Enterprises (CGTMSE) and encouraging guarantees for MSME's greening initiatives and women-owned MSMEs are all examples of how to accelerate center-state collaboration in MSME promotion and development, lowering the frequency of MSE payment delays.

Year of operation: 2022–2027

Implementing mechanism: World Bank-supported Central Sector Scheme / Ministry of Micro Small and Medium Enterprises, Government of India

Intended beneficiaries: Individual MSME existing Ministry of MSME schemes and through state government/agencies

Evaluation results:

Thirty-five states and union territories have signed letters of undertaking (LoU) with the M/o MSME, indicating their interest in taking part in the RAMP Scheme. To prepare a strategic investment plan (SIP), which will serve as a roadmap for the growth and promotion of the MSME sector in their respective states and Union territories, 33 states and union territories have been awarded a grant of INR50 million each.

Policy measures for Innovation

Scheme 2: MSME champion: MSME-Innovative (for Incubation, Design and IPR)

The scheme acts as a hub for innovation activities facilitating and guiding development of ideas and concepts into viable business value proposition that can benefit society directly and can be marketed successfully locally and globally.

The scheme has three components, i.e., (1) Incubation, (2) Design, and (3) IPR.

Incubation: The scheme facilitates the individual to incubate the ideas and concepts through incubation centers by MSME.

Design: To promote the MSME to design new products through design clinics by design intervention focusing on product and process innovations. The strength of the scheme is to make the MSME transform from original equipment manufacturers (OEM) to original design manufacturers (ODM).

IPR: The schemes facilitate the innovation through protecting intellectual property rights IPR supported by MSME IPR facilitation centers established across India in a single mode approach.

Year of operation: 10th March 2022

Category: Innovation and technological development

MSME-Innovative (Incubation)

Objectives and policy content:

To encourage and assist people with unrealized creativity and innovation, particularly in academia and universities (host institutions), in becoming entrepreneurs. To encourage the use of cutting-edge manufacturing technologies and knowledge-based, creative MSMEs. The Offices of Development Commissioner (DC(MSME)), Ministry of MSME, Government of India, is responsible for implementing the scheme. The intended beneficiaries are Udyam* Registered Manufacturing MSMEs. Results of the evaluation: 697 Host Institutes (HIs) were approved. Three ideas (women's) out of 397 were accepted at the MSME Idea Hackathon.

MSME-Innovative (Design)

Objectives and policy content:

- To connect Indian MSMEs manufacturing sector and design expertise / design fraternity on to a common and unique platform.
- To provide expert advice and cost-effective solutions on real time design problems in different sectors of manufacturing for new product development, its continuous technological enhancement and bring value addition in existing or new products through innovations.

Implementing mechanisms: Through the Offices of Development Commissioner (MSME), M/o MSME

Intended Beneficiaries: Udyam Registered manufacturing MSME.

Evaluation results:

- MoU has been signed: one with Indian Institute of Science (IISc), Bengaluru, seven with IIT, 12 with National Institutes of Technology (NIT)
- Professional design /student projects approved: 23.
- 77 awareness programs and six national-level workshops approved.

MSME-Innovative (IPR)

Objectives and policy content:

The objective of the scheme is to improve the IP culture in India with the following interventions:

Increasing MSME awareness of Intellectual Property Rights (IPRs) and promoting innovative intellectual activity in the Indian economy are two of the program's interventions aimed at improving IP culture in India.

To effectively use IPR tools and commercialize ideas, technological innovation, and knowledge-driven business strategies created by MSMEs, appropriate measures must be taken to protect them.

Implementing mechanism: MSME-Development & Facilitation Office (MSME-DFO) / TCs (Technology Centers) act as the implementing agency and The National Manufacturing Innovation Unit (NMIU) monitors the scheme on behalf of the Development Commissioner (MSME)

Intended Beneficiaries: The applicant or entity or unit must have a valid Udyam Registration.

Evaluation results:

- No. of IP Facilitation Centers approved: 20
- No. of Reimbursement for Patent: 25
- No. of Trademark reimbursement: 170
- No. of Design reimbursement: 21
- Additional initiatives: IP Outreach Mission in Aspirational Blocks, GI Facilitation to identified potential GI Products under One District One GI Program, IP Yatra

MSME-Competitive (Lean)

Objectives and policy content

To enhance the competitiveness of MSME Sectors through implementation of Lean Tools and Techniques. Lean Tools and Techniques are a tested and proven methodology for improving the competitiveness of MSME sector.

Year of operation: MSME-Competitive (Lean) Scheme was launched on 10th March 2023.

Implementing mechanism: By the offices of Development Commissioner (MSME), M/o MSME through Quality Council of India and National Productivity Council.

Intended beneficiaries: Udyam Registered manufacturing MSME.

Evaluation results:

- Registration in Scheme: 10890
- Pledge in Scheme: 10847
- Lean Basic Certified: 5144

BOX 2

ILLUSTRATES THE DETAILS OF UDYAM REGISTRATION

The Indian government offers micro, small, and medium-sized enterprises (MSMEs) doing business there an electronic certificate called Udyam Registration. MSMEs can access a range of government incentives and benefits that are only accessible to businesses classified as MSMEs by registering with Udyam. There is no need to upload any documents, papers, certificates, or proofs because the Udyam registration process is fully self-declaratory.

The Ministry of Micro, Small and Medium Enterprises (MSME) of the Government of India has established 18 Technology Centres (TCs) across the country [Tool Rooms (10) and Technology Development Centres (8)]

Ministry of Science & Technology, Government of India (Agarwal, V. et al, 2023) Department of Scientific & Industrial Research

Common Research and Technology Development Hub (CRTDH)

Objectives of the policy:

- To provide MSME clusters with the much-needed Supportive ecosystem, which encourages and facilitates innovation essential for MSMEs.
- It gives access to cutting-edge infrastructure, incubation facilities, business development services, and R&D facilities.
- Additionally, MSMEs have access to a collaborative platform that facilitates networking opportunities, collaboration between MSMEs, research institutions, and other stakeholders, development of skills, identification of new market opportunities and emerging customer needs, and promotion of knowledge sharing
- **Implementing agency:** Department of Scientific & Industrial Research

Years of operation: 2014

Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

It focuses on supporting individual innovators, start-ups and MSMEs to convert innovative ideas into demonstrable working models / prototypes / processes and assists them to become technopreneurs.

Implementing agency: Department of Scientific & Industrial Research

Years of operation: 2012

Scheme of Fund for Regeneration of Traditional Industries (SFURTI)

Objectives and policy content

The scheme's goal is to build up innovative products, improved technologies, advanced processes, market intelligence, and new models of public-private partnerships. It also aims to make traditional industries and artisans more competitive and support their long-term sustainability and sustained employment. Additionally, it aims to improve the marketability of the products produced by these clusters, equip traditional artisans in the associated clusters with improved skills, provide common facilities, and provide better tools and equipment for artisans. The scheme covers three types of interventions:

- Soft interventions include things like exposure visits, market development programs, counseling, skill and capacity building, design and product development, and activities to raise general awareness.
- Hard interventions include the establishment of shared facilities, raw material banks, improved production infrastructure, warehousing facilities, tools, and technological advancements, among other things.
- Thematic interventions: Cross-cutting interventions for research and development, e-commerce projects, new media marketing, brand building, etc.

Year of operation: 2005–2006

Implementing mechanism: Office of Ministry of Micro Small and Medium Enterprises

Intended beneficiaries: Non-Government organizations (NGO), Institutions of the Central and State Governments and semi-Government institutions, field functionaries of State and Central Government, Panchayati Raj institutions (PRI), Private sector by forming cluster specific SPVs, Corporates and Corporate Social Responsibility (CSR) foundations with expertise to undertake cluster development.

Evaluation results:

513 clusters have been approved with the government of India's grants totaling INR13.35 billion under the Scheme of Fund for Regeneration of Traditional Industries (SFURTI), which will benefit approximately 303 thousand artisans between 2015 and December 10, 2023. In the northeastern region, 87 of these clusters have been authorized. Fifty clusters are now operational, and 15 SFURTI cluster proposals have been approved between April 1, 2023, and March 31, 2024.

DEMAND-SIDE POLICY MEASURES TO PROMOTE THE INNOVATION, PRODUCT, PROCESS DEVELOPMENT AND MARKETING OF THE PRODUCT.

Objective: To create markets for innovative products made by MSME and stimulate demand of SMEs themselves to innovate. Demand-side innovation policies are public measures that aim to increase demand for innovation and improve conditions for its uptake. Some examples of demand-side innovation policies include: Public procurement—Encouraging demand for certain products, services, or technologies to stimulate the market, demonstration projects, market niche creation, creating market incentives. Defining new functional requirements for products and services, better articulating demand.

One demand-side innovation policy instrument, the Credit Linked Capital Subsidy Scheme (CLCSS), is a scheme that helps MSMEs adopt new technologies. The scheme is part of the National Manufacturing Competitiveness Programme (NMCP).

How does the scheme work?

- The scheme provides a capital subsidy to MSMEs to upgrade their technology and business processes.
- The subsidy can be used to purchase new plants and machinery, or equipment.
- The scheme is applicable to new plants and machinery that is eligible for a term loan from Prime Lending Institutions (PLIs).
- SC/ST MSEs get a 25% subsidy on the cost of plant and machinery, up to a ceiling of INR25 hundred thousand.

The Ministry of Micro Small & Medium Enterprises, Government of India has introduced both: (a) the **Government e-Marketplace (GeM)** for facilitating the MSMEs and large enterprises, and (b) the **Open Network for Digital Commerce (ONDC)**.

MSMEs are encouraged to use e-commerce platforms, especially GeM, to market their goods to support their expansion. A centralized procurement portal for ministries and public sector enterprises (PSUs), GeM is a government-owned and run online platform. MSMEs were able to reach more potential customers in the government sector and gain more visibility by promoting their goods on GeM. This initiative facilitates the simplification of the following parameters.

Procurement processes include:

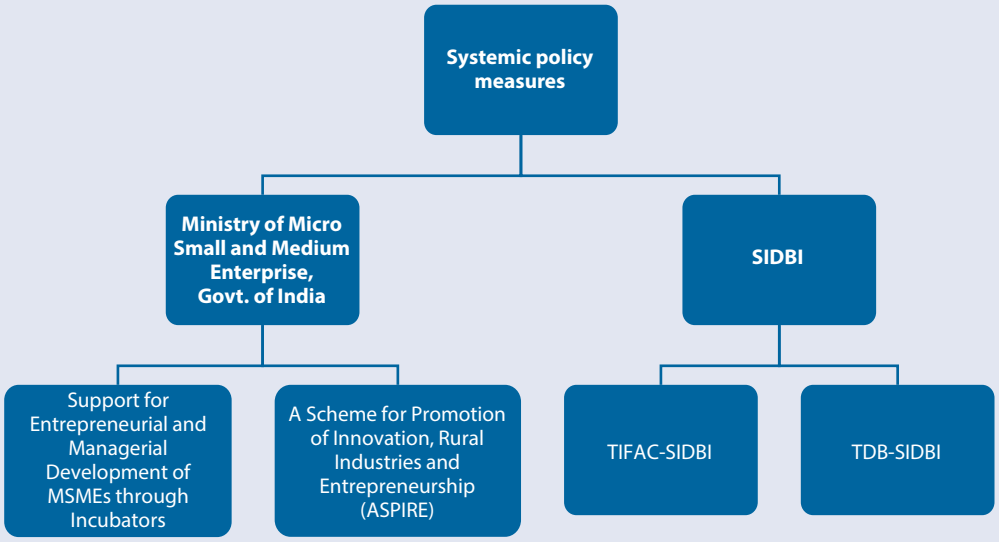
(i) Fostering transparency
(ii) Creating opportunities for MSMEs to secure government contracts
(iii) **Open Network for Digital Commerce (ONDC)** is an initiative by the government of India to promote an open e-commerce network that connects shoppers, platforms, and retailers.
(iv) The Ministry of MSME launched a sub-scheme "MSME Trade Enablement and Marketing Initiative" (MSME-TEAM Initiative), which aims at assisting five hundred thousand MSMEs to onboard the ONDC platform.
(v) **ONDC envisions bringing six to seven times more MSMEs** and connecting 80–90 million self-employed workers to the digital commerce ecosystem.

SYSTEMIC POLICY MEASURES THAT PROMOTE INNOVATIONS THEREBY LEADING TO ENTREPRENEURS

Systemic policy measures to promote innovation includes increasing R&D funding, improving the business environment, supporting a strong human capital base, promoting collaborative research, developing indigenous technologies, supporting innovation linkages. The systemic policy measures that facilitate the above parameters in Indian MSMEs are shown in Figure 10.

FIGURE 10

SYSTEMIC POLICY MEASURES THAT PROMOTE INNOVATIONS LEADING TO ENTREPRENEURS



Note: SIDBI, Small Industries Development Bank of India; TIFAC, Technology Information Forecasting and Assessment Council; TDB, Technology Development Board

Ministry of Micro Small and Medium Enterprises, Government of India

Scheme: Support for Entrepreneurial and Managerial Development of MSMEs through Incubators

Started/launched: 2008

Implementing agency: Ministry of Micro Small and Medium Enterprises, Government of India

Objectives and policy content

The scheme's primary goal is to encourage and support people's untapped creativity, the adoption of cutting-edge technologies in manufacturing, and knowledge-based, innovative MSMEs (ventures) that are looking to validate their ideas at the proof-of-concept stage. The program also encourages interaction with enablers, who will help these MSMEs grow their businesses by offering guidance on design, strategy, and execution. An essential component of business development, the enablers, will be crucial. Technical colleges, universities, R&D institutes, other professional colleges and institutions, NGOs engaged in related activities, Entrepreneurs Development Centers (EDCs), MSME-Dls (Development Institutes)/TCs, District Industries Centres (DICs), or any other Central or State Government institution or organization may apply for Host Institute (HI) and set up a Business Incubator (BI).

Benefitted under the scheme: 780 Host institutes.

Scheme:	A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship (ASPIRE)
Objective	Establishing Livelihood Business Incubation Centers (LBI) to support, mentor, and handhold young people with funding facilitation, entrepreneurship education, and skill development training to enable them to launch their own businesses. By establishing a conducive environment for the growth of entrepreneurship in the economy, the incubators' main goal is to lower unemployment and generate jobs locally.
Implementing agency:	Ministry of Micro Small and Medium Enterprises, Government of India
Start/Launch:	2015
Benefitted under the scheme:	81 Livelihood Business Incubators (LBIs)
Evaluation results	Outcomes of the scheme are tabulated (Table 1) and shown in Figure 11 which is as follows.

Small Industries Development Bank of India (SIDBI)

- **TIFAC-SIDBI Technology Innovation Program (Srijan)**

Objectives and policy content

The program's objectives are to:

(i) Identify and evaluate technological innovations and help industries, especially MSMEs, scale up. While SIDBI handles financial appraisal, TIFAC handles technical assessment.

(ii) Technology innovation projects related to new products or process development to support and foster the growth of MSMEs' capacity to innovate and introduce high-risk innovations to the market to create business opportunities for innovation-related enterprises.

TABLE 1

THE TANGIBLE OUTCOMES OF THE ASPIRE SCHEME OF MINISTRY OF MICRO SMALL AND MEDIUM ENTERPRISES, GOVERNMENT OF INDIA

ASPIRE Scheme								
Year	Total Fund	Livelihood Business Incubation	New Technology Business Incubation	Existing Technology Business Incubation	LBI-PPP	Funds Allocated		Funds Expended
						Budget Estimation	Re-Estimation	
2016	23	21	0	2	0	20	0	18
2017	28	22	1	1	4	20	20	41.11
2018	14	10	3	0	1	50	0	106.2
2019	14	8	2	1	3	232	224	219.34
2020	7	0	3	2	2	30	15	1.36
2021	38	30	4	3	1	15	0	5.8
2022	6	6	0	0	0	15	0	4.31
Average	18.571	13.857	1.857	1.286	1.571	54.571	37.000	56.589

Note: LBI-PPP, Livelihood Business Incubator - Public Private Partnership

FIGURE 11

STATISTICS OF LIVELIHOOD BUSINESS INCUBATION, EXISTING TECHNOLOGY BUSINESS INCUBATOR, NEW TECHNOLOGY BUSINESS INCUBATION AND LBI IN PPP

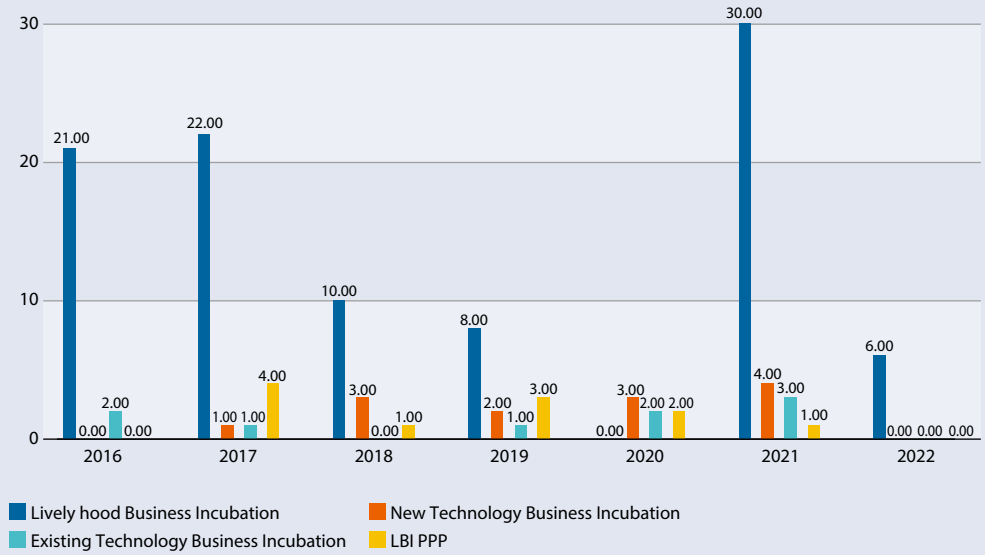
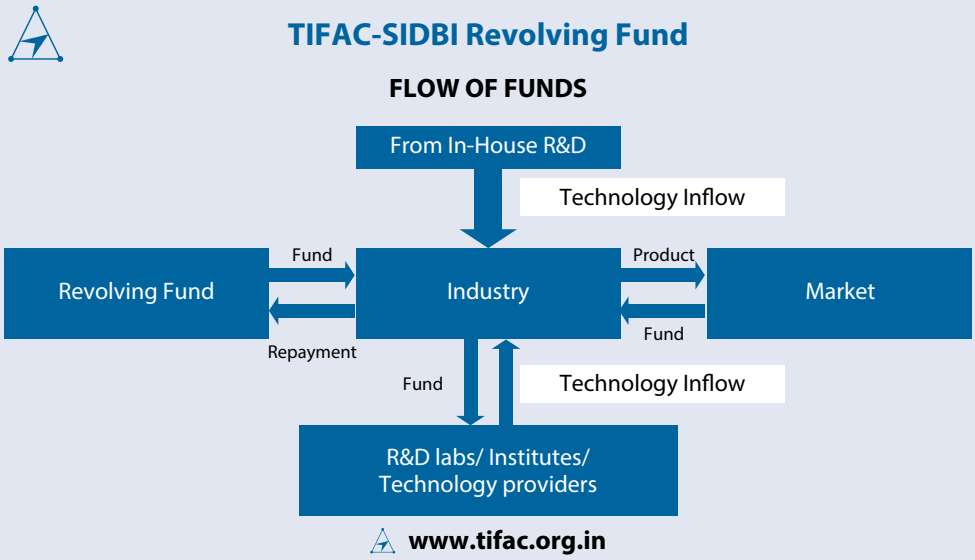


Figure 11 shows TIFAC-SIDBI flow of funds for MSMEs. To receive funding from the Fund for Technology Innovation Projects, MSMEs can submit comprehensive project proposals to SIDBI or TIFAC. TIFAC is responsible for conducting the technical evaluation of the project proposals. Only the technically suggested proposals will have their finances evaluated by SIDBI. Technical and financial recommendations will be approved for implementation by a Project Approval Committee (PAC) made up of representatives from TIFAC and SIDBI. TIFAC will entrust the Fund's management to SIDBI.

FIGURE 12

FLOW OF FUNDS IN TIFAC-SIDBI REVOLUTIONS.



Year of operation: November 01, 2010

Evaluation results

- Twenty-six MSMEs/start-ups/entrepreneurs have benefited by way of getting funds from the scheme. Other than direct funding, the entrepreneurs are also getting funding/rewards from other government schemes. Industry associations and venture capital firms (VCs) based on TIFAC recommendations.
- The scheme has helped in the creation of jobs to the extent of at least two-to-three fold of existing workforce in the enterprises, though the absolute number of job creations is being worked out.
- The beneficiaries have appreciated the mechanism of TIFAC towards faster processing of proposals in terms of technical appraisal. The assessment and recommendations of TIFAC has helped the beneficiaries in getting recognitions under other schemes of funding from government or VCs or in getting awards under various government programs like UNIDO-MSME Cleantech Program, DST (Department Of Science)-LOCKHEED Martin award, MSME awards etc.
- The majority of scaled up technologies are in areas of national importance like energy efficiency, waste heat recovery, e-waste processing & management, clean water technologies, value added products etc.

BOX 3

TDB-SIDBI

The Technology Development Board (TDB) and SIDBI have partnered to make it easier for businesses involved in the development and commercial use of indigenous or imported technology to obtain credit to support the MSME sector in India. In addition to providing financial assistance, the parties are coordinating outreach and marketing initiatives.

Box 3 Activity: Through their new credit alliance, TDB and SIDBI will refer each other to companies they have already funded for additional funding needs. Both organizations facilitate a smooth referral exchange by streamlining coordination through key contacts. In accordance with their respective policy directives, TDB and SIDBI also offer financial assistance to qualified MSMEs. In addition to providing financial support, the parties are coordinating outreach and marketing initiatives to spread the word about the project and reach more people. The joint initiatives of TDB and SIDBI, which prioritize technology-focused financial assistance, portend a bright future for MSMEs.

This strategic partnership serves as a foundation for MSMEs' innovation, resilience, and competitive advantage in the marketplace in addition to increasing their financial accessibility.

BOX 4

SMALL INDUSTRIES DEVELOPMENT BANK OF INDIA

SIDBI set up on 2nd April 1990 under an Act of Indian Parliament, acts as the Principal Financial Institution for Promotion, Financing and Development of the MSME sector as well as for co-ordination of functions of institutions engaged in similar activities.

Box 4 ACTIVITY: SIDBI has been involved in clusters through development and promotion initiatives in addition to its direct lending business. With assistance from the Reserve Bank of India (RBI), SIDBI has established the SIDBI Cluster Development Fund (SCDF) to provide targeted attention to cluster development from both soft and hard infrastructure structures. State governments will receive assistance from SCDF in building the infrastructure needed to support the growth of MSME clusters. The assistance was provided to state governments in the form of loans for the establishment of MSME clusters, both brownfield (existing clusters) and greenfield (induced clusters). SIDBI considers thematic engagements in clusters under the soft side. In addition to diagnostics, it helps clusters fill gaps in marketing, technology, skilling and reskilling, credit facilitation, etc.

The policy initiatives of the government of India's schemes which are supply side, demand side and systemic measures for facilitating the innovation and productivity of Indian MSMEs are summarized and shown in Table 2.

TABLE 2

SUMMARY SUPPLY SIDE, DEMAND SIDE, AND SYSTEMIC POLICY MEASURES THAT PROMOTED INNOVATION, AND TECHNOLOGY UPGRADATION IN INDIA.

Policy instruments of Government of India schemes			
Innovation and Productivity of MSMEs in India			
Sl. No	Supply side	Demand side	Systemic side
1.	MSME Champions Scheme • MSME Sustainable (ZED) Certification Scheme • MSME-Innovative (for Incubation, IPR, Design and Digital MSME) • MSME-Competitive (Lean)	Scheme of Fund for Regeneration of Traditional Industries (SFURTI)	Support for Entrepreneurial and Managerial Development of MSMEs through Incubators
2.			A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship (ASPIRE)
			TIFAC-SIDBI
			TDB-SIDBI

POLICY INSTRUMENTS OF SUCCESSFUL SCHEMES OF GOVERNMENT OF INDIA

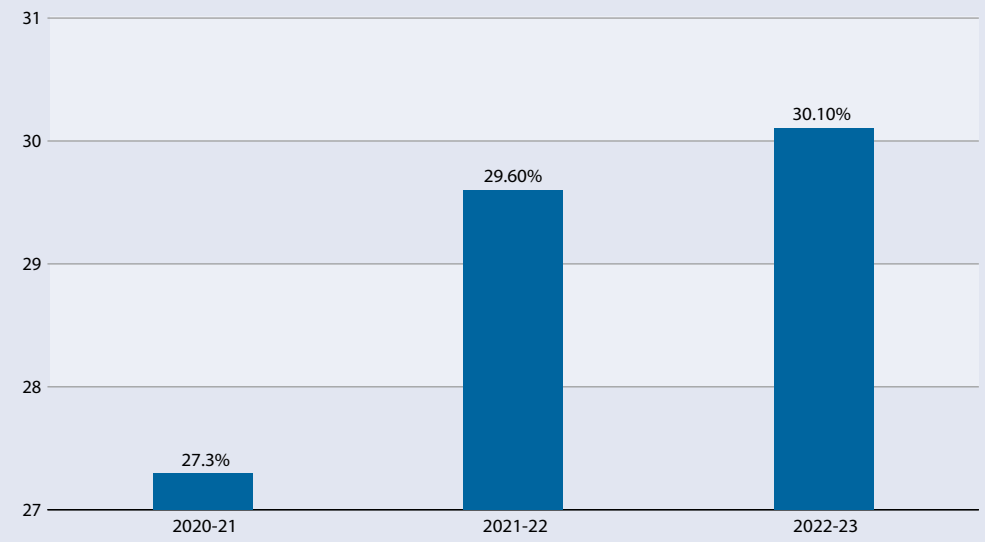
Exports from MSMEs have increased dramatically, from INR3.95 trillion in 2020–21 to INR12.39 trillion in 2024–25. This highlights the vital role that MSMEs play in bolstering India's economy and promoting international trade. In addition, there were 173,350 exporting MSMEs in 2024–2025 compared to 52,849 in 2020–2021 overall. With a 45% export contribution in 2023–2024 and a 45% export contribution in May 2024, MSMEs showed an impressive growth trajectory and their increasing influence on India's trade performance. India's MSME sector has made a substantial contribution to the GDP of the country over the years, exhibiting remarkable resilience and adaptability. In 2017–18, MSMEs contributed 29.7% of India's GDP in GVA, which increased to 30.1% in 2022–2023 (Figure 8).

Despite the COVID-19 pandemic's unprecedented challenges, the sector managed to maintain a 27.3% contribution in 2020–21, rising to 29.6% in 2021–22.

These numbers demonstrate the sector's persistent strength and significance to the Indian economy, as well as its critical role in promoting stability and economic growth.

FIGURE 13

SHARE OF MSMES GVA IN ALL INDIA GDP (%)



Source: Jocata (n.d.)

Strong growth in spite of global challenges according to the Sampoorn Index, an MSME Economic Activity Index released by Jocata (n.d) in collaboration with SIDBI, sales of MSMEs grew in fiscal year (FY) 2024 despite a decline in demand abroad. From April 2023 to March 2024, the index fluctuated between 0.53 and 0.60 (Figure 9). The MSME sector performed better than the rest, with its share of total exports rising from 43–60% in FY2023 to 45–73% in FY2024 despite global headwinds impacting India's overall exports. Furthermore, in the first two months of FY2025, MSME-related exports made up 45.79% of India's total exports (Figure 10).

TABLE 3

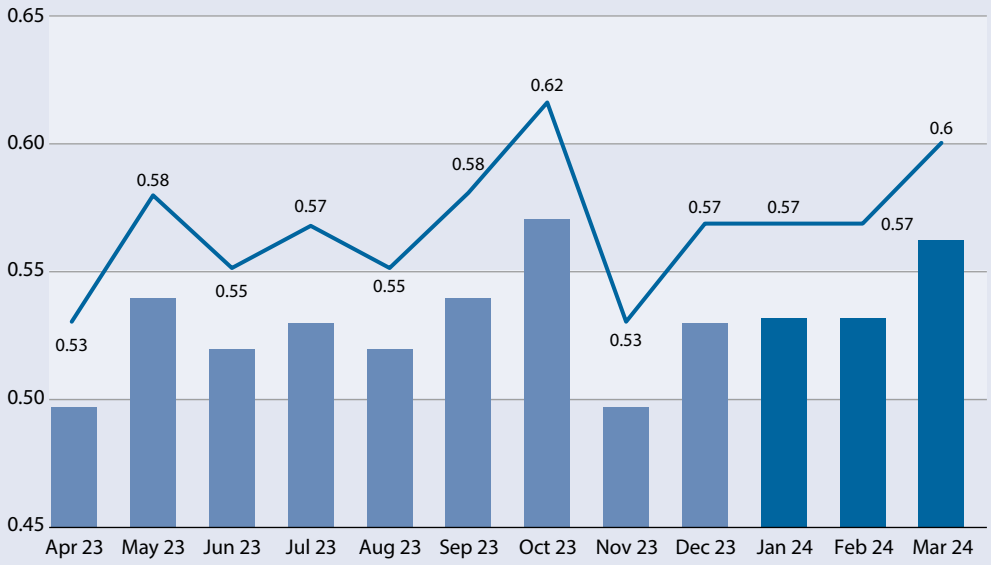
YEAR-WISE MSMES SCALED UP UNDER UDYAM FROM 2020 TO 2024

Financial Year	Micro to Medium	Small to Medium	Remarks
2020–21 to 2021–22	714	3,701	The data shows an increase in the number of MSMEs registered in Udyam
2021–22 to 2022–23	1,221	6,476	
2022–23 to 2023–24	1,835	15,918	
2023–24 to 2024–25	2,372	17,745	
04 financial years	6,142	43,840	

Source: Jocata (n.d.)

FIGURE 14

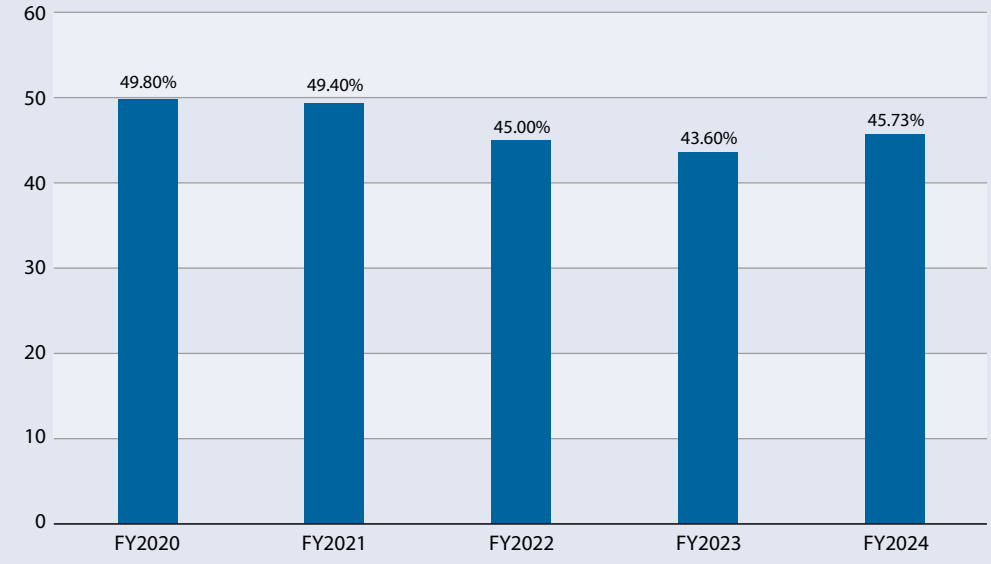
MSME ECONOMIC ACTIVITY INDEX, FY APRIL 23 – MARCH 24



Source: SIDBI (2024a, 2024b)

FIGURE 15

SHARE OF EXPORT OF MSME-RELATED PRODUCTS IN ALL INDIA EXPORT, FY2020–FY2024 (%)



Source: SIDBI (2024a, 2024b)

"Successful" policy instruments of schemes of Ministry of Micro Small and Medium Enterprises, Government of India

A considerable proportion of businesses made the shift to medium-sized businesses between July 1, 2020, and July 24, 2024.

In the fiscal years 2020–2022, 3,701 small businesses were promoted to medium-sized businesses, and 714 microbusinesses grew to medium-sized businesses. With 2,372 microenterprises and 17,745 small enterprises scaling up to medium in the fiscal years 2023–2024 and 2024–2025, this number grew steadily. This development illustrates the MSME sector's strong expansion and vibrancy in India.

The details are shown in Table 3.

As of 26th December 2024, as many as 57 million MSMEs, with employment of 241.4 million are registered on Udyam Registration Portal and UAP.

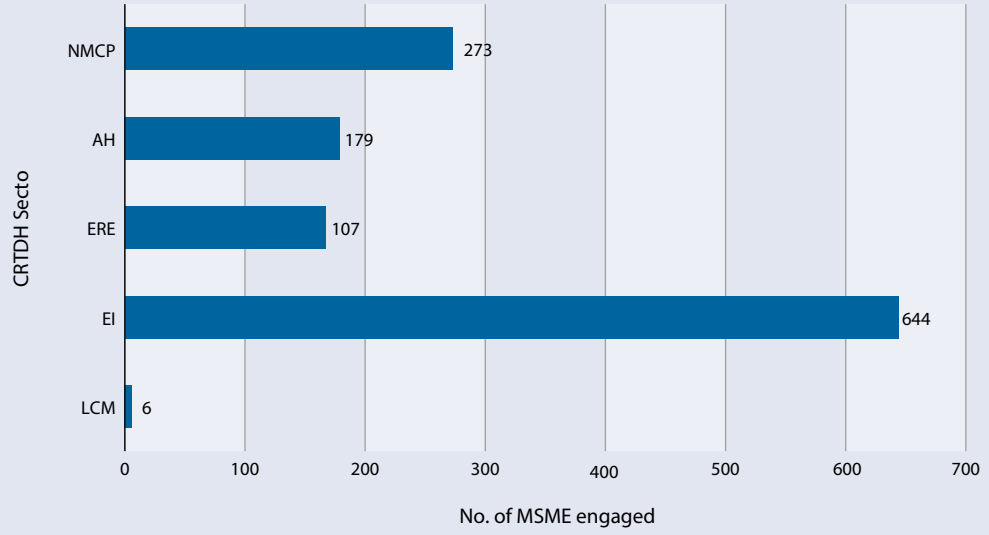
Indian-Japan collaboration for skill development / training

On December 6, 2023, the India-Japan Joint Working Group (JWG) on MSME Cooperation met for the third time in New Delhi. Mr. Katsuhiko Murayama, Director, Southwest Asia Office, Ministry of Economy Trade and Industry (METI) from Japan, and Ms. Mercy Epao, Joint Secretary (SME), M/o MSME from India, led the meeting. The two parties discussed plans for the collaboration for the upcoming year and reviewed the cooperation in skill development/training in 5S and Kaizen at M/o MSME's technology centers located in Bhiwadi and Puducherry, which is run by the Association for Overseas Technical Cooperation and Sustainable Partnership (AOTS) of Japan.

The scheme promoted by the Department of Scientific & Industrial Research has benefitted 644 MSMEs in the Environmental Interventions (EI) sector (Figure 16) and Table 4.

FIGURE 16

BENEFIT/EVALUATION RESULTS OF THE SCHEME BENEFITING MSMES



Note: NMCP, New Materials/Chemical Processes; AH, Affordable Health; ERE, Electronics/Renewable Energy; EI, Environmental Interventions; LCM, Low-Cost Machining

TABLE 4

YEAR-WISE PROJECTS SUPPORTED UNDER THE SCHEME

	2014–15	2015–16	2016–17	2017–18
New projects supported	17	13	16	21
Projects successfully completed	23	10	14	15

RESEARCH ANALYSIS OF THE SUCCESSFUL POLICY INSTRUMENTS FOR FACILITATING INNOVATION AND PRODUCTIVITY OF MSMES

The study conducted in the present research demonstrates the capability of different policy-measure instruments for promoting the innovation and productivity of MSMEs in India.

The government of India's schemes offered by different ministries such as the Ministry of Micro Small and Medium Enterprises and the Ministry of Science and Technology have been promoting the innovation and productivity of MSMEs in different manufacturing sectors. The MSME Champions scheme is to pick up clusters and enterprises and modernize their processes, reduce waste, sharpen business competitiveness, and facilitate their national and global reach and excellence.

The schemes of MSME such as innovation, incubation, design, and intellectual property rights have been accelerating the MSMEs to constantly innovate and develop products through innovative design thereby able to capture the local and global markets. Policy instruments also enable us to protect the innovation through IPR schemes. There are policy instruments that ensure the product/process/technology is transferred to large firms. The other policy instruments such as ZED, which offers the least effect on the environment, and Competitive LEAN play a vital role in ensuring productivity enhancements and quality of the products as well. Secondly, the demand-side innovation policies are public measures that aim to increase demand for product, process, and business innovation in Indian MSMEs and improve growth conditions for its uptake.

The policy measures have ensured public procurement—encouraging demand for certain products, services, or technologies to stimulate the local and global market, demonstrating/showcasing the projects through international/national exhibitions, market niche creation, creating market incentives, defining new functional requirements for innovative products and services, better articulating demand in local markets. The demand-side policy instruments have played a pivotal role in promoting local innovation in the market through strong supply chains such as GeM and ONDC e-commerce platforms as well. The e-platforms also paves the way for large firms to buy the local products manufactured by MSMEs. The research studies clearly show the systemic policy measures of MSME schemes that actively promote innovations in Indian MSMEs, which include increasing in R&D funding, improving the business environment, supporting a strong human capital base through capacity building and skill training, promoting collaborative research through academia / research laboratories / industries and its associations, developing indigenous technologies through in-house manufacturing facilities, supporting innovation linkages both locally and globally. There are several systemic policy measures that connect the academia/universities and startups and MSME through incubators such as MSME incubators established in universities.

Most importantly, to promote individual entrepreneurs the MSME scheme offers the scheme Livelihood Business Incubators thereby enabling them to set up the plant with machinery as well. LBIs are an entity which is set up for imparting skill development and incubation programs for promoting entrepreneurship and employment generation in agro-rural sector with special focus on rural and underserved areas. The programs offered by the LBIs aim to enable the beneficiaries to set up their own enterprises or get suitably employed in the nearby industrial cluster. The main objective of LBI is to generate employment opportunities by facilitating formal, scalable micro-enterprise creation, and to provide skilling, up-skilling, and re-skilling for unemployed, existing self-employed / wage earners in new disruptive technologies.

Additionally, MSME TCs under systemic policy measures function as growth drivers for technological development and enhancements. Under World Bank assisted "Technology Centre Systems Program" (TCSP), new TCs are being established and modernization of the existing TCs across the country is being done. To augment the network of TCs, under the scheme, "Establishment of New Technology Centres / Extension Centres," are being established across the country under a hub-and-spoke model, to provide numerous services like technology support, skilling, incubation, and consultation to MSMEs and creation of new MSMEs.

The Raising and Accelerating MSME Performance Program (RAMP) Scheme seeks to improve MSMEs' access to markets and credit, strengthen institutions and governance at the federal and state levels, improve centre-state partnerships and linkages, upgrade technology, and address

issues of late payments and MSMEs' greening. Under the International Cooperation Scheme, eligible central/state government organizations and industry associations receive financial assistance on a reimbursement basis to help MSMEs participate in international exhibitions held overseas, organize international conferences in India, and reimburse various costs associated with exporting goods and services for the purposes of modernization, joint ventures, technology advancement, etc.

CASE STUDIES OF INDIAN MSMES

Case study 1: Lit-Lite / Bharat Lite, Ludhiana, Punjab, India

Year of establishment: 1971

Number of employees: 100-150

MSME firm: Lit-Lite / Bharat Lite has its inception since 1971 as a well-grown and successful MSME located in the industrial hub of Ludhiana, Punjab, India. The MSME objective is to manufacture different automotive components such as bolts, nuts, washers and auto fasteners in different sizes and shapes as per the requirements of different clients spread across all of India. The industry grew leaps and bounds through resilience, inclusivity, and frugal innovations in product, process, and business.

The industry has been actively engaged in building research & digital infrastructures through own investment along with the government of India support thereby equipping with cutting-edge energy saving machineries, tools and equipment to develop globally competitive products leading to serve and enhance the customer needs and satisfaction locally/nationally and globally as well. The products conform to global standards and are internationally exported to more than thirty countries across the globe through 100% exports-oriented unit named as **M/s Bharat International** which is recognized by the government of India as a **Star Export House** and certified by ISO 9001.

Systematic Policy instruments that improve the performance of innovations, technology upgradation and productivity

Objective: To explore actors that aim to improve the performance of innovative systems by promoting better coordination and approaches

Scheme: MSME (Incubation, IPR & Design clinic)

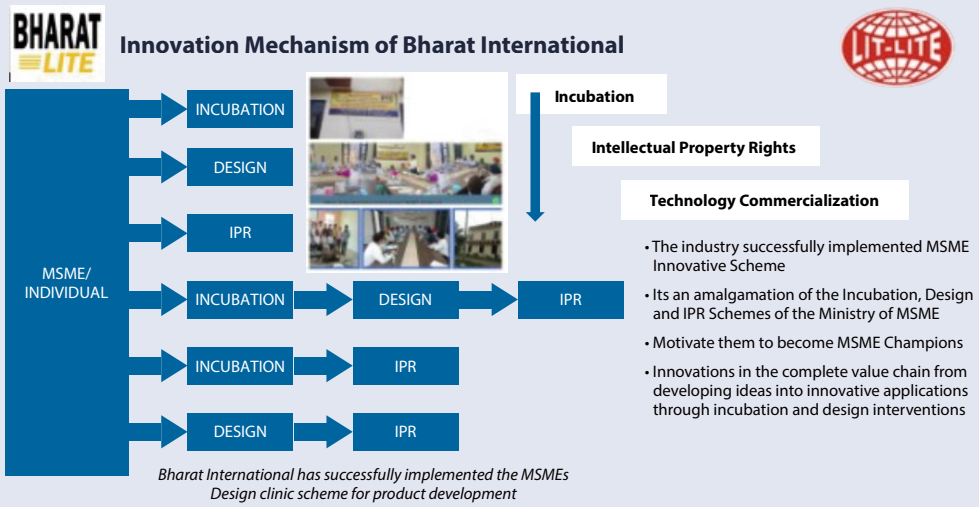
Objective: Comparing before and after recipient firms benefitted from each policy

Research and Development strategies:

New / upgrade R&D / innovation management systems: The industry has been developing facilities for the R&D innovations (Figure 17) through own investment and with the support of state and central government of India. The tangible results in product and process innovation thereby increasing the revenue through enhanced productivity (Figure 18) of the industry.

FIGURE 17

INNOVATION MECHANISM OF AN MSME



Bharat International has successfully implemented the MSMEs Design clinic scheme for product development

Ref: OECD SME AND ENTREPRENEURSHIP OUTLOOK 2023 © OECD 2023

The significant impact being.

(1) Increase in customer segment.

(2) Creating unique market for the product both as OEM and as ODM

(3) Initiating an innovative intelligent and smart value chain

The industry has expanded the facilities for supporting the innovations.

New recruitment of engineers, technicians, researchers, designers, brand managers:

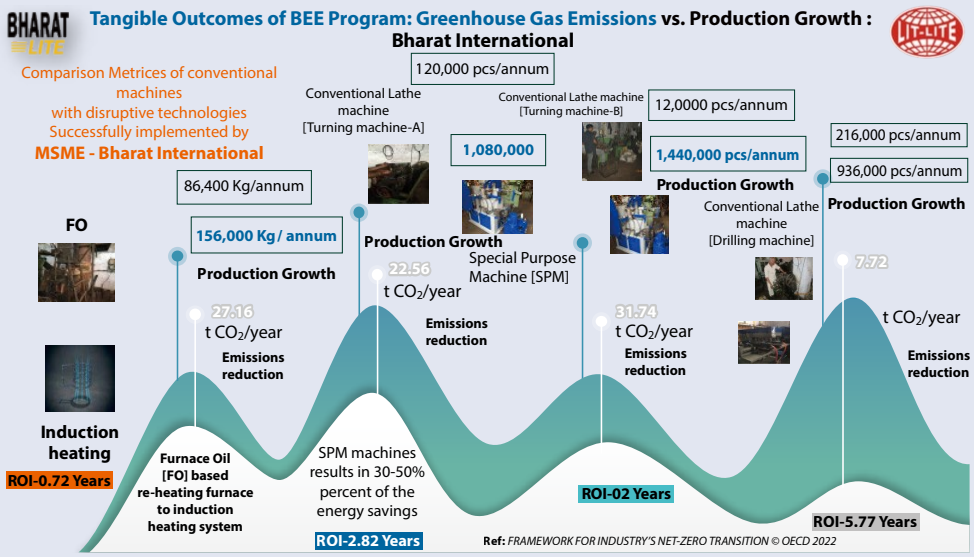
- The outcomes of talent acquisition resulted in enhancing the overall innovation systems.
- The workforce has been trained in several innovations to handle the product, process and business innovations.
- The impact is achieving the government of India policy as National Skill Development Mission.

Secondly increasing the employment opportunities in MSME as MSME play an important role in the Indian economy.

The industry has been constantly involved in research and development through implementing the MSME innovation schemes. The industry through its in-house funding and from the government of India has invested to establish the research and development laboratories, new employment, development of new products and filing intellectual property rights through IPR facilitation centers and licensed the technology as well. The industry has utilized the Bureau of Energy Efficiency scheme to upgrade the technology capability of the equipment thereby increasing the manufacturing productivity as well. The industry has been constantly involved in training the workforce to meet the objectives of innovation and productivity.

FIGURE 18

INCREASE IN PRODUCTIVITY DUE TO TECHNOLOGICAL UPGRADATIONS



Note: BEE, Bureau of Energy Efficiency; ROI, return on investment; Pcs, pieces; SPM, special purpose machines

BOX 5

OUTCOMES OF INNOVATION, TECHNOLOGICAL UPGRADATION AND PRODUCTIVITY GAINS OF MSME DUE TO EFFECTIVE POLICY INSTRUMENTS FACILITATED BY GOVERNMENT OF INDIA SCHEMES OF MINISTRY OF MICRO SMALL AND MEDIUM ENTERPRISES

Scheme: MSME (Incubation, Design and IPR)

Design and IPR: The MSME has done innovations through the in-house research and development facility. The MSME has successfully filed design registrations (Intellectual Property Rights) through IPR facilitation centers established by Ministry of Micro Small and Medium Enterprises, Government of India. The MSME has also successfully developed the product for automotive industries through its in-house well-established production facility.

Case study 2: Global Engineers and Innovators, Mohali, Punjab, India

Company profile: The location of "Global Engineers and Innovators" (GEI) is in Mohali, Punjab, India. Since its founding in 2007, the company has manufactured, traded, and supplied tractor parts, fabricated parts, and component combinations to a range of clients in the northern area. The manufacturing facility is fully equipped with all the necessary tools, machinery, devices, and equipment to produce every component in accordance with customer specifications with guaranteed quality. Due to their fair business practices, easy payment methods, positive records, and on-time delivery, GEI has amassed a solid clientele nationwide. Under the direction of our knowledgeable team members, the products are produced using state-of-the-art technology and well-tested raw

materials. Customers value this product category because of its accurate measurements, simplicity of installation, resistance to corrosion, robust design, and longevity. GEI offers these components in a range of sizes, shapes, dimensions, materials, and other specifications to meet the needs of its customers. Since the unit's motto is quality, a more focused environment is fostered among teams. The founder of this unit, Avtar Singh, has extensive managerial and technical experience. His son Harcharan Singh is a technology graduate who approaches his given goals and objectives with great sincerity and dedication.

Category of products: Titanium (titanium couplings).
Only 150–200 committed teams work together to manufacture the goods for its various clients. It is made up of entrepreneurs, nine employees, including one supervisor, and one manager/supervisor. As established by the original owner, the industry has a traditional layout and outlook. These are not significantly altered by follower entrepreneurs. In recent years, production capacity has increased. In the beginning, only three products were produced; today, there are over 23. Several large-scale manufacturers in India are the source of most of the machines and equipment installed in the unit. Every employee works as a casual worker and receives meager pay with no chance of advancement. Due to the demand for urgent products, workers are also paid overtime. This activity is irregular, though, and it costs between INR2,000 and INR4,500 per person per month. The multiskilled level of employees is impacted at every level, from upper management to the worker level. However, despite having enough workers, there is less activity and unit output because of reliance on individuals. The sector is weak due to a lack of infrastructure, a shortage of skilled workers, the use of subpar technology, and problems caused by local organizations. In small-scale industries, policies are not successfully fostering employment trust. They don't support and cooperate with each other.

The industry was building the R&D infrastructure through its own-in-house funding and thereby able to constantly be involved in product and process development. The industry has been skilling its workforce through recruitment of engineers and researchers, thereby able to perform innovation and increase productivity. The industry has taken initiatives to get funding from the government of India for building the infrastructures and thereby enhance innovation and productivity. The industry after receiving funds from the government of India has built R&D infrastructures and increases the productivity as well.

Actor: Management of 'Global Engineers and Innovators,' managers of the industry, supervisors, workforce suppliers of the industry, customer's feedback and suggestions for the industry are the 'Actors.'

Institutions affecting implementation of policies
Trust between MSMEs and Government of India agencies: MSMEs require funding for growth especially to enhance innovation and productivity. Hence the government of India has launched several schemes to support them and build a trust and strong relationship with MSME industries. As a major contributor to the economy, access to credit is crucial for MSME establishment and expansion. In India, several ministries such as the Ministry of MSME, the Ministry of Science and Technology, such as the Department of Scientific and Industrial Research, the Technology Information and Forecasting Assessment Council and other institutions such as the Small Industries Development Bank have been playing a vital role to promote the Indian MSMEs through funding, and market assistance as well. Additionally, there are several schemes to promote incubation of ideas for MSMEs and entrepreneurs to promote innovation and productivity.

To meet this need, the government, banks, and financial institutions offer various loan schemes. Some of the most recognized MSME loan schemes of 2023, especially in response to COVID-19 disruptions,

Social attitudes to failure of MSMEs: The impeding factors (challenges) impacting growth and success of MSMEs in India are: (a) low-cost financing (b) competitive technology and transfer of technology (ToT) (c) skilled workforce and their retention (d) stable and consistent market (e) export facilitation.

Availability of opportunity-based entrepreneurs

In the GEM survey, India received a score of five points in 2019, placing it sixth among GEM economies. In 2020, it received a score of six points, placing it fourth, and in 2022, it received a score of six points, placing it fourth (World Economic Forum, 2023). But in 2021, India's NECI received a score of 5.0, which is barely adequate, and was ranked 16th. The Indian entrepreneurial environment was severely but temporarily shocked by the COVID-19 pandemic, as evidenced by the lower scores for all 13 Entrepreneurial Framework Conditions in 2021 compared to 2020. All of India's Framework Conditions, however, received better than adequate scores (≥5.0) in 2020. Seven of those conditions were rated as insufficient in the results of 2021; however, by 2022, the results had returned to sufficiency because of various e-commerce platforms. Both in the fall of 2020–2021 and the recovery of 2021–2022, these changes, many of which were significant, indicate that there is a great chance for a high-quality entrepreneurial environment, particularly for startups and the expansion of MSMEs in India, but it is extremely fragile and far from resilient (GEM 2022–23). For example, all but three Framework Conditions are ranked in the top ten of the 51 GEM National Expert Survey (NES) economies (GEM 2022–23), indicating that normal service will resume in 2022, and that the entrepreneurial environment has returned to its high level. Additionally, the experts suggested that programs for capacity-building be enhanced and structured.

POLICY RECOMMENDATIONS

Policy for innovation, productivity, and technology upgradation in Indian MSMEs

The government of India has successfully implemented different schemes to promote innovation, productivity, and technology upgradation as well. The observation through primary and secondary research shows that the Indian MSMEs does not have a policy framework for the implementing the above.

Innovation and productivity form the backbone of MSMEs. Policies that promote innovation and productivity in MSMEs are important to help them compete with larger businesses and thrive in a rapidly evolving market. MSMEs can adopt innovative approaches to improve their business processes, products, services, and technology upgradation as well. Innovation can help MSMEs reduce costs, enhance productivity, and create sustainable growth models. Policy on technology upgradation could help MSMEs to enhance access to world-class technology. Hence, there is a need for all Indian MSMEs to successfully initiate a policy framework for successfully implement the innovation, productivity, and technology upgradation.

Policy for fund allocation for innovation, productivity, and technology upgradation

The study concludes that the analysis of the ASPIRE Schemes underscores several critical issues. The negative compound annual growth rate (CAGR) for both the total fund allocation and Livelihood Business Incubation suggests a concerning trend of decreasing funding over time. This

trend, combined with overestimations in budget estimations, indicates potential challenges in sustaining support for businesses. Moreover, the decline in funding for the Existing Technology Business Incubation, reflected in a substantial negative CAGR, raises significant concerns about the sustainability of businesses in this category. While New Technology Business Incubation shows stability in funding, there is still space for inclusive improvement in budget estimation accuracy. Thus, the ASPIRE scheme needs a comprehensive strategy to address these issues, ensure consistent and sufficient funding, enhance financial planning, and bridge the gap between allocation and expenditure to foster the growth and success of businesses it supports in the long term.

The policies implemented by Department of Scientific and Industrial Research (DSIR) and TIFAC need revisions, and the MSME policy should be integrated and collaborated with college and universities to effectively conduct several case studies on successful implementation of the schemes for MSMEs. The ministries can work closely with several institutions having experts to successfully conduct pilot studies, additionally there is need to create continuous exposure and awareness among Indian MSMEs about the importance of innovation, technology upgradation which would lead to achieve carbon neutrality, enhancing productivity and quality. This will enhance the product and process innovations. In fact, the Birla Institute of Technology, Pilani has taken initiatives to work on the problem statement of MSME innovation through involving the different stake holders such as students, faculty members and local MSMEs. Engineers and researchers in MSME can work closely with academic institutions to effectively work on several problem statements of MSMEs.

- The case studies carried out on innovation and productivity in MSMEs lead to investigating various dimensions of frugal innovation and technological upgradation, which resulted in the performance of innovation of the firm and social networks.
- Further to that it was observed that the Indian MSMEs do not innovate through structured and formal manner. Hence “learning by doing” being a most common practice and style of innovation. Innovation and technological upgradation in Indian MSMEs are considered as an important characteristic of the Indian entrepreneur.
- The following attributes are important factors to improve the technological innovation in Indian MSME firms:

(a) entrepreneurial mindset and capability (EC),
(b) technology resources and infrastructure capability (TIC); and
(c) Government of India initiatives.

CONCLUSION

India is aiming to become the global powerhouse and world leaders by 2032 through achieving USD10 trillion. This growth is possible by driving the MSME manufacturing sector and mission initiatives like ‘Make in India’ and Digital India with the projected export that would account for 25% of GDP by the year 2030. The digital public infrastructure of India would steer to a new age of creation and expansion in the current scenario. India through the strong initiatives like ‘Atmanirbhar Bharat’ and ‘Make in India’ would accelerate MSME innovation and productivity, to a solid stimulation to empower the district, regional and national manufacturing sectors thereby contributing to the production of innovative products such as vocal for local at economical price rates. The strong objectives of improving the manufacturing production scale, India has also continuously strived to enhance its study capabilities by introducing new policies and schemes of Science, Technology, and Innovation Policy in the year 2024. These inclusive efforts play a vital part in promoting the country’s innovative power.

APPENDIX

List of Interviews with Government of India officials and Indian MSMEs / Technology

Name of the person	Positions / Affiliation	Dates	Purpose
Mr. O.P. Singh	Senior General Manager (Technology & SBU Head) National Small Industries Corporation Ministry of Micro Small and Medium Enterprises, Govt. of India Okhla, New Delhi	May 2024 & December 2024	Visited the Ministry Discussed the MSME Champion scheme. Livelihood Business Incubator
Mr. Aradhya Sardar	Scientist 'F' Technology Information and Forecasting Assessment Council Ministry of Science & Technology, Govt. of India	November & December 2024 Note: MoU was signed between Sharda Group of Institutions and TIFAC, Govt. of India	MSME schemes offered by TIFAC
Mr. Mayank Verma	Deputy Director National Productivity Council Ministry of Commerce & Industry, Govt. of India	August 22, 2024	Indian MSMEs implementing Innovation schemes. Jointly visited the MSME in Ludhiana
Mr. Gurpreet Singh Kahlon	Senior Vice President Auto Parts Manufacturing Association Ludhiana Managing Director Bharat International, Ludhiana	August 22, 2024	Visited MSME in Ludhiana to study the Innovation schemes implemented by the Bharat International
Dr. Sanjeev Katoch	General Manager Institute for auto parts and hand tools technology, Ludhiana	August 22, 2024	Visited and discussed the Technological infrastructure that support MSME innovation and technological capabilities
Mr. Achint Gupta	Sr. Executive Institute for auto parts and hand tools technology, Ludhiana	August 22, 2024	
Dr. Vipin Shukla	Scientist 'G' & Head Department of Scientific & Industrial Research Ministry of Science & Technology Government of India	April 2022	Visited the Ministry and discussed on various schemes of DSIR that promotes the MSMEs in India
Dr. Sujata Chaklanobis	Scientist 'G' & Head, A2K+ Events. Access to Knowledge – Events Program. Department of Scientific & Industrial Research Ministry of Science & Technology Government of India		

REFERENCES

Aggarwal, A. and Joshi, N. (2024), "MSMEs' innovation: a barrier approach", *Journal of Small Business and Enterprise Development*, (31),3, 552-573. https://doi.org/10.1108/JSBED-07-2023-0304

Agarwal, V., Mathiyazhagan, K., Malhotra, S. & Pimpunchat, B., (2023) Building resilience for sustainability of MSMEs post COVID-19 outbreak: An Indian handicraft industry outlook, *Socio-Economic Planning Sciences*, (85), 101443 https://doi.org/10.1016/j.seps.2022.101443

Annalisa Caloffi, Ana Colovic, Valentina Rizzoli, Federica Rossi, (2023) Innovation intermediary's types and functions: A computational analysis of the literature, Technological Forecasting & Social Change, (189), 12235. https://doi.org/10.1016/j.techfore.2023.122351

CEIC Data (n.d.) India Labour Productivity Growth. https://www.ceicdata.com/en/indicator/india/labour-productivity-growth

CMIE Prowess (n.d.) https://prowess.cmie.com

Department of Science and Technology DST. (2020). *Science, Technology and Innovation Policy*, New Delhi: DST. https://dst.gov.in/sites/default/files/STIP_Doc_1.4_Dec2020.pdf.

Jocata (n.d.) Jocata Sumpoorn / India's First and Only MSME Economic Activity Index. SIDBI. https://www.sumpoorn.in/home

Kriti Upadhyaya, (Sep 2021) Encouraging Small Business Procurement in Indian States, A White paper series by the CSIS Wadhwani Chair

Mazumdar, Dipak (1991) Import-substituting industrialization and protection of the small-scale: The Indian experience in the textile industry, *World Development*, Elsevier, vol. 19(9), pages 1197-1213, September.

Oliver Schwabe, (2021) A Maturity Model for Rapid Diffusion of Innovation in High Value Manufacturing, *Procedia CIRP* (96) 195–200. https://doi.org/10.1016/j.procir.2021.01.074

Prihadyanti, D., Aziz, S.A. & Sari, K. (2024) Diffusion of Social Innovation: the Innovation Provider's Perspective. *J Knowl Econ* (15), 4516–4570. https://doi.org/10.1007/s13132-023-01365-y

Renana Peres, Eitan Muller, Vijay Mahajan (2010) Innovation diffusion and new product growth models: A critical review and research directions, *International Journal of Research in Marketing*, (27), 91–106. https://doi.org/10.1016/j.ijresmar.2009.12.012

SIDBI (2024a) Annual Report 2023–24. https://www.sidbi.in/annualreport/AnnualReport202324/pdf/Sidbi-AR-English-Part-I.pdf

SIDBI (2024b) Annual Report 2023–24. https://www.sidbi.in/annualreport/AnnualReport202324/pdf/SIDBI-AR-English-Part-II.pdf

Shukla, Sunil & Bharti, Pankaj & Dwivedi, A. (2023) Global Entrepreneurship Monitor India Report 2021–22: A National Study on Entrepreneurship. ISBN: 978-1-032-48428-0 (pbk)

UNIDO (2023) National Manufacturing Innovation Survey (2021–22), Ministry of Science & Technology, Government of India https://dst.gov.in/hi/node/7041

World Economic Forum (2023) Data Unleashed: Empowering Small and Medium Enterprises (SMEs) for Innovation and Success, BRIEFING PAPER

NEPAL

INTRODUCTION

The importance of SMEs in generating employment and stimulating economic growth is increasingly acknowledged in both developed and developing nations. SMEs have the potential to significantly contribute to employment, innovation, income, and growth. However, many fail to reach their full potential due to limited access to markets, finance, technology, and business skills. Globalization and liberalization have exacerbated these traditional access issues. Nepal has not been an exception in this case (Ajit Bhatta, 2022). In today's knowledge-based economy, competition hinges on both continuous innovation and pricing. Entrepreneurs must excel in design, possess deep market and technology knowledge, and continuously innovate (UN Trade and Development, n.d.). In most countries across Eastern, Central, and Western Africa, as well as South Asia, over 90% of all workers are employed by small economic units. In Southeast Asia, Central and Western Asia, and the Arab States, this share exceeds 80%. In Latin America and the Caribbean, small economic units account for 52% of employment in Chile and over 90% in Bolivia and Honduras (ILO, 2023) Globally, they account for over 50% of total employment and contribute at least 35% to the GDP (Amit Kapoor, 2023).[1] In Nepal, however, SMEs currently contribute only around 22% to the economy's GDP and create over 1.7 million job opportunities (United Nations, Economic and Social Commission for Asia and the Pacific, 2020). The slowing GDP growth rate combined with persistent inequality, high youth unemployment, and gender disparities in most socioeconomic indicators pose challenges for the government (Government of Nepal National Planning Commission, National Statistics Office (NSO), n.d.). The MSME sector plays a crucial role in unlocking an economy's economic potential and reducing poverty by creating employment and income opportunities. However, many small businesses, despite their efforts to capitalize on market opportunities, lack access to essential information on market trends, prices, exports, and financial outlooks, which hampers their growth (Amit Kapoor, 2023). In Nepal, there is a pressing need for structural transformation to create large-scale employment with decent wages. Unfortunately, the economy's productive capacity remains limited and underdeveloped, resulting in a heavy dependence on workers' remittances as the main pillar of the economy.

The Constitution of Nepal 2015 ensures that the state will not discriminate against individuals based on origin, religion, race, caste, tribe, sex, economic condition, language, region, or ideology (The Constitution of Nepal 2015, 2015). This commitment has been reflected in successive government development plans, which have formulated various strategies and programs to promote social inclusion. Industrialization in Nepal commenced following the implementation of the First Five-Year Plan in 1956. The Fifteenth Plan of the National Planning Commission (NPC) for the Fiscal Year (FY) 2019–2020 to 2023–2024 outlines a path towards prosperity and sustainable development, guided by the objective of establishing a socialist-oriented, self-reliant national economy. The plan seeks to substantially enhance the well-being of the population by improving living standards in a way that meets both biological and human needs (Amit Kapoor, 2023). Emphasizing the long-term commitment to eradicate absolute poverty in the country, the plan sets a target of reducing the number of people living below the poverty line to single digits over the plan duration (NPC, Government of Nepal, 2020). The Sixteenth Plan (2024/25–2028/29) (NPC, Government of Nepal, 2024) is a strategic document that guides Nepal's development agenda. It is

1 Author's own contribution in earlier APO publication

part of the periodic planning framework adopted by the Government of Nepal to ensure sustained economic growth, social development, and environmental sustainability. The Sixteenth Plan of Nepal prioritizes the development of SMEs as a key factor in driving economic growth and job creation. By concentrating on increasing productivity, promoting innovation, improving access to finance, and widening market opportunities, the plan seeks to cultivate a flourishing SME sector. Opportunity-based entrepreneurship is thriving in Nepal, driven by a burgeoning startup ecosystem, access to finance, and industry opportunities. These entrepreneurs are known for their innovation, market orientation, and risk-taking abilities. However, they encounter challenges related to financing, regulatory barriers, market access, and skill gaps. Addressing these issues through supportive policies, improved access to finance, and enhanced training programs can further encourage opportunity-based entrepreneurship, thereby contributing to Nepal's economic growth and development.

The Government of Nepal has initiated a noteworthy effort to enhance domestic production with the launch of the Prime Minister Nepal Production Promotion Program (PMNPPP), a decade-long special campaign running from FY2022–23 to 2031–32 (Amit Kapoor, 2023). To kickstart this initiative, the government allocated NPR3.45 billion (around USD26.6 million) for FY2022–23, which includes the new program and its associated policies. [10,11] A central component of this initiative is the promotion of domestic products within government agencies through a self-consumption campaign. By encouraging the adoption of locally produced goods, the government seeks to stimulate both domestic production and consumption. Moreover, the Government of Nepal will offer support to private sector efforts aimed at strengthening domestic production and consumption. The One Village One Product (OVOP) program, launched in 2006, is a community-driven rural economic development initiative that follows a demand-oriented approach. This program utilizes a Public-Private Partnership (PPP) model to facilitate the promotion of OVOP-branded products in both domestic and international markets. PMNPPP aims to continue and enhance this program by identifying specific products based on their industrial production potential under the concept of 'One Local Level, One Specific Product.' [10, 11] Over the past decade, numerous state-owned industries have been privatized or shut down. This has also impacted micro and small enterprises (MSEs). However, privatization seems to have primarily benefited larger enterprises, as the closure of state-owned enterprises has curtailed economic activities and restricted markets for businesses of all sizes. In Nepal, the private sector is primarily composed of small enterprises, which account for 62.4% of the total, followed by medium-sized enterprises at 22.9%, and large enterprises at 14.7%. The number of private sector establishments increased significantly over the past three decades, from 28,660 in 1983 to 923,356 in 2018 (FNCCI-IFC, 2023).

The global economy has been gradually recovering from the COVID-19 pandemic, yet growth remains slow in certain areas. While advanced economies have shown some progress, developing and least developed countries continue to grapple with major obstacles, including weak economic growth and high inflation. These challenges have resulted in unemployment and increased levels of poverty and inequality. Nepal has shown progress in the socio-demographic indicators over the past decades, but economic growth has been very slow. For SMEs in the industrial sector, the impact of COVID-19 has been more pronounced due to the sharp fall in output resulting from a lack of imported raw materials, supply disruptions, limited labor mobility, and traffic restrictions. Nepal's economic growth turned negative at -2.37% in the fiscal year 2019–2020 for the first time in 20 years (Amit Kapoor, 2023). This decline was due to the effects of the COVID-19 pandemic, which were more severe than the economic losses caused by the devastating earthquake in 2014–15. [13, 14]

The Government of Nepal has established several funds to encourage entrepreneurship and technology adoption by offering matching grants or subsidized loans to entrepreneurs who submit strong proposals and plans. However, in practice, these funds have not succeeded in driving the innovation—whether in adopting new technologies or processes—as outlined in the industrial policy. Despite the ongoing attempts by the Government to increase the involvement of MSMEs in Nepal, the advancement has been minimal. A report from ADB in 2020 (Kharel, P. and Dahal, K., 2020) indicated that Nepal lacks a solid policy structure for SMEs and has insufficient opportunities for SMEs to engage in the global value chain (GVC). Although various laws and policies have been implemented to tackle SME challenges, the government has failed to establish a comprehensive policy dedicated to the development of SMEs in Nepal (Bhatta A. and Mishra K., 2022).

Methodology

This research employs qualitative methods, including a literature review of materials such as innovation support program literature, government policies and planning documents, existing studies on Nepal's SME landscape, and publications related to entrepreneurship. Additionally, a case study of a few SMEs was conducted to validate and analyze government policies and the role of technology and innovation. A significant limitation of this study is its reliance on secondary data, as no specific survey was carried out to explore SMEs' innovation or their enabling innovation systems. This reliance made it challenging to access recent data from certain institutions and restricted the availability of time-series data. Nevertheless, available statistics from the National Statistics Office (NSO), the Ministry of Industry, Commerce, and Supplies (MoICS), and the World Bank Survey were utilized for analysis.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

SMEs, or small and medium-sized enterprises, are defined differently across the globe. The criteria for what constitute an SME vary by country and are often based on several characteristics, depending on the region in which a company operates. In Nepal, the term "small businesses" typically refers to micro, cottage, and small enterprises (MCSEs). The Industrial Enterprises Act (IEA) 2020, categorizes enterprises into micro, cottage, small, medium, and large, based on the number of employees and capital (MoICS, Government of Nepal, 2020). According to the act, firms are categorized based on their fixed capital. Small firms have fixed capital up to NPR150 million (approximately USD1.15 million), medium-sized firms have fixed capital exceeding NPR150 million (approximately USD1.12 million) but less than NPR500 million (approximately USD3.73 million), and large firms possess fixed capital exceeding NPR500 million (approximately USD3.73 million). Additionally, the act defines two other types of enterprises: microenterprises and cottage enterprises. Microenterprises are characterized by a fixed capital (excluding land and buildings) not exceeding NPR2 million (approximately USD15,000), an annual turnover not exceeding NPR10 million (approximately USD75,000), and a workforce of no more than nine employees, including the entrepreneur. Cottage enterprises are typically labor-intensive and rely on traditional, local skills, technologies, and cultural practices. In practice, cottage enterprises are often classified as microenterprises or small and medium-sized enterprises (SMEs) based on their size (Amit Kapoor, 2023).

TABLE 1

CATEGORY OF ENTERPRISES BASED ON THE INDUSTRIAL ENTERPRISES ACT, 2020 NEPAL

Enterprises	Capital
Small firms	An industry with fixed capital not exceeding NPR150 million (approximately USD1.12 million), excluding microenterprises and cottage industries.
Medium-sized firms	An industry with a fixed capital greater than NPR150 million (approximately USD1.12 million) but not exceeding NPR500 million (approximately USD3.73 million).
Large firms	Exceeding NPR500 million (approximately USD3.73 million)
Microenterprises	An industry with a maximum capital investment of NPR2 million (roughly USD15,000), an annual turnover not exceeding NPR10 million (approximately USD75,000), and employ no more than nine individuals, including the entrepreneur.
Cottage enterprises	Traditional and local skills, technology, and art and culture

Source: MoICS, 2020 [17,4]

As per the registration data of micro, cottage, and small industries, a total of 587,802 industries were registered up until mid-2023. Among these, 200,730 companies operate in the service sector, 193,766 in the agriculture and forest sector, and 156,436 in the manufacturing sector. A detailed classification of micro, cottage, and small industries based on their respective sectors is provided in Table 2.

TABLE 2

MICRO, COTTAGE, AND SMALL INDUSTRY REGISTRATION AS PER INDUSTRY CLASSIFICATION

Industry Class	Till 2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	Total
Manufacturing	113,694	7,725	8,402	5,895	9,679	6,705	4,336	156,436
Energy	1,412	17	18	1	7	6	3	1,464
Agriculture and Forest	33,819	12,256	17,687	22,097	48,852	39,755	19,300	193,766
Tourism	30,225	4,135	4,969	1	3	3,855	2,607	45,795
Minerals	1,231	40	3	4,997	5,693	3	0	11,967
Service Sector	110,295	11,717	20,899	14,879	18,218	14,226	10,486	200,720
Construction	10,020	1,089	557	903	886	413	366	14,234
Information and Technology	25	164	94	81	48	106	44	562
Total	**300,721**	**37,143**	**52,629**	**48,854**	**83,386**	**65,069**	**37,142**	**624,944**

Source: Department of Industry, 2022 [18,4]

The National Economic Census (NEC), conducted by the Central Bureau of Statistics (CBS) in 2018, serves as the primary benchmark for economic statistics, providing crucial data about the structure and functioning of Nepal's national economy, including both the formal and informal sectors. Although the NEC 2018 does not include all the necessary information to categorize businesses by size as outlined by IEA 2020, the analysis presented in Table 3 is based on the classification of businesses according to the number of employees. Table 3 indicates that, of the total 923,356 establishments in Nepal, micro establishments (employing 1–9 individuals) constitute the predominant category, representing 95.4% (Amit Kapoor, 2023). Small-scale establishments (with 10–49 employees) account for 4.2%, while medium-scale establishments (with 50–99 employees) and large-scale establishments (with 100 employees or more) each make up 0.2%. (National Statistics Office (NSO) (Then CBS, CBS), Government of Nepal, 2020).

TABLE 3

ESTABLISHMENTS IN NEPAL BY NUMBER OF EMPLOYEES

Number of Employees	Establishments	Registered	Unregistered	Unregistered/ Total %
Micro establishments (with 1-9 employees)	880,542 (95.37%)	421,996	458,258	52.1
Small-scale establishments (with 10–49 employees)	38,769 (4.20%)	36,705	2,032	5.2
Medium-scale establishments (with 50–99 employees)	2,258 (0.24%)	2,165	88	3.9
Large-scale establishments (with 100 or more employees)	1,787 (0.19%)	1,739	44	2.5
Total	**923,356**	**462,605**	**460,422**	**49.9**

Source: NEC 2018, CBS [19,4]

The proportion of unregistered enterprises differs notably across enterprise sizes. For micro-enterprises, the unregistration rate is 52.1%. This rate decreases to 5.2% for small enterprises, 3.9% for medium-sized enterprises, and 2.5% for large enterprises (Amit Kapoor, 2023).

Based on the 2018 data from NEC, the wholesale and retail trade sector, which also includes the repair of motor vehicles and motorcycles, represents the largest industry in the country, comprising 53.9% of the total 923,356 establishments. The accommodation and food service activities industry ranks second, making up 14.1% of the total establishments (Amit Kapoor, 2023). The manufacturing sector is the third largest industry, comprising 11.3% of all establishments (National Statistics Office (NSO) (Then CBS), Government of Nepal, n.d.a). The breakdown of establishments by industry type is shown in Table 4.

TABLE 4

SHARE OF ESTABLISHMENTS BY INDUSTRY TYPE

Classification of Industry	Total	Micro establishments (with 1–9 employees)	Small-scale establishments (with 10–49 employees)	Medium-scale establishments (with 50–99 employees)	Large-scale establishments (100 or more people are engaged)
Agriculture, forestry fishing	24,229	21,972	2,112	74	71
%	2.62	2.38	0.23	0.01	0.01
Mining, quarrying	663	394	255	8	6
%	0.07	0.04	0.03	0.00	0.00
Manufacturing	104,058	98,983	3,884	459	732
%	11.27	10.72	0.42	0.05	0.08
Electricity, gas	1,242	898	263	57	24
%	0.13	0.10	0.03	0.01	0.00
Water supply	2,525	2,129	383	11	2
%	0.27	0.23	0.04	0.00	0.00
Construction	1,608	1,285	282	21	20
%	0.17	0.14	0.03	0.00	0.00
Wholesale, retail trade	498,069	494,623	3,275	108	63
%	53.94	53.57	0.35	0.01	0.01
Transportation, storage	3182	2920	217	27	18
%	0.34	0.32	0.02	0.00	0.00
Accommodation, food	130,540	127,768	2,636	97	39
%	14.14	13.84	0.29	0.01	0.00
Information, communication	2,796	1,969	686	84	57
%	0.30	0.21	0.07	0.01	0.01
Financial, insurance	17,996	14,106	3631	93	166
%	1.95	1.53	0.39	0.01	0.02
Real estate	207	163	34	10	0
%	0.02	0.02	0.00	0.00	0.00
Professional, scientific, technical	8,204	7,844	321	24	15
%	0.89	0.85	0.03	0.00	0.00
Administrative, support service	6,873	6,197	630	27	19
%	0.74	0.67	0.07	0.00	0.00
Education	40,839	24,314	15414	845	266
%	4.42	2.63	1.67	0.09	0.03
Human health, social work	19,990	17,570	2069	160	191
%	2.16	1.90	0.22	0.02	0.02
Arts, entertainment, recreation	2,821	2,527	273	11	10
%	0.31	0.27	0.03	0.00	0.00
Other service activities	57,514	54,880	2404	142	88
%	6.23	5.94	0.26	0.02	0.01
Total	923,356	880,542	38769	2258	1787
%	100.00	95.36	4.20	0.24	0.19

Source: NEC 2018 [20,4]

Labor Productivity

Labor productivity in Nepal remains a critical area for improvement to achieve sustained economic growth and development. Addressing challenges in education, infrastructure, technology, and economic stability is key to enhancing productivity levels.

As reported in the 2021 Population Census, 65.55% of the population is economically active. Of these, 50.1% are employed as skilled workers in agriculture, forestry, and fisheries. The second-largest category includes elementary workers, who constitute 23%, followed by service and sales workers at 5.8%. The census also indicates that private households are the largest institutional sector in Nepal (FNCCI-IFC, 2023). The Nepal Labor Force Survey (NLFS) 2017–18 shows that out of a total population of 29 million, 13.5 million (46.5%) were male and 15.5 million (53.5%) were female (Amit Kapoor, 2023). Nearly 40% of the population was below 20 years old, indicating that Nepal had a dominant young population (National Statistics Office (NSO) (Then CBS), Government of Nepal, 2020). There were approximately 20.7 million people of working age in 2017–18 (National Statistics Office (NSO) (Then CBS), Government of Nepal, n.d.b) Compared to 14.5 million workers in 2011, and 11.9 million in 2000 (Asian Development Bank, 2015).

Nepal's most recent Labor Force Survey, conducted in 2017, indicated an unemployment rate of 11%, which is notably high. In lower-middle-income nations, a significant portion of the population is compelled to participate in economic activities without access to social protection. According to model-based estimates from ILO, which employed varying methodologies, the unemployment rate remained relatively stable throughout the 2010s but increased to 4.7% in 2020 due to the impact of the COVID-19 pandemic. The unemployment rate for women was marginally lower than that of men. Additionally, Nepal's unemployment rates were considerably lower than the regional averages, a trend that can be partially attributed to the export of workers (see Table 5).

TABLE 5

THE UNEMPLOYMENT RATE IN NEPAL AND SOUTHERN ASIA BY SEX AND AGE, 2020 (%)

Type	Gender	Nepal (%)	SA (%)
Unemployment	Total	4.7	7.4
	Men	5.0	7.7
	Women	4.5	6.4
Youth unemployment	Total	8.1	20
	Men	9.2	20
	Women	7.1	19

Source: Danish Trade Union Development Agency (n.d.)
Note: SA, Southern Asia

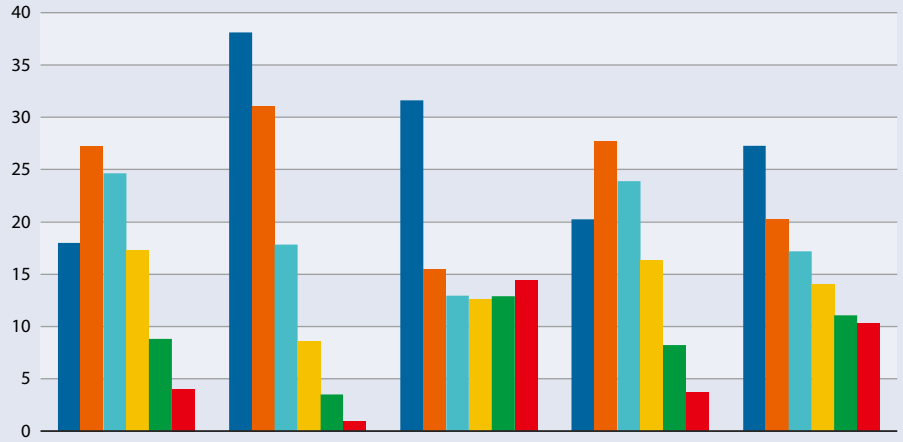
Labor Mobilization

Employment overseas has emerged as a significant source of income for numerous households in Nepal. The pattern of outmigration among Nepali youth has been on the rise annually. According to the Nepal Labor Migration Report of 2022, from 2008–09 to 2021–22, over 4.7 million new work permits were granted to Nepali migrants seeking employment abroad. Furthermore, since 2011–12, more than 1.8 million migrant workers have renewed their work permits (Amit Kapoor, 2023). The willingness of Nepalese migrant workers to continue working abroad, even after their contracts have expired, indicates a lack of domestic opportunities (Ministry of Labor, Employment and Social Security, Government of Nepal, n.d.).

Figure 3 illustrates that over 40% of the 20.7 million individuals within the working-age population (ages 15–34) are concentrated in the younger demographic, highlighting a predominantly youthful population. Within the working-age groups, females represent a larger proportion in the younger age cohorts (15–44 years), whereas males make up a larger share of the working-age population in the 45 years and older age groups. If the trend of seeking employment in foreign labor markets persists, Nepal may face a potential shortage of domestic workers by 2030, which could present significant challenges to the country's goal of transitioning into a middle-income economy (Amit Kapoor, 2023).

FIGURE 1

DYNAMICS OF THE WORKING-AGE POPULATION IN NEPAL



	Employed	Unemployed	Not in the labor force	Labor force	Working age
15–24 yrs	18.0	38.1	31.6	20.3	27.3
25–34 yrs	27.3	31.1	15.5	27.7	20.2
35–44 yrs	24.7	17.8	13.0	23.9	17.2
45–54 yrs	17.3	8.6	12.6	16.3	14.0
55–64 yrs	8.8	3.5	12.9	8.2	11.1
65+ yrs	4.0	0.9	14.4	3.7	10.3

Source: NLFS 2017–18 (National Statistics Office (NSO) (Then CBS), Government of Nepal, n.d.b)
Note: yrs, years

In Nepal, data on GDP related to labor productivity is scarce. However, ILO employs various econometric models to generate estimates and forecasts of labor market indicators for countries and years where specific country-level data is unavailable (Amit Kapoor, 2023). The annual growth rates for different GDP estimates derived from the ILO models are presented in Table 6.

TABLE 6

ANNUAL GROWTH RATE OF DIFFERENT GDP OF ILO MODELED ESTIMATES

Year	Output per hour worked (GDP constant 2017 international USD at PPP) -- ILO modelled estimates, Nov. 2023	Output per worker (GDP constant 2017 international USD at PPP) -- ILO modelled estimates, Nov. 2023	Gross Domestic Product (GDP constant 2017 international USD at PPP) -- ILO modelled estimates, Nov. 2023 (millions of 2017 PPP USD)
2024	7.74	15982.64	129325.13
2023	7.49	15481.46	123185.56
2022	7.59	15700.28	122241.85
2021	7.61	15610.16	115745.08
2020	8.05	15558.83	110403.75
2019	7.58	15778.35	113083.39
2018	7.25	15152.67	106025.24
2017	6.89	14426.24	98515.98
2016	6.45	13572.15	90400.47
2015	6.66	13818.3	90010.63
2014	6.48	13452.39	86568.61
2013	6.16	12811.46	81659.66
2012	6.04	12478.15	78879.05
2011	5.86	12026.3	75359.65
2010	5.82	11748.29	72866.3
2009	5.67	11346.25	69518.02
2008	5.48	10986.92	66503.37
2007	5.19	10484.86	62677.16
2006	5.05	10273.36	60609.43
2005	4.96	10088.1	58636.54

Source: ILOSTAT (n.d.)

Labor productivity in SMEs in Nepal is considerably lower than that in large firms. While large Nepali firms demonstrate productivity levels comparable to their international counterparts, SMEs in Nepal lag significantly behind similar-sized firms in other countries. This discrepancy highlights a critical challenge for the growth and competitiveness of SMEs in the Nepali economy (Kharel, P. and Dahal, K., 2020). Due to the formal sector not generating enough new jobs, many workers are compelled to rely on casual informal activities to make a living, often working fewer hours just to get by. In Nepal, approximately 26% of the working-age population was classified as economically inactive in 2020. This results in a significant amount of hidden unemployment across the economy and a severe shortage of employment opportunities (Danish Trade Union Development Agency, n.d.).

Total Factor Productivity (TFP)

TFP reflects how efficiently labor, capital, and other inputs are utilized in the production process. It accounts for the share of economic growth driven by advancements in technology, efficiency, and other factors, rather than the accumulation of labor and capital alone. Nepal's economy, which is predominantly agriculture-based, has seen increasing contributions from the services and industrial sectors. However, labor and capital productivity have been historically limited by structural challenges, low technological investment, and insufficient infrastructure. Table 7 provides an overview of TFP and related indicators.

TABLE 7

TFP AND OTHER INDICATORS

(%: average annual growth rate)	1970–80	1980–90	1990–2000	2000–10	2010–22	2015–22	2019–20	2020–21	2021–22	Projection			
										2022–25	2025–30	2030–35	2022–35
GDP growth	2	4.6	4.5	3.9	3.9	4.6	–0.5	8.3	6.2	4	4.7	4.6	4.5
Labor input growth	3.6	4.9	5.5	2.8	1.9	2.7	3.4	4.4	3.3	3.6	3.1	2.6	3
Labor quality growth	0.5	3.5	3.2	1.7	0	0	0.2	0.4	0.2	2.8	2.5	2.3	2.5
Hours worked growth	3.1	1.4	2.3	1.1	2	2.7	3.2	4	3.1	0.8	0.6	0.3	0.5
College labor input growth	8.9	8.9	16.8	8.5	2.3	2.9	3.8	5	3.7	5.5	4.5	3.8	4.4
Non–college labor input growth	3.4	4.7	3.9	0.8	1.8	2.6	3.2	4.1	3.1	2.5	2.2	1.7	2.1
ICT capital input growth	20.7	11.9	11.1	5.3	9.7	13.6	13	10.3	9.6	11	8.3	11.8	10.3
Non–ICT capital input growth	3.3	6.1	5.6	4.8	5.7	6.9	8	6.8	7.1	6.5	6.3	6.2	6.3
Per-worker labor productivity growth	-1.2	3.6	2.3	2.9	2	2	-3.6	4.5	3.3	3.3	4.2	4.3	4
Per–hour labor productivity growth	-1.1	3.2	2.2	2.9	2	2	-3.7	4.3	3.1	3.2	4.1	4.3	4
Capital productivity growth	-3.4	-6.1	-5.6	-4.8	-5.6	-6.9	-8.0	-6.7	-7.0	-2.5	-1.5	-1.6	-1.8
TFP growth	-1.5	-0.8	-1.0	0.3	0.4	0.2	-5.9	2.9	1.2	-0.9	0.3	0.4	0.1

Source: APO Productivity Data Book 2024 [26,4]

Technology and Innovative Capacity

Innovation encompasses activities that foster renewal, change, or the creation of more effective processes, products, or methods. It does not always necessitate scientific breakthroughs. At the firm level, innovation can include implementing new software to improve inventory management, installing new machinery, or adopting a new branding strategy. It is defined as the introduction of new products, technologies, business processes, and ideas to the market, as well as the invention of novel concepts (Singh, D. and Kharel, P., 2023).

As a least-developed country, Nepal faces several challenges that impede the growth of its small businesses, including limited access to finance, inadequate databases, low R&D spending, underdeveloped distribution channels, and low levels of financial inclusion. These factors contribute to the slow growth of small businesses in the country. The 15th Plan envisions establishing Business Incubation Centers (BICs) at each of the 753 local levels to transform innovative ideas into dynamic enterprises with national and global competitiveness (NPC, Government of Nepal, 2020) The Sixteenth Five-Year Plan also emphasizes the efficient operation of large industries, the facilitation of industrial raw material and skilled human resources, and the promotion of small, micro, and cottage industries. It aims to maintain interdependence between primary and service production sectors, establish business incubation centers, and preserve and promote traditional and indigenous industries. Additionally, the plan focuses on encouraging environmental and institutional social responsibility, promoting private sector investment in industries, fostering public-private partnerships, and enhancing good industrial labor relations (NPC, Government of Nepal, 2024) There is an increasing trend among consumers toward online purchases over traditional over-the-counter transactions, which is driving the expansion of the e-commerce market. However, SMEs have not been able to fully capitalize on these opportunities.

Nepal faces challenges related to limited productive capacity, a narrow production and export base, and low investment flows. The absence of coordinated efforts to establish a national innovation system has caused Nepal to fall behind in innovation, whether it pertains to science, technology, and innovation (STI) or managerial practices (Singh, D. and Kharel, P., 2023).

The Global Innovation Index (GII) evaluates global economies based on their innovation capabilities. It includes approximately 80 indicators, categorized into innovation inputs and outputs, with the goal of capturing the multi-dimensional aspects of innovation. In 2021, Nepal was ranked 99th for innovation inputs and 116th for innovation outputs (Amit Kapoor, 2023). However, in 2023, Nepal demonstrates better performance in innovation outputs than in innovation inputs. Specifically, Nepal holds the 106th position for innovation inputs, which is consistent with its ranking from the previous year. In contrast, Nepal ranks 103rd for innovation outputs, reflecting an improvement over the previous year's position. In the GII 2023, Nepal is ranked 9th out of the 10 economies in Central and Southern Asia (Singh, D. and Kharel, P., 2023). Table 7 shows GII positions in recent years.

TABLE 8

GII NEPAL RANKINGS

	GII Position	Innovation Inputs	Innovation Outputs
2020	95th	89th	106th
2021	111st	99th	116th
2022	111st	106th	111st
2023	108th	106th	103rd

Source: World Intellectual Property Organization (WIPO) (2023)

The index evaluates the innovation capabilities and outcomes of global economies by assessing various criteria, such as institutions, human capital and research, infrastructure, credit, investment, linkages, as well as the creation, absorption, and diffusion of knowledge, and creative outputs. GII is composed of two main sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. Additionally, it is structured around seven pillars, with each pillar further divided into three sub-pillars.

Nepal's key innovation strengths are reflected in several indicators, including loans from microfinance institutions as a percentage of GDP (ranked 1st), gross capital formation as a percentage of GDP (ranked 5th), and high-tech imports as a percentage of total trade (ranked 18th). Table 8 presents a comprehensive summary of Nepal's performance in the GII 2023 indicators, highlighting both its strengths and weaknesses.

TABLE 9

INDICATOR STRENGTHS AND WEAKNESSES OF NEPAL IN THE GII 2023

Strengths			Weaknesses		
Rank	Code	Indicator Name	Rank	Code	Indicator Name
1	4.1.3	Loans from microfinance institutions, % GDP	129	5.3.3	ICT services imports, % total trade
5	3.2.3	Gross capital formation, % GDP	125	4.3.1	Applied tariff rate, weighted avg., %
18	5.3.2	High-tech imports, % total trade	124	6.3.3	High-tech exports, % total trade
36	4.1.2	Domestic credit to private sector, % GDP	121	6.2.3	Software spending, % GDP
38	6.2.1	Labor productivity growth, %	121	2.1.5	Pupil-teacher ratio, secondary
42	7.2.2	National feature films/mn pop 15-69	95	5.2.5	Patent families/bn PPPUSD GDP
51	7.3.4	Mobile app creation/bn PPPUSD GDP	74	7.1.3	Global brand value, top 5,000
56	7.1.2	Trademarks by origin/bn PPPUSD GDP	71	2.3.4	QS university ranking, top 3
58	4.3.2	Domestic industry diversification	48	6.2.2	Unicorn valuation, % GDP
69	6.1.4	Scientific and technical articles/bn PPPUSD GDP	40	2.3.3	Global corporate R&D investors, top 3, mn USD

Source: WIPO (n.d.)
Note: bn, billion; mn, million

The World Bank Enterprise Survey (WBES) 2023 (World Bank, 2023a) is a firm-level survey conducted on a representative sample of private sector businesses within an economy. It explores a wide range of topics concerning the business environment, such as access to finance, corruption, infrastructure, competition, and business performance. The World Bank Enterprise Surveys (WBES) data for Nepal provide insights into innovation, including the adoption of new technologies, R&D investments, and barriers to innovation at the firm level. The 2019 Nepal Enterprise Survey offers relevant information on SMEs, particularly on innovation-related metrics. Table 9 summarizes key aspects such as new product/service introductions, process innovations, R&D expenditures, and the use of technology licensed from foreign companies.

TABLE 10

INNOVATION, NEW TECHNOLOGIES, R&D INVESTMENTS, AND BARRIERS TO INNOVATION AT THE FIRM LEVEL (%)

Subgroup Level	Small (5–19)	Medium (20–99)	Large (100+)
Percent of firms that introduced a new product/service over last 3 years	14.5	25.1	21
Percent of firms whose new product/service is also new to the main market	27.4	38.1	38.9
Percent of firms that introduced a process innovation over last 3 years	8.3	8.7	12.2
Percent of firms that spend on R&D in the last fiscal years		2.5	5
[B-READY] Percent of firms that introduced a new product/service and process over last 3 years, and spent on R&D over last fiscal year (excluding small firms)	0	0.2	0
[B-READY] Percent of firms with an internationally-recognized quality certification	0.9	16.7	39.6
Percent of firms using technology licensed from foreign companies*	0.1	0.3	16.6
Percent of firms having their own web site	50.1	66.3	80.9

Source: World Bank (2023b)

In Nepal, various innovation support programs are available for small businesses. However, the current scale and type of support do not adequately meet the needs of these enterprises. Understanding the effectiveness of the available support is crucial, yet there is a lack of Nepal-specific evidence on which interventions and supports are most effective for the enterprises they intend to assist (Singh, D. and Kharel, P., 2023). It is difficult to envision Nepal's MSMEs achieving or adopting a scientific breakthrough when nearly half of the firms in the country operate without registration. Additionally, small businesses in Nepal struggle with basic tasks like proper bookkeeping and human resource management, and many lack even fundamental market information. Fostering technological innovation is vital for the nation's economic growth and social advancement. To achieve this, it is essential to establish an ecosystem that nurtures and promotes innovation. This can be accomplished through a blend of government policies, private sector investments, and public-private collaborations.

ANALYSIS OF CONTENTS, IMPLEMENTATION MECHANISMS AND EFFECTIVENESS OF POLICY INSTRUMENTS FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION OF SMES

The main challenges in industrial development in Nepal include political instability and industrial insecurity, which create an unfavorable environment for industrial operations. Additional issues include poor labor relations, limited energy availability, inadequate industrial infrastructure, and inefficiencies. The industry also faces a shortage of skilled manpower, limited capacity for technology adoption, and low productivity, which affect export potential. Moreover, the lack of product diversification and weak supply chain management further hinders industrial growth.

Policies designed to promote technological development and innovation in SMEs can be classified into three categories. Supply-side policies focus on enhancing firms' incentives to invest in innovation by reducing associated costs. Demand-side policies involve governmental measures that stimulate innovation and facilitate its widespread adoption. Systemic policies focus on enhancing interactive learning among actors within innovation systems (Intarakumnerd, P. and Goto, A., 2016). This section provides an overview of the innovation support policies and programs in Nepal, focusing on industrial and science and technology-related policies, as well as the funds, programs, and projects aimed at supporting innovation in MSMEs.

Supply Side Technology Policy

The most commonly used supply-side technology policy is the provision of subsidies for R&D, which include tax incentives, grants, loans, and direct equity participation (Intarakumnerd, P. and Goto, A., 2016). However, in Nepal, it is difficult to envision MSMEs achieving significant technological advancements when nearly half of the firms operate without registration. Additionally, many small businesses in Nepal face challenges with maintaining proper bookkeeping and human resource management, and often lack essential market information (Singh, D. and Kharel, P., 2023).

Industrial Policy, 2067 (2011)

Nepal's Industrial Policy, introduced in 2011, aims to promote sustainable and inclusive industrial growth through effective and coordinated collaboration among the public, private, and cooperative sectors (MoICS, Government of Nepal, n.d.a). The policy seeks to enhance the export of industrial products and increase the industrial sector's contribution to the national economy. It includes provisions to support innovation within MSMEs. Key provisions focus on fostering industrial entrepreneurship by adopting advanced technologies and developing human resources and managerial capacities. Special measures have been implemented to support the growth of micro, cottage, and small enterprises, which are recognized as key drivers of innovation. The policy also prioritizes the development and acquisition of new technologies at both the national and industrial unit levels to improve the competitiveness, quality, and productivity of industrial products and services. Furthermore, it aims to promote research and development in the fields of industrial information and communication, appropriate technology, and biotechnology—sectors that are emerging as significant on the global stage. Additionally, the policy emphasizes the promotion of industries that utilize local resources, raw materials, skills, labor, and technology.

National Science, Technology and Innovation Policy (2019)

The Science, Technology and Innovation (STI) (Policy Ministry of Education, Science and Technology (MoEST), Government of Nepal, 2019) recognizes the need to adopt new and emerging technologies to promote production-oriented entrepreneurship and emphasizes the importance of attracting investment for innovation-driven scientific research. To achieve these goals, the policy suggests fostering cooperation and partnerships between academic institutions, research institutes, and industrial enterprises. The primary priority of the policy is the growth of industrial production and productivity. Nepal's history in science and technology is relatively short compared to other countries. Although there is a plan to establish connections between STI and industrial institutions, the policy lacks clarity on how this goal will be realized, both in terms of policy design and implementation (Singh, D. and Kharel, P., 2023).

National Start-Up Enterprise Policy, 2081 (2024)

Nepal's Startup Enterprise Policy 2081 (MoICS, Government of Nepal, n.d.b) emphasizes the importance of technological development and innovation within the country's SMEs. The policy encourages startup-driven entrepreneurship by integrating regional and global research, best practices, and fostering innovation. By attracting both national and international investments, including foreign direct investments (FDIs) and contributions from Non-Resident Nepalis (NRNs), the policy aims to establish a robust environment for technological advancements. Legal amendments have been introduced to facilitate smoother access to the capital market, enabling startups to secure the necessary financial resources to drive technological development and innovation in SMEs.

To further stimulate innovation, the National Startup Enterprise Policy proposes several supportive measures, including seed funding, human resource development, consultancy, and technical assistance. Startups focused on technological innovation will benefit from export incentives such as concessional loans, cash bonuses, and a ten-year income tax exemption. The policy also ensures that banks and financial institutions allocate a specific percentage of their loan portfolios to startups, with additional subsidies for loans aimed at fostering innovation. A dedicated fund will be created to support new ideas and innovative businesses, while an innovation center will be established to nurture and promote entrepreneurship and technological advancements within the SME sector.

A specialized financial initiative, the 'Nepal Startup Fund,' was created to support entrepreneurial ventures. This program offers loans between NPR500,000 and NPR2.5 million at a preferential interest rate of 3%. Loans of up to NPR500,000 are provided in a single installment, while amounts exceeding this threshold are distributed in up to three installments. These loans are offered without collateral, with the project itself serving as the guarantee. However, startups are required to insure their projects. Of the 183 projects selected, 165 startups have successfully received their loans, while a small number are still awaiting allocation. The disbursement process provides each startup with an initial installment of NPR500,000, with the remaining funds to be allocated based on the progress and specific needs of each project (Khatapana, 2024).

Furthermore, various programs offered by both government and non-government organizations aim to foster innovation within MSMEs. Many development agency-sponsored projects also provide essential support to MSMEs in Nepal.

Key programs include:

- **Micro, Cottage, and Small Industries Development Fund:** Subsequent to Nepal's entry into the WTO, the government has allocated funds to support infrastructure development, capacity building, technology transfer, and marketing for micro, cottage, and small-scale industries (Bhatta A. and Mishra K., 2022).

- **Micro, Domestic, and Small Industry Credit Disbursement Principal Fund:** This initiative focuses on skill development and provides raw materials, machinery, equipment, and tools necessary for establishing and operating industries (MoICS, Government of Nepal, 2020).

- **Business Promotion Program:** This program aims to transform new ideas into viable, competitive businesses by supporting the development of high-value goods and services through the use of the latest technology. The government also offers export incentives, such as cash subsidies ranging from 4% to 8% of the export transaction value, based on value addition for specific products. However, bureaucratic hurdles continue to discourage many small exporters from fully utilizing this scheme (MoICS, Government of Nepal, 2020)(Singh, D. and Kharel, P., 2023).

- **Women Entrepreneurship Development Fund:** Established under the Industrial Policy of 2010, this fund has demonstrated notable success in providing collateral-free loans of up to NPR500,000 at an interest rate of 6% over a three-year term to women entrepreneurs in micro, cottage, and small enterprises. This initiative differs from the subsidized interest loans offered by banks to women entrepreneurs (Bhatta A. and Mishra K., 2022).

These policies and programs aim to enhance the technological capabilities and competitiveness of MSMEs, despite the existing challenges in the business environment.

Summary of Individual Case Studies

A case study was conducted on three enterprises to examine the content, implementation mechanisms, and effectiveness of policy instruments aimed at enhancing the technological capabilities and innovation of SMEs. A summary of these enterprises is provided in Box 1 and the questionnaire used in the case studies is presented in Annex 1.

BOX 1

SUMMARY OF INDIVIDUAL CASE STUDIES

1. Champak Paun Industry

Champak Paun Industry, a sole proprietorship founded on March 13, 2013, specializes in producing lapsi paun, a product made from the lapsi fruit, and primarily serves the international market. Although Nepal's industrial policy aims to provide modern technology to MSMEs, the limited availability of solar drying technology and a lack of financial support from the government or external organizations have proven to be significant obstacles. Despite these challenges, the business has achieved an annual income of NPR4 million. The workforce, consisting of 15 employees, mostly women, has remained stable.

While the demand for lapsi paun is strong in the market, the absence of technical support, government grants, and awareness of industrial policies highlights key areas for improvement. The owner has expressed a need for access to new technologies to improve production processes and address existing challenges. This suggests that the National Science, Technology, and Innovation Policy has not been effectively implemented, as its primary aim is to promote the adoption of the latest technologies necessary for growth and production.

Moreover, the lack of government assistance in the form of grants, marketing support, or technological upgrades underscores a gap in the support system that could facilitate industry growth. Despite these hurdles, Champak Paun Industry continues to perform well in the competitive international market, indicating strong potential for further success if additional resources and support are provided. Unfortunately, policies aimed at supporting SMEs in Nepal have not effectively benefited this industry, as the company has received no government grants, subsidies, or marketing assistance. Furthermore, the lack of awareness of industrial policies, coupled with challenges related to technology, taxation, and employee training, has limited the company's ability to fully capitalize on available resources and opportunities for growth.

2. Resu Food Pvt. Ltd.

Resu Food Pvt. Ltd. is a joint-ownership enterprise that specializes in producing pickles, chutney (spicy condiment), amla candy (Indian gooseberry candy), and gundruk (fermented leafy vegetable). Established in 2075 Baisakh (Nepali calendar) (2018), the company operates on rented land and has an annual turnover of approximately NPR30–40 million, with a 20% profit margin. While 80% of its products are exported, the remaining 20% are sold within Nepal. The company has received some government support, including a grant in 2080 Baisakh (2023) for labeling and packaging machinery valued at NPR187,000, but no further assistance has been provided. Despite not receiving government support for marketing, the company has not faced significant challenges in this area. It currently employs 30 staff members, with 23 women, and provides regular training to its employees.

Resu Food's experience with government policies reveals several gaps in financial support and incentives for small businesses. Despite benefiting from a 30% discount on registration fees and receiving the grant for packaging machinery, the company has not accessed tax

exemptions or low-interest loans. Furthermore, while the government has made efforts to promote technological adoption and innovation, the company has not engaged in significant research or innovation. Although it received a solar dryer as part of a government initiative, this support appears to be an isolated case, with limited broader impact on the company's technological development.

While Resu Food provides training to its employees in alignment with government skill development policies, the availability and accessibility of such training programs for SMEs remain unclear. Although the government has launched various training initiatives, these may not always cater to the specific needs of food-processing industries, or may be hindered by geographic and logistical challenges. Additionally, while policies exist to promote women entrepreneurs, the company's limited access to these benefits suggests that there are issues with implementation and accessibility. The experience of Resu Food underscores the need for improved awareness, streamlined application processes, and better execution of government policies aimed at supporting small businesses and women entrepreneurs. To enhance the effectiveness of SME support, the government should address these challenges, simplify procedures, and ensure that assistance reaches small businesses, particularly those in rural areas or owned by women.

3. Om Food Product

Om Food Product, a sole proprietorship established on December 12, 2005, is a food production company operating on private land in Nepal. The company exclusively serves the domestic market, generating an annual revenue of NPR3.5 million and a net profit of NPR700,000. Despite its stable sales performance and a dedicated workforce of 14 employees (10 women and four men), the organization receives no government assistance, grants, or special tax exemptions. Furthermore, it has not engaged in research and development, nor does it offer training programs or adopt new technologies for its employees. This situation reflects a significant shortcoming in the implementation of Nepal's Industrial Policy and National Science, Technology, and Innovation Policy, which are designed to promote the adoption of advanced technologies and the development of skilled manpower.

The company has not faced any major challenges in sales or market supply, yet it operates without institutional or governmental support. Moreover, there is a lack of awareness or engagement with industrial policies or legislation. The owner has expressed a desire for government policies that offer tax exemptions to women-led businesses, but such provisions are currently absent. Om Food Product advocates for the introduction of tax incentives for women entrepreneurs, which could greatly benefit businesses in this sector.

Although Nepal has developed several policies aimed at supporting SMEs, the case of Om Food Product highlights a gap between policy formulation and effective implementation. The company has not received significant support in crucial areas such as grants, tax exemptions, training, or access to technology. The lack of awareness and engagement with government policies further suggests that these initiatives have not been effectively communicated to SME owners, particularly women entrepreneurs.

To bridge this gap and ensure the successful implementation of SME policies, it is essential for the government to enhance outreach efforts, provide more targeted support for women-led businesses, and address the challenges small businesses face in accessing training, technology, and market opportunities. Tailored financial and technical assistance could significantly support businesses like Om Food Product in achieving sustainable growth and making a more substantial contribution to the national economy.

Detailed Review of the Effectiveness of Policies for SMEs in Nepal Based on Case Studies

The case studies of Champak Paun Industry, Om Food Product, and Resu Food Pvt. Ltd. provide insight into the challenges faced by SMEs in Nepal, particularly in relation to the implementation of government policies designed to support them. These companies, though diverse in their operations, share common struggles that highlight the gaps in the current policy environment for SMEs. The review will focus on the effectiveness of the existing policies for SMEs, as evidenced by the experiences of these three businesses and shown in Box 2.

BOX 2

EFFECTIVENESS OF POLICIES FOR SMES IN NEPAL BASED ON CASE STUDIES

1. Industrial Policy and Support for Technology and Innovation

The Industrial Policy of Nepal envisions providing financial and technological support to SMEs, but the case studies reveal a disconnect between policy goals and actual outcomes.

- **Champak Paun Industry:** Despite a clear need for technological improvements (such as solar drying technology), the company has not received any technical support or access to advanced technology from the government. The lack of financial assistance or access to modern production technologies severely limits the company's potential for growth. This indicates that the industrial policy's objectives, particularly those related to technological adoption and innovation, have not been effectively implemented.

- **Resu Food Pvt. Ltd.:** While the company did receive a grant for labeling and packaging machinery, which aligns with the industrial policy's focus on technological enhancement, this support was minimal and isolated. The company also received a solar dryer under a government initiative; however, this has had limited impact on its broader technological development. Despite receiving some government assistance, Resu Food has not been able to fully leverage technological innovations due to a lack of sustained and targeted support. This highlights a gap in the industrial policy's approach to providing continuous and meaningful support for technology adoption.

- **Om Food Product:** This company has not received any form of technical support or government grants, and it has not engaged in research and development. The lack of access to new technologies or innovation is a clear indication that the industrial policy has not been effectively implemented to support this company.

Effectiveness of Industrial Policy: The case studies suggest that while the industrial policy aims to support technological advancements, its actual impact has been limited. Policies around technology transfer, support for R&D, and innovation seem to be underutilized or poorly implemented. The government's support mechanisms for technology adoption are sporadic, and many SMEs like Om Food Product have not benefited from these provisions.

2. National Science, Technology, and Innovation Policy

The National Science, Technology, and Innovation Policy is meant to promote the adoption of modern technologies and innovation in the manufacturing sector. However, the case studies illustrate that the policy has had little influence on the businesses in question.

- **Champak Paun Industry:** The company's owner has explicitly mentioned the need for new technologies to address production challenges, which suggests that the National Science, Technology, and Innovation Policy has not been effectively communicated or implemented. The lack of support for SMEs to adopt modern technologies such as solar drying technology points to the policy's failure to meet the needs of businesses.

- **Resu Food Pvt. Ltd.:** Although Resu Food received a solar dryer, this support seems to be an isolated instance rather than part of a sustained policy effort. The company has not significantly benefited from other aspects of the National Science, Technology, and Innovation Policy, particularly in areas like R&D or product innovation.

- **Om Food Product:** The absence of any technological support for this company indicates that the National Science, Technology, and Innovation Policy has not been effective for smaller SMEs, particularly those focused on domestic markets.

Effectiveness of the National Science, Technology, and Innovation Policy: The case studies highlight a significant gap in the implementation of the National Science, Technology, and Innovation Policy. While the policy aims to encourage innovation and technological advancements, SMEs in Nepal, especially those in the food processing sector, are not receiving adequate support. There is little evidence of active promotion of modern technologies or innovation in these companies, suggesting that the policy is not having the desired impact.

3. Support for Women Entrepreneurs

The government of Nepal has introduced various policies aimed at supporting women entrepreneurs, such as tax exemptions and special support programs. However, the case studies reveal that these policies have not been effectively implemented or have not reached their intended beneficiaries.

- **Champak Paun Industry:** The company employs mostly women, yet there is no mention of specific support or benefits from government policies targeting women entrepreneurs. The absence of any direct benefits suggests that the policies aimed at supporting women in business have not been adequately communicated or implemented.

- **Om Food Product:** The owner has advocated for tax incentives for women entrepreneurs, which is an important policy gap. Despite operating as a women-led business, Om Food Product has not received any such tax exemptions or special support. This indicates that women entrepreneurs face barriers in accessing the benefits that are supposed to be provided by the government.

- **Resu Food Pvt. Ltd.:** Despite employing a large percentage of women (23 out of 30 employees), Resu Food has not received specific support for women entrepreneurs. The company has not benefited from policies meant to promote women in business, indicating that these policies are not being effectively executed.

Effectiveness of Support for Women Entrepreneurs: The case studies suggest that policies designed to support women entrepreneurs are not reaching their intended beneficiaries. There is a significant gap between the government's intention to promote women in business and the actual support provided to women-led SMEs. Women entrepreneurs, particularly those in rural areas or operating smaller businesses, struggle to access these benefits, which undermines the effectiveness of these policies.

Demand-Side Technology Policy

Demand-side technology policy goes beyond creating markets for products made by SMEs. The most critical demand-side technology policy is public procurement. Central and local governments may procure goods and services from SMEs that meet specific criteria, such as achieving certain technological standards or providing products or services with superior functionality compared to existing ones (Intarakumnerd, P. and Goto, A., 2016).

In Nepal, demand-side technology policies play a crucial role in fostering local innovation, with a particular emphasis on public procurement. One significant initiative is the "Guidelines on the Use of Indigenous Products in Public Bodies," introduced in 2014. This policy is designed to prioritize the procurement of locally produced goods and services within public institutions, even if they are priced up to 15% higher than imported alternatives. The primary objectives of this policy include promoting economic self-reliance, reducing dependence on foreign imports, supporting the growth of SMEs, and preserving the cultural heritage associated with traditional manufacturing practices.

The central mechanism for implementing this policy is the requirement for public institutions—such as schools, hospitals, and government offices—to give preference to indigenous products whenever feasible. This initiative aims not only to bolster local industries but also to ensure that government expenditure stimulates the domestic economy. A certification system has been established to authenticate indigenous products, with certificates of origin issued by reputable organizations such as the Federation of Nepal Industry and Commerce. Furthermore, the policy mandates that at least 50% of products, including furniture and machinery, be sourced from domestic suppliers, provided suitable local alternatives are available.

In addition to the procurement guidelines, the Government of Nepal introduced the Micro, Cottage, and Small Industry Promotion Policy, 2081 (MoICS, n.d.c), which is specifically focused on supporting small, home-based, and cottage industries. This policy seeks to enhance collaboration with industry bodies to improve marketing strategies, promote local products, and foster skill development within these sectors. The overarching goal is to expand the market for products from micro and small industries, thereby further encouraging innovation and strengthening domestic production capabilities.

The effectiveness of this policy can be evaluated through various performance indicators, including the growth of SMEs, a reduction in reliance on imports, and the creation of employment opportunities, particularly in rural areas where indigenous industries are concentrated. Optimal utilization of indigenous products, over time, will contribute to improving product quality through technological advancements and innovation. Furthermore, the extent to which public institutions adopt local products serves as a critical measure of success. However, challenges persist, particularly regarding the price differential between indigenous and imported goods, which may limit the widespread implementation of the policy.

In conclusion, Nepal's demand-side policy through public procurement represents a strategic approach to fostering local innovation and technological advancement, with a particular focus on supporting the growth of SMEs. By prioritizing the procurement of indigenous products, the government aims to stimulate innovation within local industries, encouraging SMEs to improve their technological capabilities, enhance product quality, and develop new solutions that meet market demands. This approach not only reduces dependence on imports but also creates an environment where SMEs are incentivized to adopt advanced technologies, increase productivity, and compete on a larger scale.

Systemic Technology Policy

SMEs' performance can be enhanced through closer collaboration with universities and public research institutes. Various policy measures can promote these relationships. For instance, a targeted subsidy could support partnerships between SMEs and universities to develop specific technologies or products (Intarakumnerd, P. and Goto, A., 2016).

Nepal seeks to attain economic prosperity by safeguarding all aspects of intellectual property and labor law frameworks currently in effect. The government is committed to ensuring the security of various industries and will extend seed capital to cooperatives, micro-industries, cottage industries, and small enterprises to facilitate the establishment of industries in remote regions. Upon request, the government will also provide the land required for industrial development through the retention or leasing of publicly-owned properties (Amit Kapoor, 2023).

The 2011 Innovation in Industrial Policy focuses on promoting industrial entrepreneurship through the use of advanced technology, the development of a skilled workforce, and the enhancement of managerial capabilities essential for industrial growth. The policy aims to boost competitiveness by strengthening managerial skills, fostering creativity, promoting knowledge and expertise, and adopting suitable technologies. Additionally, it emphasizes capacity-building initiatives to develop industrial skills and entrepreneurship, and outlines programs designed to support technology, marketing, skills, and research in industries related to agriculture, non-timber forest products, animal husbandry, dairy, poultry, and fruit and herb-based industries (Singh, D. and Kharel, P., 2023).

In the recent fiscal year's budget speech, a policy was introduced to allocate at least 1% of the government's total capital budget to research, innovation, and invention. The government has earmarked NPR1 billion to establish a dedicated fund for these activities, with necessary legislation to be developed to manage the fund. Programs from various government agencies focused on research, invention, and innovation will be linked to this fund. Provinces and local levels will be encouraged to contribute as well. The government also plans to create a separate unit within the Ministry of Education, Science, and Technology to coordinate and support innovation, invention, and research efforts. A start-up ecosystem will be developed to foster innovation and entrepreneurship in the country, with an incubation center in Kathmandu to promote entrepreneurial thinking and transform ideas into businesses. Venture capital and private equity funds will be encouraged to invest in start-up ventures, and foreign investment through international investment companies will be mobilized for innovation and entrepreneurship development. To further support start-ups, NPR1.25 billion has been allocated (Ministry of Finance, Government of Nepal, n.d).

The 15th periodic plan (2019–20 to 2023–24) (NPC, Government of Nepal, 2020) emphasizes creating an investment-friendly environment by promoting technology adoption, implementing a one-window system, and improving industrial infrastructure. It prioritizes providing soft loans to micro, cottage, small, and medium enterprises (MCSMEs), encouraging the adoption of new technologies to enhance industrial capacity, and leveraging the knowledge, skills, capital, and technology of NRNs for national industrial development.

The 15th plan envisioned establishing BICs across all 753 local levels to transform innovative ideas into competitive enterprises with national and global potential. These centers are designed to support startups by offering access to experienced mentors and industry experts, who provide invaluable guidance on business strategies, market trends, and overcoming challenges. Additionally, incubation centers aim to address resource constraints by providing startups with essential tools, infrastructure, and access to funding opportunities. However, by the end of the planning period, the envisioned BICs had not been established due to several challenges, including the absence of clear operational frameworks, which delayed implementation. Additionally, limited financial, technological, and human resources have hindered their development, while inadequate collaboration among the government, private sector, and other stakeholders has further slowed progress.

Innovation and incubation centers supported by academic institutions have been expanding in Nepal, with facilities like the Nepal Technology Innovation Centre at Kathmandu University and the Enterprise Innovation and Incubation Centre at the Institute of Engineering.

The Government of Korea, through Korea International Cooperation Agency (KOICA), granted USD10 million for the "Integrated Rural Development of Nepal" project to enhance Kathmandu University's research and development capabilities. The initiative focuses on improving the quality of life and income in rural Nepali communities through technological innovation. As part of this effort, KOICA established the Nepal Technology Innovation Center (NTIC) at Kathmandu University, equipping it with advanced tools to develop business models suited for rural and remote areas (New Spotlight Online, 2023).

The National Innovation Center (NIC) (NIC, n.d) Nepal, established on 2012, is a nonprofit organization committed to fostering a culture of research, technology, and innovation within Nepal. Its goal is to support innovative solutions that address societal challenges, promote technological advancements, and nurture local talents to drive progress and self-reliance in the country. Although

both centers have produced some successful businesses, these initiatives have primarily stayed within the academic realm and have had limited success in nurturing the development of sustainable enterprises (Singh, D. and Kharel, P., 2023). Other private business incubation centers also established in the country; however, the research and innovation are limited.

INSTITUTIONS AFFECTING EFFECTIVENESS OF POLICIES

In Nepal, the development of SMEs relies on the collaborative efforts of various government ministries, public sector organizations, and private sector entities. MoICS (MoICS, Government of Nepal, n.d.d) is the central body tasked with coordinating policies and programs to promote SME growth. Supporting roles are played by the Department of Industry (DoI) (DoI, MoICS, Government of Nepal, n.d.), which facilitates business registration and investor services through the One-Stop Service Center (OSSC), and the Micro, Cottage, and Small Industry Promotion Centre, which focuses on micro-enterprises and cottage industries. Additionally, the Industrial Enterprise Development Institute (IEDI) and the National Productivity and Economic Development Centre (NPEDC) contribute to enhancing productivity and entrepreneurial training.

The Federation of Nepalese Chambers of Commerce and Industry (FNCCI) (FNCCI, n.d.) is a critical player in SME policy development. It provides valuable input and recommendations to the government to ensure that the needs of SMEs are incorporated into policy-making. FNCCI conducts research, participates in policy discussions, and assists with the implementation of new regulations by raising awareness and guiding SMEs on compliance. Through its monitoring and feedback mechanisms, FNCCI ensures that policies are both effective and responsive to the sector's needs. The organization also supports capacity-building initiatives and promotes the interests of larger enterprises, collaborating with donor agencies to launch projects that support economic development.

The NPC (NPC, Government of Nepal, n.d.), as the highest policy-making body, formulates and oversees the execution of periodic plans, ensuring that SME growth aligns with the national development framework. Similarly, the Ministry of Labour, Employment and Social Security (MoLESS) (MoLESS, Government of Nepal, n.d.) plays a significant role by addressing labor administration issues, formulating labor policies, and promoting industrial relations and human resource development, all of which are vital for SME efficiency and sustainable growth. However, challenges persist, including coordination issues between MoICS and the Ministry of Finance (MoF) (MoF, Government of Nepal, n.d.) MoF, responsible for fiscal policies and budget allocations, often has limited budgets for implementing SME-related policies, which affects the overall effectiveness of these initiatives.

Other government ministries, such as the Ministry of Agriculture and Livestock Development (MoALD) (MoALD, Government of Nepal, n.d.) and the Ministry of Forest and Environment (MoFE) (Herbs Production and Processing Co. Ltd., MoFE, Government of Nepal, n.d.), also engage with SMEs but often fall short due to coordination gaps with MoICS. Bureaucratic inefficiencies, such as slow decision-making and complex regulatory procedures, further complicate policy implementation, affecting the ability of SMEs to access financial services and obtain necessary approvals. This issue is particularly evident in the challenges that entrepreneurs face when navigating paperwork and delays in regulatory processes.

The entrepreneurial landscape in Nepal is shaped not only by governmental efforts but also by the nature of the entrepreneurs themselves. Opportunity-based entrepreneurs, who seek innovation and wealth through sectors like technology and exports, contrast with necessity-based entrepreneurs, who start businesses out of a lack of employment opportunities, particularly in rural areas. The latter group often encounters greater challenges, including restricted access to financing, markets, and business development services. Public attitudes toward entrepreneurship and failure also influence SME success, as a stigma exists around business failure, discouraging risk-taking and innovation. Additionally, trust between large firms and SMEs remains fragile, as larger companies prefer established partners and SMEs hesitate to engage due to unfavorable terms or unwillingness. Strengthening public perception, fostering trust, and improving coordination between public and private organizations are essential steps for enhancing the SME sector's contribution to Nepal's economic growth. Nepal's innovation landscape reveals a disconnect between the academic and commercial sectors. While science and technology institutions host research and innovation centers, their outputs remain largely untapped by businesses for commercial use (Singh, D. and Kharel, P., 2023).

CONCLUSION AND POLICY RECOMMENDATIONS

Conclusion

SMEs in Nepal hold significant growth potential but face numerous challenges that hinder their progress. One of the primary obstacles is the lack of awareness about existing government policies and support programs designed to promote technological adoption, entrepreneurship, and overall growth. While such policies do exist, many SMEs remain unaware of opportunities like grants, tax exemptions, and technical assistance, which are crucial for their development. This gap in knowledge severely limits their ability to access these essential resources.

Another issue is the disconnect between the needs of SMEs and the government policies meant to support them. While SMEs may require specific forms of assistance, such as advanced technologies or ongoing financial backing, the available government programs may not always align with these needs. This misalignment restricts the growth potential of businesses that could benefit from more tailored support.

Moreover, the complexity of government processes, including cumbersome application procedures for grants and tax exemptions, often discourages SMEs from seeking available assistance. The bureaucratic nature of these processes creates additional barriers, making it difficult for small businesses to benefit from resources that could help them grow.

In addition to these challenges, SMEs in Nepal face broader issues such as limited access to finance, a shortage of skilled labor, inadequate infrastructure, and regulatory hurdles that stifle productivity and innovation. While many of these businesses could benefit from preferential market access under trade agreements, they are often unable to take advantage of these opportunities due to limitations in supply chain management and product diversification.

Policy Recommendations

Numerous innovation support programs are available for small businesses in Nepal. However, the scale and type of support offered fall short of meeting the needs of these enterprises. Government and non-government entities providing assistance must assess the effectiveness of their interventions. The primary policy recommendations are as follows:

1. **Enhance Awareness and Accessibility:** The government must improve communication about available policies and support programs. Targeted outreach initiatives can help ensure that information on grants, tax exemptions, and technological support is accessible to businesses, particularly those in rural areas.

2. **Streamline Administrative Processes:** Simplifying bureaucratic processes is critical. Streamlining application procedures and implementing digital platforms for managing grants, subsidies, and other forms of assistance will make it easier for SMEs to engage with government support programs.

3. **Align Policies with SME Needs:** Government policies should be more responsive to the specific requirements of SMEs, particularly in areas like technological advancement and long-term financial support. Tailoring solutions to common challenges such as technology upgrades or packaging improvements would better serve the needs of these businesses.

4. **Focus on Skill Development:** Investing in skill development programs that focus on entrepreneurship, business management, and financial literacy is essential. Expanding access to modern business education and training will equip SME owners and employees with the necessary skills to foster growth.

5. **Improve Market Access and Export Support:** Government initiatives should prioritize helping SMEs expand their market presence both domestically and internationally. This includes providing support for marketing, digital platforms, trade fairs, and export activities. Promoting the adoption of e-commerce and fintech solutions can also help SMEs engage more effectively with global markets.

6. **Foster Innovation and R&D:** Encouraging innovation through financial incentives for R&D is vital for enhancing the competitiveness of SMEs. Establishing grant programs and other mechanisms to support R&D, particularly in high-potential sectors, will help SMEs stay competitive. Monitoring the effectiveness of these initiatives will ensure their success.

7. **Innovation and Incubation Centers:** Foster collaboration between academia and SMEs by establishing innovation hubs, offering shared facilities for technology development, and enabling access to grants or co-funding opportunities. Utilize academic networks to link SMEs with investors and industry partners, while promoting government or private-sector initiatives to support these collaborative efforts.

REFERENCES

Ajit Bhatta (2022) *Mapping Policy Landscape for SME Development for Policy Harmonization Across Government Organizations.* https://daayitwa.org/storage/projects/daayitwa-nepal-public-policy-fellowship-2022/files/16775762483_.pdf, Accessed on August 20, 2024.

Amit Kapoor (2023) *SME Transformation for Meeting the SDGs in Asia*, https://www.apo-tokyo.org/publications/sme-transformation-for-meeting-the-sdgs-in-asia/, Accessed on March 3, 2025.

Asian Development Bank (2015) *Innovative strategies in technical and vocational education and training for accelerated human resource development in South Asia, Nepal*. https.//www.adb.org/sites/default/files/publication/176564/tvet-hrd-south-asia-nepal.pdf, Accessed on 30/10/2022

Bhatta A. and Mishra K. (2022) *Mapping policy landscape for SME development for policy harmonization across government organizations*. https://daayitwa.org/storage/projects/daayitwa-nepal-public-policy-fellowship-2022/files/16775762483_.pdf, Accessed on June 25, 2024

CBS, Government of Nepal (n.d.) National Accounts Statistics of Nepal (2021/22 Annual Estimates)

Danish Trade Union Development Agency (n.d.) *Labour Market Profile, Nepal – 2022/2023*. https://www.ulandssekretariatet.dk/wp-content/uploads/2022/08/LMP-Nepal-2022-final-1.pdf, Accessed on August 3, 2024

DoI, Government of Nepal (n.d.) [*Micro, Cottage and Small Industry Statistics 2022–2023*] (In Nepali). https://doind.gov.np/uploads/notices/Notices-20240522170805227.pdf, Accessed on 2 August 3, 2024.

DoI, MoICS, Government of Nepal (n.d.)

FNCCI (n.d.)

FNCCI-IFC (2023) State of Private Sector in Nepal, CONTRIBUTIONS AND CONSTRAINTS May 2023. https://fncci.org/uploads/publication/file/Report_StatePSNepal_20230519064735.pdf, Accessed on July 24, 2024

Government of Nepal NPC, National Statistics Office (NSO) (n.d.) (Then CBS) ANNUAL HOUSEHOLD SURVEY 2016/17 (Major Findings)

Herbs Production and Processing Co. Ltd., MoFE, Government of Nepal (n.d.)

ILO (2023) *Micro and small enterprises: engines of job creation*, https://ilostat.ilo.org/blog/micro-and-small-enterprises-engines-of-job-creation/, Accessed on July 21, 2024

ILOSTAT (n.d.) ILO modelled estimates (Nov. 2023). https://ilostat.ilo.org/topics/labour-productivity/, Accessed on August 3, 2024.

Intarakumnerd, P. and Goto, A. (2016) "Technology and Innovation Policies for Small and Medium-Sized Enterprises in East Asia." *ADBI Working Paper 578*. Tokyo: Asian Development Bank Institute. https://www.adb.org/publications/technology-and-innovation-policies-small-and-medium-sized-enterprises-east-asia, Accessed on August 4, 2024.

Kharel, P. and Dahal, K. (2020) "Small and Medium-Sized Enterprises in Nepal: Examining Constraints on Exporting" *ADBI Working Paper 1166*. Tokyo: Asian Development Bank Institute. https://www.adb.org/sites/default/files/publication/623281/adbi-wp1166.pdf, accessed on 22 July 2024

Khatapana (2024) Government Disburses NPR 170 million to 165 Startups, Aug 4, 2024. https://khatapana.com/blogs/203/nepals-startup-scene-gets-a-boost-government-disbu. Accessed on 24 August 2024.

Koji N. and Mun S. H. (2024) *APO Productivity Databook 2024*. https://www.apo-tokyo.org/publications/apo-productivity-databook-2024-2/ Accessed on December 25, 2024

Ministry of Education, Science and Technology (MoEST), Government of Nepal (2019) National Science, Technology and Innovation Policy (2019). https://moest.gov.np/upload_file/files/post/1656159973_1852980912_NSTI_Policy_2019.pdf, Accessed on August 5, 2024.

Ministry of Labor, Employment and Social Security, Government of Nepal (n.d.) Nepal Labor Migration Report 2022.

MoALD, Government of Nepal (n.d.)

MoF, Government of Nepal (2022a) Budget Speech of Fiscal Year 2022/23

MoF, Government of Nepal (2022b) Economic Survey 2021/22.

MoF, Government of Nepal (2024) Budget Speech of Fiscal Year 2023/24

MoF, Government of Nepal (n.d.)

MoF, Government of Nepal, (n.d) Budget Speech of Fiscal Year 2024/25

MoICS (n.d.c) Small Domestic and Small Industry Promotion Policy 2081 (Nepalese Language) https://moics.gov.np/content/13384/small--domestic-and-small-industry-promotion-policy-/, Accessed on December 26, 2024.

MoICS, Government of Nepal (2020) The Industrial Enterprises Act, 2076 (2020)

MoICS, Government of Nepal (n.d.a) *Industrial Policy, 2067 (2011)* (Nepali) https://moics.gov.np/content/9189/9189-industrial-policy-2067/, Accessed on August 4, 2024

MoICS, Government of Nepal (n.d.b) National Start-Up Enterprise Policy, 2081 (2024) (Nepali). https://moics.gov.np/content/11424/11424-national-start-up-enterprise-p/, Accessed on August 6, 2024

MoICS, Government of Nepal (n.d.d)

MoLESS, Government of Nepal (n.d.)

National Statistics Office (NSO) (Then CBS), Government of Nepal (2020) *National Economic Census 2018, Analytical Report No.2, Comparative Analysis*

National Statistics Office (NSO) (Then CBS), Government of Nepal (n.d.a) *National Economic Census 2018, National Report No 1-3, Table 7 Data in Excel*

National Statistics Office (NSO) (Then CBS), Government of Nepal (n.d.b) *Report on the Nepal Labor Force Survey, 2017/18*.

New Spotlight Online (2023) *President Paudel Inaugurated KOICA Supported NTIC at KU Worth USD 10 Million*. https://www.spotlightnepal.com/2023/10/11/president-paudel-inaugurated-koica-supported-ntic-ku-worth-usd-10-million/, Accessed on December 20,2024

NIC (n.d) https://nicnepal.org/

NPC, Government of Nepal (2020) *The Fifteenth Plan (Fiscal Year 2019/20–2023/24)*

NPC, Government of Nepal (2024) *The Sixteenth Plan (Fiscal Year 2024/25–2029-30)*

NPC, Government of Nepal (n.d.)

Singh, D. and Kharel, P. (2023) *Mapping Innovation Support Programmes for Micro, Small and Medium Enterprise Development: Findings from Nepal*. Kathmandu: South Asia Watch on Trade, Economics and Environment (SAWTEE). https://sawtee.org/publications/SMEs-Nepal.pdf, Accessed on July 10,2024

The Constitution of Nepal 2015 (2015) https://lawcommission.gov.np/en/wp-content/uploads/2021/01/Constitution-of-Nepal.pdf, Accessed on August 3, 2024.

UN Trade and Development (n.d.) *UNCTAD/ITE/TEB/5 Growing Micro And Small Enterprises In LDCs*, https://unctad.org/system/files/official-document/poitetebd5.en.pdf, Accessed on July 21, 2024

United Nations, Economic and Social Commission for Asia and the Pacific (2020) "Micro, Small and Medium-sized Enterprises' Access to Finance in Nepal" *MSME Financing Series No. 3* https.//www.unescap.org/resources/micro-small-andmedium-sized-enterprises-access-finance-nepal, Accessed on August 3, 2024

WIPO (2023) *Global Innovation Index 2023: Innovation in the face of uncertainty*. Geneva: WIPO. DOI:10.34667/tind.48220, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023-en-main-report-global-innovation-index-2023-16th-edition.pdf, Accessed on August 3, 2024.

WIPO (n.d.) Global Innovation Index 2023. https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023/np.pdf. Accessed on August 3, 2024.

World Bank (2023a) World Bank Enterprise Surveys https://www.enterprisesurveys.org/en/enterprisesurveys, Accessed on 4 November 25, 2024.

World Bank (2023b) World Bank Enterprise Surveys https://www.enterprisesurveys.org/en/data/exploreeconomies/2023/nepal#innovation-and-technology, Accessed on 4 November, 2024

ANNEX 1: QUESTIONNAIRE FOR CASE STUDY

1. Name of the Institution/Industry:

2. Description of Institution/Industry's Activities:

3. Date of Registration of the Institution/Industry:

4. Is the ownership of the industry single or joint? .....

5. Is the land for the industry private, rented, or other? .....

6. Is there any exemption on the registration fee for the industry? Yes / No.
   If yes, what percentage? .....
   Or what other benefits have been received? .....

7. Has any special grant been received from the government? .....

8. What types of support have been received from the government or other bodies? .....

9. What is the annual income from this industry, and what are its products?.....

10. Are the markets for these products domestic or international? .....
    How much is in the domestic market? .....
    International market?.....

11. What kind of support has been received from government or other institutions for product sales? .....

12. Are there any sales issues with your product, such as a lack of market or other reasons?

13. How is the market for your products managed?

14. Has the government provided any tax exemption?

15. Has any new technology been received from the government?
    If yes, how has it been used?

16. What arrangements are there for new research in this industry?

17. How many employees were there when the industry was established, and how many are there now? What about the technical staff?

18. Are there regular training provisions for employees?

19. Who is the head of this industry, and under whose name is it registered?

20. How do you find the government's policy toward the industry?

21. Are you aware of the provisions in the industrial policy and law?

22. Have you received benefits as per the provisions in the industrial policy and law?

23. Do you have any additional suggestions?

Contact Number:
Address:
Date:

Lao PDR

INTRODUCTION

Overview

MSMEs or some time referred as SMEs are the catalysts for income creation in Lao PDR. In most cases, these firms are responsible for creating jobs in the integrated economy and generating a major part of the GDP. SMEs are the center of Lao PDR's economy, accounting for almost 99% of the registered businesses and fully employing about 80% of the total labor force. Even though they are highly concentrated and active in the creation of new employment opportunities, their contribution to GDP is only about 20% (World Bank, 2020). They create employment, assist in the alleviation of poverty, and enhance the quality of living. Besides, SMEs are crucial factors that spur the Lao economy, alleviate poverty, and promote inclusive growth. They provide employment to a large chunk of people, where 82% of total employed people in the registered businesses were of this sector. More particularly, 86% of these firms fall into the category of small firms, in which most firms are regarded as micro-enterprises of up to five employees (ILO, 2018). MSMEs have particular advantages in promoting development in rural areas by increasing employment and earnings, which help alleviate poverty and make communities stronger. They are important to the economy in that they help to diversify as they engage themselves in several activities like agriculture, manufacturing, and services. In spite of challenges such as scarcity of capital and many rules and regulations to follow, SMEs are flourishing and contributing to the economy. This importance of their contribution has made the government of Lao PDR consider them and, therefore, devise means to alleviate this problem, such as enhancing the business climate and easing credit facilities. For the implementation of and management of the Lao MSME Fund, there is the Micro, Small and Medium Enterprise Promotion Agency (MSMEPA), which operates under the Ministry of Industry and Commerce (MOIC). It aims to address the problems which restrict financing to MSMEs. Constructively, it focuses on enhancing the quantity of such funding from commercial banks. Some of these include enhancing MSMEPA's capacity to formulate and implement policies increasing MSME access to finance; these activities, in turn, increase their ability to be integrated into the society, thus contributing to the economic growth of Lao PDR in a more sustainable manner and earning a better place in the economy (MSMEPA, 2022)

TABLE 1

MICRO, SMALL AND MEDIUM ENTERPRISE CRITERIA (PERSONS, MILLION LAK) [1]

Type of firms	Micro			Small			Medium		
	Labor	Value	Rev	Labor	Value	Rev	Labor	Value	Rev
Production	1-5	120	400	6-50	1,200	3,000	51-99	4,800	6,000
Trade	1-5	148	400	6-50	1,200	4,500	51-99	4,800	9,000
Service	1-5	240	400	6-50	1,800	2,250	51-99	7,200	6,000

Source: MSMEPA (2024)
Note: Rev, revenue

1 Value and Rev/ Revenue in million LAK, 1 million LAK = 46 USD

In addition to labor size, the classification also takes into account the business registration value and annual revenue, which vary depending on both the size and type of the business activity. These factors collectively determine the specific categorization of enterprises within the MSME framework, ensuring a tailored approach to policy-making and resource allocation (Laogovt, 2023). In terms of innovation, the government has been actively developing its innovation system to enhance the productivity and innovation capabilities of MSMEs. Recognizing the pivotal role MSMEs play in economic growth, employment, and income generation, the government, in collaboration with development partners, has implemented several policies and initiatives to foster a conducive environment for MSMEs development. The MOIC has been instrumental in this regard, focusing on creating a favorable business environment, improving access to finance, and promoting entrepreneurial mindsets within the local community. The government's strategic action plan emphasizes building an impactful ecosystem for Lao MSMEs to become leading enterprises on an international scale, with core values highlighting integrity, respect, inclusiveness, innovation, and professionalism (LNCCI, 2020). To enhance SME competitiveness, the government, along with organizations like the Small and Medium Enterprise Promotion Association of Lao PDR (LAOSME), provides training workshops, business advisory services, and improved access to finance. These efforts aim to empower MSMEs to meet regional and international product and service quality standards, engage with the digital economy, and understand key laws and regulations (Yula, 2021). recognizing the growing importance of digital platforms, the Lao government has prioritized the development of e-commerce policies and strategies. By promoting digital business practices, the government aims to strengthen MSMEs' competitiveness in the regional market, especially in the context of the ASEAN Economic Community (AEC). Initiatives include the implementation of the Law on Electronic Transactions and the Decree on Electronic Commerce, which provide a legal framework to support the growth of e-commerce and instill confidence in digital transactions among traders and consumers (Lapuekou, 2023). Development partners, such as the United States Agency for International Development (USAID), have been supporting Lao PDR in its efforts to enhance MSMEs productivity and innovation. Projects like the USAID Laos Business Environment work with the government to provide targeted technical support to MSMEs, aiming to stimulate job creation, foster regional and international trade expansion, and cultivate inclusive, widespread economic growth (USAID, 2024).

Rationale for the Study

The situation in Lao PDR can be summed up as low capability and low functioning innovation system regarding technological aspects for SMEs, which hinders development and competition. This situation has been achieved partly by providing for economic growth by internalizing the already acknowledged contribution of technology and innovation. However, there are gaps in information relating to current technological capabilities and the innovation support system for SMEs. Some existing and wide-ranging government policies and initiatives in these areas need evaluation to establish their effects and how they can be improved.

Lao SMEs can still get adequate access to modern technologies in this aspect of the technology gap, but this proves detrimental to their operational efficiency and their competitive advantage within the market. The level of these gaps in technology is the definite need for more clarity of this, which brings about hindrances in targeted strategies. The innovation system's network supporting SMEs is relatively weak. Globally, insufficient interactions between businesses, research institutes, and governmental bodies are observed. It is essential to analyze these measures to justify the

support proposals made in the paper. With regard to policy effectiveness, very few studies have diagnosed the subject, methods, and results of non-financial and financial assistance measures undertaken by the government. Even so, with this evaluation, improving on these measures to enhance the technological and innovation capabilities that support SMEs becomes easier. Following the context of Lao SME, the objectives of this study are as follows:

- To assess the current state of SMEs' technological capabilities and supporting innovation system;
- To evaluate the content, implementing mechanisms and effectiveness of the existing financial and non-financial government supporting measures for enhancing SME technological and innovation capabilities; and,
- To provide policy recommendations for policymakers based on scientific findings.

Methods

Research Design

In order to fulfill the study's objectives, this study applies a cross-sectional study design. In a cross-sectional study, the investigator collects data on both the outcome of interest and the exposures at the same point in time for all participants. This means that both the dependent (outcome) and independent (exposure) variables are measured simultaneously without a time sequence (Capili, 2021).

Data Analysis

This study applies secondary data from various sources of information, namely the World Bank Enterprise Survey (WBES)—2018, the Credibility Index for SMEs—2021, JETRO 2017, government publications, websites, and accredited literature. Moreover, this study also retrieves information from SME firms using in-depth interview method.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SME

Role of MSMEs in the Lao Economy

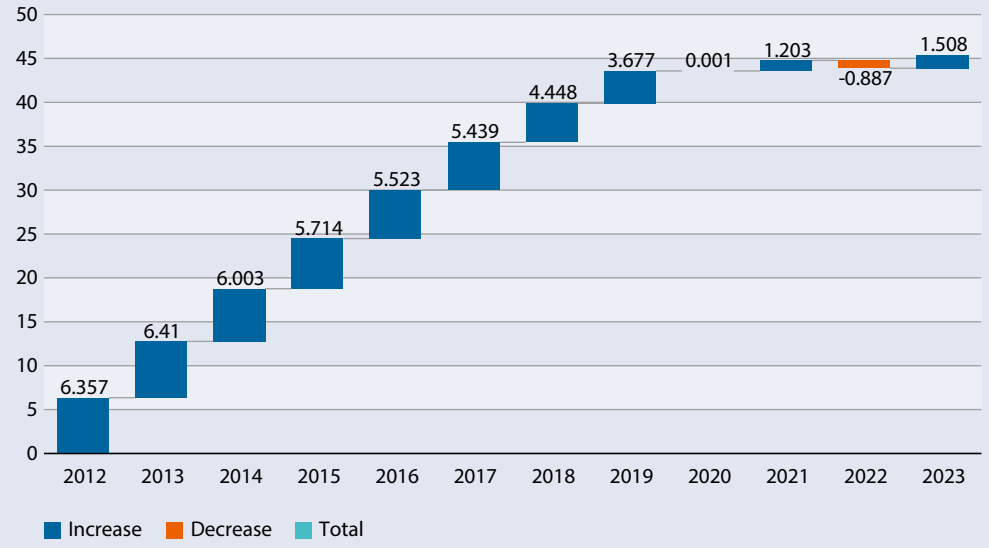
MSMEs are pivotal to Lao PDR's economy, constituting over 99% of all registered firms and providing more than 80% of employment. Despite their prevalence, MSMEs contribute less than 20% to the country's GDP, indicating challenges in productivity and innovation (World Bank, 2020). In particular, Lao MSMEs face several obstacles that hinder productivity, many MSMEs struggle to secure financing due to stringent collateral requirements and complex loan procedures. This financial constraint limits their capacity to invest in productivity-enhancing technologies and processes. Several factors influence the innovation capabilities of Lao MSMEs. A study utilizing World Bank survey data from 2018 identified key determinants, including access to finance, availability of skilled labor, and the degree of market competition. The study emphasized that limited access to financial resources and a shortage of skilled professionals hinder MSMEs' ability to innovate and improve productivity (Sisounonth & Chansomphou, 2023). Recognizing these challenges, the Lao government has implemented policies to support MSME development. The Strategic Action Plan for Private Sector Development (2021–2025) focuses on enhancing the business environment, facilitating access to finance, and promoting innovation among MSMEs. Additionally, regional initiatives like the ASEAN SME Policy Index 2024 aim to accelerate sustainable growth and digitalization, offering tailored policy recommendations to strengthen MSME frameworks across member countries, including Lao PDR (ERIA, 2024; LNCCI, 2020). Despite these efforts, Lao MSMEs continue to face obstacles in adopting new technologies and improving productivity. Challenges such as inadequate infrastructure, limited access to advanced technologies, and insufficient training opportunities impede their capacity to innovate. Addressing these issues is crucial for enhancing the competitiveness and economic contribution of MSMEs in Lao PDR.

Foreign direct investments and the opening up of trade have provided benefits but also posed some constraints to Lao SMEs. In the last twenty years, as globalization continues, small and medium enterprises have been acknowledged as positive contribution units to income generation, poverty alleviation, employment creation, and regional development. The New Economic Mechanism (NEM) was focused on searching for new opportunities for Lao PDR, which were not aimed at rotary appeasement of traditional economy sectors but rather getting into agriculture, industry, and services. There were attempts to allow more private enterprise and develop key sectors of the economy to make the country more flexible and less dependent on the adverse effects of the world economy. The other primary objective of the implanting of NEM was tourism as an industry enhancement that would be anchored upon the development of infrastructure and human capital as well as enhancing institutional dimensions. By improving the underlying infrastructures such as roads, energy supply, and telecommunications systems, it was envisaged that these regions would increase trade and attract investments to the economically disadvantaged areas of Lao PDR. Notably, despite certain advances, the NEM has nevertheless produced mixed outcomes. Some regions have reported tremendous growth and development in adapting to the economy, while others still suffer from several issues like squalor and inequality, as well as the minimal reach of basic necessities. SMEs are capable of adjusting to evolving market conditions and introducing new products and services as a result of their agility and flexibility, which contribute to economic dynamism and competitiveness. Furthermore, SMEs frequently function as incubators for local talent and expertise, fostering the development of skilled workers and entrepreneurs who can drive economic growth in Lao PDR (Kongmanila, 2023; Sayvaya & Phommason, 2023; Thorsteinsdóttir & Bandyopadhyay, 2024).

Lao Labor Productivity

FIGURE 1

LAO LABOR PRODUCTIVITY GROWTH (%)



Source: CEIC (2024)

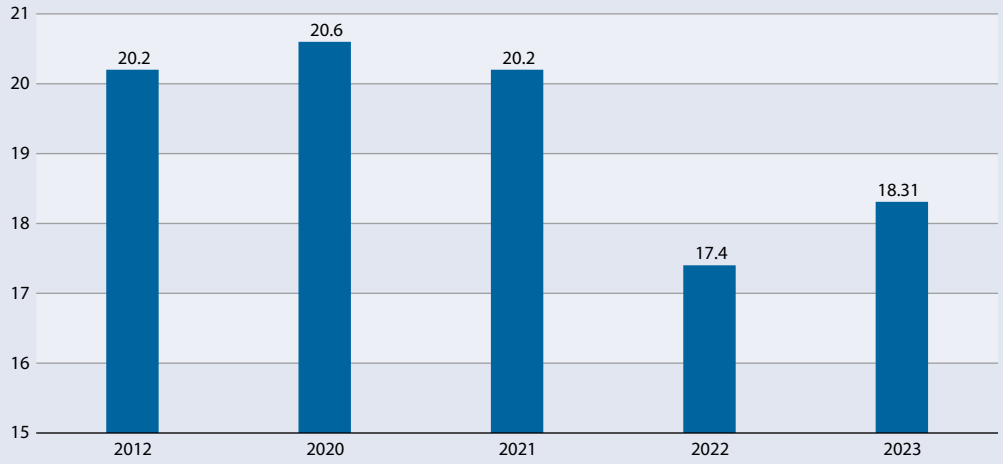
According to Figure 1, as of December 2023, Lao PDR managed a 1.51% increase in labor productivity compared to the previous year. After witnessing a decrease of 0.89% in December last year (December 2022), this is a sizable improvement for the nation's economy. Such recovery implies that there has been an improvement in the efficiency and production of the workforce, which holds promise for better economic growth.

Lao PDR's labor productivity data is released for periods of a year with the commencement of the first series in December 1992 to December 2023. The time span records of average annual growth rate of 4.57% which depicts a general progressive trend in overall output of workforce in the country.

The tremendous increase in labor productivity was recorded in December 2013, when it stood at 6.41%. The fact that it rose to such a height leads to the conclusion that some active internal and external factors supported it. The figure for 2022, which was the lowest that was recorded, showed a decrease of -0.89% for the month of December, which was considered to be a slump in productivity as a result of several issues, including economic downturn or external shocks such as the COVID-19 pandemic.

FIGURE 2

LAO INNOVATION INDEX



Source: Global Economy data (Globaleconomy, 2023)

In Figure 2, it should be noted that the innovation index ranges from 0–100. For Lao PDR, the most recent value from 2023 is 18.31 points, which represents an increase from 17.4 points in 2022. In contrast, the global average is 33.17 points, as determined by data from 126 countries. The average for Lao PDR from 2012 to 2023 is 19.34 points. The minimum value of 17.4 points was achieved in 2022, while the maximum value of 20.6 points was recorded in 2020.

Total Factor Productivity

Total factor productivity is a critical determinant of economic growth, representing an economy's capacity to produce more output without a proportional increase in inputs. It reflects the efficiency and effectiveness with which labor, capital, and other resources are utilized in the production process. Enhancements in TFP enable economies to achieve higher levels of output and income without merely expanding the quantity of inputs, thereby fostering sustainable economic development. TFP captures the effects of technological advancements, improved managerial practices, better organizational structures, and innovations that allow for more efficient production processes. Unlike measures that focus solely on individual inputs like labor or capital, TFP encompasses the productivity of all factors collectively, providing a comprehensive view of an economy's efficiency (Francis et al., 2020).

TABLE 2

TOTAL FACTOR PRODUCTIVITY, 1981–2019

Year	TFP	Year	TFP
1981	12.91	2001	1.90
1982	4.10	2002	0.89
1983	0.16	2003	0.74
1984	4.31	2004	-0.64
1985	1.56	2005	-0.94
1986	1.92	2006	-9.28
1987	-7.08	2007	6.59
1988	-9.08	2008	-0.75
1989	2.98	2009	0.92
1990	-1.49	2010	2.76
1991	-2.74	2011	1.65
1992	-0.71	2012	-0.18
1993	-0.74	2013	0.73
1994	0.68	2014	0.17
1995	0.90	2015	-0.23
1996	-0.31	2016	-0.25
1997	0.37	2017	0.23
1998	-1.58	2018	-0.24
1999	0.91	2019	-1.09
2000	1.83		

Source: FRED (2024)

Positive TFP in Lao PDR reflects enhanced efficiency in utilizing inputs like labor and capital, often resulting from structural economic reforms and sectoral shifts. The government's NEM, initiated in 1986, transitioned the economy from a centrally planned system to a more market-oriented approach, promoting private enterprise and foreign investment. This shift facilitated improvements in productivity across various sectors (Stategov, 2014). Despite an instant increase in TFP, the rates experienced periods of negative growth due to several factors. The manufacturing sector in Lao PDR has been found to operate below its full production potential, with average technical efficiency around 72.51%. Factors such as firm size, accounting systems, and access to credit significantly influence production efficiency. The labor force often lacks the necessary skills and training to adapt to new technologies and industries, resulting in stagnant or declining labor productivity. This is particularly evident in sectors like food processing, where labor productivity is significantly lower compared to regional peers (Sayavong, 2020). Inadequate infrastructure, particularly in energy and transportation, constrains economic efficiency and slows productivity gains (Berument et al., 2013). Power outages and unreliable electricity supply have been linked to significant revenue-based TFP losses among firms in Lao PDR. Challenges such as corruption, bureaucratic inefficiencies, and weak governance reduce the effectiveness of economic policies and discourage investment. These institutional weaknesses have hindered the successful implementation of economic reforms and the transition to a market-oriented economy. External economic shocks, such as the 1997 Asian Financial Crisis, which led to significant economic downturns in Lao PDR, including high inflation, currency devaluation, and a stagnation of foreign

direct investments that had been flourishing between 1992 and 1996, also affected TFP. Moreover, the economic downturn in 2020 was primarily due to the global effects of the COVID-19 pandemic, which disrupted trade, tourism, and investment. This marked a significant deviation from the consistent growth experienced over the previous three decades.

Technological Capability and Innovation

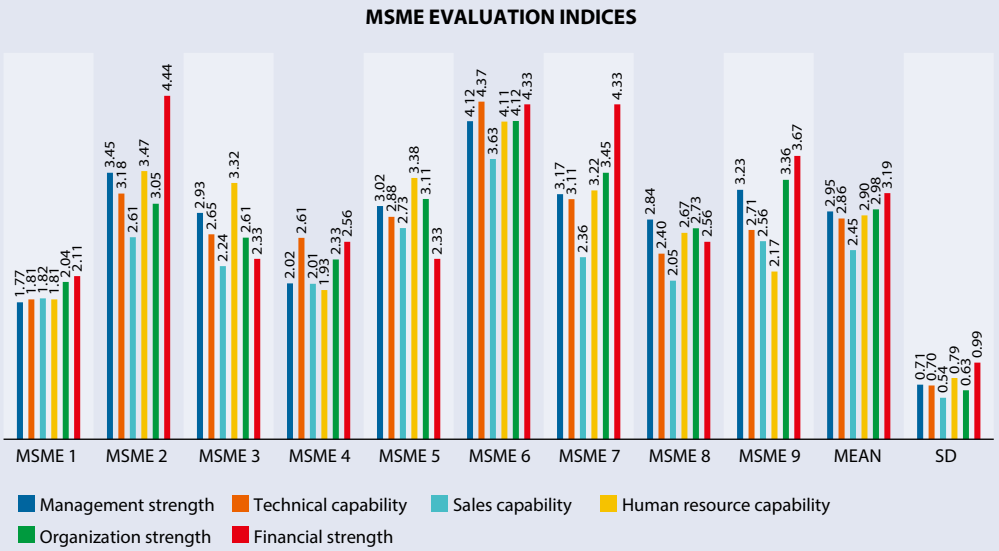
According to the Credibility Index for SMEs, the Lao MSMEs consist of six factors namely: management capability, technical capability, sales capability, human resource capability, organization strength, and financial strength. As indicated in Figure 3, these factors could be broken down as following:

1. Management capability (Blue)
2. Technical capability (Orange)
3. Sales capability (Gray)
4. Human resource capability (Yellow)
5. Organization strength (Light Blue)
6. Financial strength (Green)

Technical capability has been used as the variable of interest to understand firms' overall innovation, production innovation, and business process innovation. It can be seen that the technological capability data is relatively low for most firms when compared to other indicators.

FIGURE 3

PARTICIPANTS' SCORE RETRIEVED FROM MSMES



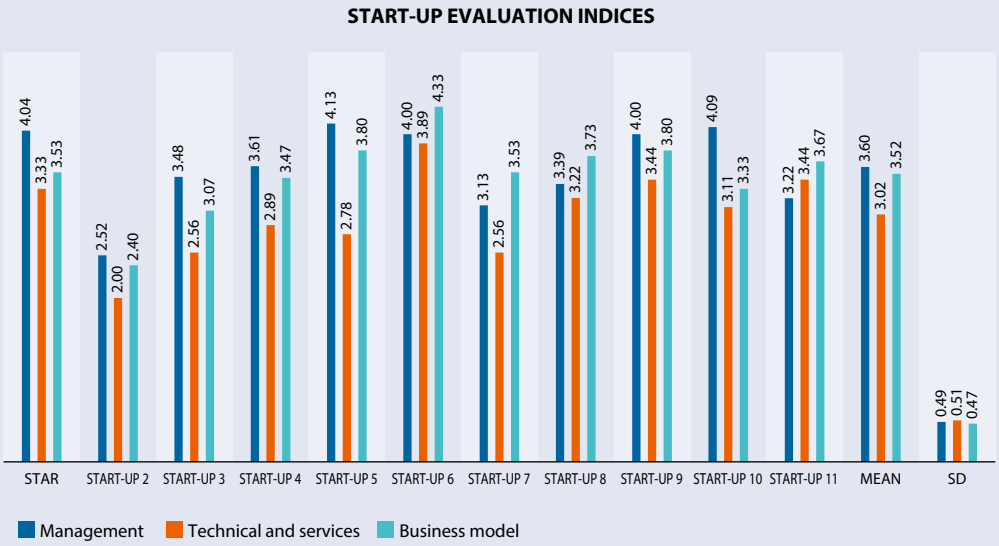
Source: WBES (2018)

On the other hand, the identical statistical technique had been used to analyze start-up SMEs. These factors cover of the following sub-factors as follows:

1. Management
2. Technical services
3. Business model

FIGURE 4

PARTICIPANTS' SCORE RETRIEVED FROM START-UP FIRMS



Source: WBES (2018)

Information shown in Figure 4 illustrates that technological capability scores for start-up firms are the lowest among three factors. The relationship between technological capabilities, innovation, and firm performance is a critical strategic factor that companies can leverage to enhance their performance. Despite the constraints of limited resources, enterprises must enhance their technological capabilities and foster innovation. This can be achieved through the continuous learning process, which involves the participation of the workforce in appropriate training, participation in a variety of seminars and exhibitions, and interaction with suppliers, customers, public institutions, and industry associations (Lestari & Ardianti, 2019).

TABLE 3

TOWS MATRIX OF LAO PDR TECHNOLOGICAL CAPABILITY AND INNOVATION

	S-STRENTHS	W-WEAKNESSES
	• Government policies • Economic growth • Presence of niche market	• Lack of access to modern technology • Unskilled workforce • Weak industry-research linkage • Lack of funding for innovation
O-OPPORTUNITIES	**SO-STRATEGIES (Proactive)**	**WO-STRATEGIES (Develop)**
• Existence of regional trade agreement • Emerging digital technology • Increasing demand for innovative solutions	• Utilize government assistance in obtaining funds • Encourage entrepreneurial business scope to penetrate new and uncharted markets with innovations • Develop similar partnerships with local companies to leverage their technologies and the market	• Prioritize establishing competencies via education and training and international scientific co-operation to augment the knowledge gap • Employ various technologies through financing as a result of the high need to solve problems in the society which could include foreign funds. • Foster academic-industrial collaboration aimed towards regional trade and technology advancement
T-THREATS	**ST-STRATEGIES (React)**	**WT-STRATEGIES (Adapt)**
• High competition • Economic uncertainty	• Use government measures to reduce the dangers of recession by providing employment and security • Stimulate business more efficiently as well as maintaining niche markets and competitiveness thereby, less reliant on generalized approaches of volatile markets • Enhance and strengthen regulatory compliance policies with the available intervention strategies to clearly manage the uncertainties	• Have coherence plans for recession situations so as to have a strong and wide ranged structure for technology. • Carry out routine innovations without using high financial cost

As shown in Table 3, similar to the SWOT analysis, the TOWS Matrix includes the strengths, weaknesses, threats, and opportunities of Lao PDR's technological capability and innovation. Outcomes have been used to develop proactive, re-act, adapt, and strategic strategies as policy recommendations for policymakers.

TABLE 4

ASSOCIATION BETWEEN FIRMS' CHARACTERISTICS AND INNOVATION

Firms' characteristics (Independent variables)	Binary logistic regression model 1: New innovation	
	Nagelkerke R2 = .158	
	Odd Ratio (OR)	P-Value
Owning a website(s)		
• Yes		
• No	1.372	0.33
Access to finance		
• Yes		
• No	3.221	0.001*
Female manager		
• Yes		
• No	0.788	0.488
Number of employees		
• 1–5 people		
• 6–5 people	0.42	0.123
• 51–99 people	0.413	0.292
• More than 100 people	0.32	0.14
Legal status		
• Sole proprietorship		
• Partnership	0.317	0.035*
Export		
• Yes		
• No	2.175	0.076

Source: WBES (2018)

In Table 4, according to WBES, a Binary Logistic Regression model has also been used in this research to establish any links between the characteristics of the firms and the innovation. Herein, on the counterpart, the dependent variable has been the existence of innovation within the firms. On the other hand, independent variables include different firms' characteristics, including owning a website, access to finance, female manager, number of employees, legal status of firms and export (as the main market). In the regression analysis, it was highlighted that for this particular model, sole proprietorships and firms with no access to finance are more likely to have been involved with a new innovation at a 95% confidence level. More specifically, it is about 3.221 and 3.15 (Invert OR, 1/0.317) for firms that have no deepening or taking of loans and sole proprietorships.

Based on the JETRO 2017 database, Table 5 provides an overview of firm characteristics and their engagement in new product introductions within a two-year period, serving as a proxy for product innovation. The characteristics examined include the origin of investors, R&D expenditure, CEO nationality, and CEO education level. The data reveals that companies with local investors constitute the largest proportion, representing nearly 40% of firms introducing new products. However, a notable observation is the relatively low investment in R&D among these locally invested firms. Specifically, 38.30% of these firms allocate no financial resources for R&D, indicating a limited emphasis on innovation-driven expenditures. When considering CEO nationality and educational background, firms reporting new product developments within the two-year timeframe were predominantly led by Lao CEOs with undergraduate-level education. This suggests that local leadership, despite limited formal education at higher levels, plays a

significant role in driving product innovation in these companies. These findings highlight the unique interplay between resource allocation, leadership characteristics, and innovation outcomes within the context of locally driven firms.

TABLE 5

FIRMS' CHARACTERISTICS AND NEW PRODUCT INTRODUCTION WITHIN TWO YEARS

			New products within 2 years		Total
			No	Yes	
Investor origin	Local	Count	28	73	101
		% of total	15.30%	39.90%	55.20%
	Foreign country	Count	28	36	64
		% of total	15.30%	19.70%	35.00%
	Joint venture	Count	5	13	18
		% of total	2.70%	7.10%	9.80%
R&D Expenditure	No cost	Count	47	70	117
		% of total	25.70%	38.30%	63.90%
	Less than 0.5%	Count	9	20	29
		% of total	4.90%	10.90%	15.80%
	0.5%–0.99%	Count	1	15	16
		% of total	0.50%	8.20%	8.70%
	More than 1%	Count	4	17	21
		% of total	2.20%	9.30%	11.50%
CEO Nationality	Lao	Count	30	80	110
		% of total	16.40%	43.70%	60.10%
	Foreigner	Count	31	42	73
		% of total	16.90%	23.00%	39.90%
CEO Education	Secondary school	Count	12	11	23
		% of total	6.60%	6.00%	12.60%
	Undergraduate	Count	32	51	83
		% of total	17.50%	27.90%	45.40%
	Graduate/ Ph.D.	Count	9	40	49
		% of total	4.90%	21.90%	26.80%
	Others	Count	8	20	28
		% of total	4.40%	10.90%	15.30%
Total	Count	61	122	183	
	% of total	33.30%	66.70%	100.00%	

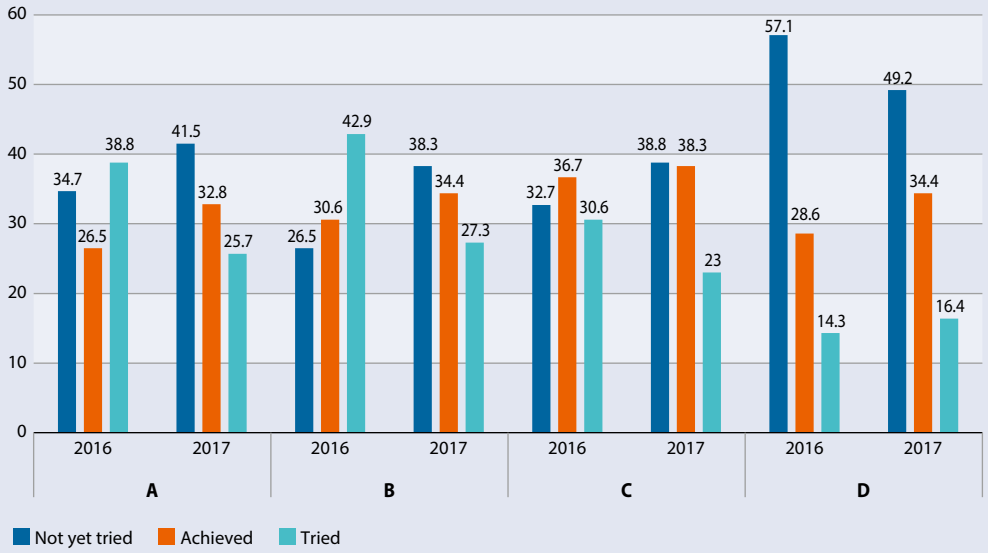
Source: CEIC (2024)

Lao PDR ranks lower in the productivity, technology, and innovation dimension compared to other ASEAN member states, indicating significant challenges in improving productivity and fostering innovation within its SME sector. The country's limited progress in these areas highlights systemic barriers that hinder its ability to compete regionally. These obstacles include inadequate infrastructure to support innovation, minimal investments in R&D, and restricted access to

technology-related services that are vital for modernizing business operations. Specifically, the technology and innovation promotion dimension for Lao PDR is composed of three major components, all of which score relatively low compared to other ASEAN countries: planning and design (2.67), implementation (2.17), and monitoring and evaluation (1.99). These scores yield an overall average of 2.31, positioning Lao PDR as the second-lowest performer in this category, ahead of only Myanmar, which scores 1.83. In contrast, the highest-performing country in this dimension is Singapore, with a perfect score of six, followed by Malaysia (5.46) and Thailand (5.14).[2] This significant disparity highlights the challenges faced by Lao PDR in effectively planning, implementing, and monitoring innovation initiatives compared to its more advanced regional peers (ERIA, 2024)

FIGURE 5

NEW PRODUCT DEVELOPMENT THE LAST TWO YEARS



Source: JETRO (2017)
Note: Data collected in 2016 and 2017

The data collected by JETRO in 2016 and 2017 was gathered from participating firms asked four key questions related to their new product development process, which are as follows:

A. Have you tried to introduce a new product in the last two years?
B. Introduced a new product, significantly improving your existing products with respect to its capabilities, user friendliness, components, subsystems, etc.
C. Development of a totally new product based on the "existing" technologies for your establishment
D. Development of a totally new product based on "new" technologies for your establishment

Each participant was required to select one of the following responses: "Not yet tried," "Tried," or "Achieved successfully." These responses indicated the firm's level of engagement in new product development activities.

2 Scores are on a scale of one (lowest) to six (highest)

In terms of sample size, 49 firms participated in the survey in 2016, while 183 firms took part in 2017. According to the data presented in Figure 5, a significant portion of firms reported that they had not yet attempted any activities related to new product development. However, the findings also revealed that more than 36% of firms in 2016 and over 38% in 2017 successfully developed a completely new product based on existing technologies. This suggests a growing trend in firms leveraging their current technological capabilities to innovate and introduce new products into the market.

Moreover, participating firms were asked 11 questions regarding whether their establishment has reduced specific factors over the past two years. These reductions could indicate positive trends, such as the adoption of new innovations and improvements in production processes. The key areas of reduction include the following:

A. Reduced defects during manufacturing process
B. Reduced labor input (man-hour)
C. Reduced lead time to introduce a new product
D. Reduced unscheduled line stop
E. Reduced worker's injuries
F. Reduced plant accidents
G. Reduced delivery delay
H. Reduced dispersion in product quality
I. Reduced time to changeover (converting production line)
J. Reduced claims from customers
K. Reduced plant maintenance costs

According to the information provided in Figure 6, it can be seen that in both 2016 and 2017, there have been significant reduction such as reducing defects during manufacturing process, reducing labor input (man-hour), reducing lead time to introduce a new product, reducing unscheduled line stops, reducing worker's injuries, reducing plant accidents, reducing delivery delay, reducing product quality, and reducing time to changeover for the year 2016 (categories A, B, C, D, E, F, G, H and I). It means that the companies based in Lao PDR have made good progress in improving new innovations. However, there is room to improve in reducing claims from customers and reducing plant maintenance costs.

Based on the data presented in Figure 6, it is evident that in both 2016 and 2017, significant improvements were achieved across multiple aspects of the manufacturing process. These improvements include a reduction in defects during production, decreased labor input (measured in man-hours), and a shorter lead time for introducing new products. Additionally, there was a notable decrease in unscheduled production line stoppages, worker injuries, plant accidents, and delivery delays. Furthermore, companies successfully minimized variations in product quality and reduced the time required for production changeovers in 2016. In other words, there is a significant reduction in categories A, B, C, D, E, F, G, H, and I. These positive trends indicate that companies operating in Lao PDR have made substantial progress in adopting and implementing innovative manufacturing practices. However, despite these advancements, there remains an opportunity for further improvement, particularly in reducing customer claims and lowering plant maintenance costs. Addressing these areas will enhance overall operational efficiency and further strengthen the competitiveness of these companies.

FIGURE 6

ESTABLISHMENT REDUCED IN THE LAST TWO YEARS

Source: JETRO (2017)
Note: Data collected in 2016 and 2017

ANALYSIS OF CONTENTS, IMPLEMENTATION MECHANISMS AND EFFECTIVENESS OF POLICY INSTRUMENTS FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION OF SMES

Supply-side Policy Instruments

Supply-side policy instruments are strategic measures implemented by governments to enhance the productive capacity of an economy by improving the efficiency and effectiveness of producers and businesses. These policies focus on creating favorable conditions that enable firms to produce goods and services more efficiently, thereby fostering innovation, economic growth, and increased productivity. In the context of Lao PDR, the core activities aimed at promoting SMEs include a range of targeted initiatives designed to foster growth and development across various sectors as follows (NA, 2011):

1. Creating an enabling environment: establishing the infrastructure and legal requirements that encourage growth and development of the SMEs
2. Access to finance: making sure that the SMEs are able to obtain funds or finance in order to grow and operate
3. Policy on customs and taxation: customs taxation policy in place aimed at lowering costs and stimulating engagements in businesses
4. Creating and developing entrepreneurs: training and offering resources which develop entrepreneurs' skills and thought processes
5. Providing services on business development consultation: providing planning and management consultancy services to SMEs to assist them in their business operations
6. Cooperating between SMEs and large-size enterprises and foreign investment enterprises: bridging the gap between small and large business as well as foreign investments
7. Increasing on productivity: putting strategies into action to improve SMEs' productivity and efficiency
8. Accessing and expanding markets: Assisting SMEs in entering new markets and extending their reach into current ones
9. Business clustering: encouraging the geographic concentration of similar companies in order to improve productivity and teamwork
10. Allocating business location: establishing designated locations or areas where SMEs can establish their operations
11. Promoting advanced technology utilization: supporting and assisting SMEs in implementing cutting-edge technology to gain a competitive edge
12. Using and protecting intellectual property: assisting SMEs with the protection, use, and understanding of their intellectual property rights
13. Providing and accessing to information: ensuring SMEs have access to information and data that is necessary for making well-informed decisions

More specifically, on access to finance, under MSMEPA, MOIC, the Lao SME Fund provides financial resources through seven commercial banks, namely: Lao Development Bank, Lao Viet Bank, Vietinbank, Sacombank, Lao China Bank, Maruhan Japan Bank, and ST Bank. Moreover, The Lao SME Fund also provides credit to micro-enterprises and producer groups through 11 micro-finance institutions. Under this funding initiative, SMEs are able to access low-interest rate loans of 3%, which is immensely low when compared with the market rate loan at the rate of 8–12%.

TABLE 6

ACCESS TO THE SME FUND BY BUSINESS SECTOR

Sectors	2024	2012–2024
Agriculture	194	1,302
Trade	92	623
Service	56	477
Handicraft	36	327
Industry	17	146
Total	395	2,875

Source: MSMEPA (2024)

In Table 6, as of 2024, the Lao SME Fund has distributed financial resources for 2,875 businesses, of which 1,705 business or more than 59% are geographically located in Vientiane Capital. In the agricultural sector, there is a project call "Developing Capacity in Agriculture Innovation Systems: Scaling up the Tropical Agriculture Platform Framework" (TAP-AIS) that aims to strengthen capacities to innovate for climate-resilient agriculture and food systems, which could play an important role in developing new ideas in doing business (FAO, 2022).

Referring to the Lao context, there are some reasons for the limited access of SMEs to some special loans that are provided through the government. These may include a lack of knowledge among the SMEs concerning the existence of such funds, financial constraints, as well as administrative bottlenecks regarding loan applications. Several interconnected factors may explain why SMEs are not fully accessing special loans offered by government initiatives. One of them is the problem of the lack of awareness, which is very often the consequence of insufficient means of communication towards small businesses, mostly in rural areas, and at the tip of the spear, funding. Even when the business is aware of the situation, what deters them are the long processes and amount of paperwork that needs to be done, due to the already existing operations performed on a daily basis. Moreover, the basic requirements that members have to meet, for instance, a good credit score, submission of many documents, and providing collateral, put young startups out of business. Compounding these issues are the generally low levels of financial literacy, resulting in SMEs failing to adequately fill up any application forms for those loans or appreciate the need for government loans. In addition, although there may be access to loans for SMEs, these borrowers tend to avoid such loans due to the fear of debt owing to the volatile economy and repayment issues. Other problems that have made borrowers very reluctant to commit themselves to great debt are the usual cases of high interest rates and unfriendly terms and conditions. Moreover, there is a scarcity of assistance provided to complete the loan application.

Tax Incentives

In order to boost the growth SMEs in Lao PDR, the government of Lao PDR has been introducing the effective tax policy for ease of tax declaration. In this instance, businesses whose annual revenue is less than LAK12 million[3] are not eligible for value added tax (VAT) designation. These enterprises are not required to comply with the normal taxation on income but pay a specific amount of tax calculated on the revenue of the business. This tax, also called a lump-sum tax, ranges from 3% to 7% depending on the gross economic returns and the activities pursued by the business entity. This, in most cases, lessens the tax administrative requirement that would have otherwise been required of small entities regarding tax diligence and hence assures a more efficient tax system. However, no specific policies have been exclusively designed and developed to provide tax incentives for SMEs' innovation.

Grant/Subsidies

The Lao government also has another interesting project known as the Business Assistance Facility (BAF), which aims to assist SMEs and businesses in the private sector in developing their knowledge and abilities to become more competitive on a local, regional, and global scale. When it comes to pre-approved business development services that lower the cost of hiring technical advisory services meant to increase competitiveness, BAF offers matching grants to cover 50% of the expenditure. More than 50 businesses in the following categories have so far benefited from BAF grants: agriculture, contracting, consulting, education and training, healthcare, hospitality and tourism, ICT, logistics, manufacturing, and trading (BAF, 2024).

Direct Equity Participation (direct government investment on firms' project)

The MOIC's Five-Year Industry and Handicraft Plan (2021–2025) states why the Lao government has participated in many direct equity participation projects:

- A promotion project to increase the productivity of mills' production of goods under the national program to promote the production of goods and food security in which one rice mill improved its efficiency until it was certified as having Good Manufacturing Practice (GMP) in 2019, and another rice mill in 2020.
- A project to strengthen the handicraft production groups of Vientiane and Huaphan province to share lessons and techniques of making wooden products as souvenirs related to tourism as well as produce a manual for making wooden products under the technical promotion fund of the SME Fund.
- Research project and extraction of dyes from plants to be used in silk dyeing by publishing a handbook on extracting dyes from natural plants so that experts can take the lessons and use them in the silk dyeing process with funding from the office of the National Council of Science and Technology.

Moreover, according to Article 28 of the Law on the Promotion of Small and Medium Enterprises, version 2023, the state promotes invention and the use of innovation by encouraging, promoting enterprises to invent and use innovations in various fields such as technological innovation in production, marketing, design and packaging of goods, business services to be used in business development, and support for research institutes and educational institutions to research inventions and innovations in various areas for enterprises to use.

3 Approximately USD550

Financial and Non-Financial Assistance to Train Skilled Workers Technicians, Scientists, Engineers, Designers, Researchers and Others Necessary for Firm' Innovation

With the subject "New Lao Gift, New Lao Handicraft," a seminar was conducted in the year 2015 with the aim of enhancing the design capacity of the Lao handicraft industry. Many of them were aiming at giving ideas on the souvenir business to the participants and its packaging and other related concepts. The Japanese government in cooperation with Japan External Trade Organization (JETRO) aided the gift project by providing technical assistance. In addition to that, the Lao companies were provided free advisory services, and a very lively discussion ensued concerning what was not right and how it could be fixed. Some ideas were offered about how to create products that had not been seen in Lao PDR before, such as novel kinds of material applications and designs. The objective of the first gift competition undertaken jointly with the Lao Handicraft Association (LHA) was at the Vientiane International Handicraft Festival held from October to November 2015 to compete to improve the quality of their products in a form of gifts. In addition, in order to promote the quality dedication of Lao firm's products, JETRO prepared a catalog of the winning 10 Lao companies' products together with LHA (JETRO, 2017).

JETRO provided funding for the "SOZAI" project in 2018. A business plan that educates foreign architects, interior designers, and product planners about the methods, materials, and skills passed down from traditional craft companies and fosters collaboration to create new materials for their projects, which could be positioned as a new venture for small-scale traditional craft industries with little capacity for customer development and international marketing. In October 2018, JETRO held its inaugural SOZAI contest at the Lao Handicrafts Festival. Ten companies that won the contest showcased their products at the "SOZAI Exhibition" in the 5th Life × Design at the "87th Tokyo International Gift Show in Spring 2019" that took place in February 2019. The pre-exhibition guidance provided by the interior and lifestyle producer was helpful to the exhibiting Lao companies, as many of them had never participated in an international exhibition before. It enabled them to gather the necessary information for their business talks with buyers at the exhibition (Katusiimeh et al., 2013) .

TABLE 7

SELECTED SUPPLY-SIDE INSTRUMENT MATRIX

Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
SME Development Plans 2011–2015	Strategic frameworks outlining goals to promote productivity, technology adoption, and innovation among SMEs. For instance, the SME Development Plan (2016–2020) focused on enhancing competitiveness and integration into regional markets.	The government, through the MOIC, developed and disseminated these plans, setting specific targets and action plans for SME development. Implementation involved coordination with various stakeholders, including provincial authorities and international partners.	The plans provided a structured approach to SME development, raising awareness and setting development agendas. However, challenges in resource allocation and coordination limited full achievement of objectives.	Enhance monitoring and evaluation mechanisms to track progress. Ensure adequate resource allocation and strengthen inter-agency coordination for effective implementation (Tachasermsukkul, 2010).
Access to Finance Programs 2014 – on going	Initiatives aimed at improving SMEs' access to financial services, including credit facilities, to support business expansion and technological investment. Programs like the SME Access to Finance Project provided long-term funding sources for banks to offer credit to SMEs.	The World Bank's SME Access to Finance Project facilitated the transfer of funds to participating financial institutions for on-lending to SMEs. By 2019, approximately USD13.6 million had been transferred (World Bank, 2018).	The project increased the availability of long-term financing for SMEs, supporting business growth. However, some SMEs still faced challenges in meeting collateral requirements and navigating application processes.	Simplify loan application procedures and provide capacity-building for SMEs to improve financial literacy. Consider alternative collateral options to accommodate a broader range of SMEs (World Bank, 2020).
Business Development Services 2013–2014	Provision of training, mentorship, and consulting services to build managerial and technical skills among SMEs, fostering innovation and enhancing competitiveness. Programs have been implemented to improve SMEs' access to these services.	International partners, such as Gesellschaft für Internationale Zusammenarbeit (GIZ), have collaborated with the Lao government to offer business development services, focusing on improving the framework conditions for competitive enterprises, especially SMEs.	These services have enhanced SMEs' capabilities, but outreach has been limited, particularly in rural areas, and awareness of available services remains low among some SMEs.	Expand outreach to rural areas and increase awareness campaigns about available services. Enhance collaboration with local business associations to extend service delivery (GIZ, 2014)
Regulatory Reforms 2011–2015	Measures to simplify business registration processes, reduce bureaucratic hurdles, and improve legal frameworks to support SME growth and development. Reforms have aimed at creating a more enabling environment for SMEs.	The government has undertaken steps to streamline procedures and improve the business environment, including the establishment of the Enterprise Law and the SME Strategy.	While reforms have made progress in easing business operations, some SMEs continue to encounter regulatory challenges, indicating the need for further improvements.	Continue efforts to simplify procedures and reduce bureaucratic obstacles. Enhance transparency and communication regarding regulatory requirements to assist SMEs in compliance.

Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Infrastructure Development 2013–2014	Investments aimed at improving transportation networks, electricity supply, and internet services to support SME operations, particularly in rural areas. Enhanced infrastructure facilitates market access and integration into value chains.	Projects have been initiated to develop infrastructure, with a focus on reducing disparities between urban and rural areas. Implementation involves collaboration between government agencies and development partners.	Improved infrastructure has benefited SMEs by enhancing access to markets and resources. However, gaps remain, especially in remote regions, affecting the operational efficiency of SMEs.	Increase investment in infrastructure projects targeting underserved areas. Ensure maintenance and sustainability of infrastructure to provide long-term support for SME activities (GIZ, 2014).
E-Commerce Policy Development (2023)	Development of policies and strategies to promote e-commerce among SMEs, enabling them to compete effectively in the digital era. This includes creating a supportive regulatory framework and providing guidance for digital business practices.	The MOIC, through the SMEs Promotion Department, organized seminars and consultations with government officials and business representatives to exchange knowledge and experiences in e-commerce. These efforts aim to formulate comprehensive e-commerce policies and strategies.	While e-commerce platforms are increasingly adopted by SMEs in Lao PDR, there is a recognized need for continued development and refinement of digital business practices to fully leverage e-commerce opportunities.	Accelerate the development and implementation of e-commerce policies. Provide training and resources to SMEs to enhance digital literacy and e-commerce capabilities. Ensure infrastructure supports digital transactions, particularly in rural areas.
Tax Incentives for Adoption of New Technologies (2015)	Provision of tax deductions or credits for SMEs investing in new technologies, encouraging modernization and innovation. This policy aims to reduce the financial burden of technological upgrades.	The government has enacted tax laws that include provisions for deductions related to technological investments by SMEs, with guidelines issued to ensure compliance and accessibility.	While some SMEs have benefited from these incentives, awareness and utilization rates are relatively low, indicating a need for better dissemination of information	Increase awareness campaigns about available tax incentives. Simplify the application process for tax benefits. Provide advisory services to assist SMEs in leveraging these incentives effectively.
Subsidies for Sustainable Product Development (2018)	Financial subsidies provided to SMEs for developing environmentally friendly products, aiming to stimulate demand for sustainable goods and services. This policy encourages eco-friendly innovation within the SME sector.	Environmental agencies, in collaboration with industry associations, have established subsidy programs and application procedures for SMEs focusing on sustainable product development.	The uptake of subsidies has been moderate, with some SMEs successfully launching sustainable products; however, the overall impact on market demand remains limited.	Expand outreach to inform SMEs about subsidy opportunities. Streamline the application and approval process. Monitor market trends to align subsidies with consumer demand for sustainable products (Tachasermsukkul, 2010).
Digital Literacy Training Programs (2021)	Initiatives aimed at enhancing digital skills among SME owners and employees, facilitating the adoption of digital tools and platforms to meet market demands. This includes training workshops and online courses.	The Lao National Chamber of Commerce and Industry (LNCCI), in partnership with international organizations, has conducted training sessions and developed resources to improve digital literacy within the SME sector.	Participants have reported improved digital competencies; however, the reach of these programs is limited, particularly in rural areas, and ongoing support is needed to ensure sustained impact.	Expand training programs to rural and underserved areas. Develop follow-up support mechanisms to assist SMEs in implementing digital tools. Evaluate program effectiveness regularly to adapt to evolving digital trends.

According to the data presented in Table 7, it is evident that tax incentives are available to support the adoption of new technology in Lao PDR. These incentives aim to encourage modernization and enhance productivity in various industries. However, most large investors operating in Lao PDR are multinational companies that predominantly conduct their R&D activities in their home countries. As a result, there is limited local innovation and technological development within Lao PDR itself.

Consequently, factories in Lao PDR rely heavily on importing advanced machinery and technology from the countries where these multinational companies are based. This dependency on foreign technology underscores the need for the Lao government to create policies that not only incentivize the importation of machinery but also foster local R&D initiatives. By doing so, Lao PDR could gradually build its own innovation capabilities, reducing reliance on external sources and increasing the long-term sustainability of its industrial growth.[4]

Information from In-Depth Interview Sessions

The in-depth interview sessions revealed significant challenges faced by small businesses in accessing financial support. A key issue is their limited understanding of the application process, which hinders their ability to navigate and fulfill the requirements. Additionally, the MSMEPA project necessitates the use of collateral to secure funding. However, most start-ups and production unions do not own land or property, as they typically rely on rented spaces for their operations. This lack of ownership disqualifies them from meeting the collateral requirements, further restricting their access to financial resources under the program. These barriers underscore the need for more inclusive financing mechanisms and better support systems to help small businesses overcome these obstacles.

A notable example is Mulberries Company Limited, a pioneering enterprise that specializes in producing silk and toiletry products derived from silk protein. This innovative company operates under the leadership of a Nobel Prize winner and benefits from strong support from the Lao government as well as international organizations. Through its groundbreaking efforts, Mulberries Company Limited has successfully developed a range of silk protein-based products, including shampoos, body lotions, shower creams, and various other toiletries, positioning itself as a leader in sustainable and innovative product development. However, despite its achievements, the company faces a significant challenge in accessing funding. Although the Lao government has granted Mulberries Company Limited a long-term lease on land for its operations, the lease structure does not allow the company to use the land as collateral. This limitation prevents the company from qualifying for loans from special funds that offer lower interest rates, thereby hindering its ability to secure affordable financing for further expansion and innovation.[5]

This study also retrieved information from Hi-Tech Apparel in Saysetha district, Vientiane capital. Hi-Tech Apparel is a globally recognized leader in garment manufacturing, setting the standard for excellence across Southeast Asia. With a robust workforce of over 14,000 dedicated team members, the company operates expansive and continually growing manufacturing facilities in Thailand, Cambodia, Vietnam, and Lao PDR. This dynamic network of facilities enables Hi-Tech Apparel to produce an impressive volume of over 60 million high-quality garments annually, catering to diverse markets and maintaining a reputation for reliability and innovation. By leveraging advanced production techniques and a skilled workforce, the company has solidified its position as a key

4 Interview with Dr. Xaybandith Rasphone, Vice president LNCCI
5 In-depth interview session with Mrs. Kommaly Chanthavong

player in the global apparel industry, driving growth and delivering exceptional value to its customers. Based on information retrieved from Thailand's Hi-Tech Apparel, the company is currently investing in two locations. The first factory, established in 2005, is located in Vientiane Capital, while the second factory, opened in 2023, operates within the Special Economic Zone in Savannakhet Province. These garment factories primarily focus on cut, make, and trim (CMT) processes for export purposes. The decision to open factories in Lao PDR was driven by the significantly lower labor costs compared to Thailand. However, post-COVID-19 inflation has prompted a substantial number of Lao workers to migrate to Thailand in search of better wages. This labor migration has posed challenges for maintaining the workforce in the Lao factories. To adapt to these changes and enhance efficiency, the company has leveraged its expertise and innovation capabilities in Thailand to transition from labor-intensive operations to technology-driven processes. This shift involved the importation of advanced cutting machines from overseas. The new machinery has drastically reduced the labor force required for cutting processes, decreasing the workforce from 40 to just 14 workers. During an interview, a company representative highlighted that no tax incentives are provided for the importation of such machinery unless the company operates within the Special Economic Zone. This lack of support persists despite the fact that the company's operations are primarily export-oriented. For the factory located within the Special Economic Zone, investors are offered tax incentives specifically for machinery imports aimed at supporting export-oriented operations. These incentives are designed to attract foreign and domestic investments, encouraging the use of advanced technology to enhance productivity and competitiveness in the global market. Despite these benefits, the factory, which was originally constructed with the capacity to employ 1,000 workers, has faced significant challenges in recruiting its workforce. Currently, it has only been able to hire around 100 employees, far below its intended staffing levels. This shortfall is largely attributed to labor shortages caused by a combination of factors, including competition from higher-paying opportunities in neighboring countries like Thailand and the impact of regional migration trends. The inability to attract a sufficient workforce has posed operational challenges, potentially limiting the factory's ability to fully capitalize on the advantages offered by its location within the Special Economic Zone.

Demand-side Policy Instruments

A demand-side policy instrument is a strategic measure implemented by governments to stimulate or influence the demand for specific goods, services, or innovations within an economy. Unlike supply-side policies, which focus on enhancing production capabilities, demand-side instruments aim to create market demand by encouraging the adoption and consumption of targeted products or services. These policies typically motivate consumers, businesses, or the public sector to invest in innovative, sustainable, or technology-driven solutions. Common examples of demand-side policy instruments include subsidies, tax incentives, grants, certifications, and public procurement policies. Subsidies and grants can lower the cost for consumers purchasing eco-friendly products, thereby increasing their attractiveness. Tax incentives, such as deductions or credits, can encourage businesses to invest in research and development of new technologies. Certifications can build consumer trust in innovative products, boosting their market acceptance. Public procurement policies, where governments prioritize purchasing sustainable or innovative products, can create significant demand, setting industry standards and encouraging broader market adoption. By driving demand through these instruments, governments can help establish markets for innovative offerings, reduce risks for producers, and support overall economic and technological development (Hall, 2023).

TABLE 8

DEMAND-SIDE INSTRUMENT MATRIX

Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Public Procurement Policies Favoring SMEs (2010)	Implementation of procurement policies that provide preferential treatment or set-asides for SMEs, encouraging their participation in public tenders and contracts. This aims to stimulate demand for SME products and services.	The government has introduced measures to simplify procurement procedures and reduce barriers for SMEs, including capacity-building initiatives to help SMEs meet procurement requirements.	These policies have increased SME participation in public procurement; however, challenges remain in ensuring transparency and equal access for all eligible SMEs.	Enhance transparency in the procurement process. Provide ongoing support and training to SMEs on procurement procedures. Monitor and evaluate the impact of procurement policies on SME growth.

The implementation of demand-side policy instruments aimed at stimulating private demand for innovative products is currently limited. The government has initiated several policies to foster digital transformation and innovation; however, specific measures such as subsidies or tax incentives to encourage individual or industry consumers to purchase innovative products are not extensively developed.

Table 8 highlights Public Procurement Policies Favoring SMEs (2010) in Lao PDR, focusing on providing preferential treatment or "set-asides" for SMEs in public tenders and contracts to boost demand for SME products and services. The government has simplified procurement procedures and reduced barriers for SMEs, introducing capacity-building initiatives to help them meet procurement requirements. While these policies have increased SME participation in public procurement, challenges persist in ensuring transparency and equitable access for all eligible SMEs. Suggestions for improvement include enhancing transparency in the procurement process, providing ongoing training and support to SMEs, and regularly monitoring and evaluating the impact of these policies on SME growth.

INSTITUTIONS AFFECTING EFFECTIVENESS OF POLICIES

Capacity of Executing Government Agencies

The Lao government's efforts to develop technological capabilities are steadily evolving, reflecting a mix of challenges and notable progress. A key milestone in this journey is the adoption of three comprehensive frameworks: the 20-Year National Digital Economic Development Vision (2021–2040), the 10-Year National Digital Economy Strategy (2021–2030), and the 5-Year National Digital Economic Development Plan (2021–2025). These initiatives underscore the government's commitment to integrating digital technologies across various sectors, fostering innovation, and driving balanced and sustainable development. Together, these strategic plans aim to modernize the economy, enhance competitiveness, and create a robust foundation for long-term digital transformation in Lao PDR (ANN, 2024).

Despite the adoption of strategic frameworks for digital transformation, Lao PDR continues to face significant infrastructural challenges, including limited access to high-speed internet and advanced technological facilities, particularly in rural areas. To address these issues, the government is investing in digital infrastructure projects, such as expanding e-government services and developing smart cities, to improve accessibility, efficiency, and public service delivery. The Ministry of Technology and Communications (MTC), in collaboration with the UNDP, has launched the Digital Government Transformation project, which focuses on building digital capacities and strengthening infrastructure to support more inclusive governance and service provision.

However, challenges persist, such as a shortage of skilled professionals in science, technology, engineering, and mathematics (STEM), exacerbated by gaps in the education system and the lack of advanced training programs. To bridge this gap, efforts are underway to upskill government employees through international collaborations and capacity-building initiatives. Limited financial resources also constrain government agencies' ability to invest in research, development, and technological innovation. Development aid and foreign direct investments, particularly from China and ASEAN countries, have provided critical funding for technology-driven projects. Strategic partnerships with international entities have facilitated knowledge transfer, infrastructure development, and the adoption of best practices.

Governance reforms and digital transformation initiatives, including e-Government projects, aim to streamline bureaucratic processes and enhance service delivery. To build on these efforts, Lao PDR must prioritize enhancing training and development for civil servants in technology-related fields, strengthening STEM education, establishing research and innovation centers, and fostering public-private partnerships to leverage expertise and funding from the private sector. Strengthening relationships with international organizations for knowledge sharing and technical assistance is also essential. With sustained investments, regional collaborations, and governance improvements, Lao PDR is well-positioned to expand its capacity for executing technology-driven initiatives and achieving its digital transformation goals.

Cross-Ministerial/Agency Coordination

In Lao PDR, enhancing technological capabilities and productivity among small and SMEs requires a coordinated approach involving multiple ministries and agencies. The MOIC plays a pivotal role in this effort, with its Department of SME Promotion leading the formulation and implementation of strategies designed to foster SME development. To improve the regulatory environment and streamline business licensing processes, MOIC has established inter-ministerial task forces tasked with simplifying procedures, reducing bureaucratic hurdles, and expediting license issuance. These efforts aim to create a more supportive and efficient business environment for SMEs in Lao PDR.

The Lao Business Forum (LBF), established in 2005 and managed by LNCCI, serves as a vital platform for dialogue between the government and the private sector, including SMEs. By addressing issues affecting the national business climate, the LBF promotes transparency, inclusivity, and collaborative policy development, ensuring that SMEs' concerns are addressed effectively. International organizations, such as the APO, also play a crucial role in boosting SME productivity. In November 2023, the APO Secretary-General visited Lao PDR to strengthen partnerships, participate in the National Productivity Festival, and engage directly with local SMEs to identify opportunities for growth and innovation.

Additionally, the Ministry of Agriculture and Forestry (MAF) contributes significantly to SME productivity, particularly in the agribusiness sector. By promoting sustainable agricultural practices, enhancing efficiency, and supporting rural development, MAF's initiatives benefit SMEs engaged in agriculture and related industries, driving inclusive economic growth. Through these combined efforts, Lao PDR is working to create a dynamic MSME ecosystem that supports technological advancement, productivity, and sustainable development.

Despite these collaborative efforts, several challenges persist, MSMEs in Lao PDR face several significant challenges that hinder their growth and competitiveness. One major issue is the complexity of the regulatory environment, where overlapping requirements from various ministries create confusion and increase compliance costs for businesses. Limited access to finance further exacerbates these challenges, as many SMEs struggle to meet stringent lending criteria and often lack access to financial products tailored to their specific needs, restricting their ability to invest in technological upgrades and expansion. Infrastructure constraints, particularly in rural areas, limit access to markets and technology, significantly affecting productivity and growth potential. Additionally, the shortage of skilled labor poses a critical barrier, as the lack of workers equipped to adopt and implement new technologies prevents SMEs from advancing technologically. While inter-ministerial coordination efforts exist, inconsistencies and communication gaps often lead to fragmented support for SMEs, reducing the overall effectiveness of programs and initiatives aimed at their development. Addressing these challenges requires targeted interventions to simplify regulations, improve access to finance, strengthen infrastructure, enhance workforce skills, and ensure cohesive policy implementation across ministries (Kyophilavong, 2008).

Addressing these challenges requires ongoing commitment to regulatory reforms, improved access to finance, investment in infrastructure, workforce development, and enhanced inter-agency collaboration to create a more supportive environment for SME growth and productivity enhancement in Lao PDR.

Trust between Government Agency and Firms

The level of trust between government agencies and firms in Lao PDR concerning technological capability enhancement support for SMEs and productivity improvement is influenced by several factors. The Lao government has implemented several initiatives to support SMEs, such as the Strategic Action Plan for Private Sector Development (2021–2025), which focuses on creating a favorable business environment and boosting SME competitiveness. Financial assistance programs, including allocated funds for MSMEs and SMEs, further demonstrate the government's commitment to fostering business growth. However, the effectiveness of these policies is hampered by gaps in implementation, such as the absence of specific programs to address high tax burdens and limited access to finance. Bureaucratic hurdles, including complex procedures and regulatory compliance costs, also discourage SMEs from fully engaging with government initiatives. To address these challenges, the government has promoted public-private partnerships through platforms like the Trade and Private Sector Working Group (TPSWG) and established SME Service Centers (SSC) to provide technical support and facilitate access to resources. Building trust through transparent communication and consistent application of policies remains a priority to strengthen relationships between government agencies and SMEs, ensuring a more supportive and reliable framework for business development (LNCCI, 2020; Vixathep, 2014).

Attitude of Policymakers in Helping Firms and Having Selective Policies

Policymakers in Lao PDR have demonstrated a commitment to enhancing technological capabilities and productivity among SMEs. Their approach includes both broad-based support and selective policies targeting specific sectors, clusters, and products. Key aspects of this strategy include:

Promotion of SMEs

The government has implemented a robust policy framework to support SME development, emphasizing the creation of an enabling business environment, enhancing competitiveness, and improving access to finance and markets. Complementing these efforts, the LNCCI has formulated the Strategic Action Plan for Private Sector Development (2021–2025), which focuses on fostering a conducive and competitive business ecosystem with a particular emphasis on driving SME growth and sustainability (LNCCI, 2020; Vixathep, 2014).

Selective Industrial Policies

The government's industrial policy focuses on three key elements: promoting SMEs, encouraging import substitution, and prioritizing specific industries and products for development. This strategic approach seeks to reduce reliance on imports while strengthening domestic production capabilities. Additionally, the "Lao PDR at the Crossroads: Industrial Development Strategies 2016–2030" report outlines comprehensive policy measures designed to transform the country's land-locked status into a land-linked advantage, driving industrialization through targeted sectoral development and fostering sustainable economic growth (Cuts, 2006).

Cluster Development and Special Economic Zones (SEZs)

The government has prioritized the development of SEZs as a key strategy for attracting foreign direct investment (FDI) and driving industrial growth. By concentrating efforts on high-potential SEZs, the aim is to establish successful models that can later be replicated in other regions. Additionally, a cluster-based approach is being promoted in sectors such as agriculture, manufacturing, and services. This strategy focuses on enhancing productivity through the shared use of infrastructure, fostering knowledge transfer, and encouraging collaborative innovation among businesses within these clusters, thereby strengthening overall economic competitiveness.

Challenges and Considerations

Despite having well-defined policies to support SMEs, the lack of specific programs for effective implementation poses significant challenges, including high tax burdens and limited access to finance, which hinder SME growth and development. Moreover, fostering technological innovation awareness is crucial, as studies show it plays a key role in mediating the effective use of SME resources, driving their sustainable growth. This highlights the need to cultivate a strong culture of innovation among SMEs to enhance their productivity, competitiveness, and long-term success (Kyophilavong, 2008; Nouanpaseuth & Syphoxay, 2025).

Societal Attitude to Failure

Societal attitudes toward failure significantly influence the entrepreneurial landscape, particularly concerning technological capability enhancement and productivity improvement among SMEs. Key aspects of this dynamic include:

Cultural Perceptions of Failure

Lao PDR's collectivist culture, which places strong emphasis on community and familial ties, often fosters a heightened fear of failure due to concerns about losing face and damaging communal reputation. This cultural dynamic can discourage individuals from pursuing entrepreneurial ventures perceived as risky. Coupled with a societal tendency toward risk aversion, this results in a preference for stable employment over entrepreneurship, potentially stifling innovation and hindering the adoption of new technologies within SMEs.

Impact on technological Capability Enhancement

Fear of failure and societal stigma surrounding business setbacks significantly impact the willingness of SME owners in Lao PDR to embrace innovation and entrepreneurship. This hesitancy to invest in new technologies or adopt innovative processes hinders productivity and limits competitiveness in modern markets. Studies emphasize the importance of fostering creativity and innovation to meet evolving market demands, highlighting that overcoming this fear is crucial for technological advancement. Furthermore, the stigma associated with business failure suppresses entrepreneurial activity, resulting in fewer startups and a less dynamic SME sector, ultimately impeding the technological progress of the country's industries and economic development (Sisounonth & Chansomphou, 2023).

Government and Policy Responses

To address cultural challenges such as fear of failure and risk aversion, the Lao government has introduced policies aimed at fostering a supportive environment for entrepreneurship. The Strategic Action Plan for Private Sector Development (2021–2025) emphasizes creating a competitive business climate with a strong focus on SME growth. Complementing these efforts, educational initiatives promoting entrepreneurial awareness are vital for shifting societal perceptions of failure. By fostering a mindset that views failure as a learning opportunity, these initiatives aim to encourage innovation and risk-taking among entrepreneurs, ultimately driving the development and dynamism of the SME sector (LNCCI, 2020).

Moving Forward

Addressing societal attitudes toward failure in Lao PDR requires a cultural shift that normalizes failure as a natural part of the entrepreneurial journey, with initiatives such as sharing stories of successful entrepreneurs who have overcome setbacks to change perceptions and reduce the stigma associated with business failures, while continued government support through enhanced policies, including access to finance and business advisory services, can provide safety nets that mitigate the fear of failure and foster a more dynamic and resilient SME sector.

Existence of Opportunity-Based Entrepreneurs

Several systemic policies and intermediary organizations have been established to support SMEs by providing consultation, technical knowledge, and facilitating connections with larger firms, universities, and multinational corporations:

- SSC: This ASEAN program provides Lao SMEs with access to finance, training workshops, business advisory services, and co-working spaces, fostering an environment conducive to entrepreneurial growth. The center offers business advisory services, organizes seminars, and facilitates participation in regional exhibitions to enhance SME capabilities and market access. For instance, between July 19–21, 2023, the SSC led a group of Lao entrepreneurs to participate in the Mega Show Bangkok, providing them with exposure to international markets and networking opportunities (Yula, 2021).
- LBF: Established in 2005, the LBF serves as a platform for dialogue between the government and the private sector, including SMEs. It facilitates discussions on national business climate issues, promoting transparency and inclusivity in policy development (ADB, 2014).
- Business Assistance Facility II (BAF II) supports eligible Lao companies, including SMEs, to increase their competitive advantage and grow into larger, more sustainable businesses. The facility provides matching grants that reduce the cost of hiring technical advisory services aimed at improving competitiveness. This initiative helps SMEs build their skills and expertise to become locally, regionally, and internationally competitive.
- LNCCI: Serving as a bridge between the government and the private sector, LNCCI plays a crucial role in advocating for SME development. It provides various services, including policy advocacy, business matching, and capacity-building programs, to support SMEs in navigating the business environment.

Moreover, the Strategic Action Plan for Private Sector Development (2021–2025), developed by the LNCCI, emphasizes public-private dialogue, SME support services, product promotion, regional integration, and entrepreneurship development to create a competitive business environment (LNCCI, 2020).

Despite supportive measures, opportunity-based entrepreneurs in Lao PDR face significant challenges, including limited access to finance due to stringent lending criteria and a lack of tailored financial products that restrict investment in technological upgrades; a complex and overlapping regulatory environment that increases compliance costs and creates confusion for SMEs; a shortage of skilled labor capable of adopting and implementing new technologies, which hampers technological advancement; and inadequate infrastructure, particularly in rural areas, that limits access to markets and technology, affecting productivity and growth potential, all of which necessitate ongoing regulatory reforms, improved access to finance, investment in infrastructure, workforce development, and enhanced inter-agency collaboration to foster a more supportive entrepreneurial environment.

CONCLUSION AND POLICY RECOMMENDATIONS

Conclusion

Economic Significance of MSMEs

MSMEs make up over 99% of registered businesses in Lao PDR, serving as a cornerstone of the country's economy by employing more than 80% of the labor force. However, their contribution to GDP remains disproportionately low at just 20%, highlighting significant challenges that hinder their potential. These challenges include limited access to affordable and adequate financing, technological gaps that constrain productivity and innovation, a shortage of skilled labor to drive growth, and insufficient infrastructure to support business operations effectively. Despite these obstacles, MSMEs hold immense potential to foster rural development, alleviate poverty, and promote inclusive economic growth by creating jobs, empowering local communities, and bridging the urban-rural economic divide. Addressing these issues through targeted policies, capacity building, and infrastructure development can unlock the full potential of MSMEs, enabling them to play a more significant role in driving sustainable economic progress in Lao PDR.

Challenges and Opportunities

MSMEs in Lao PDR face numerous challenges that limit their growth and competitiveness, including financial constraints that restrict access to affordable credit and investment, regulatory complexities that create administrative burdens and compliance difficulties, a persistent lack of skilled labor to drive efficiency and innovation, inadequate technological capabilities that hinder productivity, and weak linkages between industry and research institutions, stifling the adoption of cutting-edge solutions. Despite these challenges, significant opportunities exist to propel MSME development. Regional trade agreements, such as those within the ASEAN framework, provide access to broader markets and encourage cross-border trade, while emerging digital technologies offer transformative potential to improve operations, enhance customer engagement, and drive innovation. Additionally, the increasing demand for innovative solutions, both domestically and globally, creates avenues for MSMEs to cater to niche markets and position themselves as competitive players in a rapidly evolving economic landscape. By addressing these challenges and capitalizing on these opportunities, MSMEs can play a pivotal role in fostering economic growth and development in Lao PDR

Government Initiatives

The MOIC plays a central role in driving the development of SMEs in Lao PDR through a comprehensive framework of supportive policies and initiatives. Key measures include the implementation of SME Development Plans, the provision of tax incentives, access to grants, and even direct equity participation to encourage growth and innovation. Financial support programs like the SME Fund offer low-interest loans to address financing challenges, although their effectiveness is sometimes hampered by limited awareness among SMEs and administrative bottlenecks that slow the disbursement process. Recognizing the transformative potential of digitalization, the MOIC has also initiated efforts to integrate SMEs into digital platforms and foster the adoption of e-commerce. These initiatives aim to improve operational efficiency, expand market access, and enhance the regional and global competitiveness of SMEs. By addressing existing challenges and continuing to promote digital and financial inclusion, these efforts hold significant promise for strengthening the SME sector and driving sustainable economic development in Lao PDR.

Infrastructure and Innovation

Investments in digital infrastructure and the development of smart cities in Lao PDR are steadily advancing, although their reach remains largely confined to urban areas, leaving rural regions underserved and highlighting the need for more inclusive progress. To address these gaps and stimulate economic growth, initiatives such as the BAF and international partnerships are being implemented, aiming to foster innovation, improve productivity, and empower businesses to adapt to modern challenges. Central to these efforts are policies that prioritize the expansion of e-commerce, encouraging businesses to tap into digital markets and increase their regional and global competitiveness. Additionally, there is a strong emphasis on promoting sustainable product development, ensuring that growth aligns with environmental goals, and enhancing digital literacy across the population to enable individuals and enterprises to fully utilize emerging technologies. Together, these focus areas are integral to creating a robust digital economy, reducing regional disparities, and paving the way for long-term, inclusive development in Lao PDR.

Cultural and Societal Influences

The collectivist culture deeply rooted in Lao PDR, while fostering strong community bonds and mutual support, often encourages risk aversion, which can inadvertently hinder entrepreneurial activities and the adoption of new technologies. This cultural tendency toward caution and the avoidance of failure limits individuals' willingness to take bold steps in business or experiment with innovative solutions. To address this, targeted efforts are required to shift societal perceptions and normalize failure as a valuable learning opportunity rather than a setback. Encouraging this mindset would help cultivate a culture of innovation and entrepreneurship, empowering individuals and businesses to embrace calculated risks, explore new ideas, and adapt to evolving market demands. By promoting success stories, providing mentorship, and creating supportive environments for startups and innovators, Lao PDR can unlock its entrepreneurial potential and drive forward a more dynamic and resilient economy.

Policy Recommendations

Financial Accessibility

Expanding financial literacy programs is a critical step in empowering SMEs in Lao PDR to navigate loan applications and improve their financial management skills effectively. This initiative aims to equip business owners with the knowledge needed to make informed financial decisions, enhance their creditworthiness, and better utilize available financial resources. The Ministry of Finance (MOF) and the MOIC are at the forefront of this effort, tasked with implementing measures to ensure widespread access to these programs. Simplifying loan application processes is a key component, reducing administrative complexities and making financial support more accessible to SMEs. Additionally, the introduction of alternative collateral options, such as movable assets or future receivables, is essential to address the challenges faced by businesses that lack traditional forms of collateral. Together, these actions aim to create a more inclusive financial ecosystem, enabling SMEs to access the funding necessary for growth and contributing to the broader economic development of Lao PDR.

Infrastructure Development

Prioritizing investments in rural digital infrastructure is essential to bridging the digital divide in Lao PDR, enabling improved internet access and fostering greater market integration for underserved communities. Enhanced connectivity will empower rural businesses, entrepreneurs, and individuals to participate more actively in the digital economy, access e-commerce platforms, and integrate into broader regional and global markets. The MTC plays a pivotal role in spearheading

this initiative, focusing on creating inclusive digital frameworks that benefit all regions of the country. Collaboration with international donors and development partners is a crucial aspect of this effort, providing both financial resources and technical expertise to accelerate the rollout of e-government services and smart city initiatives. These advancements aim to modernize public service delivery, improve urban management, and create a foundation for sustainable and inclusive economic growth. By addressing the challenges of rural connectivity, this initiative seeks to unlock the potential of digital transformation for the entire nation.

Technological Capability Enhancement

Establishing innovation hubs is a transformative initiative aimed at empowering SMEs in Lao PDR with access to critical resources such as R&D, technical support, and advanced technologies. These hubs will serve as dynamic centers of collaboration, fostering innovation and enabling SMEs to improve productivity, competitiveness, and adaptability in rapidly evolving markets. The Ministry of Science and Technology (MOST) and the MOIC will lead this effort, working together to design and implement these hubs strategically. A cornerstone of their success will be the development of partnerships with research institutions and the private sector, creating platforms for knowledge sharing, capacity building, and the transfer of cutting-edge technologies. By bridging the gap between academia, industry, and SMEs, these innovation hubs will drive the adoption of modern solutions, stimulate entrepreneurial activity, and play a vital role in advancing the sustainable economic development of Lao PDR.

Regulatory Simplification

Simplifying business registration and compliance requirements is a critical step in reducing barriers and fostering growth for SMEs in Lao PDR. The MOIC is spearheading this initiative, aiming to create a more efficient and accessible business environment. Central to this effort is the development of a centralized online platform that will streamline the registration process, enabling SMEs to complete applications, submit required documents, and monitor their status seamlessly in one place. This platform will significantly reduce the time, effort, and costs associated with traditional paper-based processes, particularly for businesses in remote areas with limited access to administrative offices. Additionally, by consolidating compliance requirements and offering clear guidance through the platform, the initiative seeks to eliminate unnecessary bureaucratic hurdles that often discourage entrepreneurship. Simplifying these processes will not only encourage the formalization of businesses but also enhance transparency, improve regulatory oversight, and support the growth of a dynamic and inclusive SME sector, ultimately contributing to Lao PDR's economic development.

Workforce Development

Expanding vocational training programs that focus on digital skills and entrepreneurship is essential for equipping the workforce in Lao PDR with the tools needed to thrive in an increasingly digital and innovation-driven economy. The Ministry of Education and Sports (MOES) plays a pivotal role in this initiative, working to design and implement training programs that address the specific skill gaps in the labor market. These programs will emphasize practical and market-relevant skills, such as digital literacy, e-commerce management, and entrepreneurial competencies, empowering individuals to start and grow their own businesses or contribute effectively to existing enterprises. Collaboration with development partners is a cornerstone of this effort, ensuring access to necessary resources, expertise, and funding. By facilitating training workshops and creating partnerships with private sector stakeholders, this initiative aims to align vocational training with industry needs and emerging economic trends. Ultimately, these efforts will help build a resilient, skilled

workforce capable of driving innovation, fostering economic growth, and ensuring sustainable development across Lao PDR.

Promoting Innovation and Research

Increasing funding for R&D and fostering partnerships between SMEs and universities are vital strategies to drive innovation and economic growth in Lao PDR. The MOST, in collaboration with the MOF, is tasked with leading this initiative to bridge the gap between academic research and industry needs. By offering grants and targeted tax incentives, the government aims to encourage collaborative research projects that address specific market demands, enhancing the competitiveness of SMEs while promoting the commercialization of innovative ideas. These partnerships will leverage the expertise of universities to provide SMEs with access to cutting-edge technologies, advanced knowledge, and technical support, enabling businesses to develop new products, improve processes, and adapt to changing market dynamics. Increased R&D funding and strategic collaboration will not only bolster the innovation ecosystem but also help create a more resilient and diverse economy, positioning Lao PDR as a hub for sustainable and forward-looking enterprise development.

Encouraging Exports and Market Expansion

Providing technical assistance to SMEs in Lao PDR to help them meet international standards and access new markets is a crucial step toward enhancing their competitiveness and integration into the global economy. The MOIC, in collaboration with the Ministry of Foreign Affairs (MOFA), is leading this initiative to ensure that SMEs are equipped with the knowledge, skills, and resources needed to comply with international quality, safety, and environmental standards. This assistance will empower SMEs to produce goods and services that meet global market demands, opening opportunities for export and participation in international trade networks. Key implementation strategies include organizing trade expos to showcase SME products and services to potential international buyers and investors while also facilitating their entry into global value chains through targeted support programs. These efforts aim to connect SMEs with foreign markets, promote partnerships with international businesses, and encourage knowledge transfer, ultimately contributing to sustainable economic growth and the diversification of Lao PDR's economy.

Enhancing Collaboration and Coordination

Establishing an inter-ministerial task force is a strategic initiative to ensure streamlined and effective implementation of policies that support SME development and economic growth in Lao PDR. Chaired by the MOIC and comprising key stakeholders such as the MOST, MOF, Ministry of Education and Sports (MOES), and MTC, this task force will serve as a centralized body for coordination and decision-making. Its primary objectives include fostering collaboration across ministries, addressing policy overlaps, and eliminating bottlenecks that hinder progress. Regular reviews of policy implementation will be conducted to assess effectiveness, identify challenges, and make timely adjustments. Additionally, the task force will prioritize enhanced communication between government agencies, private sector representatives, and other stakeholders to ensure transparency, inclusivity, and alignment of objectives. By uniting diverse expertise and resources, this initiative aims to create a cohesive policy framework that drives innovation, strengthens SMEs, and supports sustainable economic development across Lao PDR.

Subsidies for R&D and Innovation

The Lao government should consider implementing tax incentives and increasing subsidies for R&D and innovation-related activities to stimulate economic growth and enhance national

competitiveness. As a developing economy, Lao PDR faces challenges in diversifying its industries and improving its technological capabilities. By offering tax incentives, the government can encourage private companies to invest in research and development, leading to the creation of new products, technologies, and processes that can drive productivity and increase exports. Furthermore, subsidies can help offset the financial risks associated with innovation, making it more accessible for MSMEs that may lack the resources to invest heavily in R&D. Promoting innovation would also attract foreign investment, enhance the skill set of the local workforce, and support the development of high-value industries such as clean energy, biotechnology, and digital technology. Ultimately, these measures can create a more resilient economy by fostering homegrown innovation, reducing dependency on raw material exports, and positioning Lao PDR as a more competitive player in the global market.

Ways to Increase Uptake Benefits of Existing Policies

To increase the uptake of existing policy instruments, especially among MSMEs, the government must focus on raising awareness, improving accessibility, and better aligning policies with business needs. Many MSMEs are unaware of available programs or find them difficult to navigate. To address this, the government should run targeted awareness campaigns through local business associations and digital platforms, offering workshops and simplified information on how to access benefits. Policies should also be reviewed to ensure they address the specific challenges MSMEs face, such as limited access to finance and technical expertise. Simplifying application procedures, offering smaller-scale subsidies, and providing capacity-building support could make policies more effective. Additionally, the government should foster trust and collaboration with MSMEs by engaging directly with business owners, gathering feedback, and adjusting policies accordingly. This approach will help ensure that existing policy instruments are more accessible and better tailored to the needs of MSMEs, ultimately increasing their effectiveness.

Demand-side Policy Instruments

Since there are still very limited demand-side policy instruments, to stimulate private demand for innovative products in Lao PDR, the Lao government can implement demand-side policies that include direct subsidies and tax incentives targeted at individuals and industries. Direct subsidies, such as cash rebates, vouchers, or grants, can be offered to consumers purchasing innovative products like renewable energy systems, energy-efficient appliances, or advanced agricultural tools. Tax incentives could involve reduced VAT, income tax deductions, or import duty exemptions for specific high-tech goods to enhance their affordability. To complement these measures, the government could organize promotional campaigns and innovation expos to raise awareness of the benefits of innovative products, emphasizing long-term savings and environmental impact.

Increasing Bureaucratic Capacity, Local Entrepreneurship and Society Attitude to Failures

To enhance technological capability, increasing bureaucratic capacity, fostering local entrepreneurship, and shifting societal attitudes toward failure are essential. Strengthening bureaucratic capacity requires investing in the skills of government officials, streamlining processes with digital tools, and establishing dedicated agencies or task forces to oversee innovation policies. Training programs, inter-agency coordination, and international collaborations can further improve efficiency and effectiveness in managing technological initiatives. To foster local entrepreneurship, governments can provide financial incentives like grants, tax breaks, and low-interest loans, alongside creating business incubators and innovation hubs that offer mentorship and technical support. Public procurement policies favoring local innovations, stronger intellectual property protection, and partnerships between businesses and research institutions can further drive

entrepreneurial growth. At the societal level, normalizing failure as part of the innovation process is critical. Public campaigns, entrepreneurship education, and platforms for sharing lessons from unsuccessful projects can promote a culture of resilience and learning. Financial safety nets, such as innovation insurance or failure compensation mechanisms, can reduce the risks associated with failure and encourage risk-taking. Together, these measures create a supportive ecosystem that accelerates technological capability enhancement and innovation-driven development.

REFERENCES

ADB. (2014). *Second Private Sector and Small and Medium-Sized Enterprises Development Program*. https://www.adb.org/sites/default/files/linked-documents/44057-012-lao-ssa.pdf

ANN. (2024). *Lao PM: Leverage digital technology, innovation to spur development*. Asian News Network Retrieved January 1 from https://asianews.network/lao-pm-leverage-digital-technology-innovation-to-spur-development

BAF. (2024). *BAF II Recipients*. Business Assistance Facilities. Retrieved August 23 from https://www.baflaos.com/en/our_partners_baf

Berument, H., Dincer, N. N., & Mustafaoglu, Z. (2013). *Total Factor Productivity and Macroeconomic Instability*. W. Bank. https://documents1.worldbank.org/curated/en/277061468150575917/pdf/Total-Factor-Productivity-and-Macroeconomic-Instability.pdf

Capili, B. (2021). Cross-Sectional Studies. *Am J Nurs, 121*(10), 59-62. https://doi.org/10.1097/01.NAJ.0000794280.73744.fe

CEIC. (2024). *Laos Labour Productivity Growth*. CEIC Data

ISI Emerging Markets Group Company. Retrieved November 1 from https://www.ceicdata.com/en/indicator/laos/labour-productivity-growth

Cuts. (2006). *Promoting Competition Policy & Law in Lao PDR A Civil Society Perspective*.

ERIA. (2024). *SME Policy Index ASEAN 2024 Enabling Sustainable Growth and Digitalisation* (Vol. 2024). Economics Research Institute for ASEAN and East Asia. https://www.eria.org/publications/sme-policy-index-asean-2024-enabling-sustainable-growth-and-digitalisation

FAO. (2022). *FAO in Lao People's Democratic Republic*. Food and Agriculture Organization of the United Nations. Retrieved November 22 from https://www.fao.org/lao-people-democratic-republic/news/detail-events/en/c/1633823/

Francis, D. C., Karalashvili, N., Maemir, H., & Meza, J. R. (2020). Measuring Total Factor Productivity Using the Enterprise Surveys. *Policy Research Working Paper, 9491*. https://documents1.worldbank.org/curated/en/306091607457083831/pdf/Measuring-Total-Factor-Productivity-Using-the-Enterprise-Surveys-A-Methodological-Note.pdf

FRED. (2024). *Total Factor Productivity at Constant National Prices for Lao People's Democratic Republic*. Federal Reserve of St Louis. Retrieved December 23 from https://fred.stlouisfed.org/series/RTFPNALAA632NRUG

GIZ. (2014). *SME in Laos - GIZ's challenges, approaches and achievements in the business enabling environment*. D. G. für & I. Z. G. GmbH.

Globaleconomy. (2023). *Laos: Innovation index*. 2023. Retrieved November 2 from https://www.theglobaleconomy.com/Laos/GII_Index/

Hall, M. (2023). *Demand-Side Economics: Definition and Examples of Policies*. Investopedia. Retrieved December 22 from https://www.investopedia.com/ask/answers/040915/what-demandside-economics.asp

ILO. (2018). *ILO Technical Advice for Lao PDR Capacity building for Small and Medium Enterprises (SMEs)*.

JETRO. (2017). *Laos Traditional Handicraft Assistance Project - The Gift Project by JETRO* Japan External Trade Organization Retrieved August 23 from https://www.jetro.go.jp/en/jetro/topics/2017/1701_topics1.html

Katusiimeh, M. W., Burger, K., & Mol, A. P. J. (2013). Informal waste collection and its co-existence with the formal waste sector: The case of Kampala, Uganda. *Habitat International, 38*, 1-9. https://doi.org/https://doi.org/10.1016/j.habitatint.2012.09.002

Kongmanila, X. (2023). Small and Medium-Sized Enterprise Dynamics in Laos. *Journal of Business and Economic Options, 6*(2), 9-17. https://resdojournals.com/index.php/jbeo/article/view/235

Kyophilavong, P. (2008). SME Development in Lao PDR. In H. Lim (Ed.), *SME in Asia and Globalization*. ERIA. https://www.eria.org/SMEs%20Development%20in%20Lao%20PDR.pdf

Laogovt. (2023). *Lao government decree on MSME*. Vientiane Capital, Lao PDR: Lao government Retrieved from https://laoofficialgazette.gov.la/kcfinder/upload/files/04ฉบ12.1.2023.pdf

Lapuekou, C. (2023). *Laos to Develop E-Commerce Policies, Strategies for Local Enterprises*. Retrieved November 22 from https://laotiantimes.com/2023/11/20/laos-to-develop-e-commerce-policies-strategies-for-local-enterprises/

Lestari, E. R., & Ardianti, F. L. (2019). Technological capability and business success: The mediating role of innovation. *IOP Conference Series: Earth and Environmental Science, 250*(1), 012039. https://doi.org/10.1088/1755-1315/250/1/012039

LNCCI. (2020). *Strategic Action Plan for Private Sector Development in the Lao PDR 2021 - 2025 - Building up a conducive and competitive business environment with a strong business sector that contribute substantially to the sustainable economic growth of the Lao PDR*.

MSMEPA. (2022). *Lao SME Fund Report 2022*. https://www.laosmefund.org/blog/ບົດລາຍງານ%20ທສອ/626b62063105c7558d2b92bb

NA. (2011). *Law on the promotion of small and medium sized enterprises* Vientiane Capital, Laos: National Assembly, Laos Retrieved from https://laoofficialgazette.gov.la/kcfinder/upload/files/Law%20on%20the%20%20Promotion%20of%20%20Small%20and%20Medium%20Sized%20Enterprises.pdf

Nouanpaseuth, S., & Syphoxay, P. (2025). The Mediating Role of Technological Innovation Awareness on the Impact of SMEs' Resources on Their Sustainable Growth in Lao PDR. *Economics World, 12*(1), 52-72. https://doi.org/10.17265/2328-7144/2025.01.005

Sayavong, V. (2020). Technical inefficiency of the manufacturing sector in Laos: a case study of the firm survey. *Journal of Asian Business and Economic Studies, 39*(4).

Sayvaya, I., & Phommason, S. (2023). Discussion on Rainy Season Road Access and Poverty Alleviation in Laos. *Journal of Business and Economic Options, 6*(4), 1-7. https://resdojournals.com/index.php/jbeo/article/view/243

Sisounonth, O., & Chansomphou, V. (2023). Factors Influencing Innovation on SMEs in Lao PDR. *Chinese Business Review 22*(3), 141-150. https://doi.org/10.17265/1537-1506/2023.03.004

Stategov. (2014). *Department of State: 2014 Investment Climate Statement*. 2014. https://2009-2017.state.gov/documents/organization/229132.pdf

Tachasermsukkul, L. (2010). *Small & Medium Enterprises Development Policies in Laos*. ASEAN. Retrieved December 23 from https://www.asean.org/wp-content/uploads/images/archive/documents/SME%20Development%20Policies%20in%204%20ASEAN%20Countries%20-%20Lao%20PDR.pdf

Thorsteinsdóttir, H., & Bandyopadhyay, N. (2024). Research for understanding and promoting innovation by small-and-medium sized firms in the least developed countries. *Innovation and Development*, 1-25. https://doi.org/10.1080/2157930X.2024.2375485

USAID. (2024). *USAID Laos Business Environment*. Retrieved December 2 from https://www.usaid.gov/laos/fact-sheets/usaid-laos-business-environment

Vixathep, S. (2014). *Entrepreneurship, Government Policy and Performance of SMEs in Laos*. https://www.research.kobe-u.ac.jp/gsics-publication/gwps/2014-28.pdf?utm_source=chatgpt.com

WBES. (2018). *World Bank Enterprise Surveys (WBES) data for Lao PDR*. Retrieved August 22 from https://www.enterprisesurveys.org/en/data/exploreeconomies/2018/lao-pdr

World Bank. (2018). *Lao PDR - Small and Medium Enterprise Access to Finance Project*. https://documents1.worldbank.org/curated/en/405831543934270806/pdf/Disclosable-Version-of-the-ISR-Lao-PDR-Small-and-Medium-Enterprise-Access-to-Finance-Project-P131201-Sequence-No-09.pdf

World Bank. (2020). *Unlocking Access to Finance for Small and Medium Enterprises in Lao PDR*. World Bank Group. Retrieved August 2 from https://www.worldbank.org/en/news/feature/2020/09/18/unlocking-access-to-finance-for-small-and-medium-enterprises-in-lao-pdr

Yula. (2021). *Insight on Lao SMEs Business Environment*. Yula.la News. Retrieved July 2 from https://www.yula.la/en/news/lao-MSMEs-insight

APPENDIX 1

PARTICIPANTS IN THE IN-DEPTH INTERVIEW SESSIONS

Participants	Date of Interview	Position and affiliation
Mr. Vilakone Pilomlack	September 10, 2024	Deputy Director General, Micro, Small, Medium Enterprise Promotion Agency, MOIC
Mr. Viengsavang Thipphavong	September 20, 2024	Director General, Institute for Industry and Commerce, MOIC
Mr. Xaysomphet Norasingh	December 24, 2024	Director General Department of Intellectual Properties, MOIC
Mr. Neung Mr. Ning Mr. Phet	December 24, 2024	Lao Hi-Tech Apparel
Mrs. Souvita Prasert	December 25, 2024	President of Lao Handicraft Magic Lao Carpets
Mrs. Kommaly Chanthavong	December 26, 2024	Owner/ Founder Mulberries Company
Dr. Xaybandith Rasphone	December 30, 2024	Vice President Member of National Assembly Lao National Chamber of Commerce and Industry, MOIC
Mr. Phoutthasone Phomvisay	December 31, 2024	Member Lao National Chamber of Commerce and Industry, MOIC
Ms. Palidaphone Phoutthavong	January 3, 2025	Officer Department of Foreign Trade, MOIC

PHILIPPINES

INTRODUCTION

Innovation is a crucial driver of economic growth and competitiveness, particularly for MSMEs. In the Philippines, where MSMEs constitute the backbone of the economy, enhancing their technological capabilities is essential for sustained development. The Philippine government has recognized this need and has implemented a range of policies, programs, and initiatives aimed at fostering innovation within the MSME sector. This paper provides a review of these policy instruments, analyzing their content, mechanisms, implementation, and effectiveness. The goal is to assess how well these policies are positioned to meet the innovation needs of SMEs in the Philippines.

AN OVERVIEW OF INNOVATION AND PRODUCTIVITY OF SMES

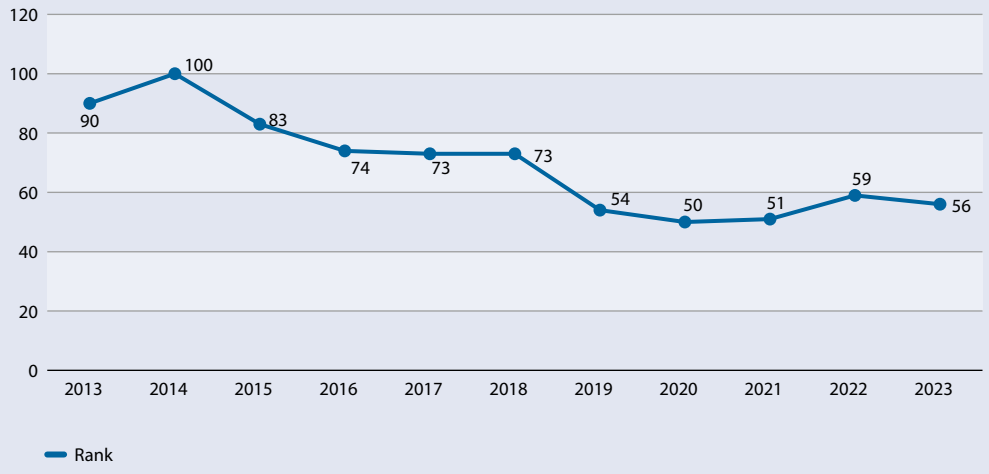
Trends in the Global Innovation Index (Macro Picture)

The innovation ecosystem in the Philippines is characterized by a combination of government initiatives, private sector activities, and academic research. However, the economy faces significant challenges in building a robust innovation environment. The Philippines ranked 56th in the 2023 Global Innovation Index (GII) (Figure 1) reflecting progress from the 2022 rankings.

However, analysis of the economy's performance reflects persistent challenges (Figure 2). Figure 2 shows very little improvements in the scores of the Philippines in almost all indices with scores for earlier years being much better than more recent scores. The 2023 GII report does indicate that the Philippines was able to improve slightly from its 2022 performance because of improvements in the creative outputs index and the market sophistication index.

FIGURE 1

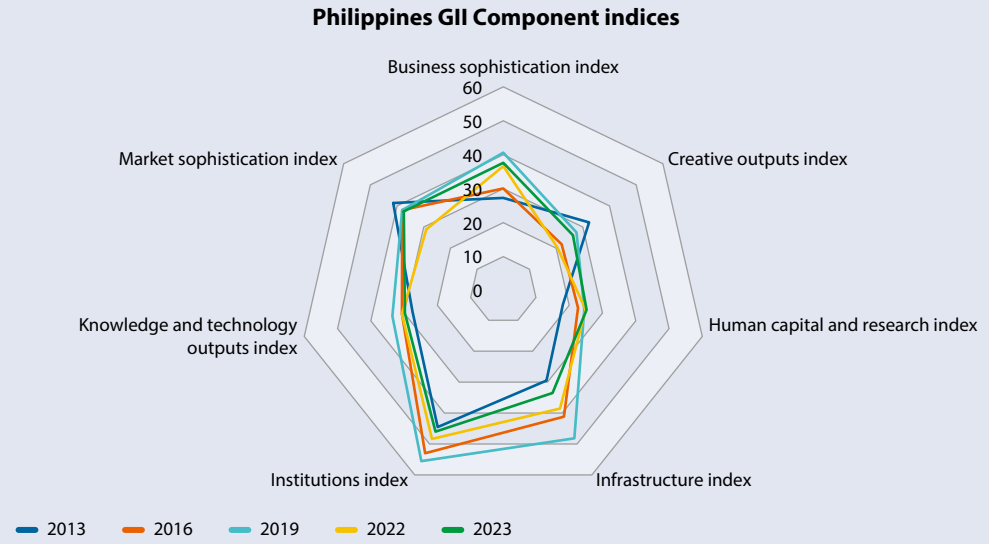
PHILIPPINES' RANKING IN THE GLOBAL INNOVATION INDEX, 2013–2023



Source: GII, various years

FIGURE 2

TRENDS IN THE GLOBAL INNOVATION INDEX, SELECTED YEARS



Comparing the economy's performance over time shows that the Philippines has demonstrated several persistent strengths in its innovation landscape over the years. Notably, the economy has consistently excelled in high-tech imports and exports. Another enduring strength is the high proportion of firms offering formal training, with the Philippines consistently ranking in the top 10 globally for this indicator. The economy has also maintained a strong position in ICT services exports, consistently placing in the top 20. Additionally, the Philippines has shown consistent strength in creative goods exports, maintaining a top-10 ranking over the years.

On the other hand, the Philippines has faced persistent weaknesses in several areas. The economy has consistently struggled with its scientific output, ranking very low in terms of scientific and technical articles per billion PPPUSD GDP. Environmental performance has been another area of concern, with the Philippines consistently ranking in the bottom quartile globally. The cost of redundancy dismissal has remained high, resulting in low rankings year after year. The education system faces challenges, particularly in terms of the pupil-teacher ratio in secondary education, which has consistently ranked poorly. The rule of law indicator has also been a persistent weakness, with low rankings indicating challenges in this area. Furthermore, the economy has consistently ranked low in terms of gross expenditure on R&D (GERD) financed from abroad as a percentage of GDP, as well as in the number of researchers per million population.

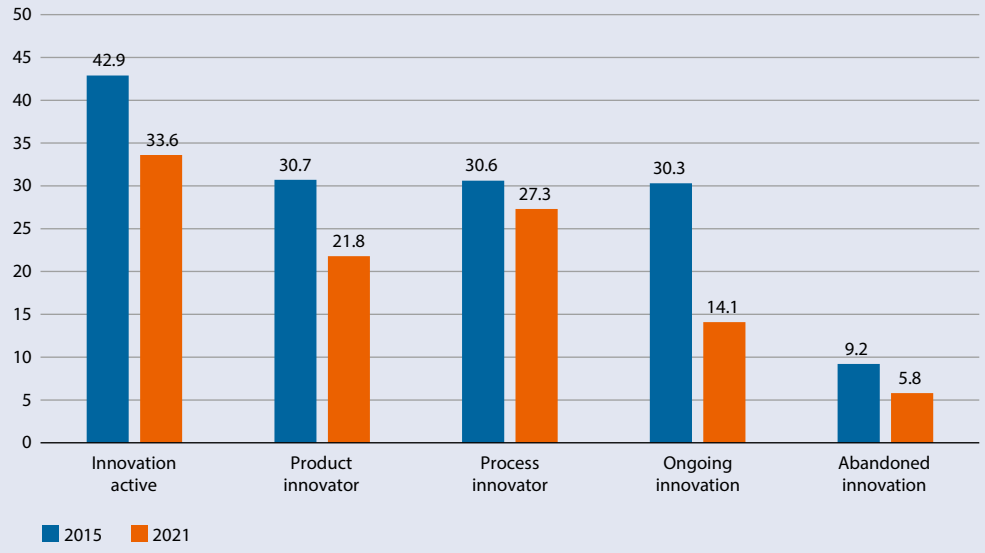
Innovation in Establishments (Micro Picture)

To assess the innovation activity of firms in the economy, the Philippines conducted innovation surveys in 2015 (Albert et al. 2016) and in 2018 (Albert et al. 2021). While not necessarily comparable, looking at the results of the two surveys may provide an indication as to the innovation activity of Philippine firms. The performance may also capture the impact of the COVID-19 pandemic as the 2021 round of the innovation survey was conducted at the height of the pandemic.

Figure 3 reveals a significant reduction in the innovation activity of firms in 2021. About 43% of surveyed firms are innovation-active in 2015 but this significantly dropped to 34% in 2021. All components of being innovation-active also declined with large declines observed for product innovators and those that have ongoing innovations.

FIGURE 3

INNOVATION-ACTIVE FIRMS, 2015 AND 2021

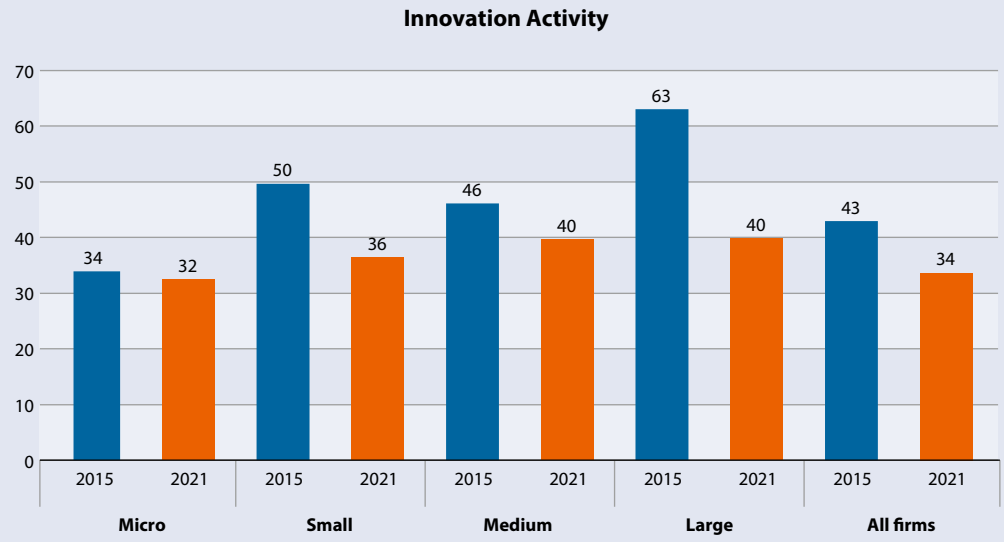


Source: Philippines Institute for Development Studies (PIDS) PIDS Survey of Innovation Activities (PSIA) (2015/2021)

By firm size, results of the innovation surveys show that innovation is mostly occurring among large firms with close to two thirds of large firms being innovation-active in 2015 (Figure 4). Innovation activity considerably declined in 2021 possibly because of the restrictions and disruptions caused by the pandemic. One notable pattern is the higher proportion of micro firms undertaking process innovations in 2021 relative to 2015 (Figure 6). One possible explanation for this would be the e-commerce or other process adaptations done by these micro firms to adapt to the pandemic.

FIGURE 4

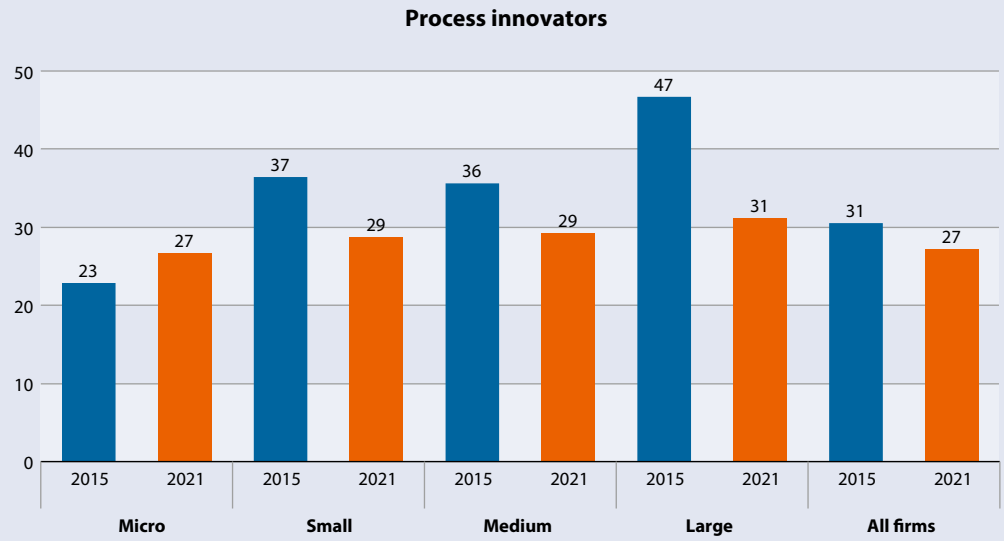
PROPORTION OF ESTABLISHMENTS WHO ARE INNOVATION-ACTIVE, BY FIRM SIZE, 2015 AND 2021



Source: PIDS PSIA (2015/2021)

FIGURE 5

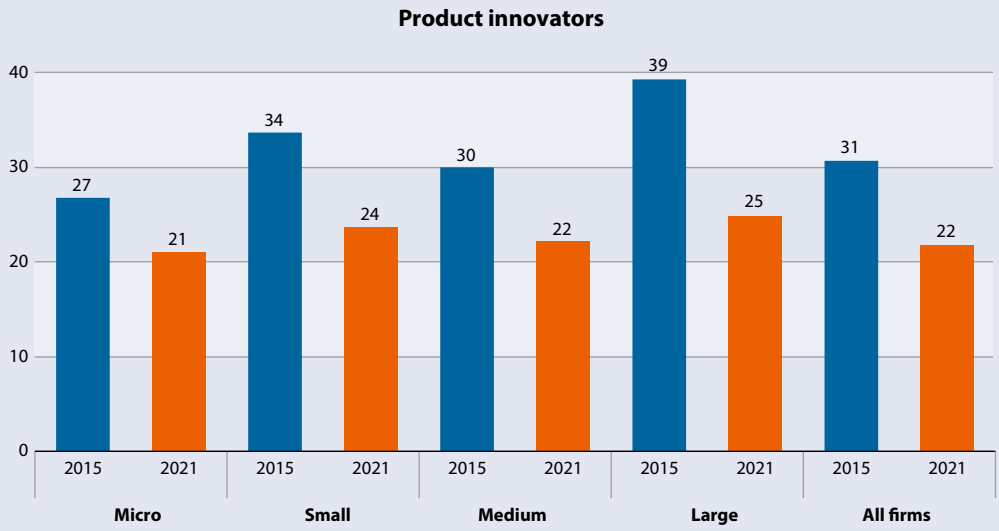
PROPORTION OF ESTABLISHMENTS WHO ARE PROCESS INNOVATORS, BY FIRM SIZE, 2015 AND 2021



Source: PIDS PSIA (2015/2021)

FIGURE 6

PROPORTION OF ESTABLISHMENTS WHO ARE PRODUCT INNOVATORS BY FIRM SIZE, 2015 AND 2021



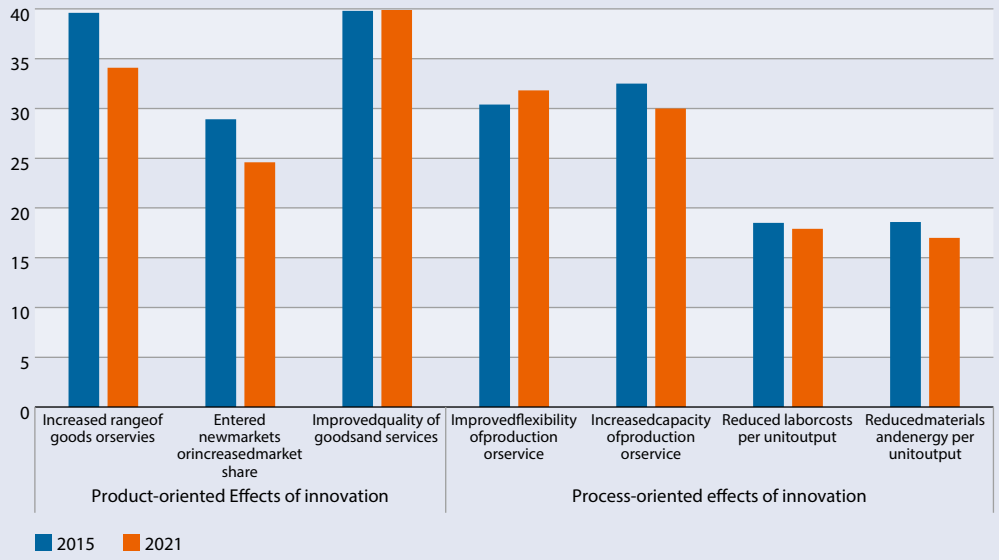
Source: PIDS PSIA (2015/2021)

Effects of Product and Process Innovation

The innovation surveys asked respondents about their perception of the effects of the innovations that they have implemented. Figure 7 shows that most of the innovations have product-oriented impacts but there are also significant process-oriented effects of innovation. It is worth highlighting again that it would be more firms reporting improved flexibility of production or service in 2021 possibly because of adaptations due to the pandemic restrictions. The disruptions have also affected product-oriented effects which has considerably decreased for increased range of goods or services and entering of new markets in 2021.

FIGURE 7

INNOVATION-ACTIVE ESTABLISHMENTS THAT RATED EFFECTS OF PRODUCT AND PROCESS INNOVATION AS 'HIGH'



Source: PIDS PSIA (2015/2021)

Table 1 shows that product-oriented effects were rated "high" more frequently (25–40%) than process-oriented effects (17–32%). Large firms generally reported higher ratings than MSMEs, particularly in agriculture, where MSMEs showed limited high ratings except for increasing goods/services range (17.2%) and improving health and safety (25.3% for small/medium firms). In the industry sector, quality improvement was rated highest by large firms (46.4%), with MSMEs following closely at 38%. In services, large and small/medium firms have consistently rated product-oriented and process-oriented effects higher than micro firms. One notable item where micro firms outperformed large firms is in terms of reducing environmental impacts or improved health and safety. These may be because the survey was done at the height of the pandemic which captures the need of micro firms for innovation to address the challenges of lockdowns.

TABLE 1

PROPORTION OF INNOVATION-ACTIVE ESTABLISHMENTS THAT RATED EFFECTS OF PRODUCT AND PROCESS INNOVATION AS 'HIGH', BY MAJOR SECTOR AND SIZE OF FIRM (%)

Perceived Effects of Organizational Innovation		Agriculture				Industry				Services				Total			
		Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms
Product-oriented Effects	Increased range of goods or services	17.2	12.8	54.5	17.7	27.2	30.6	40.2	29.7	35.7	38.3	39.6	36.7	33.6	34.2	41.0	34.1
	Entered new markets or increased market share	5.7	15.9	27.3	13.8	16.5	24.9	20.2	20.9	25.5	28.8	27.6	26.6	23.3	26.7	24.3	24.6
	Improved quality of goods or services	5.7	19.0	81.8	20.4	38.2	37.7	46.4	38.4	40.7	42.8	45.0	41.4	39.6	39.7	48.3	39.9
Process-oriented effects	Improved flexibility of production or service provision	0.0	9.6	54.5	10.5	26.5	32.2	41.4	30.2	33.1	33.5	37.1	33.3	31.1	31.9	40.3	31.8
	Increased capacity of production or service provision	0.0	6.3	54.5	8.5	25.3	31.8	38.5	29.3	29.8	33.4	37.7	31.2	28.4	31.5	39.2	30.0
	Reduced labor costs per unit output	0.0	9.4	54.5	10.4	12.5	20.5	27.3	17.4	17.3	20.4	21.5	18.5	16.0	19.9	26.5	17.9
	Reduced materials and energy per unit output	0.0	6.3	81.8	10.9	13.6	17.6	26.5	16.4	16.1	20.0	23.1	17.6	15.3	18.5	28.8	17.0
Other effects	Reduced environmental impacts or improved health and safety	11.4	25.3	54.5	23.6	20.5	31.9	41.2	27.4	28.7	29.4	27.9	28.9	26.7	30.1	35.7	28.3
	Met regulatory requirements	5.7	18.8	54.5	17.9	20.5	33.9	41.3	28.4	32.3	34.1	31.2	32.9	29.4	33.3	37.4	31.2
	Increasing collaboration with other institutions or agencies	0.0	13.0	27.3	10.2	13.1	20.1	23.4	17.2	19.6	23.1	28.9	20.9	17.9	21.5	26.3	19.6
	Competitive advantage over other competitors in the industry	5.7	6.5	27.3	8.1	15.7	22.6	37.8	20.5	27.5	31.2	40.3	29.0	24.6	26.9	38.2	26.0
	Positive impact on company culture (e.g. innovation mind setting)	5.7	9.4	27.3	9.8	15.9	26.9	46.4	23.2	30.3	34.6	34.0	31.8	26.9	30.5	39.1	28.7
	Increased profitability and maximized return on investment (ROI)	0.0	6.3	27.3	6.2	18.5	27.4	35.1	23.9	24.7	30.8	36.9	27.0	22.9	28.3	35.4	25.5

Source: PIDS PSIA (2021)
Note: mi, micro; sm, small; md, medium; lg, large

Effects of Organizational Innovation

Table 2 shows the highest-rated effects of organizational innovation were improving the quality of goods and services (42.9%) and communication or information sharing (42.2%). While large firms emphasized the importance of public awareness (54.1%), small and medium enterprises focused on improved communication or information sharing (46.9%). Micro firms, on the hand, gave highest ratings to improvement in the quality of goods and services (40.1%).

Effects of Marketing Innovation

Table 3 reveals that large firms rated marketing innovation effects highest across all outcomes, especially in agriculture (56–78%). Significant benefits in customer satisfaction, strengthened relationship with customers, and sales growth can be seen for agriculture firms. For Industry and services, significantly fewer micro firms report 'high' the positive effects of marketing innovation relative to Small/Medium and Large firms. This indicates that there must be very specific characteristics particular to micro firms in the industry and services sector that prevent them from benefiting from marketing innovation.

TABLE 2

PROPORTION OF ORGANIZATIONAL INNOVATORS THAT RATE EFFECTS OF ORGANIZATIONAL INNOVATION AS 'HIGH' BY MAJOR SECTOR AND SIZE OF FIRM (%)

Perceived Effects of Organizational Innovation	Agriculture				Industry				Services				Total			
	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms
Reduced time to respond to customer or supplier needs	9.2	11.6	19.3	11.4	22.4	16.6	31.3	21.1	16.4	25.3	34.7	22.8	20.9	23.2	28.7	23.3
Improved quality of goods or services	25.9	30.6	38.6	29.8	54.0	51.5	54.0	53.3	37.4	57.3	53.3	49.9	40.1	43.9	43.2	42.9
Reduced costs per unit output	6.1	19.6	38.6	17.0	24.1	19.6	50.4	23.8	8.7	32.0	32.6	23.7	12.1	25.0	36.0	23.1
Improved employee satisfaction and/or lower employee turnover	12.2	26.6	38.6	23.4	34.4	34.5	30.2	34.3	20.1	31.8	35.8	27.9	29.9	36.5	32.5	34.6
Improved communication or information sharing	21.4	29.3	38.6	27.7	46.5	35.4	42.9	43.2	23.2	37.4	40.5	32.6	28.4	46.9	43.3	42.2
Increased public's awareness of the company/product/service	29.0	26.5	38.6	27.9	45.4	40.5	35.5	43.6	23.8	38.8	38.9	33.5	31.5	40.1	54.1	39.6
Increased ability to develop new products or processes	19.8	19.7	38.6	20.8	31.3	32.9	35.5	31.9	24.3	39.4	37.8	33.9	20.1	29.3	25.3	26.7
Others	0.0	0.0	—	0.0	8.9	17.4	0.0	10.2	5.0	10.2	69.6	7.7	6.0	11.1	41.2	8.2

Source: 2021 PSIA, PIDS
Note: mi, micro; sm, small; md, medium; lg, large

TABLE 3

PROPORTION OF MARKET INNOVATORS THAT RATE EFFECTS OF MARKET INNOVATION AS 'HIGH' BY MAJOR SECTOR AND SIZE OF FIRM (%)

Perceived Effects of Market Innovation	Agriculture				Industry				Services				Total			
	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms	Mi	Sm/ Md	Lg	All firms
Sales growth for its goods and services	27.2	32.1	56.2	32.7	24.8	38.9	44.1	32.4	37.2	42.0	54.5	38.9	35.0	40.5	50.0	37.3
Increase in product/service exports	17.3	18.1	56.2	20.8	15.7	28.1	28.9	22.2	24.9	26.7	40.0	25.7	23.2	26.7	36.0	24.8
Increased visibility of products or business	22.3	23.9	78.1	27.6	22.3	35.2	39.5	29.3	33.6	37.9	50.0	35.2	31.6	36.4	47.1	33.6
Expanded market reach (whether local or global)	7.8	16.1	78.1	18.9	18.6	28.9	27.3	23.9	27.4	33.1	46.4	29.4	25.7	31.0	39.8	27.9
Strengthened relationships with customers	22.3	34.2	78.1	34.6	34.0	47.9	48.6	41.3	45.0	47.6	59.0	46.0	42.9	47.1	55.6	44.7
Improved customer satisfaction	17.3	44.2	78.1	40.0	39.6	51.6	50.6	45.8	47.5	49.9	59.8	48.4	45.9	50.2	56.8	47.6
Identified more specific sectors for target market	12.3	28.4	56.2	26.5	24.1	37.3	33.4	30.8	34.3	38.1	43.5	35.6	32.4	37.4	39.8	34.3
Increased market share	12.3	24.2	56.2	23.7	17.4	28.2	32.8	23.3	26.5	31.0	42.6	28.1	24.8	29.8	39.1	26.9
Increased market leadership/ market concentration	12.3	22.1	56.2	22.2	23.1	29.5	32.1	26.6	29.0	32.2	44.5	30.2	27.8	30.9	39.7	29.2
Others	67.2	0.0	—	38.9	24.3	0.0	—	16.5	5.0	27.7	25.1	12.8	11.4	20.8	25.1	14.7

Source: PIDS PSIA (2021)
Note: mi, micro; sm, small; md, medium; lg, large

Barriers to Innovation

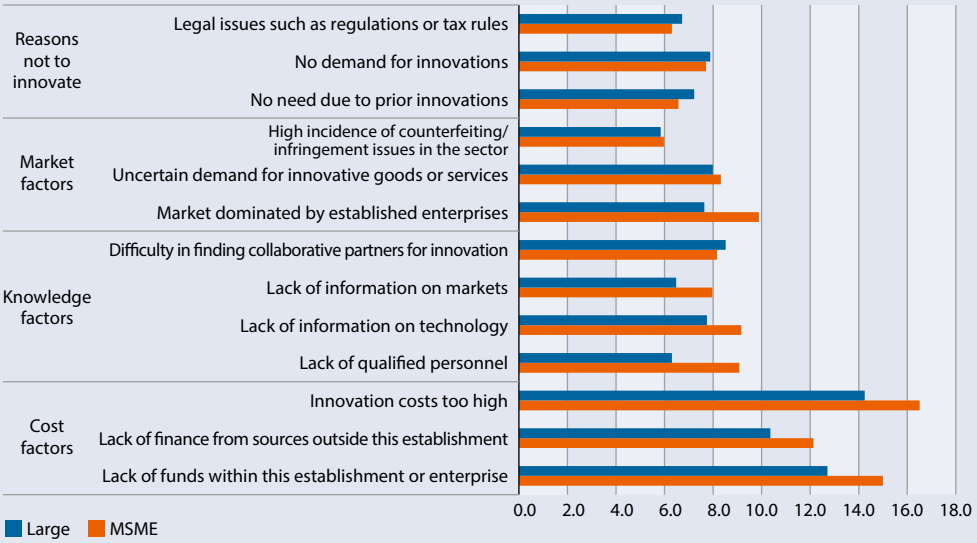
Consistent with findings from the 2015 Survey of Innovation Activities (SIA), cost-related barriers emerged as the most significant challenges to innovation. Among these, 16.5% of establishments identified the prohibitive cost of innovation as a high-priority concern. This was closely followed by a lack of internal funding (15.0%) and limited access to external funding sources (12.2%) (Figure 8).

MSMEs were more likely than large enterprises to rate various barriers to innovation as highly important. This trend held true across most factors such as cost factors (e.g. Innovation costs too high, lack of finance from sources outside this establishment and lack of funds within the establishment or enterprise) with only a few cases where the differences were minimal (less than one percentage point, as shown in Figure 8). However, the distinction between MSMEs and large enterprises becomes more nuanced when considering whether a firm was innovation-active or not.

For firms engaged in innovation during the period, large enterprises more frequently rated barriers as highly significant compared to MSMEs. An exception was the lack of qualified personnel, where MSMEs slightly outpaced large enterprises in identifying it as a major barrier. The difference in perception for this factor, however, was marginal (see Figure 9).

FIGURE 8

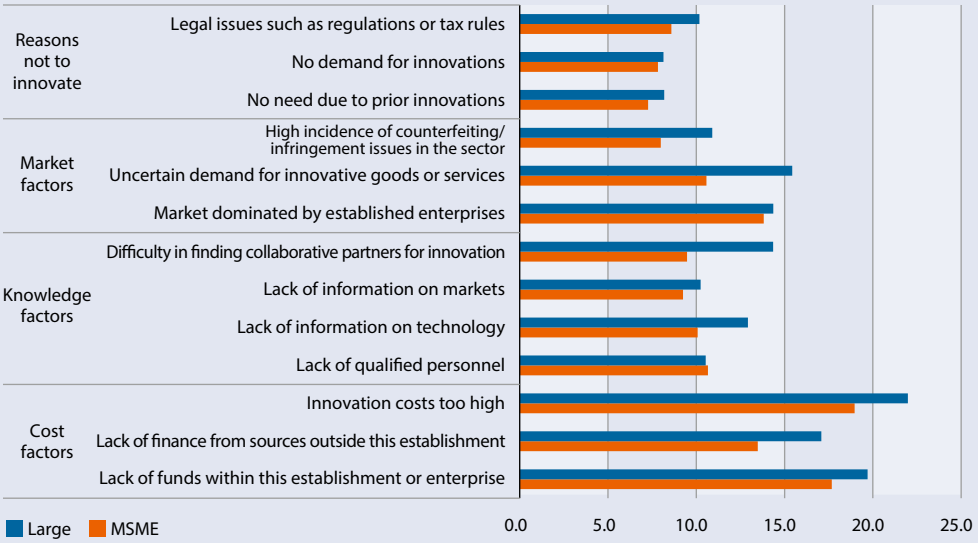
PROPORTION (%) OF ESTABLISHMENTS THAT REGARDED THE IMPORTANCE OF BARRIERS TO INNOVATION AS "HIGH", BY SIZE OF ESTABLISHMENT



Source: PIDS PSIA (2021)

FIGURE 9

PROPORTION OF INNOVATION-ACTIVE ESTABLISHMENTS THAT REGARDED THE IMPORTANCE OF BARRIERS TO INNOVATION AS "HIGH", BY SIZE OF ESTABLISHMENT (%)

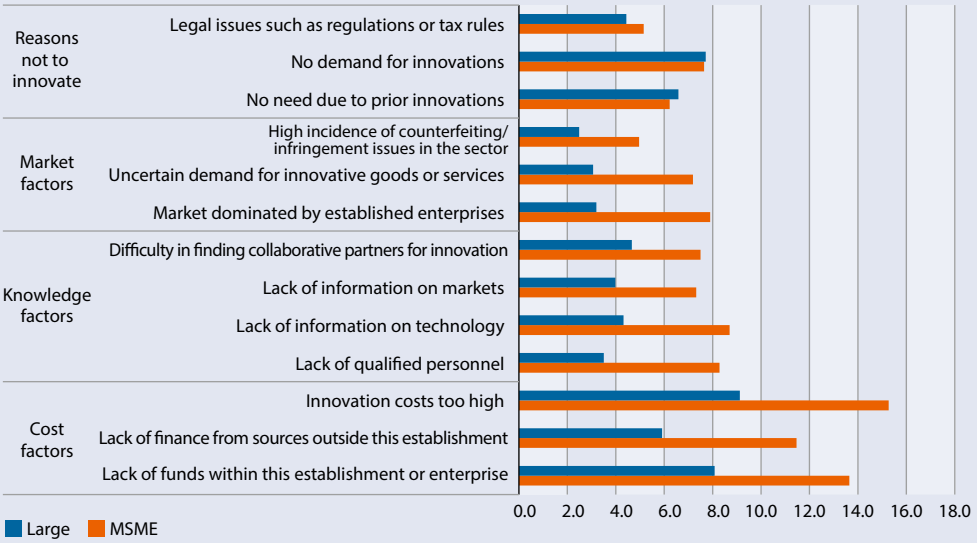


Source: PIDS PSIA (2021)

For establishments not actively pursuing innovation, the pattern was reversed. MSMEs were more likely to identify barriers as highly significant compared to large enterprises. This was consistent across most factors, with two exceptions—"no demand" for innovation and the impact of prior innovations—where large enterprises reported slightly higher percentages. Nevertheless, these differences were minimal (see Figure 10).

FIGURE 10

PROPORTION OF NON-INNOVATION ACTIVE ESTABLISHMENTS THAT REGARDED THE IMPORTANCE OF BARRIERS TO INNOVATION AS "HIGH", BY SIZE OF ESTABLISHMENT (%)

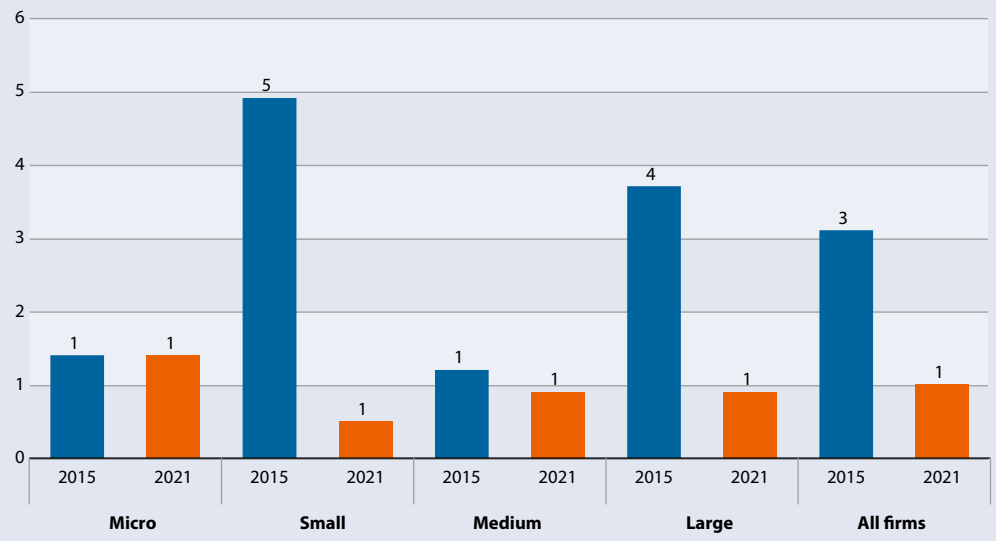


Source: PIDS PSIA (2021)

Looking at government support for innovation, the survey has a question on receiving public financial support for innovation. In terms of receiving public financial support for innovation, considerably more firms have reported having received financial support for the conduct of innovation activities in 2015. The figure has considerably declined in 2021 despite efforts to push continued operations of firms during the pandemic (Figure 11). Understandably, the public financial resources provided would be used to continue operations rather than conduct innovation activities.

FIGURE 11

PUBLIC FINANCIAL SUPPORT FOR INNOVATION



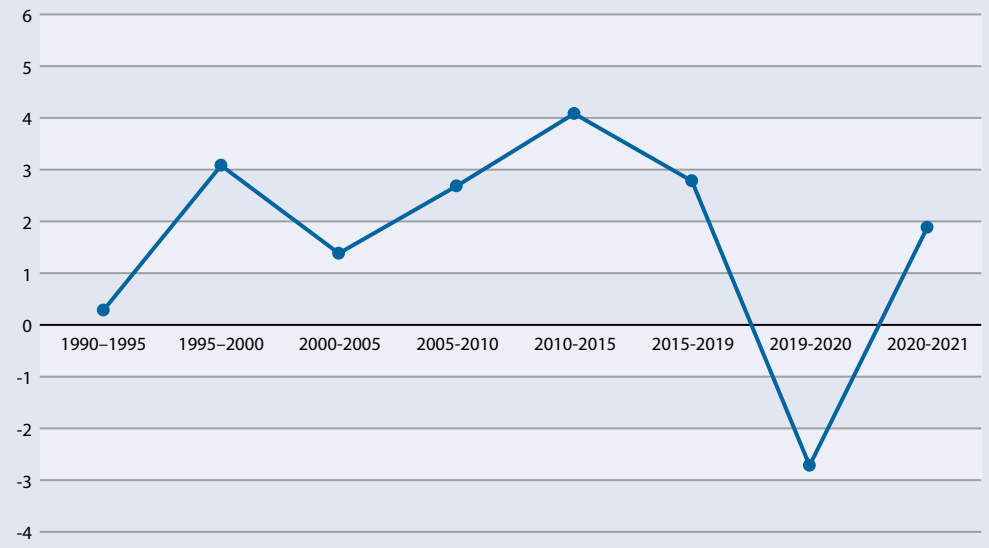
Source: PIDS PSIA (2015/2021)

Productivity Trends in the Philippines

The trends in productivity growth within the Philippines, as captured by the APO Productivity Databook 2023, reflect both the Philippines' economic trajectory and its responses to systemic challenges over the last three decades. Using metrics such as per-worker labor productivity growth, per-hour labor productivity growth, and TFP growth, this analysis contextualizes the Philippines' performance within broader regional and global developments.

FIGURE 12

PER-WORKER LABOR PRODUCTIVITY GROWTH, 1990–2021

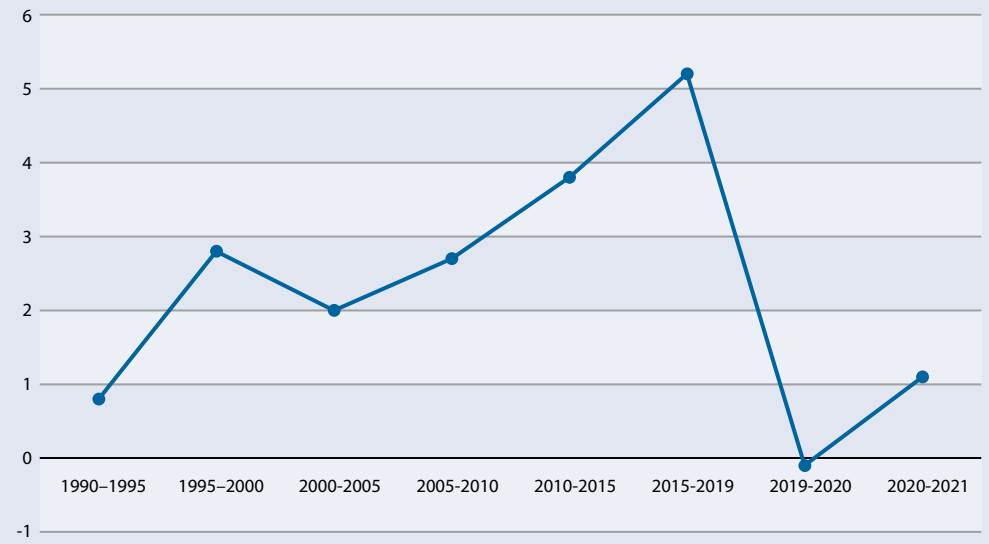


Source: APO Productivity Databook 2023 (Nomura & Kimura, 2023)

Labor productivity in the Philippines, as measured by GDP at constant prices per worker, underscores the complex dynamics influencing the efficiency of resource use (Figure 12). From 1990 to 2021, per-worker labor productivity exhibited a cyclical pattern, with periods of growth interrupted by stagnation and declines. Early growth, peaking in the late 1990s, slowed in the 2000s, reflecting structural and institutional barriers. The period from 2010 to 2015 marked significant gains, corresponding with regional economic integration and policy reforms aimed at boosting investment and labor market efficiency. However, the sharp decline in 2019–2020, attributable to the COVID-19 pandemic, emphasized vulnerabilities within the labor ecosystem. The subsequent recovery in 2020–2021 highlights the resilience of the Philippine economy, supported by adaptive measures and fiscal stimulus.

FIGURE 13

PER-HOUR LABOR PRODUCTIVITY GROWTH, 1990–2021

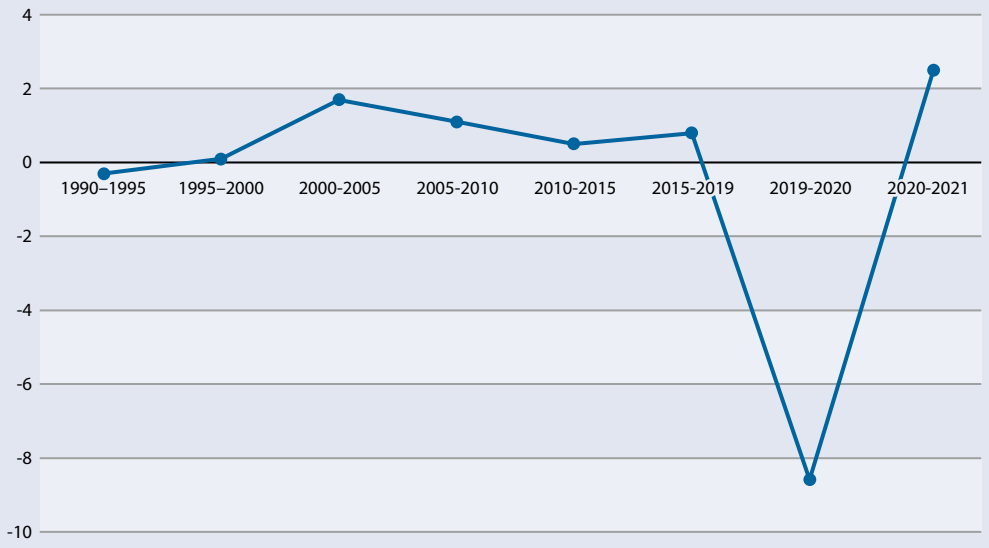


Source: APO Productivity Databook 2023 (Nomura & Kimura, 2023)

Per-hour labor productivity presents a similar narrative, albeit with a sharper focus on labor efficiency relative to working time. Incremental improvements through the 2000s culminated in a peak between 2015 and 2019, reflecting gains in technological adoption and human capital development. Yet, the pandemic's impact was severe, with a pronounced contraction in 2019–2020. The partial recovery in 2020–2021 underscores the economy's capacity for adaptation, albeit with lingering challenges related to labor market disruptions and underemployment (Figure 13).

FIGURE 14

TOTAL FACTOR PRODUCTIVITY GROWTH, 1990–2021



Source: APO Productivity Databook 2023 (Nomura & Kimura, 2023)

Meanwhile, the trend of total factor productivity has shown mixed results over the period. Positive trends during the 1990s and 2000s, driven by technological innovation and improved resource allocation, gave way to stagnation in the mid-2010s (Figure 14). The contraction in 2019–2020, one of the most severe among ASEAN economies, underscores the disproportionate impact of the pandemic on productivity drivers. Despite this, the strong rebound in 2020–2021 demonstrates efforts to restore economic equilibrium through structural reforms and targeted investments.

In a regional context, the Philippines' performance has been influenced by broader trends in Asia, where productivity growth has been predominantly driven by capital deepening and improvements in labor quality. The APO report highlights how neighboring countries have leveraged technological advances and human capital to achieve sustained growth, providing a benchmark for Philippine policymakers. For instance, countries such as Vietnam and the People's Republic of China have demonstrated the potential for rapid productivity gains through structural reforms and export-oriented strategies.

The Philippines' productivity trends illustrate the interplay of policy, external shocks, and structural dynamics. While the recovery from the pandemic is a testament to the resilience of the Philippine economy, sustaining long-term growth requires addressing foundational challenges. Meanwhile, the Philippines' innovation profile presents a mixed picture, with clear strengths in high-tech trade, training, and creative exports, balanced against weaknesses in scientific output, environmental performance, and certain aspects of its legal and educational systems. While the economy has made strides in some areas, such as business and market sophistication, addressing the persistent weaknesses will be crucial for improving its overall innovation performance. The challenge for the Philippines moving forward will be to leverage its strengths in high-tech and creative industries while working to bolster its scientific capacity, improve its environmental policies, and enhance its

educational and legal frameworks to create a more robust and balanced innovation ecosystem. Despite these challenges, there is growing recognition of the importance of innovation for economic growth, and this is reflected in various government strategies and policies.

ANALYSIS OF CONTENTS, IMPLEMENTATION MECHANISMS AND EFFECTIVENESS OF POLICY INSTRUMENTS FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION OF SMES

Key Government Agencies Involved in Innovation Policies, Programs, and Implementation

In the Philippines, several government agencies play pivotal roles in fostering innovation, each contributing uniquely to research and development, technology adoption, and innovation policy formulation. The **Department of Science and Technology (DOST)** serves as the primary government body responsible for coordinating science and technology activities nationwide. DOST formulates and implements policies, plans, and programs aimed at advancing science and technology, while also managing various research and development institutes that focus on industrial technology, nuclear research, and information and communications technology.

Meanwhile, the **Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD)**, an attached agency of DOST, focuses on the development of industries, energy, and emerging technologies. PCIEERD funds and monitors research and development projects to enhance the economy's innovation capacity.

The **Department of Trade and Industry (DTI)**, through its various bureaus and attached agencies like the Board of Investments (BOI) and the Export Marketing Bureau (EMB), plays a significant role in promoting innovation within the business and industrial sectors. DTI supports startups, MSMEs, and larger enterprises by crafting policies and programs designed to foster innovation, especially in manufacturing and services.

Another key agency, the **Intellectual Property Office of the Philippines (IPOPHL)**, administers and implements state policies on intellectual property, promoting intellectual property rights as tools for technological innovation and economic growth.

Complementing DOST and DTI's efforts, the **National Economic and Development Authority (NEDA)** acts as the economy's economic planning agency, crucially integrating innovation strategies into the national development plans. NEDA coordinates the alignment of government agencies with the Philippine Development Plan, particularly through the Innovation Chapter.

The **National Innovation Council (NIC)**, established under the Philippine Innovation Act (RA 11293), is tasked with formulating the economy's innovation goals, priorities, and long-term strategies. Chaired by the **President of the Philippines**, the NIC comprises key government officials such as the Secretary of **NEDA** as Vice-Chair, along with the Secretaries of **DOST**, **DTI**, Department of Finance (DOF), and Department of Agriculture (DA), among others. These officials represent crucial sectors driving innovation, such as technology, trade, finance, and agriculture. The NIC also includes seven private sector representatives. These are usually industry leaders from fields like IT, manufacturing, and the creative industries. Recent appointees as private sector representatives have included CEOs and founders of tech firms and start-ups, bringing valuable industry insights. Academic experts, typically leading researchers or university officials, are among

the members of the council. Recent appointments from top universities ensure that innovation policies are supported by rigorous academic research. The NIC's mandate is to formulate and implement the National Innovation Agenda and Strategy Document (NIASD), promoting R&D, enhancing innovation capacities across sectors, and fostering sustainable, inclusive growth and competitiveness in line with the economy's long-term development goals.

Lastly, the **Commission on Higher Education (CHED)** oversees higher education institutions and promotes research and innovation through academic programs, grants, and partnerships with universities and research institutions. CHED encourages the integration of research and innovation into the curriculum and supports initiatives that enhance the economy's research and development capabilities.

These agencies work collaboratively to create an environment conducive to innovation, aiming to bolster the Philippines' competitiveness and economic growth through science, technology, and creative industries.

TABLE 4

KEY GOVERNMENT AGENCIES INVOLVED IN INNOVATION POLICIES, PROGRAMS, AND IMPLEMENTATION

Agency	Description
DOST	- Leads coordination of science and technology in the Philippines. - Formulates policies, plans, and programs for science and technology development. - Manages R&D institutes for industrial technology, nuclear research, and ICT.
NEDA	- Economic planning agency integrating innovation into national plans. - Coordinates government agencies to align with the Philippine Development Plan, including the Innovation Chapter.
IPOPHL	- Administers and implements state policies on intellectual property. - Promotes the use of IP rights as tools for technological innovation and economic growth.
DTI	- Promotes innovation in business and industry through various bureaus and agencies. - Supports startups, MSMEs, and larger enterprises with policies and programs for innovation, particularly in manufacturing and services.
NIC	- Established under the Philippine Innovation Act (RA 11293). - Formulates innovation goals, priorities, and strategies. - Responsible for NIASD.
PCIEERD	- Attached to DOST, focuses on industry, energy, and emerging technology development. - Funds and monitors R&D projects to advance the economy's innovation capacity.
CHED	- Oversees higher education and promotes research and innovation through academic programs and partnerships. - Encourages integration of research and innovation into curriculum and supports initiatives to enhance R&D capabilities.

Source: Author's compilation

Major Innovation Legislation and Mandates

The following are the recent pieces of legislation that support innovation in the Philippines.

Innovative Startup Act (RA 11337)

The Innovative Startup Act, signed into law in 2019, provides a comprehensive support framework for startups in the Philippines. The law offers various incentives, including tax breaks, easier business registration, and access to government funding. This initiative aims to create a thriving startup ecosystem that can drive innovation across various sectors, including technology, healthcare, and agriculture.

Go Negosyo Act

The Go Negosyo Act, initiated by DTI, is another key program that supports entrepreneurship and innovation among SMEs. The program offers access to financing, training, and market development services. Additionally, it aims to establish "Negosyo Centers" across the economy, providing a one-stop-shop for business development services. This program has been particularly successful in promoting grassroots entrepreneurship and fostering innovation at the local level.

Philippine Innovation Act (RA 11293)

The Philippine Innovation Act aims to create a unified framework for the Philippines' innovation strategy. The act mandates the development of NIASD, which outlines the government's innovation goals and priorities. The act also establishes the NIC as the central body responsible for overseeing the implementation of the innovation strategy.

Philippine Export Development Plan (PEDP)

PEDP, overseen by DTI, is designed to boost the economy's export performance by enhancing the capacity of export-oriented SMEs. The plan focuses on improving the competitiveness of Philippine products in global markets through innovation and technology adoption.

Philippine Development Plan 2023–2028: Legislative Agenda to Advance R&D, Technology, and Innovation

The 2023–2028 Philippine Development Plan (PDP) outlines a robust Legislative Agenda designed to propel the Philippines toward a more competitive and innovation-driven economy. The priority bills presented aim to strengthen the foundational pillars of R&D, enhance the adoption of advanced technologies, and support the commercialization of innovations across various sectors. These legislative measures are critical for ensuring that the Philippines can harness its scientific and technological capabilities to address both domestic challenges and global opportunities.

Building on the Foundations of 2017–2022

A notable feature of the 2023–2028 legislative agenda is its continuity and improvement of key initiatives introduced during the 2017–2022 period. The Science for Change Program (S4CP), a cornerstone of the previous PDP, remains a priority in the current agenda. The new plan seeks to institutionalize this program through a stable funding mechanism, ensuring its long-term sustainability and impact on the economy's R&D landscape. By addressing the nation's research gaps and fostering collaboration between government, academia, and industry, S4CP continues to be central to the Philippines' innovation strategy.

Similarly, the ongoing amendments to the Intellectual Property (IP) Code highlight the government's commitment to adapting the legal framework to the challenges of the digital age. The 2023–2028 PDP builds on the groundwork laid in the earlier period by proposing more specific changes to address issues related to digital copyright infringement and secondary liability, particularly concerning peer-to-peer (P2P) networks and internet service providers (ISPs). These amendments are vital for protecting creative works and fostering a conducive environment for innovation and creativity.

Basic Research and Development and Knowledge Creation Strengthened

A significant portion of the Legislative Agenda focuses on bolstering basic R&D and knowledge generation, which are essential for long-term economic growth and resilience. The establishment of the Virology and Vaccine Institute of the Philippines (VIP) is a key legislative proposal that will make the Philippines a global leader in virology by advancing the study, identification, and response to viral threats. This initiative, which continues the health-focused priorities of the previous PDP, underscores the government's commitment to enhancing public health infrastructure.

The agenda also includes the creation of a Comprehensive Atomic Regulatory Framework, which aims to provide a legal framework for the safe use of nuclear technologies. The establishment of the Philippine Atomic Regulatory Commission will ensure the safety and security of radiation sources, aligning the country's policies with international safety standards. Additionally, the plan proposes strengthening the National Measurement Infrastructure System through amendments to the National Metrology Act, further supporting the harmonization of national standards with international benchmarks.

Market-Driven and Customer-Centered Research and Development Advanced

An important addition to the 2023–2028 legislative agenda is the promotion of the bamboo industry through the creation of a Bamboo Industry Research and Development Center. This initiative reflects a new focus on sustainable development and rural economic growth, areas that were less emphasized in the 2017–2022 PDP. By supporting research, trade promotion, and capacity-building within the bamboo industry, the government aims to position the Philippines as a key player in the global market for sustainable materials.

Technology Adoption, Utilization, and Commercialization Scaled-Up

The Legislative Agenda also emphasizes enhancing the country's defense capabilities through technological innovation. The proposal for a National Defense Industry reflects a strategic shift from the previous PDP, with a focus on revitalizing the Self-Reliant Defense Posture (SRDP) Program and supporting local enterprises involved in defense technology. This legislative push underscores the importance of building a robust defense industrial base that can contribute to both national security and economic development.

Innovation and Entrepreneurship Accelerated

The 2023–2028 PDP continues to prioritize innovation and entrepreneurship, as evidenced by the inclusion of S4CP and amendments to the IP Code. By institutionalizing these programs, the legislative agenda seeks to ensure that the Philippines remains competitive in the global innovation landscape. The government's emphasis on fostering an environment conducive to innovation highlights its ongoing commitment to addressing national challenges through evidence-based and technologically driven solutions.

Major Innovation Programs and Initiatives

Innovation is a key driver of economic growth, and the Philippine government has implemented a variety of programs to enhance the innovation ecosystem, particularly for SMEs. These initiatives fall under three main categories of policy instruments—demand side, supply side, and systemic. Each category addresses different aspects of fostering innovation, from creating market demand to strengthening the innovation infrastructure. Below is an overview of the programs categorized by their policy types, highlighting their contributions to the innovation landscape.

Demand-Side Policy Measures

Demand-side policies aim to stimulate the market for innovative products and services, encouraging both the production and adoption of new technologies. These measures often focus on creating opportunities for SMEs to thrive by incentivizing the use of their innovations through public procurement, regulatory incentives, or tax benefits. By generating demand, such policies help firms commercialize their innovations and integrate into broader markets.

However, in the Philippines, demand-side innovation policies remain underdeveloped compared to supply-side interventions. While initiatives like the Philippine Innovation Act recognize government procurement as a potential tool for driving innovation, challenges in execution—such as bureaucratic inefficiencies and weak enforcement—have resulted in minimal impact on firm-level innovation activity. The 2021 PIDS Survey of Innovation Activities (PSIA) underscores this gap, showing that firms primarily rely on internal resources, with only 1% receiving public financial support.

Instead, government efforts have largely focused on supply-side measures such as grants and technology upgrading programs. While these interventions support firms in developing innovations, the absence of strong demand-side policies means that many struggle to bring their products to market, limiting the overall impact on economic growth and competitiveness.

Supply-Side Policy Measures

Supply-side policies focus on building the capabilities of SMEs by reducing costs and enhancing their capacity for innovation. These initiatives provide financial and technical support, equipping businesses with the tools they need to improve productivity and competitiveness.

Managed by DOST, the *Small Enterprise Technology Upgrading Program (SETUP)* is one of the most significant initiatives aimed at improving the technological capabilities of SMEs. SETUP provides funding for equipment, technical training, and consultancy services to help SMEs adopt new technologies and enhance their productivity. The program has been instrumental in enabling SMEs to scale their operations and compete in both domestic and international markets.

DOST oversees a range of programs designed to foster scientific and technological advancements in the Philippines. Among these is the *Balik Scientist Program*, which encourages Filipino scientists, technologists, and experts abroad to return to the Philippines and contribute their expertise to the economy's scientific and technological development. The program offers financial incentives, research funding, and logistical support, with flexible opportunities for involvement in local R&D projects.

Another key initiative by DOST is the *Tuklas Lunas Program*, which focuses on discovering and developing indigenous resources and traditional knowledge into scientifically validated health

products. This program is central to bioprospecting and the creation of a drug discovery pipeline, exploring natural resources for potential therapeutic applications.

Additionally, *S4CP* is a flagship initiative aimed at accelerating science, technology, and innovation in the Philippines. It supports research and development in strategic sectors, strengthens regional research capabilities, and fosters partnerships between academia, industry, and government through sub-programs like NICER, CRADLE, BIST, and RDLead.

Managed by DOST-PCIEERD, the *Technology Business Incubator (TBI) 4.0 Program* supports the growth of startups by providing them with access to incubation facilities, mentorship, and networking opportunities. This program aims to build a robust startup ecosystem by fostering innovation and collaboration among technology-driven enterprises.

Another notable program under this category is the *Comprehensive Automotive Resurgence Strategy (CARS) Program*.

The *CARS Program* initiated in 2015 through Executive Order 182, was created to stimulate the Philippine automotive manufacturing industry, which had lagged behind its ASEAN counterparts. This program aimed to revive a sector that was struggling due to heavy reliance on imported vehicles, a weakening domestic production base, and fierce competition from established automotive hubs like Thailand and Indonesia. With a performance-based, time-bound, and budget-capped fiscal support system, CARS sought to incentivize both local assembly and parts manufacturing through targeted investments and production goals.

The program also serves as a case study in the Philippines' broader innovation agenda. The lessons from CARS are vital for understanding how government support can drive industrial growth, foster localization, and generate employment while contending with external challenges such as economic policy shifts and global crises like the COVID-19 pandemic.

DTI also plays a crucial role in promoting innovation across various sectors. The *DTI Startup Ecosystem Development Program* is designed to foster a conducive environment for startups by providing support in terms of funding, mentorship, and market access. This program includes initiatives such as startup grants, innovation hubs, and international linkages to connect Filipino startups with global networks.

CHED contributes to the innovation landscape through the *CHED Higher Education Institution (HEI) Innovation and Research Grant*. This grant supports research and innovation projects within higher education institutions, focusing on priority areas such as technology, engineering, and social sciences. The program also encourages collaborative research between universities, industry, and government agencies, aiming to align academic research outputs with national development goals.

IPOPHL offers programs like the *Patent Assistance Program (PAP)* and the *Juana Make a Mark Program* to support innovators and entrepreneurs. The PAP provides financial assistance and guidance for patent applications, along with training on intellectual property rights. The Juana Make a Mark Program specifically targets women-led MSMEs, offering free trademark registration and capacity-building workshops on branding and intellectual property management. These initiatives are crucial in ensuring that Filipino inventors and businesses can protect and commercialize their innovations.

Systemic Policy Measures

Systemic policies work to strengthen the overall innovation ecosystem by fostering collaboration among key actors such as government, academia, and industry. These initiatives aim to improve coordination and create a more supportive environment for innovation to flourish.

The *Tatak Pinoy Act (RA 11981)* was enacted in February 2024 to boost the competitiveness of Philippine industries both locally and globally. The law mandates key agencies like **DTI**, **NEDA**, and DOF to implement a multi-year strategy known as the **Tatak Pinoy Strategy**. The act's main objectives include promoting innovation, supporting high-value production, and enhancing the quality of Philippine products and services.

The implementing agencies are empowered to facilitate market access, provide financing for MSMEs, and create a more conducive business environment. Specific strategies include prioritizing Filipino products in government procurement, simplifying investment procedures, and promoting innovation-led industrialization. Programs like training for stakeholders, infrastructure support, and technology transfer are central to achieving these goals (Lawphil) (Mindanao Times) (Department of Trade and Industry).

Another important initiative is the Inclusive Innovation Industrial Strategy (i3S), which seeks to enhance the competitiveness of Philippine industries through innovation. *i3S* emphasizes collaboration among government, industry, and academia to upgrade industries and promote inclusive economic growth.

By implementing a range of demand-side, supply-side, and systemic policies, the Philippine government demonstrates its commitment to fostering a vibrant and inclusive innovation ecosystem. These programs not only address immediate needs for financial and technical support but also create long-term opportunities for collaboration and market growth. Together, these initiatives lay the foundation for sustained economic development, empowering SMEs and other stakeholders to contribute to a more competitive and innovative Philippines.

In addition, sectoral case studies (see Box 1) illustrate how public sector intermediaries lead in the provision of innovation support in the Philippine rice industry through their well-developed capabilities and comprehensive knowledge base. Meanwhile, the private sector intermediaries play crucial complementary roles in market development and organizational capacity building. Go identified five key capabilities needed for successful innovation intermediation: external networking, internal communication, knowledge-building, management capabilities, and human resource development—with knowledge-building emerging as the most critical capability across all intermediary types. Effective innovation support requires both public and private intermediaries working in concert, with public organizations leading technology generation and resource provision while private intermediaries focus on market brokerage and developing organizational capacities of farmer groups to achieve economies of scale.

BOX 1

HOW DIFFERENT INTERMEDIARIES FOSTER INNOVATION IN THE PHILIPPINE RICE INDUSTRY

Go (2022) examines various innovation intermediaries and their roles in supporting the Philippine rice industry as it faces competition from cheaper imported rice. Through analysis of 11 organizations, the research reveals how different types of intermediaries contribute uniquely to industry innovation and development.

Government agencies serve as primary network orchestrators and resource providers. They coordinate relationships between industry actors while distributing critical resources like training programs, farm inputs, and machinery. One government agency successfully brokered inter-sectoral opportunities by facilitating mushroom farming using rice waste as compost, demonstrating innovative approaches to resource utilization.

Public research institutes act as key technology brokers through research and development activities. They transfer new technologies to farmers and manufacturers while providing technical consultation services. For example, one institute developed and distributed rice farming smartphone applications alongside high-yield rice seed varieties, combining technological and agricultural innovation. These institutes also unexpectedly emerged as significant resource providers, offering various resources at minimal or no cost to support adoption of innovations.

Industry associations and NGOs primarily facilitate innovation through market-oriented brokerage and mediation roles. They connect members to financing opportunities, enable trades between stakeholders, and organize communities for collective action. These organizations provide consultancy beyond basic rice production, addressing organizational development, value chain analysis, and legal matters that support broader system innovation.

A notable private firm demonstrated comprehensive innovation support by integrating multiple roles. The firm provides high-yielding seeds and zero-interest loans for imported fertilizer while offering machinery access and technical guidance through field technicians. By controlling its value chain from production to marketing, the firm creates opportunities for partner farmers to upgrade their capabilities and adopt innovations.

A social media group represented a modern approach to innovation diffusion, serving as a platform for knowledge exchange and consultation among industry stakeholders. This digital intermediary helps spread innovative practices and connects actors across the value chain.

All intermediaries build and utilize four key capabilities to support their innovation-enabling roles: external networking, internal communication, knowledge-building, and management capabilities. Knowledge-building emerged as particularly critical, allowing intermediaries to understand stakeholder needs and effectively transfer rice-specific knowledge. External networking enables collaboration for research and development, while internal communication ensures effective knowledge transfer within existing networks.

These programs reflect the Philippine government's commitment to fostering innovation and supporting the growth of a knowledge-based economy through various initiatives across multiple sectors.

TABLE 5

MAJOR INNOVATION PROGRAMS AND INITIATIVES

Policy Type	Agency	Program	Description	Components
Demand Side		(None)		
SupplySide				
	DOST	SETUP	Helps MSMEs improve productivity through technology. Provides funding, technical assistance, and training across various industries.	- **Technology Assistance:** Access to the latest technologies. - **Training and Consultancy:** Workshops and expert support. - **Financial Assistance:** Interest-free loans for technology acquisition.
	DOST	Balik Scientist Program	Encourages Filipino experts abroad to return and contribute to national R&D efforts. Provides financial incentives and logistical support.	- **Engagements:** Short, medium, and long-term involvement in local R&D. - **Research Grants:** Funding for research in the Philippines.
	DOST	Tuklas Lunas Program	Develops indigenous resources into validated health products. Focuses on natural products and drug discovery.	- **Natural Products Research:** Exploration for therapeutic applications. - **Drug Development:** Pipeline for herbal medicines and pharmaceuticals.
	DOST	S4CP	Accelerates innovation through regional R&D centers and industry-academia collaborations.	- **NICER:** Establishes regional R&D centers. - **CRADLE:** Collaboration between academia and industry. - **BIST:** Financial support for companies to acquire R&D technologies. - **RDLead:** Enhances university research with expert involvement.
	DOST-PCIEERD	TBI 4.0 Program	Supports startup growth by providing access to incubation facilities, mentorship, and networking. Aims to foster innovation and collaboration among technology-driven enterprises.	- **Incubation Facilities:** Access to physical and virtual incubation spaces. - **Mentorship:** Guidance from industry experts. - **Networking:** Opportunities to connect with other startups and investors.
	DTI	CARS Program	Revitalizes the automotive industry with fiscal support for manufacturing parts locally.	- **Fiscal Incentives:** Tax breaks for companies meeting production targets. - **Local Production:** Promotes local supply chains and manufacturing.
	DTI	Kapatid Mentor ME (KMME) Program	Provides mentoring for MSMEs to scale up and innovate, covering business development and market access.	- **Mentorship:** One-on-one sessions with industry experts. - **Business Development:** Support for creating growth strategies.
	DTI	DTI Startup Ecosystem Development Program	Supports startups with funding, mentorship, and market access. Includes grants, innovation hubs, and global linkages.	- **Startup Grants:** Financial support for early-stage startups. - **Innovation Hubs:** Collaboration spaces for startups. - **International Linkages:** Connects startups with global networks.
	CHED	CHED HEI Innovation and Research Grant	Supports research in higher education, focusing on priority areas and aligning with national goals.	- **Research Grants:** Funding for research in key areas. - **Collaborative Research:** Partnerships with industry and government.
	IPOPHL	PAP	Helps inventors and MSMEs with patent applications, offering financial assistance and training.	- **Patent Application Support:** Financial aid and guidance. - **Training and Workshops:** IP rights education.
	IPOPHL	Juana Make a Mark Program	Provides free trademark registration for women-led MSMEs to protect their brand and IP.	- **Free Trademark Registration:** No-cost trademark assistance. - **Capacity Building:** Branding and IP management workshops.

Policy Type	Agency	Program	Description	Components
Systemic				
	DTI	Tatak Pinoy Act (RA 11981)	Facilitates market access, provide financing for MSMEs, and create a more conducive business environment.	- **Market Access:** Facilitates entry to local and global markets. - **MSME Financing:** Provides funding for business growth. - **Infrastructure and Training:** Supports innovation and technology transfer.
	DTI	i3S	Enhances industry competitiveness through innovation and collaboration among stakeholders.	- **Industry Upgrading:** Support for advanced technologies. - **Collaboration:** Encourages partnerships among stakeholders. - **Human Capital Development:** Focus on skills enhancement.

Policy Effectiveness Analysis of Philippine Innovation Programs

The findings in this section are drawn from the case studies presented in this paper. For detailed information, please refer to the Annex.

DOST's SETUP

This analysis draws from Herpacio and Hidalgo (2018) (see Annex 1). In terms of policy instrument effectiveness, Herpacio and Hidalgo (2018) finds that SETUP has proven effective in increasing productivity (157.9%), sales (51.65%), and employment (191.82%) in MSMEs, particularly in low-tech sectors like agriculture and food processing. The program has resulted in **growth in R&D investment as evidenced by** beneficiaries of SETUP adopting technology upgrades that improved their operational efficiency, though these were largely small-scale improvements rather than radical innovations. Firms also improved compliance with market standards, particularly in packaging and labeling, which allowed them to access more demanding markets.

The program has also resulted in business process innovation through new equipment helping firms modernize production processes, though full-scale integration of innovation management systems was limited by technology complexity and financial constraints. The improvements in packaging and product quality allowed firms to access higher-value markets domestically which shows that SETUP was able to contribute to the **export and market diversification goals of the Philippines. Finally, in terms of local high-value production, Firms report that** improvements were primarily in enhancing existing production processes rather than producing more sophisticated components.

The high cost of equipment installation and repayment issues limited full utilization of provided technologies. The program did not drive firms toward engaging in substantial R&D or product innovation. Also, there were some limitations related to technical staff recruitment: No significant recruitment of technical personnel, as the focus remained on upgrading production processes rather than building in-house R&D capacity.

Given all this, SETUP may be seen as an effective program for enhancing short-term production efficiency and accessing higher-value markets, but its long-term impact on innovation and technological sophistication remains limited.

DOST-Technology Application and Promotion Institute (TAPI) Programs (Invention Development Assistance Fund and Related Programs)
This analysis draws from Vidal et al. 2020 (see Annex 2).

DOST-TAPI has been successful in increasing patent filings and IP protection, contributing to an improved Global Innovation Index ranking for the Philippines. The focus on IP protection supported R&D in terms of protecting inventions, but it did not substantially increase innovation activities within firms. Still, the emphasis on IP protection and patent filings helped improve firms' standing, though the commercialization gap hindered full participation in higher-value segments of global value chains.

The program has a number of challenges and limitations such as pre-commercialization efforts remained underfunded, limiting the potential for product diversification, focusing more on protecting existing intellectual property rather than encouraging recruitment for innovation-driven roles, and the uneven allocation of resources between IP protection and commercialization limited the broader impact of the program. A lack of technical evaluators further reduced its effectiveness.

DOST-TAPI is effective in protecting intellectual property but needs stronger commercialization efforts to fully capitalize on the inventions and improve the Philippines' position in global markets.

DOST-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD)-funded Projects (University of the Philippines Los Baños (UPLB) Technology Commercialization)
This analysis draws from Cabrera et al. 2021 (see Annex 3).

UPLB's technology commercialization efforts, supported by DOST-PCAARRD, have successfully licensed several agricultural technologies, generating royalties and supporting local farmers. The program helped UPLB transition research projects into commercially viable technologies, though there was limited development beyond agricultural innovations. It also resulted in the introduction of new products like biofertilizers, which were commercially successful. In terms of expanding technical talent in the University, the study found that recruitment remained focused within academia, with limited efforts to engage external technical talent. One highlight of the project is in terms of expanding **local high-value production as evidenced by** UPLB's biofertilizers and pest control agents contributed to higher value-added agricultural processes but did not represent significant technological leaps outside this sector.

The study found limited collaboration between academia and industry which slowed the commercialization process, and government funding for research was insufficient.

Overall, UPLB's efforts have been effective in advancing agricultural technology but would benefit from stronger industry partnerships and increased government support to expand into other sectors.

CARS Program (Comprehensive Automotive Resurgence Strategy)
This analysis draws from BOI 2022 (see Annex 4).

The CARS program demonstrated mixed results in enhancing the Philippine automotive industry's technological capabilities. While the program successfully attracted PHP9.6 billion in investments and increased local parts production, it faced significant headwinds from the implementation of the

Tax Reform for Acceleration and Inclusion (TRAIN) law and the unprecedented challenges of the COVID-19 pandemic.

In terms of innovation outcomes, the program's focus on localizing production rather than driving original research and development limited its transformative impact on the industry's technological advancement. However, the program achieved notable success in employment generation, creating 110,000 direct and indirect jobs in the automotive manufacturing sector. The localization of high-value components, including body shells and large plastic parts, showed meaningful improvements in domestic technological capabilities.

Despite these gains, the program fell short in facilitating the industry's progression from original equipment manufacturing (OEM) to original design manufacturing (ODM) or original brand manufacturing (OBM), which constrained the Philippines' ability to advance in the global automotive value chain. External market challenges, particularly the impact of the TRAIN law and the pandemic, severely affected demand and production, preventing the program from reaching its intended production targets.

Overall, while CARS successfully contributed to job creation and production localization, the program ultimately missed opportunities to significantly elevate the economy's position in the global automotive value chain, largely due to external challenges and ambitious production targets.

RIICS (Regional Inclusive Innovation Centers)
This analysis draws from USAID 2022 (see Annex 5).

RIICs Region 11 (Davao)
Effectiveness of the Policy Instrument:
The policy instrument of establishing the RIIC in Region 11 (Davao) has been largely effective in fostering innovation and supporting MSME growth, as evidenced by several measurable outcomes. These include increased MSME participation in innovation-related activities, improvements in product and business process innovation, and enhanced collaboration between government, academia, and the private sector.

Assessment against Combined Indicators:

- **Growth in R&D investment:** The RIIC facilitated increased investments by MSMEs in innovative technologies, such as the solar-powered cooker for coconut sugar production, which helped local producers reduce fuel costs and improve production efficiency. This represents a clear instance of firms adopting new technologies as a result of RIIC support.
- **Product innovation:** Several MSMEs, including Malagos Foods, developed new product lines that catered to local and international markets, showcasing the tangible product innovation outcomes fostered by the RIIC's support. The Innovation for Business Recovery (IBR) program specifically helped businesses identify market gaps and develop innovative solutions to address them.
- **Business process innovation:** Beyond product innovation, the RIIC also assisted businesses in adopting more efficient business processes. For example, MSMEs that participated in the IBR project integrated strategic business planning and improved their financial management practices to cope with pandemic-induced disruptions.

Challenges and Limitations

While the RIIC has shown overall effectiveness, some challenges limited its broader impact:

- **Initial resistance to innovation:** Many MSMEs were initially reluctant to invest in new technologies or adopt innovative business models due to a lack of awareness about the potential benefits. This reluctance was partly cultural, as local businesses were more comfortable with traditional production methods.
- **Coordination among stakeholders:** The implementation process faced challenges in aligning the objectives of the various stakeholders, including government agencies, academic institutions, and MSMEs. Although collaboration eventually improved, the initial stages of the RIIC's development were hampered by the disparate goals of the involved parties.

The RIIC in Region 11 was most effective under conditions where there was strong leadership and active participation from all stakeholders. The development of the iSTRIKE Davao Strategic Plan played a pivotal role in formalizing collaboration efforts and providing a clear roadmap for the RIIC's long-term sustainability. Moreover, the RIIC's alignment with local government priorities, such as through DTI and DOST's involvement, ensured that innovation initiatives were adequately supported and funded.

Assessment of Policy Effectiveness

The RIIC in Region 11 has been an effective policy instrument for fostering innovation in the region. The increase in product and process innovation, as well as the adoption of new technologies by MSMEs, indicates that the RIIC successfully addressed the region's innovation needs. The long-term impact is further ensured by the iSTRIKE Davao strategic plan, which continues to guide the RIIC's initiatives. However, the policy's full effectiveness could be enhanced by further outreach and engagement efforts to ensure broader participation by local businesses that are still hesitant to innovate.

RIICs Region 3 (Central Luzon)

Effectiveness of the Policy Instrument:

The policy instrument for Region 3's RIIC has proven effective in promoting innovation, particularly in supporting MSMEs' recovery from the pandemic and enhancing their competitiveness through product and process innovation. The implementation of digital tools, such as the THRIVE Central Luzon app, played a crucial role in extending innovation support to businesses across the region.

Assessment against Combined Indicators:

- **Growth in R&D investment:** By facilitating collaboration between academic institutions and local businesses, the RIIC encouraged firms to invest in product and process innovations. The THRIVE app provided MSMEs with access to research data, technical expertise, and business consultancy, which enabled them to invest in new technologies and improve their operations.
- **Business process innovation:** MSMEs in Central Luzon, particularly those in the manufacturing and agriculture sectors, adopted more efficient business processes through their participation in the RIIC. The digital nature of the THRIVE app allowed businesses to access business development services remotely, improving their supply chains and operational efficiency.
- **Product innovation and diversification:** Several MSMEs expanded their product offerings as a result of their collaboration with the RIIC. These businesses were able to diversify their products to meet changing market demands, such as shifting to more pandemic-resilient goods and services.

Challenges to Effectiveness

The effectiveness of the RIIC in Region 3 was somewhat limited by coordination challenges and the difficulty of engaging the private sector at a time when many businesses were struggling financially due to the pandemic:

- **Coordination challenges:** Similar to Region 11, aligning the interests of various stakeholders (government, industry, and academia) was initially challenging. In particular, the coordination of activities between these groups required extensive effort, and some MSMEs were slow to participate due to resource constraints.
- **Limited private sector engagement:** Many MSMEs in Region 3 were hesitant to invest in innovation due to financial difficulties caused by the pandemic. While the THRIVE app helped alleviate some of these issues by offering remote access to support services, sustained participation from businesses in the region remained a challenge.

Conditions of Success

RIIC Region 3 was most effective in conditions where businesses had access to digital tools and resources that could be utilized remotely. The THRIVE Central Luzon app was a critical success factor, enabling the RIIC to reach businesses across a wider geographic area, regardless of physical constraints. Furthermore, the strong support of academic institutions like Bulacan State University provided businesses with the research and technical expertise they needed to innovate and improve their competitiveness.

Assessment of Policy Effectiveness

The RIIC in Region 3 has proven effective in supporting innovation and business recovery, especially through its focus on digital solutions. The THRIVE Central Luzon app allowed the RIIC to overcome many of the logistical challenges posed by the pandemic, enabling MSMEs to access innovation support services remotely. However, the RIIC's full potential could be realized by addressing the ongoing challenges related to private sector engagement and coordination among stakeholders. Increasing efforts to involve more MSMEs in innovation activities and improving stakeholder alignment will be crucial for the RIIC's continued success.

Comparative Analysis: Region 11 vs. Region 3

When comparing the effectiveness of the RIICs in Regions 11 and 3, both regions showed positive outcomes in terms of fostering product and process innovation, encouraging firms to invest in R&D, and supporting MSME recovery. However, Region 11's success was more pronounced in terms of strategic long-term planning and the adoption of new technologies (e.g., solar-powered coconut sugar production), while Region 3 excelled in leveraging digital tools to extend the RIIC's reach and support.

Both regions faced similar challenges in stakeholder coordination and private sector engagement, particularly due to the pandemic's impact. However, the effectiveness of these policy instruments highlights the potential of the RIIC model to foster regional innovation when supported by strong coordination frameworks and sustained stakeholder commitment.

Summary

Table 6 highlights the effectiveness, challenges, and outcomes of key innovation programs in the Philippines. A recurring strength across the programs is their ability to drive targeted outcomes, such as productivity gains, job creation, intellectual property protection, and commercialization of specific technologies. Programs like SETUP and RIICs demonstrated success in enhancing MSME

competitiveness and promoting regional innovation, while initiatives like DOST-TAPI advanced intellectual property filings. These efforts reflect the programs' contributions to short-term technological upgrades, regional growth, and sector-specific advancements, particularly in agriculture and manufacturing.

However, significant challenges hinder their broader impact. Many programs face resource constraints, including limited funding for commercialization and R&D investments, as seen in DOST-TAPI and UPLB Technology Commercialization Projects. Stakeholder coordination is another recurring issue, with misalignment between government, industry, and academia reducing the effectiveness of initiatives like RIICs. Additionally, high costs, repayment challenges, and external factors, such as economic disruptions, have limited their scalability and ability to achieve global value chain integration.

TABLE 6

POLICY EFFECTIVENESS ANALYSIS OF SELECT INNOVATION PROGRAMS

Policy	Effectiveness Summary	Expanded Indicators Summary	Challenges	Conclusion
DOST SETUP	Effective in enhancing productivity, sales, and employment in MSMEs but limited in fostering long-term R&D investments and product diversification.	Limited recruitment of technical personnel; some improvement in accessing higher-value markets but no significant leap in producing sophisticated components.	High equipment costs, repayment issues, underutilization of technology, limited R&D investment.	Effective in supporting short-term technological upgrades but less impactful in driving deeper innovation and higher-value production.
DOST-TAPI Programs (IDAF and Related Programs)	Successful in IP protection and patent filings but underfunded commercialization efforts limited broader innovation impact and global value chain positioning.	No significant recruitment for innovation roles; limited commercialization restricted shifts in global value chains despite patent success.	Uneven resource allocation, underfunded commercialization, lack of trained evaluators.	Effective in IP protection but needs more balanced resource allocation toward commercialization.
UPLB Technology Commercialization (DOST-PCAARRD-funded Projects)	Effective in commercializing agricultural technologies but faced challenges in scaling to other sectors due to limited industry collaboration and funding.	Limited external recruitment; success in agricultural diversification but limited impact beyond this sector; some value-added production in farming.	Information asymmetry between academia and industry, limited government funding.	Successful in advancing IP and commercialization in agriculture but needs stronger partnerships and more robust support for scaling.
CARS Program	Partially successful in localizing production and creating jobs, but faced external challenges that prevented full achievement of its goals and value chain upgrades.	Significant job creation; localized production of components improved, but did not lead to a major value chain upgrade.	External challenges like COVID-19 and the TRAIN law, overly ambitious production targets.	Partially successful in creating jobs and improving local production but missed opportunities for global value chain upgrades.
RIICS (Region 11)	Fostered innovation and MSME growth through improved product innovation and business process innovation.	Increased R&D investment in technologies like solar-powered coconut sugar production and improved collaboration between government, academia, and the private sector.	Encountered initial resistance to innovation from MSMEs and coordination challenges among stakeholders.	Effective in promoting regional innovation with strong leadership, but requires better stakeholder coordination and outreach.
RIICs (Region 3)	Supported MSME recovery from the pandemic and enhanced competitiveness through digital tools like the THRIVE app.	Facilitated R&D investment and improved business processes through the use of digital support tools like the THRIVE app.	Challenges included stakeholder coordination and limited private sector engagement due to the financial constraints imposed by the pandemic.	Effective in extending innovation support through digital tools, but requires stronger private sector engagement and improvements in stakeholder coordination.

RESULTS FROM PRIMARY DATA COLLECTION

The impact of government innovation support programs on SMEs in the Philippines is best illustrated through concrete examples of successful interventions. This paper examines three distinctive cases where DOST's SETUP directly contributed to transformative technological advancement and business growth. These cases—spanning food manufacturing, digital printing, and agricultural processing—demonstrate how targeted government support can help traditional businesses overcome technological barriers and compete effectively in modern markets. Through detailed analysis of these enterprises' experiences, we can better understand the practical implementation and effectiveness of innovation policy instruments in the Philippine context. These cases particularly highlight how technological upgrading, combined with technical consultancy and innovation funding, enables SMEs to enhance their production capabilities, expand their market reach, and achieve sustainable growth.

Case Study 1: Traditional Food Manufacturing Company (Innovative Snack Production)

A family-owned traditional Filipino snack manufacturing company exemplifies how technological innovation can elevate a home-based recipe into a scalable food enterprise. The company's story began when an overseas Filipino worker, employed as an aircraft mechanic in Dubai, started sharing his unique recipe for salted egg-flavored chicharon with family and friends. What started as a passion project soon revealed significant market potential, leading the owner to seek support for scaling up production while maintaining product quality.

Through DOST's SETUP program, the company received comprehensive innovation support that transformed their production capabilities. "The innovation funding wasn't just about acquiring equipment," the owner explained during our interview. "It was about reimagining our entire production process." The company implemented a heat pump dryer system, which significantly improved the consistency and quality of their products while reducing production time. The addition of modern packaging machinery enabled them to extend product shelf life and improve market presentation.

The technical support through SETUP proved equally valuable. Food experts from DOST-National Capital Region (NCR) conducted extensive technical consultancy sessions, helping the company optimize their recipes and production processes. "The sensory evaluation sessions were eye-opening," shared the owner. "They helped us understand how to maintain consistent quality while scaling up production." The program also provided crucial support for nutritional analysis and shelf-life testing, enabling the company to meet regulatory requirements and expand their market reach.

This technological foundation empowered the company to innovate beyond their original product. They developed an expanded product line featuring three distinct variants: their original classic recipe, a premium salted egg flavor, and an innovative spicy garlic and salted egg variant that combines traditional flavors with contemporary taste preferences. "Each flavor profile required careful development and testing to ensure it could be consistently produced at scale," the owner noted.

While the company currently focuses on e-commerce platforms for distribution, their improved production capabilities have positioned them for future expansion. "The innovation in our production process means we can now consider establishing physical retail locations," the owner shared. "Our standardized production methods ensure that whether customers buy our products online or in stores, they'll get the same high-quality experience."

The company's greatest challenge now lies in marketing and logistics, areas they're addressing through digital innovation. "We're exploring new e-commerce platforms and delivery systems to reach more customers," the owner explained. "The production efficiency we've achieved through SETUP means we can focus on these growth aspects without worrying about maintaining product quality."

Looking ahead, the company plans to further innovate their product line while maintaining their commitment to quality. "The SETUP program showed us that innovation isn't just about new products—it's about creating systems and processes that enable sustainable growth," the owner reflected. "We're now exploring new flavors and formats that weren't possible before we modernized our production process."

Case Study 2: Local Printing Enterprise (Digital Printing Innovation)

A remarkable transformation from a modest computer shop to a leading digital printing enterprise demonstrates how technological innovation can revolutionize a traditional business model. In 2013, facing changing market conditions, the owner made a strategic decision to pivot their business from computer services to printing solutions, a move that would prove transformative through SETUP's support.

"The decision to change our business model coincided with the 2013 elections, but we needed the right technology to capitalize on the opportunity," the owner shared during our interview. Through SETUP, the company secured financing of PHP460,000 to acquire a high-end digital printer, complementing their existing tarpaulin printer. This technological upgrade marked the beginning of a remarkable growth trajectory.

The innovation impact was immediate and substantial. "Our sales didn't just increase—they doubled, even tripled in some periods," the owner explained. "The new technology allowed us to expand our product range dramatically." The company began producing a diverse portfolio of printed materials, including posters, product labels, magazines, souvenir programs, yearbooks, brochures, and specialized stickers. This versatility in product offerings opened new market segments and revenue streams.

The financial impact of this technological innovation was striking. Within three years, the company's asset value grew from the initial SETUP investment of PHP460,000 to an impressive PHP5.8 million. More significantly, the workforce expanded from three employees to fourteen full-time staff members. "We didn't just create jobs," the owner emphasized. "We created quality employment opportunities with full benefits—health insurance, social security, housing benefits, 13th month pay, and performance bonuses."

The company's innovation journey didn't stop with technology acquisition. They developed a unique financial management strategy that the owner credits as crucial to their success. "We implemented a strict cash flow control system, using Microsoft Excel for daily monitoring. This allowed us to maintain positive cash flow while continuing to invest in growth and innovation," the owner detailed.

Geographic expansion followed their technological growth. The company opened a second branch in Caraycaray, Naval, Biliran, and soon after, a third location in Carigara, Leyte. "Each new location required us to innovate our management and operational systems," the owner noted. "We had to develop standardized processes while maintaining the flexibility to serve local market needs."

Looking ahead, the owner sees continued innovation as essential to their success. "The printing industry is constantly evolving, and we need to stay ahead of the curve. The foundation SETUP helped us build gives us the confidence to keep investing in new technologies and capabilities," they concluded.

Case Study 3: Agricultural Processing Innovation (Sugar Production Modernization)

A traditional sugar plantation's transformation into an innovative processing enterprise illustrates how technological advancement can help agricultural businesses compete in the global market. The company's journey began when its owner, previously a legal counsel for a sugar association, recognized the need to innovate in response to the impending ASEAN integration and increased regional competition.

"The threat from Thailand's highly subsidized and efficient sugar industry was significant," the owner shared during our interview. "We had to make a critical decision—either give up our plantation or innovate to add value to our products. We chose innovation." This decision marked the beginning of a comprehensive modernization effort supported by DOST's SETUP program.

The innovation journey started with establishing their own sugar mill, but the real transformation came through SETUP's technological interventions. The program provided crucial equipment that revolutionized their production capabilities: a specialized cube sugar making machine, an advanced band sealer for hygienic packaging of various muscovado products, and a sophisticated form fill sealing machine for producing convenient sachets of powdered muscovado.

"The innovation wasn't just about the equipment," the owner emphasized. "It began with our staff receiving specialized training in cleaner production technology for muscovado from DOST's Industrial Technology Development Institute. This knowledge foundation was crucial for maximizing the potential of our new equipment." The combination of advanced technology and enhanced technical expertise enabled the company to develop unique product formats—muscovado powder, rocks, and cubes—that set them apart in the market.

The impact of these innovations was transformative. The company successfully penetrated international markets, with their products earning organic certification from certifiers in Italy and South Korea. "Today, 90% of our production is exported," the owner proudly shared. "This success wouldn't have been possible without the technological capabilities we gained through SETUP."

The company's innovation strategy focused on three key areas: product development, quality assurance, and market adaptation. "We learned to choose products that could be made with locally sourced raw materials, maintain consistent quality through our new processing methods, and keep our products affordable despite their premium nature," the owner explained. This approach helped them build a sustainable competitive advantage in both domestic and international markets.

Starting from a few hectares of sugar plantation, the owner now manages over a hundred hectares, with their processing facility serving as a model of agricultural innovation. "The most valuable lesson we learned was that innovation isn't a one-time event—it's a continuous process," the owner reflected. "Every new market we enter presents unique challenges that require innovative solutions, whether in processing, packaging, or distribution."

The success of this agricultural processing innovation demonstrates how traditional farming operations can evolve into sophisticated agribusiness enterprises through technological advancement. "For other agricultural entrepreneurs, my advice is clear," the owner concluded. "Don't just focus on production—look for ways to add value through processing and innovation. SETUP provided us with the tools and knowledge to make this transition successfully."

Analysis

The analysis of these case studies reveals several key characteristics of effective government innovation interventions. First, successful programs combine hardware upgrades with comprehensive technical support—as evidenced by the food manufacturer's experience with both equipment modernization and expert consultancy in product development. Second, effective interventions create scalable impacts beyond the initial investment, as demonstrated by the printing enterprise's growth from a PHP460,000 investment to a PHP5.8-million operation with multiple branches. Third, innovation support must be flexible enough to address industry-specific challenges while maintaining consistent quality standards, as shown in the sugar processor's successful transition to export markets.

The cases also highlight that effective government support goes beyond mere technology transfer. It should enable MSMEs to develop internal capabilities for continuous innovation, from production processes to market adaptation. The success of these interventions appears to stem from their holistic approach—combining financial support, technical expertise, and business development assistance. This comprehensive support creates a foundation for sustainable growth and helps businesses build resilience against market changes and competitive pressures. Furthermore, the cases demonstrate that timing and responsiveness of support are crucial factors, allowing businesses to capitalize on market opportunities and address competitive challenges proactively.

INSTITUTIONAL FACTORS AFFECTING EFFECTIVENESS OF INNOVATION POLICIES

Capacity of Executing Government Agencies

The capacity of government agencies significantly impacts the execution of innovation policies. For instance, **DOST's SETUP** program has been instrumental in supporting MSMEs, but limited agency capacity has hampered its full potential. Challenges such as underutilization of technologies and repayment issues point to gaps in monitoring, evaluation, and follow-up (Herpacio and Hidalgo 2018). Similarly, the **DOST-TAPI programs** suffer from inadequate funding and insufficient personnel for assessing and commercializing inventions (Vidal et al. 2020). This suggests that while the programs are well-conceived, the lack of capacity in terms of financial resources and human capital limits their effectiveness.

In contrast, the **CARS Program** demonstrates how a relatively strong institutional capacity in BOI has led to success in attracting substantial investments and boosting employment (BOI 2022). However, the program still struggled with the ambitious production targets, indicating that even high-capacity agencies may face challenges when external factors are not adequately accounted for.

Moreover, the UPLB's **Technology Transfer and Business Development Office (TTBDO)** encountered difficulties due to limited government funding allocated to research and development, particularly in agriculture. The underfunding restricted the ability of agencies to move innovations from research to commercialization (Cabrera et al. 2021).

Strengthening the technical and managerial capacities of executing agencies is essential to ensure policies are effectively implemented. Increasing training programs for agency personnel, improving staffing continuity, and securing adequate funding for long-term programs can boost the effectiveness of innovation policies.

Level of Cross-Ministerial/Agency Coordination

Coordination across ministries and government agencies is critical for the coherent implementation of innovation strategies. A lack of coordination was evident in programs like the **CARS** initiative, where external policies such as the **TRAIN law** introduced tax exemptions for certain vehicle categories (e.g., pickup trucks), indirectly harming the passenger car models targeted by CARS. The unintended overlap between fiscal policy and industrial policy led to reduced effectiveness in achieving the program's goals (BOI 2022).

Additionally, the establishment of **RIICs** under the STRIDE program illustrates how improved coordination between DOST, DTI, and local government units (LGUs) enabled more effective implementation of innovation hubs (USAID 2022).

Policymakers should establish formal mechanisms for cross-ministerial communication and collaboration. Joint steering committees, better inter-agency dialogues, and synchronized policy initiatives can reduce conflicting policies and improve program alignment across sectors.

Level of Trust Between Government Agencies and Firms

Trust between government agencies and firms is a critical enabler of innovation programs. In the **DOST SETUP program**, some MSMEs expressed hesitation in fully adopting the technologies offered due to concerns about long-term sustainability and the complexity of innovation processes. This reflects a trust deficit, particularly in how government-provided solutions are perceived (Tambago et al. 2017).

Conversely, the **RIIC model** demonstrates how consistent government support and collaboration with local firms helped build trust, with businesses more likely to participate in innovation ecosystems when they perceive direct benefits from government intervention (USAID 2022).

In the **CARS Program**, trust between the government and large firms like Toyota and Mitsubishi was key to securing their participation. However, challenges arose when external shocks, such as the TRAIN law and the pandemic, affected program outcomes. A more flexible policy framework might have helped maintain trust and engagement (BOI 2022).

In contrast, the **UPLB's IP and commercialization efforts** show that trust can be undermined when there are gaps in communication between researchers and industry partners. Researchers were sometimes hesitant to fully disclose their technologies, resulting in information asymmetries and slower commercialization (Cabrera et al. 2021). Strengthening this trust through better communication and partnership models is essential for more effective technology transfer.

Building trust requires transparent communication, simplified processes, and evidence of successful program outcomes. Government agencies should also invest in creating feedback loops with firms, allowing businesses to contribute to program design and ensuring their concerns are addressed.

Attitude of Policymakers toward Helping Firms and Selective Policies

Policymakers' attitudes toward assisting specific sectors and products vary, which impacts the design and implementation of selective policies. For instance, the **CARS Program** demonstrates a deliberate focus on reviving the local automotive industry through targeted fiscal incentives. While the program achieved notable results, such as attracting over PHP9.6 billion in investments, the ambitious production targets excluded many smaller manufacturers, limiting broader industry participation (BOI 2022).

Similarly, **DOST-TAPI's** focus on IP protection prioritized certain types of innovations (e.g., patentable technologies) while leaving others, such as commercialization and pre-market support, underfunded (Vidal et al. 2020).

Selective policies should balance support across multiple stages of the innovation process. Policymakers should design programs that allow flexibility for firms of varying sizes and sectors to participate, encouraging inclusivity and addressing sector-specific needs.

Societal Attitude toward Failures

In the Philippines, societal attitudes toward failure in innovation initiatives can influence participation, particularly among MSMEs. Failure is often stigmatized, which can discourage risk-taking in innovation. For example, the **DOST SETUP** program encountered resistance from firms hesitant to adopt new technologies due to fears of financial losses or operational disruptions (Tambago et al. 2017).

However, the success of initiatives like the **RIICs in Regions 11 and 3** suggests that providing businesses with innovation safety nets—such as technical support and financial backing—can mitigate the fear of failure. By fostering environments that tolerate trial and error, these programs encouraged firms to take greater risks (USAID 2022).

Promoting a societal shift toward viewing failures as learning opportunities is crucial. Government agencies should communicate success stories alongside examples of failure recovery, creating a culture of resilience in innovation.

Availability of Opportunity-Based Entrepreneurs

The presence of opportunity-based entrepreneurs is essential for driving innovation. Programs like **DOST SETUP and RIICs** have created avenues for opportunity-based entrepreneurship, especially in regions where local industries have embraced innovation to scale up. In regions with strong entrepreneurial ecosystems, such as **Davao** (Region 11), the **RIIC** program has fostered innovation through collaboration between government, academia, and entrepreneurs (USAID 2022). Similarly, **UPLB's commercialization efforts** have benefitted from technopreneurs who are willing to take university-developed technologies to market (Cabrera et al. 2021).

However, the limited number of entrepreneurs aware of or willing to engage in government-sponsored programs restricts the overall impact. Only 0.3% of MSMEs have participated in **SETUP** since its inception (Tambago et al. 2017).

Expanding outreach efforts to inform and incentivize opportunity-based entrepreneurs, particularly in underserved regions, will help unlock untapped innovation potential. This can be done through increased marketing campaigns, regional workshops, and partnerships with local business chambers.

Demand-Side Measures Remain Limited

The limited focus on demand-side innovation policies in the Philippines, as opposed to supply-side policies, can be substantiated using the findings from the latest 2021 PIDS PSIA and previous studies by Albert et al., Quimba et al., and Aldaba et al.

According to the 2021 PSIA only a third (33.6%) of firms (much lower than earlier findings by Albert et al. (2017) that 42.9% of firms in 2015 were innovation-active) are innovation-active signifying a low level of engagement in innovation and weak internal capabilities and incentives for firms to develop and adopt new innovations, making demand-side interventions (e.g., public procurement of innovative products) less effective. Process innovation (27.3%) is also more prevalent than product innovation (21.8%), which may imply that firms are more focused on efficiency rather than new market creation.

Aside from this, there exist market and financial barriers to innovation for firms. Similar to the findings of Quimba et al. (2019) and Aldaba (2012), the 2021 PSIA highlights that firms face high costs of innovation, limited access to finance, and market constraints. Firms' expenditures on innovation are small relative to total sales (only 4.7% on average), with microenterprises spending even less. The survey also shows that only 1% of firms received public financial support for innovation. Thus, government may have focused more on addressing the supply-side issues of innovation.

Furthermore, the 2021 PSIA finds that only 3.5% of firms engaged in innovation as part of a public procurement contract. Among them, nearly half (46%) did so because the procurement contract required it. This low participation in government procurement suggests that public procurement's potential to stimulate innovation has not been maximized. The survey also finds that regulatory barriers are the most significant challenge in providing innovative goods and services to government entities, further disincentivizing firms from responding to demand-side innovation policies.

The Philippine Innovation Act (RA 11293) and Innovative Startup Act (RA 11337) emphasize strengthening R&D and technological capacity but offer limited provisions on demand-side interventions. While there are provisions in the Philippine Innovation Act that recognizes government procurement as a means of pushing for innovation, the implementation seems weak and have not substantially improved innovation activity. The 2021 PSIA supports this, showing that firms primarily rely on internal resources for innovation rather than collaborative demand-driven mechanisms. This is reinforced by Quimba et al. (2019), who found that the government prioritizes supply-side measures such as grants, loans, and technology upgrading programs like SETUP over demand-side tools.

Other Institutional Factors

Availability of Financial Resources: Programs such as **DOST-TAPI** and **SETUP** often face limitations in terms of financial resources, especially for pre-commercialization support. For instance, firms under DOST-TAPI faced repayment issues due to cash flow constraints (Herpacio and Hidalgo 2018; Vidal et al. 2020).

Policy Continuity: The **CARS Program** experienced delays and reduced effectiveness due to the introduction of the TRAIN law, highlighting the need for policy continuity. Frequent shifts in economic policies or fiscal incentives can disrupt long-term industrial strategies (BOI 2022).

Institutional Continuity: The reliance on contractual staff in agencies like **DOST-TAPI** has led to a lack of continuity and expertise retention, which negatively impacts program implementation (Vidal et al. 2020). Converting contractual positions to permanent roles would improve institutional capacity and program efficiency.

Long-term financial planning and consistent policy support are crucial to sustaining innovation initiatives. Expanding access to credit, streamlining subsidy mechanisms, and ensuring policy continuity will improve the effectiveness of these programs.

Conclusion

The institutional factors influencing policy effectiveness in the Philippines range from capacity limitations in executing agencies and inter-agency coordination challenges to societal attitudes toward failure and entrepreneur availability (Table 7). Addressing these challenges through capacity-building, improved cross-agency coordination, trust-building, and inclusive policymaking will be essential in enhancing the outcomes of innovation programs and driving sustainable economic growth.

TABLE 7

INSTITUTIONAL FACTORS AFFECTING POLICY EFFECTIVENESS

Institutional Factor	Key Challenges	Examples	Recommendations
1. Capacity of Executing Government Agencies	Limited technical and managerial capacity; inadequate funding; insufficient personnel.	- **SETUP Program:** Underutilization of technologies due to high costs. - **DOST-TAPI:** Lack of funding for commercialization. - UPLB TTBDO: Lack of funding for R&D	- Increase training programs for personnel. - Secure adequate long-term funding. - Improve staffing continuity and monitoring systems.
2. Cross-Ministerial/ Agency Coordination	Conflicting policies and lack of synchronized implementation.	- **CARS Program:** TRAIN law's unintended impact on targeted vehicles. - **RIICs:** Successful collaboration between DTI, DOST, and LGUs.	- Establish formal inter-agency mechanisms for communication - Joint steering committees and policy alignment efforts.
3. Trust Between Government Agencies and Firms	Mistrust and uncertainty about long-term sustainability of government interventions.	- **SETUP Program:** Hesitation from MSMEs to adopt technology due to financial concerns. - **RIICs:** Successful trust-building in Region 11.	- Improve transparent communication. - Create feedback loops between firms and agencies. - Simplify program processes and show evidence of success.
4. Attitude of Policymakers toward Selective Policies	Policies often favor specific sectors, excluding smaller firms or broader innovation ecosystems.	- **CARS Program:** Targeted fiscal incentives but ambitious production goals limit inclusivity. - **DOST-TAPI:** Focus on IP protection over commercialization.	- Allow flexibility for firms of different sizes and sectors. - Balance support across multiple stages of innovation (e.g., IP protection and commercialization).
5. Societal Attitudes toward Failures	Stigma around failure discourages risk-taking and experimentation in innovation.	- **SETUP Program:** Resistance to technology adoption due to fear of financial loss. - **RIICs:** Encouraged risk-taking through innovation safety nets.	- Promote cultural shift viewing failure as learning. - Highlight success stories and failure recoveries to build resilience in innovation.
6. Availability of Opportunity-Based Entrepreneurs	Limited awareness and participation of entrepreneurs, especially in underserved regions.	- **SETUP:** Only 0.3% of MSMEs have participated since inception. - **RIICs:** Strong entrepreneurial activity in Davao Region 11.	- Expand outreach efforts through regional workshops and campaigns. - Partner with local business chambers and universities to promote entrepreneurship.

Institutional Factor	Key Challenges	Examples	Recommendations
7. Demand-Side Measures Remain Limited	Low firm engagement in innovation; high innovation costs; limited access to finance; weak implementation of demand-side measures.	- Only 33.6% of firms innovate; 1% received public financial support. - **Public Procurement:** Only 3.5% of firms engaged, mostly due to requirements. - **Legislation:** Philippine Innovation Act & Innovative Startup Act prioritize supply-side measures.	- Strengthen public procurement policies to incentivize innovation. - Improve financial support and incentives for firms to engage in demand-driven innovation. - Address regulatory barriers to market-driven innovation.
8. Other Institutional Factors	Availability of financial resources and policy/ institutional continuity.	- **DOST-TAPI:** Firms face repayment issues. - **CARS Program:** Delays due to TRAIN law which reduced effectiveness.	- Increase flexibility in fiscal policies, ensure consistent program funding, and address cash flow constraints for participating firms. - Maintain consistency in economic policies to avoid frequent shifts that impact program execution.

Source: Author's compilation

CONCLUSION AND POLICY RECOMMENDATIONS

The analysis of various innovation programs in the Philippines reveals significant strides in fostering technological adoption, intellectual property protection, and cross-sectoral collaboration. However, challenges such as limited capacity in executing agencies, inconsistent cross-agency coordination, and societal resistance to failure continue to hinder the full potential of these initiatives. To strengthen the effectiveness of future innovation policies, it is essential to address these gaps through targeted reforms in policy content, implementation mechanisms, and enabling institutions. Below are key recommendations:

1. Improving Policy Content

Balance Support for Innovation Strategies: Future policies should provide balanced support across all stages of the innovation process—research, commercialization, and scaling. This includes funding not just for intellectual property protection, but also for commercialization and pre-commercialization phases. Programs like DOST-TAPI should ensure that commercialization efforts receive adequate attention and resources (Vidal et al. 2020).

Sectoral Inclusivity: Policies should cater to businesses of varying sizes and sectors, with flexible criteria to encourage broader participation. This includes lowering entry barriers for MSMEs in programs like SETUP (Tambago et al. 2017) and allowing adjustments in production targets, as seen in the CARS Program, where high production thresholds excluded many potential participants (BOI 2022).

Flexibility in Policy Design: To mitigate external shocks (e.g., TRAIN law, COVID-19), policies should be designed with built-in flexibility. Adjusting timelines, incentives, or targets based on unforeseen circumstances can maintain program effectiveness (BOI 2022).

Implement Demand-Side Innovation Policies: To enhance innovation-driven growth, the Philippine government should strengthen demand-side policies by leveraging public procurement as a key driver of innovation. This includes implementing clearer guidelines and incentives for procuring innovative products and services while addressing regulatory barriers that hinder firm participation. Additionally, expanding financial support, such as targeted subsidies and innovation grants, can encourage SMEs to invest in market-driven innovations.

Handholding and Technical Support for MSMEs: MSMEs may lack the necessary skills to fully engage with government through public procurement. Thus, it is recommended that government establishes a dedicated support program that provides one-on-one guidance, technical training, and mentorship to MSMEs aiming to participate in government procurement. Government agencies should collaborate with industry associations, academic institutions, and chambers of commerce to deliver these training sessions.

2. Strengthening Policy Implementation Mechanisms

Enhance Cross-Ministerial Coordination: To avoid conflicting policies and maximize efficiency, formal mechanisms for cross-agency collaboration should be established. This can include joint steering committees for innovation programs and dedicated channels for inter-ministerial communication to align fiscal, industrial, and innovation policies (BOI 2022; USAID 2022).

Increase Technical and Managerial Capacity in Executing Agencies: Programs like DOST-TAPI and SETUP have faced limitations due to staffing and technical capacity constraints. Building technical expertise through training programs, providing long-term employment contracts for key staff, and improving resource allocation within these agencies will enhance their ability to effectively implement policies (Vidal et al. 2020; Herpacio and Hidalgo 2018).

Simplify Procedures for MSMEs: The complexity of adoption processes and financial assistance repayment mechanisms has hindered broader participation in innovation programs like SETUP. Simplifying application processes, offering clearer guidance, and reducing administrative burdens will make these programs more accessible to MSMEs (Tambago et al. 2017).

Improve Monitoring and Evaluation: Agencies like DOST and BOI should enhance their monitoring and evaluation processes to track the progress of innovation programs. Continuous feedback loops and data-driven decision-making will help refine programs based on real-time outcomes (Herpacio and Hidalgo 2018).

3. Strengthening Enabling Institutions

Foster a Culture of Innovation and Risk-Taking: The societal stigma around failure hinders innovation. Public campaigns that celebrate both successful innovations and the lessons learned from failures can shift societal attitudes toward innovation and encourage more businesses to take calculated risks (Tambago et al. 2017; USAID 2022).

Institutionalize Regional Innovation Hubs: The success of the RIICs under the STRIDE program highlights the importance of regional innovation ecosystems. To ensure sustainability, RIICs should be integrated into government frameworks and provided with long-term financial and institutional support. Expanding their role to facilitate innovation across diverse industries can further strengthen regional economic growth (USAID 2022).

Expand Financial Support Mechanisms: Limited access to financing is a common barrier for MSMEs engaged in innovation. The government should increase the availability of low-interest loans, grants, and subsidies specifically aimed at supporting innovation and technology adoption, as well as facilitate access to venture capital (Herpacio and Hidalgo 2018; Vidal et al. 2020).

Encourage Public-Private Partnerships: Collaboration between government, academia, and industry should be deepened, especially in sectors like agriculture and manufacturing. Establishing clearer partnership guidelines and incentivizing private sector involvement in public innovation procurement programs can accelerate commercialization and industry growth (Cabrera et al. 2021; BOI 2022).

By addressing these recommendations, the Philippines can further enhance the effectiveness of its innovation policies and create a robust, sustainable innovation ecosystem that drives long-term economic growth and competitiveness.

ANNEX: CASE STUDIES

1. Impact Assessment of State Assistance Program to Agri-based Micro, Small and Medium Enterprises in the Philippines (Herpacio and Hidalgo 2018)

The SETUP, administered by DOST, has been instrumental in supporting the growth and development of MSMEs in the Philippines, particularly in the agricultural sector. This case study, derived from the impact assessment conducted by Charles Allen L. Herpacio and Hanilyn A. Hidalgo, evaluates the effectiveness of SETUP in enhancing the productivity, profitability, and overall sustainability of agri-based MSMEs.

Profile of Beneficiaries

The assessment covered a diverse range of enterprises, with more than half (78.27%) belonging to low-technology industries such as food processing, primary crop and animal production, and horticulture. The majority of these businesses are small enterprises, primarily owned by individual entrepreneurs operating as sole proprietorships. A significant proportion (60.87%) of the SETUP projects remain ongoing, indicating sustained engagement with the program. This profile highlights the program's focus on empowering low-tech and small-scale enterprises that often face challenges in accessing external funding for innovation and technological upgrades.

Technological Intervention and Project Implementation

The SETUP program allocated approximately PHP13.26 million (USD249,534) to provide technological assistance to the proponents. The majority of the funds (68%) were used to purchase production equipment across seven priority industries, including food processing, furniture, and metals engineering. These investments were critical in modernizing production processes, enhancing product quality, and expanding operational capacity.

Technological interventions under SETUP were well-received by the proponents, with the majority reporting that the new technologies offered a clear relative advantage and were compatible with their existing operations. This compatibility eased the adoption process, and the simplicity of the technology further facilitated its integration into daily business activities. However, the program also encountered challenges, such as underutilization of equipment, difficulties in repaying assistance, and issues related to reporting and documentation. These challenges underscore the need for continuous monitoring and tailored support to ensure that MSMEs can fully leverage the benefits of the program.

Impact on Production, Sales, and Employment

The impact of SETUP on production volumes was significant, with an average increase of 157.99% across the assessed enterprises. This boost in production capacity translated into a 51.65% increase

in sales, driven by improved product quality and compliance with industry standards. The adoption of new technologies enabled businesses to meet the stringent packaging and labeling requirements of large retailers, thereby expanding their market reach.

In addition to enhancing productivity and sales, SETUP also contributed to job creation. The assessment found a 191.82% increase in employment across the participating enterprises, reflecting the program's role in supporting sustainable business growth and local economic development.

Financial Outcomes and Challenges

The financial analysis revealed that the net income of the proponents increased by PHP1,298,924.48 (USD24,437.82) after the intervention. However, the assessment also identified several challenges that affected the program's effectiveness. For instance, some proponents struggled with the high cost of equipment installation, which led to underutilization. Additionally, repayment issues arose for 35% of the proponents, largely due to insufficient cash flow and competing financial priorities.

Lessons Learned and Recommendations

The assessment concluded that while SETUP has significantly improved the productivity and profitability of agri-based MSMEs, there is room for improvement in the program's implementation. Key recommendations include refining the selection criteria to ensure that proponents have the financial capability to adopt and sustain the new technologies, providing extended business development services to address financial management skills, and strengthening the monitoring and evaluation processes to track long-term outcomes.

Conclusion

Overall, the SETUP program has demonstrated its value in enhancing the technological capabilities and market competitiveness of agri-based MSMEs in the Philippines. By addressing the challenges identified in this assessment, the program can further increase its impact and contribute to the broader goal of inclusive economic growth in the agricultural sector.

2. Assessment on the Assistance Program for Inventions of the DOST-TAPI Using Analytic Hierarchy Process (AHP) Approach (Vidal et al. 2020)

The paper assesses selected programs of DOST-TAPI that assist Filipino inventors under the Inventors and Inventions Incentives Act (RA 7459). These programs fall under the Invention Development Assistance Fund (IDAF) and aim to protect IP and support the development and commercialization of inventions. Key programs assessed include the Intellectual Property Rights Assistance Program (IPRAP), Invention Testing and Analysis Assistance, Industry-Based Development (IBID), and Invention-Based Enterprise Development (IBED).

Methodology

The study used AHP, a decision-making tool that determines priorities among programs by creating pairwise comparisons. Data were gathered from key decision-makers within DOST-TAPI, and a pairwise comparison matrix was created to calculate the priority of each program. This model helped identify which programs should receive higher priority for budget allocation.

Profile of Beneficiaries

The beneficiaries of DOST-TAPI's invention assistance programs are Filipino inventors, institutions, and organizations from various sectors, including individuals, universities, government agencies, and private enterprises. The IPRAP program is the most utilized, supporting both DOST-

affiliated and non-DOST inventors. The number of beneficiaries has consistently increased from 2011 to 2018, particularly in the IP protection phase. The programs cater to inventors at various stages of their development, from initial research to pre-commercialization.

Project Implementation

Project implementation under DOST-TAPI involves a multi-step process, with IP protection prioritized in terms of funding allocation. From 2011 to 2018, IPRAP consistently received more funding than other programs. For instance, in 2018, IPRAP accounted for over 50% of the total funds, reflecting the agency's focus on protecting inventions. Programs like IBID and Testing Assistance received lesser but still significant allocations, though the distribution of resources fluctuated year by year, often favoring IP protection over development and commercialization.

Results and Challenges

The DOST-TAPI programs have led to a significant increase in patent filings and IP applications, contributing to the Philippines' improved GII ranking. The IPRAP program is the most successful in terms of the number of beneficiaries and the amount of funding allocated. Inventions supported through pre-commercialization programs such as IBID and Testing Assistance have shown potential in transforming ideas into market-ready products, although these programs receive less attention.

Challenges include the uneven allocation of resources, with a heavy focus on IP protection, which leaves pre-commercialization efforts underfunded. There is also a shortage of trained personnel to evaluate inventions, and limited access to patent databases, making it difficult to assess the novelty and commercial potential of new inventions. Additionally, the contractual nature of the staff handling these programs results in a lack of continuity and expertise retention within the agency.

Lessons Learned and Recommendations

One key lesson is the need to balance resources between IP protection and commercialization. Focusing too much on IP protection can hinder the broader goal of innovation commercialization. It is also clear that technical training for evaluators is essential for high-quality assessments, and that sufficient funding should be provided for programs like IBID and Testing Assistance, which are crucial for moving inventions from concept to market. Furthermore, ensuring continuity in staff through permanent positions is necessary to retain expertise.

To enhance the effectiveness of DOST-TAPI's programs, several recommendations are proposed:

- Increase funding for pre-commercialization programs, particularly IBID and Testing Assistance, to ensure that inventors have sufficient resources to bring their innovations to market.
- Invest in technical training for staff and acquire commercial patent databases to improve the quality of invention evaluations.
- Convert contractual staff to permanent roles to ensure continuity in the evaluation and implementation of invention support programs.
- Introduce sensitivity analyses in the budgeting process to ensure more balanced resource distribution across IP protection and commercialization.
- Foster partnerships with private sector stakeholders to enhance the commercialization and scaling of inventions.

Conclusion

The DOST-TAPI invention assistance programs have played a vital role in supporting Filipino inventors, particularly through **IPRAP**, which has been instrumental in increasing patent filings and improving the Philippines' innovation metrics. However, the study highlights the need for a more balanced approach, ensuring that pre-commercialization programs like **IBID** and **Testing Assistance** receive adequate resources to bring inventions to market. By addressing these challenges, DOST-TAPI can strengthen its role in fostering innovation and contribute to the Philippines' long-term economic growth through technology commercialization.

3. Towards a Robust Intellectual Property and Technology Commercialization Platform at UPLB: The Case of DOST-PCAARRD-funded Research Projects (Cabrera et al. 2021)

Introduction

UPLB has played a pioneering role in advancing IP protection and technology commercialization (TC), particularly in the fields of agriculture, biotechnology, and related industries. With the support of DOST-PCAARRD, UPLB's research initiatives have focused on creating innovative technologies aimed at benefiting diverse sectors of society. These include smallholder farmers, technopreneurs, and industry players. This paper examines UPLB's efforts in conducting an IP audit and commercialization of government-funded research projects, profiling beneficiaries, assessing project implementation, and discussing the outcomes and challenges encountered in the commercialization process. Additionally, it draws on the lessons learned and provides recommendations for future initiatives.

Methodology

The primary methodology utilized in this study involved conducting an IP audit of 212 DOST-PCAARRD-funded research projects at UPLB between 2010 and 2015. The projects were evaluated for their potential in both IP protection and commercialization using the Technology Readiness Level (TRL) system, which measures the maturity of technologies from initial research to market readiness. To facilitate this assessment, UPLB's TTBDO developed an IP audit form and invention disclosure form. These forms helped categorize technologies based on key factors such as market size, legal and technical issues, investment needs, and strategic relevance to UPLB's research priorities. Additionally, market validation and technology valuation were conducted for promising projects, ensuring that resources were allocated efficiently for commercialization efforts, including licensing and spin-offs.

Profile of Beneficiaries

The beneficiaries of UPLB's IP and technology commercialization programs are diverse, reflecting the wide range of fields impacted by UPLB's research initiatives. Farmers and agribusinesses are among the primary beneficiaries, as many of the university's technologies are designed to improve agricultural productivity and sustainability. Products such as biofertilizers, pest control agents, and improved crop varieties directly enhance the livelihoods of smallholder farmers by increasing yields, reducing input costs, and promoting environmentally friendly farming practices.

Technopreneurs also benefit from these programs, gaining access to university-developed technologies through licensing agreements and business incubation services provided by the TTBDO. These entrepreneurs, often in collaboration with private sector partners, can bring new products to market based on UPLB's innovations. Additionally, the university's researchers and inventors benefit from the protection of their intellectual property rights and the financial rewards from royalties generated through commercialization, which provides an incentive for continued

innovation. Finally, private sector companies, particularly those in agriculture and biotechnology, gain competitive advantages by partnering with UPLB and accessing its cutting-edge technologies, enabling them to introduce innovative products and services to the market.

Project Implementation

The implementation of UPLB's IP protection and commercialization activities is led by the TTBDO, which oversees every stage of the process. The project began with the comprehensive IP audit conducted in 2017, which evaluated 212 research projects across eight colleges and one institute. The audit focused on identifying technologies with both IP and commercialization components, ultimately selecting 17 projects for further development. These projects were assessed using the TRL system, which helped determine their level of readiness for commercialization.

Following the TRL assessment, the selected technologies underwent market validation to determine their potential for revenue generation. This process included evaluating market interest, competitive landscapes, and potential benefits to end-users. Additionally, technology valuation was conducted by third-party consultants to avoid bias in assessing the value of the technologies, which provided a foundation for negotiating royalty rates and terms of licensing agreements. Once the most promising technologies were identified, UPLB engaged in licensing negotiations and developed spin-offs for commercialization. The entire process, from research to commercialization, was guided by UPLB's overarching goal of translating research outputs into tangible products and services that benefit society.

Results and Challenges

UPLB's efforts in IP protection and commercialization have resulted in significant achievements. To date, six technologies have been successfully licensed to private sector partners, and three more are in the process of being developed into spin-off companies. These technologies, including biofertilizers like Trichoderma and Mykovam, are already making an impact in the agricultural sector. The commercialization of these products has provided substantial financial returns to UPLB, its researchers, and inventors, with royalties ranging from 3% to 10% of licensees' gross sales. In addition to generating revenue, the introduction of these technologies has contributed to the improvement of agricultural practices across the economy, providing farmers with innovative tools to enhance productivity and sustainability.

Despite these successes, UPLB faced several challenges in its technology commercialization efforts. One of the main issues was the gap between academia and industry, particularly in terms of communication and collaboration. Researchers were sometimes hesitant to disclose their technologies fully, leading to information asymmetries that hindered successful partnerships with industry. Moreover, the limited government funding allocated to research, particularly in the agricultural sector, posed a significant obstacle. The Philippines' investment in research and development, especially in agriculture, remains lower than that of other ASEAN countries, limiting the resources available to further develop technologies to a higher level of market readiness. Another challenge was the capacity of technology transfer offices (TTOs), such as the TTBDO, which often lacked the technical expertise and resources necessary to move technologies swiftly through the commercialization pipeline, resulting in delays.

Lessons Learned and Recommendations

Several valuable lessons emerged from UPLB's experience in IP protection and technology commercialization. First, institutional support is critical to the success of technology transfer and

commercialization activities. UPLB's establishment of the TTBDO and its ongoing support for the office's efforts played a crucial role in ensuring that the university's research outputs were adequately protected and commercialized. Second, conducting market validation early in the commercialization process is essential for identifying the technologies with the greatest potential for success. By focusing on technologies that have strong market demand, UPLB was able to allocate its resources more efficiently. Lastly, bridging the gap between academia and industry requires deliberate efforts to foster communication and collaboration. Addressing information asymmetries and creating formal channels for dialogue between researchers and industry partners can greatly enhance the commercialization process.

To build on its successes and address the challenges encountered, UPLB should consider several key recommendations.

- Increase Government Funding for Research: The government should allocate more resources to research and development, especially in agriculture, where technological innovation can directly impact food security and rural livelihoods. Greater investment will allow researchers to develop their technologies to a higher level of readiness.
- Enhance the Capacity of Technology Transfer Offices: UPLB and other universities should invest in training and resources for their TTOs to improve their ability to commercialize technologies. This includes developing stronger business acumen and technical knowledge within the TTO staff.
- Foster Stronger Industry-University Partnerships: Establishing clearer guidelines for partnerships and improving communication between universities and industry can address many of the challenges encountered during technology commercialization. Joint ventures and collaborative research should be encouraged.

Conclusion

UPLB's efforts in IP protection and technology commercialization have made significant contributions to national development, particularly in the agricultural sector. The university's innovative technologies, supported by DOST-PCAARRD, have provided tangible benefits to farmers, technopreneurs, and industry partners, while also generating revenue through licensing agreements and spin-offs. Despite the challenges of limited funding and communication gaps between academia and industry, UPLB has demonstrated the potential for Philippine universities to play a central role in the economy's innovation ecosystem. Moving forward, continued institutional support, increased government investment in research, and stronger industry-university partnerships will be essential for sustaining and expanding these efforts. Through these initiatives, UPLB can continue to lead the way in transforming research into impactful technologies that benefit society.

4. CARS Program Implementation: Status and Assessment of Outcomes (BOI 2022)

The CARS Program, initiated in 2015 through Executive Order 182, was created to stimulate the Philippine automotive manufacturing industry, which had lagged behind its ASEAN counterparts. This program aimed to revive a sector that was struggling due to heavy reliance on imported vehicles, a weakening domestic production base, and fierce competition from established automotive hubs like Thailand and Indonesia. With a performance-based, time-bound, and budget-capped fiscal support system, CARS sought to incentivize both local assembly and parts manufacturing through targeted investments and production goals.

The program also serves as a case study in the Philippines' broader innovation agenda. The lessons from CARS are vital for understanding how government support can drive industrial growth, foster localization, and generate employment while contending with external challenges such as economic policy shifts and global crises like the COVID-19 pandemic.

Methodology

The CARS Program assessment used a mixed-methods approach, combining quantitative and qualitative analyses. Data was gathered on production volumes, investments, employment, and localization from government reports, industry stakeholders, and companies. Interviews were conducted with key stakeholders, including government officials, car manufacturers (Toyota Motor Philippines and Mitsubishi Motors Philippines), and parts suppliers, to evaluate the program's implementation and outcomes.

The review also examined documents like the 2022 CARS Assessment Report, Executive Order 182, and relevant fiscal policies, such as the TRAIN law. Performance metrics—capital investments, production targets, localization, foreign exchange savings, and job creation—were analyzed against the program's goals to assess effectiveness.

Finally, the program's socio-economic impact was evaluated, focusing on job creation, industry growth, and trade balance improvements, while also addressing challenges like the TRAIN law and the COVID-19 pandemic.

Profile of Beneficiaries

The primary beneficiaries of the CARS Program are the two major participating car manufacturers (PCMs): Toyota Motor Philippines and Mitsubishi Motors Philippines. These companies enrolled specific models in the program (the Toyota Vios and Mitsubishi Mirage) and received fiscal incentives to increase their local production capacity.

In addition to the PCMs, the parts manufacturers involved in the production of key components, particularly body shell and large plastic parts (BSLP), also benefited from the program. These companies included both local and foreign-owned businesses, such as SMRC Automotives Technology, Manly Plastics Inc., and Denso Philippines Corporation, which invested in manufacturing facilities to meet the parts localization requirements.

Indirect beneficiaries include the workers employed across the assembly plants and parts manufacturing facilities, as well as ancillary industries such as logistics, maintenance, and supplier firms that support the automotive manufacturing sector. By the end of 2022, approximately 110,000 direct and indirect jobs had been created, representing a significant portion of the expected employment growth from the two car models.

Project Implementation

The CARS Program was rolled out as a six-year, time-bound initiative to boost the production of specific vehicle models and encourage capital investments in local parts manufacturing. The fiscal support offered under CARS was structured in two key components:

1. **Fixed Investment Support (FIS):** This component offered direct subsidies to participants to cover up to 40% of eligible capital investments. The total budget for FIS was capped at PHP9 billion per vehicle model, with the goal of incentivizing investments in local parts production.

2. **Production Volume Incentive (PVI):** To ensure scale in production, CARS provided an additional incentive based on achieving a minimum production volume of 200,000 units over the six-year program period. This incentive was intended to offset the high production costs faced by local manufacturers due to limited economies of scale.

The program required that participating manufacturers produce key parts locally, including body shells and large plastic parts, as a way to increase the localization rate of vehicles. Toyota and Mitsubishi began enrolling their models in the program in 2016, with production commencing soon after. However, the implementation was impacted by external factors such as the TRAIN law and the COVID-19 pandemic, which disrupted vehicle sales and production levels.

Results and Challenges

The CARS Program produced several notable outcomes:

- **Capital Investments:** The program attracted PHP9.6 billion in total investments, of which PHP7.6 billion was eligible for CARS incentives. These investments were directed toward expanding assembly operations and developing local parts manufacturing capabilities.
- **Production Volumes:** By the end of 2022, Toyota had achieved 83% of its production target, while Mitsubishi reached 39%. Cumulative production of both models totaled 202,121 units, with Toyota showing stronger performance.
- **Localization:** Localization of parts improved under the CARS Program. Toyota Vios increased its localization rate from 35% to 42%, while the Mitsubishi Mirage rose from 31% to 38%. This demonstrates the program's success in encouraging local production, although the aspirational 50% target has not yet been achieved.
- **Employment:** The program created around 110,000 direct and indirect jobs in both assembly plants and parts manufacturing operations, contributing to the Philippine economy's broader employment goals.
- **Foreign Exchange Savings:** Local vehicle production under CARS generated approximately USD1 billion in foreign exchange savings by reducing the reliance on imported vehicles. An additional USD400 million in savings is expected by 2024.

However, it also encountered several significant challenges that hindered its ability to fully meet its ambitious goals. Understanding these challenges is critical for future policymaking, as they highlight areas where the program's design and external factors impacted its performance.

- **Impact of TRAIN Law:** The introduction of the TRAIN law in 2018 raised vehicle prices and reduced consumer demand, leading to a significant decline in production levels. The exemption of pickup trucks from excise taxes under TRAIN further skewed the market away from passenger vehicles, affecting the CARS-enrolled models.
- **COVID-19 Pandemic:** The global COVID-19 pandemic severely disrupted both production and demand. Lockdowns and quarantine measures led to a 45% drop in vehicle sales in 2020. This had a major impact on production targets, particularly for Mitsubishi, which struggled with market demand even before the pandemic.
- **High Production Targets:** The requirement to produce 200,000 units per model over six years proved too ambitious for Mitsubishi, which faced declining demand for its Mirage model. This high threshold limited participation from other potential manufacturers and restricted the program's ability to generate a wider impact.

Policy Implications and Lessons Learned

The CARS Program offers key lessons for advancing the Philippine automotive industry and shaping broader industrial policy. These insights are crucial for future innovation programs and ensuring effective, sustainable government interventions.

1. Targeted Fiscal Support is Effective

The CARS Program's ability to attract PHP9.6 billion in investments, boost local production, and generate foreign exchange savings shows the effectiveness of targeted fiscal support in stimulating strategic industries. However, it also underscores the need to align fiscal support with industry specifics, as overly ambitious targets can reduce participation and limit incentives' effectiveness.

2. Mitigation of External Shocks

Events like the TRAIN law, the Taal volcanic eruption, and the COVID-19 pandemic highlight the necessity for flexibility in industrial policy. Although time-bound, the CARS Program revealed the importance of adjusting timelines and incentive periods to accommodate unforeseen events. Extending the incentive period for Mitsubishi, for instance, ensures the realization of program benefits.

3. Market Scale Matters

The challenge of parts localization emphasizes the need for industrial policies that account for market size. Compared to other ASEAN nations, the smaller Philippine automotive market limits economies of scale, raising production costs. Future policies should explore strategies like public procurement and export incentives to boost demand for locally manufactured vehicles.

4. Encouraging Broader Participation

The CARS Program's focus on a few participants, high production targets, and limited vehicle models may have excluded smaller manufacturers crucial for developing the local parts sector. Future initiatives should promote inclusivity, especially for SMEs, to drive innovation and competitiveness in the industry.

5. Transition to Electric Vehicles (EVs)

As the industry shifts to EVs, the CARS Program serves as a template for fiscal mechanisms to support this transition. The Electric Vehicle Industry Development Act (EVIDA) calls for an EV Incentive Strategy (EVIS), likely modeled after CARS. While fostering EV manufacturing is vital, policies must also ensure the continued use and adaptation of capabilities developed under the CARS Program, such as body shell and large plastics production.

Conclusion

The CARS Program illustrates the potential of targeted, performance-based fiscal support in revitalizing key industries. While the program encountered significant challenges, including external shocks and overly ambitious production targets, its successes in attracting investment, increasing local production, generating employment, and saving foreign exchange highlight its overall effectiveness. The lessons learned from the CARS Program should inform future industrial policies, particularly as the Philippines transitions toward electric vehicle manufacturing and continues to develop its automotive and broader manufacturing sectors. The program also underscores the importance of flexibility, scalability, and inclusivity in the design of innovation programs aimed at industrial development.

5. RIICS Region 11 (Davao) and RIICS Region 3 (Central Luzon) (USAID 2022)

RIICS Region 11 (Davao)

The RIIC in Region 11, also known as the Davao-based RIIC, was established under the USAID STRIDE program to foster innovation-driven economic growth by bringing together government, industry, and academe. Its key goal is to support MSMEs in adopting innovative technologies and business practices. The success of Region 11's RIIC has been largely attributed to its structured collaboration efforts, strategic planning, and its focus on developing a strong regional innovation ecosystem.

Methodology

The impact assessment of RIIC Region 11 employed a qualitative approach, relying on data collected through key informant interviews (KIIs) with government officials, business leaders, and academic institutions. Focus group discussions (FGDs) were conducted with local MSME owners who participated in the IBR project. These data were supplemented by an analysis of project reports and regional economic data to evaluate the success and challenges of the RIIC.

Profile of Beneficiaries

The primary beneficiaries of RIIC Region 11 were MSMEs in industries such as food processing, agriculture, and manufacturing. Key businesses, including Malagos Foods and A's & R's Food Products, received technological support and business consultancy services through the IBR project. Additionally, higher education institutions like Ateneo de Davao University and the University of the Philippines (UP) Mindanao played a critical role by providing technical expertise and facilitating collaboration between academia and industry.

Project Implementation

Region 11's RIIC built on the region's longstanding Industry Clustering (IC) Strategy, which had been in place since 2006. The early adoption of this strategy provided a foundation for collaboration between government agencies such as DTI and DOST, private sector leaders, and academic institutions. STRIDE's technical assistance was crucial in formalizing these collaborations, leading to the creation of the iSTRIKE Davao Strategic Plan (2021–2025). This strategic plan laid the groundwork for the long-term sustainability of the RIIC by focusing on building a robust innovation ecosystem that supports MSME growth.

Results and Challenges

The RIIC in Davao achieved several key outcomes that significantly impacted the region's innovation landscape. One of its most notable achievements was the development of a solar-powered cooker for coconut sugar production. This technology helped local producers reduce their energy costs, making their production processes more sustainable and efficient.

Additionally, the RIIC's IBR project played a crucial role in helping MSMEs recover from the economic downturn caused by the COVID-19 pandemic. Through strategic business consultancy and technical assistance, businesses like Malagos Foods were able to develop new product lines and expand their markets, enhancing their resilience during challenging times.

The iSTRIKE Davao Strategic Plan also provided a clear direction for the RIIC's future, ensuring that it continues to support innovation and MSME growth through a formalized, region-specific strategy that aligns with the goals of local stakeholders.

Despite its successes, RIIC Region 11 encountered several challenges. The primary issue was fostering a culture of innovation among local stakeholders. Many businesses were initially reluctant to embrace new technologies and collaboration models due to uncertainties about immediate benefits. Additionally, coordinating the objectives of various stakeholders—including government agencies, private sector players, and academic institutions—required significant effort, as these groups often had divergent priorities.

Lessons Learned

The key lesson from RIIC Region 11 is the importance of building trust and fostering long-term relationships among stakeholders. While the RIIC was able to successfully bring together government, industry, and academe, building a culture of collaboration required sustained effort. Additionally, the success of the iSTRIKE Davao Strategic Plan highlighted the need for structured, long-term planning to ensure the sustainability of innovation ecosystems.

Recommendations

1. **Strengthen Stakeholder Coordination:** Establish a formalized coordination framework that aligns the activities of government, industry, and academic stakeholders to streamline collaborative efforts.
2. **Promote Innovation Adoption:** Implement targeted outreach programs to encourage MSMEs to adopt new technologies, showcasing successful case studies like the solar-powered cooker to demonstrate the tangible benefits of innovation.
3. **Expand Support for MSMEs:** Provide continued access to funding and technical expertise to ensure that MSMEs can innovate and compete in both local and global markets.

Conclusion

RIIC Region 11 has proven to be a successful model for fostering innovation in a regional context. Through strategic planning, technical assistance, and a focus on building collaborative networks, the RIIC has strengthened the region's innovation ecosystem and enhanced the capacity of local MSMEs to innovate and grow. Continued investment in stakeholder coordination, outreach, and support for MSMEs will be essential to maintaining and expanding these gains.

RIICS Region 3 (Central Luzon)

The RIIC in Region 3 (Central Luzon) was established as part of the second phase of RIIC development under the USAID STRIDE program. Its primary aim is to enhance the region's innovation ecosystem by facilitating collaboration between government, industry, and academia. The focus of the RIIC in Central Luzon has been on fostering innovation among local businesses, particularly MSMEs, and supporting their recovery from the economic impacts of the COVID-19 pandemic.

Methodology

This assessment utilized qualitative data gathered from KIIs with representatives from DTI, DOST, local business leaders, and academic institutions. FGDs were also conducted with MSMEs that benefitted from RIIC programs, and project reports were analyzed to assess the RIIC's outcomes and challenges.

Profile of Beneficiaries

The RIIC in Region 3 supported a diverse range of beneficiaries, including MSMEs in agriculture, manufacturing, and technology sectors. The Bulacan Chamber of Commerce and Industry (BCCI) was a key partner in this effort, working alongside local universities such as Bulacan State University to provide technical support and business consultancy services to MSMEs. Additionally, the Philippine Chamber of Commerce North Luzon collaborated with the RIIC to strengthen industry-academia partnerships and support regional economic development.

Project Implementation

The implementation of the RIIC in Central Luzon focused on providing direct support to MSMEs, particularly those that were severely impacted by the pandemic. A key initiative was the launch of the web-based THRIVE Central Luzon app, which allowed MSMEs to access innovation-related services remotely. This app was instrumental in extending the RIIC's reach, enabling businesses across the region to benefit from the program's services, regardless of their geographic location.

RIIC Region 3 also placed a strong emphasis on fostering collaboration between industry and academia. Bulacan State University played a central role in integrating academic research with business needs, offering technical consultancy services that helped MSMEs improve their products and processes.

Results and Challenges

The launch of the THRIVE Central Luzon app was one of the most significant outcomes of RIIC Region 3. By offering a digital platform where MSMEs could access innovation support, the app removed geographical barriers and expanded the reach of the RIIC's services. MSMEs were able to receive business consultancy, product development advice, and technical support remotely, allowing them to innovate and recover more quickly from the economic challenges posed by the pandemic.

The RIIC's collaboration with BCCI and other local business groups also contributed to improving the competitiveness of MSMEs in the region. By strengthening industry-academia linkages, the RIIC helped businesses adopt new technologies and improve their market positioning, particularly in the agriculture and manufacturing sectors.

One of the key challenges faced by RIIC Region 3 was coordinating the activities of its diverse stakeholders. While the RIIC succeeded in bringing together government, industry, and academia, ensuring sustained participation from the private sector proved difficult, particularly as many businesses were still recovering from the financial impacts of the pandemic. Additionally, logistical challenges related to the implementation of digital solutions, such as the THRIVE app, required ongoing technical support and refinement.

Lessons Learned

A major lesson from RIIC Region 3 is the importance of digital platforms in extending the reach of innovation services. The success of the THRIVE app demonstrated the value of offering remote access to innovation support, particularly in regions where physical access may be limited. Another lesson is the critical role that industry-academia partnerships play in fostering innovation. By integrating academic research into business processes, the RIIC helped MSMEs adopt more sustainable and innovative practices.

Recommendations

1. **Enhance Digital Infrastructure:** Continue to improve and expand the THRIVE app to provide more comprehensive innovation support, including access to funding, mentorship, and market data.
2. **Strengthen Industry Engagement:** Foster deeper engagement with industry stakeholders by involving chambers of commerce in leadership roles within the RIIC.
3. **Expand Outreach Programs:** Increase awareness of the RIIC's services among MSMEs, particularly those in remote areas, through targeted outreach campaigns and success stories.

Conclusion

RIIC Region 3 has made significant strides in supporting MSMEs through innovative digital solutions and fostering strong industry-academia partnerships. By providing remote access to innovation support and encouraging collaboration between key regional stakeholders, the RIIC has enhanced the competitiveness of local businesses and contributed to the region's economic recovery. Moving forward, expanding digital infrastructure and deepening industry engagement will be key to ensuring the sustainability and continued success of the RIIC in Central Luzon.

6. Organizational Innovation and Innovation Adoption Among Philippine Food Processing Micro, Small, and Medium Enterprises (Tambago et al. 2017)

Innovation plays a vital role in enhancing the competitiveness of MSMEs, particularly in the Philippines' food processing sector. DOST SETUP has aimed to support MSMEs in adopting new technologies to improve their productivity and competitiveness. Despite these efforts, the program's reach remains limited, and many MSMEs struggle to adopt and integrate innovative practices. This paper examines the interplay between organizational innovation and innovation adoption in the Philippine food processing MSMEs. It investigates the beneficiaries' profiles, the project's implementation, and the outcomes and challenges faced by these enterprises.

Methodology

This study utilized a quantitative-descriptive-explanatory approach, with data collected through self-administered surveys. The respondents included 48 management-level participants and 221 production workers from DOST SETUP-assisted MSMEs in the food processing sector in Central Visayas. The study focused on measuring perceptions of organizational innovation and innovation adoption through Likert-scale questionnaires. The innovation adoption process was examined using Rogers' Diffusion of Innovations Theory, particularly the persuasion stage where decision-makers form attitudes toward innovation.

Profile of Beneficiaries

The beneficiaries of DOST SETUP are MSMEs in the food processing industry, one of the Philippines' top exporting sectors. These enterprises receive technical assistance, technology upgrades, and training from the government to improve their productivity. However, despite the existence of over 800,000 MSMEs nationwide, only 0.3% have participated in the DOST SETUP program since its inception in 2002. A majority of the beneficiaries in the study were food manufacturers, indicating the sector's potential for growth but also its challenges in adopting innovation.

Project Implementation

DOST SETUP aims to assist MSMEs by providing technical interventions, including technology transfer, product design enhancements, training, and consultancy services. The program focuses on improving the competitiveness of businesses in priority sectors, including food processing. While the program has been successful in providing support to firms, its implementation has faced obstacles, particularly in encouraging full adoption of the innovation interventions. The complexity of innovation processes, combined with limited collaboration and awareness among firms, has limited the impact of DOST SETUP.

Key Findings

- **Organizational Innovation:** There is a significant difference between the perceptions of innovation between management and production groups. Production workers scored higher in innovation culture than management, suggesting that employees may be more receptive to innovative changes.
- **Innovation Adoption:** The overall perception of DOST SETUP by management was favorable, particularly in areas such as relative advantage (economic benefits) and compatibility (alignment with business needs). Observability (seeing results from others) and complexity (ease of use) also contributed to adoption, though complexity scored lower, indicating some challenges in implementation.
- **Relationship Between Innovation and Adoption:** Organizational innovation, particularly the culture of innovation, has a positive association with innovation adoption. Management's decision to adopt is significantly influenced by the presence of an innovative culture.

Results and Challenges

The study revealed that the DOST SETUP participants generally had a favorable perception of the program, particularly regarding its potential economic advantages. Managers viewed the program positively, especially in terms of relative advantage (economic benefits) and compatibility with their existing practices. The study also highlighted that innovation adoption was positively influenced by the observability of the program's outcomes, as firms that observed success in other enterprises were more likely to adopt the innovations themselves.

A significant challenge was the complexity of the innovations being introduced. Many MSMEs struggled with understanding and fully implementing the new technologies and practices. There was also a notable gap between management and production workers in terms of their receptiveness to innovation. Production staff were more open to innovation than management, but a lack of communication and alignment between the two groups created barriers to effective adoption. Additionally, cost factors and limited access to information hindered broader participation in the program.

Lessons Learned and Recommendations

One of the key lessons from this study is that fostering an innovation culture at all organizational levels is crucial for the successful adoption of innovation. Production workers, who often display a higher openness to innovation, should be actively engaged in the process, and their ideas should be recognized and implemented. Additionally, training and capacity-building initiatives targeted at management can help create a more innovation-friendly environment, ensuring that leaders are equipped to support and promote innovative practices within their firms. Simplifying the adoption process and providing clearer guidance are also essential in reducing the perceived complexity of innovations.

To improve the effectiveness of innovation programs like DOST SETUP, the following recommendations are proposed:

- **Strengthen Innovation Culture:** Organizations should build a strong innovation culture by fostering open communication, encouraging risk-taking, and engaging employees at all levels.
- **Improve Management Training:** Targeted training programs for MSME leaders can help them better understand and manage innovation processes.
- **Simplify Innovation Processes:** Efforts should be made to simplify the innovation adoption process, providing clearer guidance and step-by-step support to reduce complexity.
- **Expand Outreach:** The government should intensify efforts to raise awareness about DOST SETUP and other innovation programs to reach more MSMEs, especially those in rural areas.
- **Enhance Collaboration:** Greater cooperation between MSMEs and innovation agencies can create a more robust support system for technology adoption.

Conclusion

The findings of this study highlight the importance of innovation in enhancing the productivity and competitiveness of MSMEs in the Philippines, particularly in the food processing sector. While programs like DOST SETUP provide essential support, their impact is hindered by barriers such as perceived complexity, lack of communication between organizational levels, and limited awareness. By addressing these challenges, particularly through the strengthening of innovation culture and leadership training, MSMEs can be better equipped to adopt and sustain innovative practices. Moving forward, fostering an environment that encourages continuous innovation will be key to ensuring the long-term success of MSMEs in the global market.

REFERENCES

Albert, J. R. G., Quimba, F. M., & others (2023) The extent of innovation in Philippine business and industry: Results of the 2021 PIDS survey of innovation activities. PIDS Discussion Paper Series No. 2023-11.

Albert et al. (2016) Innovation survey

Albert, J. R. G., Quimba, F. M., & others (2017) Measuring and examining innovation in Philippine business and industry. PIDS Discussion Paper Series No. 2017-28.

Albert et al. (2021) Innovation survey

Aldaba, R. (2012) Trade Reforms, Competition, and Innovation in the Philippines. PIDS Discussion Paper Series No. 2012-06.

Aldaba, R. (2018) The Philippine inclusive Filipinnovation and entrepreneurship roadmap: Bridging the gaps and setting milestones. DTI Policy Briefs, Special Issue, October. https://industry.gov.ph/wp-content/uploads/2018/12/Inclusive-Filipinnovation-and-Entrepreneurship-Roadmap.pdf

Nomura K. & Kimura F. (2023) *APO Productivity Databook 2023*. APO. https://doi.org/10.61145/TRKP9496

Board of Investments (2022) CARS Program: Status and assessment. Board of Investments. https://boi.gov.ph

Cabrera, E. J. C., et al. (2021) Towards a robust intellectual property and technology commercialization platform at the University of the Philippines Los Baños (UPLB): The case of DOST-PCAARRD-funded research projects. Philippine Journal of Science, 150(5), 1187-1196. https://doi.org/10.55960/pjs.v150i5.927

De la Peña, F. (2020) Filipinnovation: Financing science for the people. In The Global Innovation Index 2020 (Chapter 8). World Intellectual Property Organization. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020-chapter10.pdf

Herpacio, C. A. L., & Hidalgo, H. (2018) Impact assessment of state assistance program to agri-based micro, small, and medium enterprises in the Philippines. International Journal on Advanced Science, Engineering and Information Technology, 8(6), 2088-5334. https://doi.org/10.18517/ijaseit.8.6.6800

Go, K. C. (2022) Enabling Innovation in The Philippine Rice Industry: The Roles and Key Capabilities of Innovation Intermediaries. *Journal of STI Policy and Management*, 7(1), 1-20. http://dx.doi.org/10.14203/STIPM.2022.315

Philippines Institute for Development Studies (2015–2021) PIDS Survey of Innovation Activities

Quimba, Francis Mark A. and Rosellon, Maureen Ane D (2019) Impact of government incentive on MSME innovation. PIDS Discussion Paper Series No. 2019-27.

Tambago, R. D., & Espinosa, E. B., Sr. (2017) Organizational innovation and innovation adoption among Philippine food processing micro, small, and medium enterprises. International Journal of Organizational Innovation. https://www.ijoi-online.org

USAID (2022) Science, Technology, Research, and Innovation for Development (STRIDE) performance evaluation: Final report. USAID. https://usaid.gov

Vidal, J. C., Bauzon, C. C., & Robielos, R. A. C. (2020) Assessment on the assistance program for inventions of the DOST-Technology Application and Promotion Institute (TAPI) using analytic hierarchy process (AHP) approach. In Proceedings of the 5th North American International Conference on Industrial Engineering and Operations Management (pp. 1527-1537). Detroit, Michigan, USA, August 10-14, 2020. https://ieomsociety.org/ieom2020/papers/601.pdf

World Intellectual Property Organisation (2013–2023) Global Innovation Index 2013–2023

SINGAPORE

INTRODUCTION

After the pandemic, SMEs are facing productivity and innovation challenges. This report aims to assess the current state of SMEs' technological capabilities and the supporting innovation system in Singapore. It analyses the content, implementing mechanisms and effectiveness of the existing financial and non-financial government supporting measures for enhancing SMEs' technological and innovation capabilities. The report concludes by proposing policy recommendations to improve the existing policy measures and initiatives, initiate new ones and enhance the innovation system to enable more effective implementation of the policies.

AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

Historical Development of Singapore's National Innovation System

Since its political independence in 1965, Singapore has achieved high economic growth performance in the past five decades. Singapore's GDP per capita reached USD141,500 in 2023 in current international dollars converted by purchasing power parity (PPP) conversion factor (World Bank, 2023).

Public policy played a critical role in shaping Singapore's national innovation system (NIS), to support its economic development strategy. The country started labor-intensive industrialization with foreign MNCs in the first decade (1965 to mid-1970s), before developing local technological capabilities in precision engineering and components assembly (mid-1970s to late-1980s), establishing new public research institutions (PRIs) to support applied R&D activities of foreign MNCs (late-1980s to late-1990s). The country began its emphasis on indigenous technological capabilities by funding universities and PRIs to perform basic R&D including life sciences, fostering creation of high-tech start-ups, and creating a new biomedical industry (late-1990s to 2010). Following the review of the national science and technology (S&T) plans from 1991 to 2005, Singapore shifted its approach of focusing on S&T planning to mission-oriented innovation policy (MOIP) to tackle grand societal challenges (Cheah & Phua, 2022). From 2010, Singapore launched three five-year research, innovation and enterprise plans (RIE2015, RIE2020, and RIE2025). These RIEs aimed to support enterprises on their innovation journey by strengthening their capabilities and capacities for market-oriented innovation, as well as their connectivity with major innovation hubs and key demand markets (NRF, 2020). In 2023, 311,100 enterprises are operating in the country, offering employment to 3.71 million people and generating SGD615.7 billion in nominal value added (Department of Statistics, 2024). See Table 1.

TABLE 1

SINGAPORE'S ENTERPRISE LANDSCAPE 2023

		Enterprise Count Total: 311,100	Employment Total: 3.71 million	Nominal Value Added Total: SGD615.7 billion
Enterprise Size	SMEs	99%	71%	44%
	Non-SMEs	1%	29%	56%
Enterprise Ownership	Majority Local-owned	79%	68%	29%
	Majority Foreign-owned	21%	32%	71%

Source: SingStat (2023)

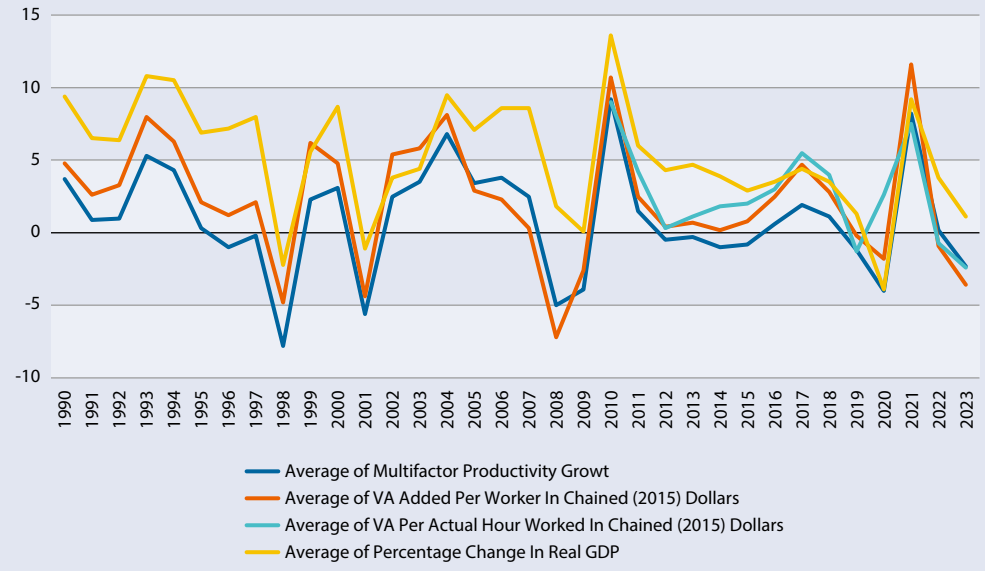
SMEs, defined as enterprises with operating revenue not exceeding SGD100 million or staff strength exceeding 200, play an important role in Singapore's economy as they make up 99% of these enterprises, creating 71% of employment, and contributing to about 44% of Singapore's nominal value added (SingStat, 2023). The number of SMEs in Singapore has increased from 273,800 in 2019 to 311,100 in 2023 (SingStat, 2024a).

Productivity

Singapore's productivity growth generally follows a cyclical pattern. See Figure 1. During economic downturns, its productivity declines as the GDP drops when firms reduce output before retrenching staff. During economic upturns, firms increase their output but employ staff after a lag. Due to the impact of business cycles on productivity, it is more meaningful to measure its performance over a longer time period, rather than for individual years.

FIGURE 1

SINGAPORE'S REAL GDP, REAL VA PER WORKER AND REAL VA PER AHW GROWTH, 1990–2023



Source: SingStat (2024b)

From 2009 to 2019, labor productivity, measured by real Value Added (VA) per Actual Hour Worked (AHW) and real VA per worker, met the productivity growth target of 2 to 3% per annum set by Economic Strategies Committee appointed by the government. real VA per AHW rose at a compounded annual growth rate (CAGR) of 2.8%. The real VA per worker grew by 2.4% per annum, from the 1.4% per annum growth in the preceding 1999–2009 period. Overall, Singapore's productivity improved by one-third (VA per AHW) to one-quarter (VA per worker) over the decade (SingStat, 2024b).

R&D Activities

Singapore's R&D journey was different from that of many other successful research-intensive countries. Unlike such countries as Germany and Switzerland where their national innovation systems developed organically from research-intensive industries or universities, Singapore's research and innovation system was directed by the government with the aim of fueling economic growth and achieving economic outcomes. Given its capacity constraints, the country adopted a phased and outcome-based approach to its R&D activities. Its public R&D budget has increased from SGD2 billion under the 1991 five-year National Technology Plan to SGD25 billion under the 2025 RIE Plan. Its annual public annual expenditure on R&D (PUBERD) rose from SGD262.2 million in 1990 to reach SGD4,087 million in 2021 at a compound annual growth rate (CAGR) of 9.3% over the past three decades (1990–2021). Its annual business expenditure on R&D (BERD) grew at a CAGR of 10.6% over the same period, from SGD309.5 million in 1990 to SGD7,088 million in 2021 (SingStat, 2024c). From Table 2, it is evident that both private and public sectors contributed to the high growth in R&D intensity, with the private sector R&D growing at a higher rate than the public sector R&D for the past three decades.

TABLE 2

COMPARISON OF R&D INTENSITY BETWEEN PRIVATE AND PUBLIC SECTORS

Year	GERD (SGD million)	BERD (SGD million)	PUBERD (SGD million)
1990	571.7	309.5	262.2
1991	756.8	442	314.8
1992	949.5	577.6	371.9
1993	997.9	618.6	379.3
1994	1,175	736.2	438.8
1995	1,366.6	881.4	485.2
1996	1,792.1	1,133.4	658.7
1997	2,104.6	1,314.5	790.1
1998	2,492.3	1,536.1	956.2
1999	2,656.3	1,670.86	985.4
2000	3,009.52	1,866.05	1,143.5
2001	3,232.68	2,045.02	1,187.7
2002	3,368.34	2,055.01	1,313.3
2003	3,396.9	2,053.62	1,343.3
2004	4,041.47	2,569.56	1,471.9
2005	4,569.41	3,018.54	1,550.9
2006	4,998.45	3,281.74	1,716.7
2007	6,326.2	4,222.1	2,104.1
2008	7,113.54	5,105.45	2,008.1
2009	6,009.08	3,689.06	2,320.0
2010	6,308.04	3,761.11	2,546.9
2011	7,271.73	4,446.29	2,825.4
2012	7,074.25	4,238.01	2,836.2
2013	7,393.51	4,315.42	3,078.1
2014	8,307.22	4,989.14	3,318.1
2015	9,207.58	5,469.39	3,738.2
2016	9,136.46	5,295.59	3,840.9
2017	9,002.13	5,325.15	3,677.0
2018	9,198.76	5,484.22	3,714.5
2019	9,690.45	5,916.67	3,773.8
2020	10,405.17	6,602.9	3,802.3
2021	11,175.89	7,088.19	4,087.7

Source: SingStat (2024c)

BERD is made up of capital expenditure, manpower and other operating expenses that are incurred for conducting three main types of R&D comprising basic research (15.5% of BERD in 2021), applied research (29.6%) and experimental development (53.6%), in a range of technology fields including electronics, biomedical sciences, precision and transport engineering, info-communication and media technology, as well as chemicals (A*STAR, 2024). Foreign companies play an important role in BERD as they accounted for 77% of BERD at SGD5,497 million in 2021. Manufacturing R&D, especially in the electronics sectors, attracted the most R&D expenditure among foreign companies at SGD3,183 million, representing 1.55% of their total sales revenue. Local companies, on the other hand, concentrated on services, particularly R&D and financial intermediation and other businesses, with R&D expenditure of SGD1,055 million at 0.68% of their sales revenue (A*STAR, 2024). This reflects that electronics and services remain as important sectors in the Singapore economy since the 1980s.

PUBERD is split among three public R&D sectors: institutes of higher learning (IHL), government sectors and PRIs. Prior to 1991, IHL performed much of the public R&D. With the setup of National Science and Technology Board (NSTB) in 1991 that later became Agency for Science, Technology and Research (A*STAR) in 2002, new PRIs were established and existing PRIs in some government ministries and IHLs were re-organized under A*STAR to focus on mission-oriented research, while universities would concentrate on academic research to build a base of fundamental scientific knowledge and polytechnics on translational research. The academic medical centers and hospitals would focus on translational and clinical research. PUBERD by PRIs grew rapidly to exceed that by IHLs, reaching a peak of 41% in 2005. From 2004 to 2006, as Singapore moved into the second phase of its biomedical initiative, reviews of Singapore's public universities were made to transform them into autonomous and research-intensive institutions, leading to a significant increase in PUBERD to these universities for academic research (Lim, 2016). Five Research Centres of Excellence (RCEs) were set up in the two largest universities - the National University of Singapore (NUS) and the Nanyang Technological University (NTU) to attract and develop high-quality research talent to generate new knowledge, and attaining high international ranking in global university rankings in the process. NUS was ranked eighth while NTU emerged 15th in Britain-based Quacquarelli Symonds (QS) World University Rankings 2025 (Chan, 2024).

Singapore's government actively monitors the returns to R&D among firms operating in the country. A 1% increase in R&D stock was found to raise firm-level productivity by 0.135% on average during the 2002–2017 period, comparing favorably with that of other advanced economies (Teo et al., 2019). A review of the impact of R&D on firms' productivity shows its steady increase over two S&T and two RIE plans in the same period. See Table 3 below. The estimated elasticity increased from 0.107 for S&T Plan 2005 (2002–2005) to 0.168 for RIE Plan 2020 (2016–2017), with corresponding increase in dollar impact from SGD0.20 in 2002–2005 to SGD0.28 in 2016–2017 (Teo et al., 2019).

TABLE 3

IMPACT OF R&D ON FIRM'S PRODUCTIVITY

Period	2002–2005	2006–2010	2011–2015	2016–2017
βs	0.107***	0.140***	0.144***	0.168***
Dollar impact (SGD)	0.20	0.24	0.24	0.28

*p<0.10 **p<0.05 ***p<0.01

Source: Teo et al. (2019)

Innovation and Intellectual Property (IP) of Singapore's NIS

Innovation

According to a study of 272 SMEs conducted in 2017 by the Asian Competitiveness Institute at the NUS School of Public Policy, 26% introduced new products and services in 2015 primarily in the food manufacturing and retail industries. The other industries including logistics, precision engineering and transport engineering were lacking in innovation (Zhang & Zhu, 2021). The study revealed that skilled labor, R&D expenditure and internalization factors were significantly associated with higher levels of innovation, raising the innovation probability by 22%, 17% and 10%, respectively.

Although Singapore has consistently ranked first in the Innovation Input Sub-Index of the Global Innovation Index (GII) published by the United Nations (UN) agency World Intellectual Property Organization (WIPO), it ranked 20th in the Innovation Output Sub-Index in 2015, resulting in an overall innovation efficiency ratio ranking of 100th. Creative outputs were reported to be a weak area at the 33rd place, while knowledge and technology outputs ranked 12th in the same year (Lim, 2016) This could be attributed in part to the relatively early stage of the government-led effort of developing the country's innovation ecosystem. MNCs dominated in many R&D-intensive industry sectors, while local enterprises were still conservative in their R&D investments. This contrasted sharply with the other innovative small economies such as Sweden and Switzerland, where several home-grown MNCS would contribute to a major proportion of BERD at about 80% and 49%, respectively (Jacob et al., 2016). Cognizant of this challenge, the Singapore government has since increased its emphasis on upgrading the technological capability of SMEs by offering incentives and schemes to encourage SMEs to perform R&D through transfer of technologies and expertise from PRIs. For the past four years, Singapore has witnessed a steady improvement in its ranking in Innovation Output Sub-Index, rising 15th in 2020 to 12th in 2023 (WIPO, 2023). In 2023, Singapore's creative outputs rose to 18th place from 33rd in 2015, while knowledge and technology outputs emerged as 10th place from the 12th in 2015.

The World Bank (2024) began to collect firm-level Enterprise Survey (ES) through its partners worldwide since 2002. To date, they had collected data from over 125,000 firms in more than 140 countries. Data are utilized to create over 100 indicators to benchmark the quality of the business environment around the world. Each country survey could take place every three to four years. In 2023, Singapore participated in the ES for the first time to capture innovation and technology output of the companies, among other characteristics. The ES cover small, medium, and large firms. The size of the firm is determined by the number of employees: 5 to 19 (small), 20 to 99 (medium), and 100 or more (large). Firms with less than five employees are ineligible for the survey. Firms that are 100% state-owned are also ineligible. Table 4 compares Singapore firms' innovation and technology output with other economies in East Asia Pacific, as well as high-

income countries worldwide. Compared to other economies in East Asia and Pacific, a higher proportion of large Singapore firms spent on R&D and medium firms introduced a new product/ service in the last three years. However, Singapore's firms tend to fall behind their counterparts in East Asia and high-income countries in other aspects.

TABLE 4

COMPARISON OF SINGAPORE FIRMS' INNOVATION AND TECHNOLOGY OUTCOMES WITH EAST ASIA PACIFIC AND HIGH-INCOME ECONOMIES.

Innovation and Technology Indicator	Singapore				East Asia & Pacific	High Income
	All firms	Small	Medium	Large		
Percent of firms that spend on R&D in the last fiscal year	12.2	n.a.	11.5	15.6	11.7	22.4
Percent of firms that introduced a new product/ service over the last 3 years	18.5	15.9	23.6	20.2	22.8	39.8
Percent of firms whose new product/ service is also new to the main market	54.3	59.0	50.1	40.4	73.9	64.4
Percent of firms that introduced a process innovation over the last 3 years	14.9	13.0	17.7	19.7	22.2	25.0

Source: World Bank (2024)

Intellectual Property (IP)

From the 1970s to mid-1990s, the number of patents granted by USPTO to Singapore-based inventors was low at 52 in 1976–1985 and 375 in the 1986–1995 periods. Over half of these patents were assigned to foreign companies, indicating Singapore's reliance on the R&D performed by foreign MNCs. See Table 5.

TABLE 5

ANALYSIS OF PATENTS BETWEEN 1976 TO 2015

Periods	1976–1985	1986–1995	1996–2000	2001–2005	2006–2010	2011–2015	Total
Patents by Singapore Inventors							
Singapore Assignee	30	148	480	1303	1443	2157	**5561**
Foreign Assignee	22	227	463	1239	1708	1408	**5067**
Total	52	375	943	2542	3151	3565	**10628**
Patents by Foreign Inventors Assigned to Singaporean Organizations	11	30	64	134	1865	1729	**3833**
Total	**63**	**405**	**1007**	**2676**	**5016**	**5294**	**14461**

Source: USPTO (2024a, b)

As the Singapore government pushed towards a knowledge-based economy in 1999, it revamped the regime through new legislation and growing IP awareness and expertise for strong protection of designs, as well as knowledge in the form of patents and other IP, that can be managed. Since then, the number of USPTO patents granted to Singapore-based inventors rose to 9258 after 2000, making up over 87% of the total cumulative number of patents granted. The number of patents assigned to Singapore companies exceeded that to the foreign companies, indicating the growth in home-grown innovation by the local public and private sector companies, including high-tech startups (USPTO, 2024a, b).

Entrepreneurial Propensity

The annual Global Entrepreneurship Monitor (GEM) study provided a good source of data comparing the entrepreneurial propensity of Singapore against other 26 participating countries. One of the indicators Total Early-Stage Entrepreneurial Activity (TEA) measured the sum of the percentage of all respondents involved in either a nascent firm (a new start-up with no wages paid for more than 3 months) or a young firm (new business for which wages have been paid between 3 and 42 months). In the GEM study led by Chernyshenko et al. (2015), Singapore's TEA was found to rise from 4.2% in 2000 to 11.0% in 2014. This means in 2014, 11% of the adult population aged between 18 and 64 was found to be engaged in new entrepreneurial ventures, compared to only 4.2% in 2000. The increase in Singapore's entrepreneurial activity saw its ranking climb from 20th of 21 participating countries in 2000 to 4th of 27 participating countries in 2014. Among the top five countries in TEA, Singapore was behind the US (13.8%). Australia (13.1%) and Canada (13.0%). Its consistent high ranking in TEA among the top five economies since 2012 could be attributed to the munificence of entrepreneurial finance and strong government policy support in entrepreneurial education. The country's strong emphasis on R&D and its commercialization through high-tech startups could partially explain why Singapore early-stage businesses were among the highest in deploying the latest or new technology. More than half (52.2%) of new businesses reported utilizing the latest (19.3%; ranked 3rd) or new technology (32.9%; ranked 1st) to operate their business. This marked an improvement from past results (where combined latest and new technology utilization rates were 46.5% in 2011, 43.9% in 2012, and 48.0% in 2013) (Chernyshenko et al., 2015). See Table 6.

TABLE 6

ENTREPRENEURIAL PROPENSITY OF SINGAPORE ADULT POPULATION, 2000–2013

	2000	2002	2006	2012	2013	2014
Singapore						
Total Entrepreneurial Activity Rate (TEA)	4.2	5.9	4.9	11.6	10.7	11
Ranking of Singapore	20 of 21	21 of 37	16 of 22	2 of 25	3 of 26	4 of 27
Utilization of the latest technology (%)				15.4	24.2	19.3
Ranking of Singapore				4 of 25	3 of 26	3 of 27
Utilization of the new technology (%)				28.5	23.8	32.9
Ranking of Singapore				2 of 25	6 of 26	1 of 27

Source: Chernyshenko et al. (2015)

Entrepreneurial Financing

The emergence of alternative financing mechanisms has provided SMEs with an additional, more flexible source of funding that offers quicker turnaround times and comes with less stringent eligibility criteria. This shift has significantly contributed to economic development by creating more jobs and driving national growth. Singapore's positioning as a technopolis and financial hub has further enhanced its economic resilience and global competitiveness. Government initiatives have cultivated a vibrant ecosystem, attracting stakeholders from local, regional, and global arenas. In 2023, venture capital firms invested USD6.1 billion to support the continued growth of this ecosystem. Crowdfunding has also become a vital resource for SMEs in Singapore, helping them manage debt effectively, with the volume of crowdfunding projected to reach USD0.62 million by 2024 (Statista, 2024).

Debt Funding

Interest rates for SME loans saw a significant spike in 2023, rising more than threefold from a low of 2.5% per annum in April 2020 to 8.16% per annum (Linkflow Capital, 2024) (see Table 7).

TABLE 7

SME LOAN INTEREST RATE MOVEMENT, 2013–2023

Year	2013	2014	2015	2016	2017	2018	2019	2020	2020 Mar	2020 Apr	2021	2022	2023
Effective Interest Rate p.a.	5.75	6.00	6.50	6.75	6.75	7.00	7.00	6.50	3.75	2.50	4.50	5.55	8.16

Source: Linkflow Capital (2024)

This surge reflects the broader global economic conditions and central bank policies aimed at combating inflation. The higher borrowing costs have placed increased financial strain on SMEs, particularly those with tighter margins. As a result, the average loan quantum has decreased, dropping from SGD184,345 in 2022 to SGD130,236 in 2023 (Linkflow Capital, 2024) (see Table 8). Faced with rising borrowing costs, many SMEs have been forced to reassess their financing strategies, explore alternative funding sources, or implement cost-cutting measures to manage higher debt servicing expenses.

TABLE 8

AVERAGE SME-APPROVED LOAN QUANTUM, 2021–2023

	2021	2022	2023
Average-approved loan quantum (in SGD)	224,398	184,345	130,236

Source: Linkflow Capital (2024)

Equity Funding

A study led by DealstreetAsia in collaboration with Enterprise Singapore highlights notable changes in Singapore's venture capital landscape. Singapore outperformed other ASEAN countries in terms of both deal volume and market value, recording 552 deals worth SGD6.10 billion (DealstreetAsia, 2023) (see Table 9).

TABLE 9

DEAL VOLUME AND VALUE PER MARKET ACROSS ASEAN COUNTRIES IN 2023

Country	Deal Count	Deal Value (USD Billion)
Thailand	28	0.13
Philippines	34	0.19
Malaysia	52	0.11
Vietnam	54	0.51
Indonesia	130	1.28
Singapore	522	6.10

Source: DealstreetAsia (2023)

While Singapore has maintained its status as a leading venture capital hub in Southeast Asia, the market has faced significant contraction in recent years, reflecting broader global economic challenges. According to (DealstreetAsia, 2023), there was a 26.3% year-on-year decline in deal volume across the six ASEAN countries (see Table 10).

TABLE 10

YEAR-ON-YEAR CHANGE IN DEAL VOLUME ACROSS ASEAN COUNTRIES, 2022–2023

	2022	2023	Year-on-Year Change in Deal Volume
Singapore	651	522	-19.8%
Indonesia	255	130	-49%
Vietnam	82	54	-34.1%
Malaysia	68	52	-23.5%
Philippines	45	34	-38.2%
Thailand	38	28	-26.3%

Source: DealstreetAsia (2023)

Overall, these countries experienced a 28.6% drop in venture capital activity, with the number of deals decreasing from 1,149 to 820, and the total value falling by 52.9% from SGD17.65 billion to SGD8.32 billion between 2022 and 2023 (DealstreetAsia, 2023). When segmented by industry, payment service providers and gateways showed the most significant growth in deal value, with a 42,496.9% increase from the first to the second quarter of 2022. Meanwhile, the highest number of deals occurred in the payment processors and specialty finance: commercial-focused industries (Zhang, 2022) (see Table 11).

TABLE 11

DATA STORIES: H1 2022 PRIVATE EQUITY AND VENTURE CAPITAL TRENDS IN ASEAN

Top 10 Industry Verticals by Deal Value	Deal Value (USD Million)			Deal Count		
	1Q2022	2Q2022	% Change	1Q2022	2Q2022	% Change
Internet Software and Services	829.6	1,108.8	33.4%	96	63	-34.4%
Application Software	825.6	554.7	-32.8%	59	47	-20.3%
Internet and Direct Marketing Retail	311.2	405.8	30.4%	30	12	-60.0%
Healthcare Technology	14.7	364.3	2383.9%	9	10	11.1%
Systems Software	101.6	341.7	236.4%	6	7	16.7%

Source: Zhang (2022)

OVERVIEW OF GOVERNMENTAL SCHEMES FOR SMES

Singapore has introduced a range of government schemes designed to promote innovation and provide support to SMEs. These programs aim to boost SMEs' competitiveness and encourage the adoption of technology to drive business innovation. Through these grants and other targeted funding options, business owners receive the financial backing necessary to improve their capabilities, skills, and knowledge (GoBusiness, 2024a). These initiatives are part of a larger national strategy that reflects the government's dedication to building a dynamic entrepreneurial ecosystem, ensuring that SMEs have the resources they need to innovate, grow, and compete on a global scale.

The government actively fosters innovation and productivity through a mix of supply-side policy instruments (grants/subsidies, investments and loans) and demand-side policy instruments.

Supply-side Policy Instruments and Effectiveness

Grants/Subsidies

Introduced in April 2018, the Productivity Solutions Grant (PSG) offers Singaporean companies the means to enhance their productivity by leveraging IT tools and solutions to automate processes. With a cap of SGD30,000 per company, business owners can receive financial assistance for purchasing IT solutions and equipment (Enterprise Singapore, 2024a). This support scheme was extended in recognition of how technology can assist businesses to remain resilient, giving them additional time to adopt these systems amidst the disruptions caused by the COVID-19 pandemic.

PSG offers both sector-specific and generic solutions to increase the scope of coverage while enhancing innovation and improving productivity. Sector-specific solutions are tailored to meet the needs of businesses within particular industries. Developed in collaboration with key industry players, these solutions align with strategic frameworks such as the Industry Transformation Maps (ITMs) and Industry Digital Plans (IDPs). They are aimed at modernizing operations, improving efficiency, reducing manual tasks, and enhancing data management to address industry-specific challenges and boost productivity. In contrast, generic solutions are applicable to businesses across various sectors and industries. These solutions are designed to improve productivity in managing general business functions and processes, benefiting organizations regardless of their industry or sector.

As reported by the Infocomm Media Development Authority (IMDA, 2023), the overall technology adoption rate and intensity rose from 74% to 94% between 2018 and 2022 (see Table 12).

TABLE 12

OVERALL TECHNOLOGY ADOPTION RATE AND ADOPTION INTENSITY, 2018–2022

	Technology Adoption Rate (%)	Technology Adoption Intensity
2018	74%	1.7
2019	85%	1.9
2020	88%	1.9
2021	91%	2.0
2022	94%	2.1

Source: IMDA (2023)

This notable increase demonstrates the effectiveness of the PSG in promoting technological adoption among businesses. The scheme has also bolstered the competitiveness of non-SMEs by providing them with a market advantage through timely responses to emerging needs and facilitating efficient scaling of operations. However, statistics indicate that there remains potential for further technology adoption among SMEs, with a 94.3% adoption rate compared to full utilization by non-SME companies (see Table 13).

TABLE 13

TECHNOLOGY ADOPTION RATE AND INTENSITY BY SMES AND NON-SMES, 2018–2022

	Technology Adoption Rate (%)		Technology Adoption Intensity	
	2018	2022	2018	2022
SMEs	73.8%	94.3%	1.7	2.1
Non-SMEs	99.5%	100.0%	4.7	5.7

Source: IMDA (2023)

To address this gap, the PSG employs a lean, multi-pronged approach, offering both generic and sector-specific solutions to help SMEs effectively meet their business needs.

The number of unique PSG recipients that participated in the SME Go Digital Programme by IMDA increased from 100 in 2017 to 9,545 in 2020 (Liu et al., 2023). Receiving a PSG grant of an average amount was found to have improved firms' value added per worker (VAPW) and revenue by 3.0% and 2.2% respectively. The higher VAPW was driven by an increase in value added, rather than cutting down headcount as the total employment increased by 1.0% (Liu et al., 2023).

The SkillsFuture Enterprise Credit (SFEC) provides invited eligible businesses with an automatic disbursement of a lump-sum of SGD10,000 to invest in enterprise transformation and employees' capabilities, covering up to 90% of out-of-pocket expenses for eligible initiatives (Enterprise Singapore, 2024b). The expiry date for SFEC has been extended by one year to 30 June 2025, giving employers an additional year to claim any unused credit. In 2022, about 20,000 enterprises participated in SkillsFuture Singapore-supported programs, of which more than 5,000 new enterprises used SkillsFuture Enterprise Credit to offset course fees for their employees (SSG, 2023).

The Enterprise Development Grant (EDG) offers financial assistance to Singapore companies for projects aimed at improving their business, exploring new growth opportunities, or expanding internationally (Enterprise Singapore, 2024c). To qualify, business owners must submit detailed project proposals that outline their business plans and anticipated outcomes. Local SMEs can receive up to 50% support through the EDG, with sustainability-related projects eligible for up to 70% support from 1 April 2023 to 31 March 2026 (Enterprise Singapore, 2024d). The EDG provides businesses with a fixed term of 12 to 18 months to complete their projects, allowing them to strengthen new capabilities and ensure that outcomes remain relevant to market needs (Enterprise Singapore, 2024c). Past statistics has been observed that out of over 20,400 EDG applications received between Financial Year (FY) 2019 and 2021, approximately 85% were approved, with most projects completed within three years of receiving the grant (MTI, 2022). From 2009 to 2018, there were on average over 700 EDG recipients per year (Toh et al., 2021a).

The Global Innovation Alliance (GIA) co-innovation programs provide Singapore-based companies and their overseas partners with the opportunity to collaborate on R&D projects with strong market potential. According to Enterprise Singapore (2024e), eligible companies can receive up to 70% support through the Enterprise Development Grant (Co-Innovation Programme), or EDG (CIP), which allows them to purchase items necessary for their joint R&D projects to develop new products or solutions. Through platforms like b2match or Innovation Partner for Impact (IPI), businesses can connect with overseas collaborators across 37 countries to initiate these projects (Enterprise Singapore, 2024e). To date, 481 firms have benefited from this collaboration, including 231 Singapore firms, representing 48.02% of all participating countries (b2Match, 2024).

The Local Enterprise and Association Development (LEAD) Programme provides trade associations and chambers (TACs) with vital financial and resource support to enhance their internal capabilities and broaden market access through international trade fairs and overseas business missions. The program offers subsidies covering up to 70% of eligible costs across various development areas, including manpower expenses, equipment, and materials. This support is designed to transform industries by enhancing core capabilities such as manpower efficiency, productivity, business capability development, market offerings, and the adoption of sustainability initiatives (Enterprise Singapore, 2024f; Singapore Tourism Board, 2023). The LEAD Programme is particularly focused on driving industry-wide initiatives in crucial areas like productivity, sustainability, technology and infrastructure, business collaborations, and intelligence and research. By fostering these areas, the program aims to promote industry transformation, enabling local enterprises to compete more effectively on a global scale while ensuring sustainable growth and innovation within their sectors. Since its inception, 23 TACs have engaged in this initiative to co-create growth opportunities, with over 8,300 local SMEs expected to benefit from these industry-led projects upon their completion (SPRING Singapore, 2017).

Investments

SEEDS Capital, the investment arm of Enterprise Singapore, is one of the designated fund managers for the Startup SG Equity (SSGE) scheme, which plays a key role in fostering innovation and entrepreneurship. This initiative supports early-stage startups in Singapore by co-investing alongside accredited private sector investors. The co-investment approach offers the dual advantages of tapping into the expertise and capital of these investors while mitigating risks through shared investment. This is particularly beneficial in reducing the financial burden on startups working with frontier technologies, which typically require a longer time to reach maturity (see Table 14) (Enterprise Singapore, 2024g; SEEDS Capital, 2024).

TABLE 14

RATIO OF SEEDS CAPITAL CO-INVESTMENT IN START-UPS AND AN IDENTIFIED CO-INVESTMENT PARTNER

	General Tech	Deep Tech
Investment cap for each startup	SGD2 million from SEEDS Capital	SGD8 million from SEEDS Capital
Co-investment Ratio (SEEDS Capital: Co-investor) for first institutional round and before	7:3 up to the first SGD250,000 from SEEDS Capital; 1:1 thereafter, up to SGD2 million	7:3 up to the first SGD500,000 from SEEDS Capital; 1:1 thereafter, up to SGD4 million; 3:7 thereafter, up to SGD8 million
Co-investment ratio (SEEDS Capital: Co-investor) for second institutional round and onwards	1:1 thereafter, up to SGD2 million	1:1 thereafter, up to SGD4 million; 3:7 thereafter, up to SGD8 million

Source: Enterprise Singapore (2024g)

By driving innovation, this funding initiative also enhances Singapore's appeal to foreign investors. SEEDS Capital not only nurtures startups but also helps them scale, thereby creating significant economic growth and increasing job opportunities for local residents. This aligns with its core objective of supporting promising startups across diverse sectors, including deep tech, healthcare, food and agritech, and urban solutions, to strengthen Singapore's innovation ecosystem.

The Startup SG Equity scheme enhances Singapore's innovation ecosystem by offering equity co-investment and significant support to early-stage startups. Overseen by Enterprise Singapore along with its designated fund managers like SEEDS Capital and SGInnovate, this initiative was started in 2017 employs a co-investment model to underscore the government's commitment to fostering a startup culture and mitigating early-stage risks for startups (see Table 15) (Startup SG, 2024). Between 1 April 2017 and 31 October 2018, the government co-invested in 62 startups under the Startup SG Equity scheme. The government's funding of SGD43.8 million for these 62 startups catalyzed SGD50.3 million of private sector funds from their appointed co-investment partners (MTI, 2018). In 2020, another SGD300 million fund was injected by the government in 2020 was expected attract at least SGD800 million in private funding for deep-tech startups over the next decade (Quek, 2020).

TABLE 15

INVESTMENT PARAMETERS OF STARTUP SG

Investment Parameters		
	General Tech	Deep Tech
Investment Cap for each startup	SGD2 million from SEEDS Capital	SGD8 million from SEEDS Capital
Co-Investment Ratio (SEEDS Capital: Co-investor) for 1st institutional round and before	7:3 up to the first SGD250,000 from SEEDS Capital; 1:1 thereafter, up to SGD2 million	7:3 up to the first SGD500,000 from SEEDS Capital; 1:1 thereafter, up to SGD4 million 3:7 thereafter, up to SGD8 million
Co-Investment Ratio	1:1 thereafter, up to SGD2 million	1:1 thereafter, up to SGD4 million 3:7 thereafter, up to SGD8 million

Source: Startup SG (2024)

By adopting a fund-of-funds strategy, the government selects promising venture capital firms that focus on early-stage deep tech startups in sectors such as Advanced Manufacturing, Pharmbio/Medtech, or Agri-food tech, with at least SGD30 million allocated to these businesses (Startup SG, 2024). Table 16 illustrates that startups have actively sought initial funding, as evidenced by an SGD0.53 billion increase in early-stage funding from 2021 to 2022 (DealstreetAsia, 2023). By reducing investment risk for private investors, the scheme plays a crucial role in accelerating the growth of innovative startups in Singapore.

TABLE 16

DEAL VALUE OF EARLY VERSUS LATE STAGE FUNDING (SGD BILLION)

	2020	2021	2022
Early Stage	1.46	4.28	4.81
Late Stage	2.66	7.05	6.18

Source: DealstreetAsia (2023)

Loans

The Enterprise Financing Scheme - Venture Debt (EFS – VD) is a financing initiative designed to support the growth of innovative enterprises by providing access to non-dilutive capital. Launched in October 2015, it primarily serves high-growth startups and SMEs with high-risk profiles or insufficient tangible assets for collateral and hence, which limits their ability to secure traditional bank loans (Enterprise Singapore, 2021). The maximum loan amount under this scheme is set at SGD8 million per borrower, with a repayment period of up to five years (Enterprise Singapore, 2024h). Since 1 April 2021, the EFS – VD has been extended, with the loan quantum increased from SGD5 million to SGD8 million per borrower, enabling more flexible repayment plans for early-stage or deep tech start-ups with inconsistent cash flows (Enterprise Singapore, 2021).

The loans can be used to enhance capacity expansion, diversify product offerings, bolster working capital, undertake new projects, or pursue mergers and acquisitions. The Committee of Supply 2023 has announced that the EFS has been further enhanced to include venture debt loans backed by Redeemable Convertible Preference Shares (RCPS), providing repayment flexibility for early-stage or deep-tech startups with irregular cash flows (Enterprise Singapore, 2024h). This enhancement, extended until 31 March 2024, includes a 70% government risk-share for trade loans, increased maximum quantum for trade and working capital loans, and support for domestic construction projects through project loans (Enterprise Singapore, 2024h)

See Table 17 for a summary of supply-side policy instruments.

TABLE 17

SUMMARY OF SUPPLY-SIDE POLICY INSTRUMENTS

No	Scheme/Agency/ Date of Introduction	Impact	Objective	Mechanism
	GRANTS			
1	Productivity Solutions Grant (PSG) Enterprise Sg April 2018	The number of unique PSG recipients increased from 100 in 2017 to 9,545 in 2020. Receiving a PSG grant of an average amount was found to have improved firms' VAPW and revenue by 3.0% and 2.2% respectively.	PSG aims to improve productivity and enhance business processes through a wide range of productivity solutions, including IT solutions and equipment.	PSG provides companies up to 80% of funding support to adopt the pre-scoped solutions. The list of supportable solutions for PSG can be found on GoBusiness Gov Assist
2	SkillsFuture Enterprise Credit (SFEC) SkillsFutures Singapore 2020	In 2022, more than 5,000 new enterprises used SkillsFuture Enterprise Credit to offset course fees for their employees.	SFEC aims to encourage employers to undertake enterprise and workforce transformation initiatives. It provides additional support, over and above the existing schemes, to eligible employers for their enterprise and workforce transformation efforts.	Eligible employers receive a one-off credit of up to SGD10,000 per entity to cover up to 90% of out-of-pocket expenses (refer to Q5 for illustration) on qualifying costs for enterprise transformation programs and workforce transformation programs. a. Enterprise Transformation (up to SGD7,000 only) – Schemes by various agencies hosted on the Business Grant Portal (BGP); and/ or b. Workforce Transformation (up to the full SGD10,000) – Training courses aligned to the various Industry Skills Frameworks by SkillsFuture Singapore (SSG), Job Redesign initiatives, and Career Conversion Programmes etc. by Workforce Singapore (WSG)
3	Enterprise Development Grant (EDG) Enterprise Sg 25 Oct 2018	From 2009 to 2018, there were on average over 700 EDG recipients per year.	EDG supports projects that help companies upgrade, innovate, grow and transform their business.	EDG funds qualifying project costs namely third-party consultancy fees, software and equipment, and internal manpower cost. Up to 50% of eligible costs for local SMEs From 1 April 2023, SMEs can receive up to 50% support for EDG (sustainability-related projects may be supported at up to 70% from 1 April 2023 to 31 March 2026). Please refer to the Enterprise Sustainability Programme page for more details.
4	Co-innovation Programmes Enterprise Sg 24 Nov 2017	To date, over 480 firms have benefited from this collaboration, including 231 Singapore firms, representing 48.02% of all participating countries	The Global Innovation Alliance (GIA) is a network of Singapore and overseas partners in major innovation hubs and key demand markets, with a focus on technology and innovation. Under GIA, Co-innovation Programmes support Singapore-based companies and their overseas partners to collaborate on R&D projects which will result in new products or solutions with strong market potential.	If awarded, eligible companies could receive up to 70% support from the Enterprise Development Grant (Co-Innovation Programme), or EDG (CIP), for qualifying cost items to collaborate with their foreign, in-market partners on innovation activities such as joint R&D projects to develop new products or solutions.

No	Scheme/Agency/ Date of Introduction	Impact	Objective	Mechanism
5	Local Enterprise and Association Development Programme Enterprise Sg 2005	Since its inception, 23 TACs have engaged in this initiative to co-create growth opportunities, with over 8,300 local SMEs expected to benefit from these industry-led projects upon their completion	For trade associations and chambers that aim to drive capability development and internationalization projects for SMEs. Enterprise capability and industry development Innovate and automate for better productivity. This includes adopting technology, developing industry-wide certification and technical standards, and establishing shared infrastructure or service. Market access Help companies access overseas markets through participation in international trade fairs and overseas business missions. TAC capability upgrading Strengthen internal capabilities to be effective change agents and industry multipliers.	Support for up to 70% of eligible costs for qualifying projects, including: Manpower-related costs: project members' salaries Equipment and materials: equipment, materials, consumables and technical software required for the project Professional services: consultancy and subcontracting Business development costs: organizing a Singapore Pavilion at Trade Fairs or leading Business Missions IP costs: licensing, royalties and technology acquisition costs
	INVESTMENTS			
6	SEEDS Capital Enterprise Sg 2001	Currently, there are over 100 deep tech startups in SEEDS Capital's portfolio, and more than 50 co-investment partners, consisting of institutional investors including venture capital firms and investment arms of corporations.	For co-investors in strategic industries such as Advanced Manufacturing & Engineering, Health & Biomedical Sciences, and Urban Solutions & Sustainability, and emerging industries such as agritech, Artificial Intelligence, Blockchain, Quantum Computing, and Space Technologies. For Singapore-based startups to get early-stage funding for the development of nascent technologies and innovative solutions.	SEEDS Capital co-invests in startups alongside an identified co-investment partner, with predetermined ratios.
7	Startup SG Equity Enterprise Sg 2017	The government's funding of SGD43.8 million for these 62 startups catalyzed SGD50.3 million of private sector funds from their appointed co-investment partners.	The Startup SG Equity scheme aims to stimulate private sector investments into innovative, Singapore-based technology startups with IP and global market potential.	As part of the Startup SG Equity scheme, the government will: (i) Co-invest with independent, qualified third-party investors into eligible startups; and (ii) Invest in selected venture capital firms that will in turn invest into eligible startups, through a fund-of-funds approach. SEEDS Capital and SGInnovate have been appointed to manage the co-investment modality under Startup SG Equity. EDBI has been appointed to manage the fund-of-funds modality under Startup SG Equity. Under the co-investment modality, Startup SG Equity has different investment parameters for general tech and deep tech startups:

No	Scheme/Agency/ Date of Introduction	Impact	Objective	Mechanism
	LOANS			
8	Enterprise Financing Scheme - Venture Debt (EFS-VD) Enterprise Sg October 2015	NA	EFS-VD aims to support the adoption of venture debt in Singapore. Venture debt and warrants can help to finance and improve the growth of innovative, high-growth enterprises that may not have significant assets to be used as collateral under traditional bank lending. Enterprises may use the loan to grow and expand existing capacity, diversify into other product lines, augment working capital needs, undertake new projects, and to undergo mergers and acquisitions.	The EFS-VD provides Participating Financial Institutions (PFIs) with 50% risk-share for eligible loans, with the option of 70% risk-share for young companies.

Source: Enterprise Singapore (2024a, b, c, d, e, f, g, h); GoBusiness (2024b)

Demand-side Policy Instruments

Tender Lite

Tender Lite is a newly established category aimed at fostering innovation by promoting competition and the creation of innovative solutions to address specific public sector challenges or needs. Launched in late 2023, it simplifies the traditional public procurement process to make it easier for SMEs and startups to engage in public tenders, particularly those focused on innovation. This approach encourages technological progress and enhances problem-solving abilities among entrepreneurs. Additionally, it ensures the efficient use of public funds by attracting more suppliers to compete for tenders ranging from SGD90,000 to SGD1,000,000, with over 70% of these tenders awarded to SMEs (Huang, 2023). Each year, around 80% of government contracts go to SMEs, helping these businesses build their track records and develop capabilities for new growth opportunities (Huang, 2023).

Grants

Market Readiness Assistance (MRA) Grant was launched in 2013, by Enterprise Singapore to support SMEs in business development, promotion and set-up costs when they expand into a new overseas market. The MRA grant provides funding support, where local SMEs can receive a support level of up to 50% of eligible costs for supported activities in new markets, capped at SGD100,000 per company per new market until the end of March 2025 (Enterprise Singapore, 2024i). Supported activities for Singapore companies include overseas market promotion, overseas business development and overseas market set-up. From 2009 to 2018, there were on average 398 recipients of MRA grant per year (Toh et al., 2021b).

The Productivity Solutions Grant (PSG) would enable Singapore companies to purchase their IT tools and solutions from fellow Singapore companies providing such equipment and solutions in the infocommunication industry (Enterprise Singapore, 2024a).

The Skills Future Enterprise Credit (SFEC) by SkillsFutures Singapore would allow Singapore companies to purchase skill training and development services provided by Singapore companies in the training and education industry (Enterprise Singapore, 2024b).

Enterprise Development Grant (EDG) would facilitate adoption of new capabilities provided by Singapore companies to Singapore companies to improve their businesses, explore new growth opportunities and expanding internationally (Enterprise Singapore, 2024c).

The Local Enterprise and Association Development (LEAD) Programme provides trade associations and chambers (TACs) with vital financial and resource support to drive industry-wide initiatives in crucial areas like productivity, sustainability, technology and infrastructure, business collaborations, and intelligence and research. This grant will enable adoption of such services and solutions provided by Singapore companies (Enterprise Singapore, 2024f).

See Table 18 for a summary of demand-side policy instruments.

TABLE 18

SUMMARY OF DEMAND-SIDE POLICY INSTRUMENTS

No	Scheme/Agency	Impact	Objective	Mechanism
1	Tender Lite/ Ministry of Finance Apr 2024	NA	Allow businesses easier access to smaller value Government Tenders and build their capabilities before competing for higher value Tenders.	The streamlined set of contract conditions for Tender Lite creates a more gradual progression from Quotations (simple and few conditions) to Tenders (more and complex conditions).
2	Market Readiness Assistance (MRA) Grant/ Enterprise Singapore 2013	From 2009 to 2018, there were on average 398 recipients of MRA grant per year.	Provide SMEs with support for business development, promotion and set-up costs when they expand into a new overseas market	Funding support: Local SMEs can receive a support level of up to 50% of eligible costs for supported activities in new markets, capped at SGD100,000 per company per new market until the end of March 2025. Supported activities for Singapore companies include: Overseas market promotion (capped at SGD20,000 per new market) including overseas physical trade fairs, virtual trade fairs, overseas marketing and public relations activities (in-store promotions, road shows, pop-up stores, media announcements and ads) Overseas business development (capped at SGD50,000 per new market) such as business matching, overseas marketing presence, in-market business development Overseas market set-up (capped at SGD30,000 per new market) including market entry support (IP application, import-export licenses, etc.) and free trade agreements (FTAs) and trade compliance consultancy.
3	Productivity Solutions Grant (PSG) Enterprise Sg April 2018	Receiving a PSG grant of an average amount was found to have improved firms' VAPW and revenue by 3.0% and 2.2% respectively	PSG aims to improve productivity and enhance business processes through a wide range of productivity solutions, including IT solutions and equipment.	PSG provides companies up to 80%1 of funding support to adopt the pre-scoped solutions. The list of supportable solutions for PSG can be found on GoBusiness Gov Assist

No	Scheme/Agency	Impact	Objective	Mechanism
4	Skills Future Enterprise Credit (SFEC) SkillsFutures Singapore 2020	In 2022, more than 5,000 new enterprises used SkillsFuture Enterprise Credit to offset course fees for their employees.	SFEC aims to encourage employers to undertake enterprise and workforce transformation initiatives. It provides additional support, over and above the existing schemes, to eligible employers for their enterprise and workforce transformation efforts.	Eligible employers receive a one-off credit of up to SGD10,000 per entity to cover up to 90% of out-of-pocket expenses (refer to Q5 for illustration) on qualifying costs for enterprise transformation programs and workforce transformation programs. a. Enterprise Transformation (up to SGD7,000 only) – Schemes by various agencies hosted on the Business Grant Portal (BGP); and/or b. Workforce Transformation (up to the full SGD10,000) – Training courses aligned to the various Industry Skills Frameworks by SkillsFuture Singapore (SSG), Job Redesign initiatives, and Career Conversion Programmes etc. by Workforce Singapore (WSG)
5	Enterprise Development Grant (EDG) Enterprise Sg 25 Oct 2018	From 2009 to 2018, there were on average over 700 EDG recipients per year.	EDG supports projects that help companies upgrade, innovate, grow and transform their business.	EDG funds qualifying project costs namely third-party consultancy fees, software and equipment, and internal manpower cost. Up to 50% of eligible costs for local SMEs From 1 April 2023, SMEs can receive up to 50% support for EDG (sustainability-related projects may be supported at up to 70% from 1 April 2023 to 31 March 2026). Please refer to the Enterprise Sustainability Programme page for more details.
6	Local Enterprise and Association Development Programme Enterprise Sg 2005	Since its inception, 23 TACs have engaged in this initiative to co-create growth opportunities, with over 8,300 local SMEs expected to benefit from these industry-led projects upon their completion.	For trade associations and chambers that aim to drive capability development and internationalization projects for SMEs. Enterprise capability and industry development Innovate and automate for better productivity. This includes adopting technology, developing industry-wide certification and technical standards, and establishing shared infrastructure or service. Market access Help companies access overseas markets through participation in international trade fairs and overseas business missions. TAC capability upgrading Strengthen internal capabilities to be effective change agents and industry multipliers.	Support for up to 70% of eligible costs for qualifying projects, including: Manpower-related costs: project members' salaries Equipment and materials: equipment, materials, consumables and technical software required for the project Professional services: consultancy and subcontracting Business development costs: organizing a Singapore Pavilion at Trade Fairs or leading Business Missions IP costs: licensing, royalties and technology acquisition costs

Source: Huang (2023); Toh et al. (2021b); Enterprise Singapore 2024a, b, c, f, i); (GoBusiness, 2024b)

Systemic Policy Instruments

SME Centres

Enterprise Singapore has collaborated with five trade associations and chambers to set up a network of 11 SME Centres across Singapore. Introduced in 2013, the SME Centres provide one-on-one business diagnosis and advisory services, capability workshops and group-based upgrading (GBU) projects. The Centres provide consultancy services through their Business Advisor Programme to support SMEs in growing their business, through areas such as overseas expansion, financing, productivity and human resources. Collectively, the SME Centres island-wide have assisted over 28,000 SMEs and initiated 13 new GBUs in 2019 (Enterprise Singapore, 2024j).

Centres of Innovation (COI)

Since 2006, Enterprise Singapore (formerly known as SPRING) has partnered with polytechnics and public research institutes to form 11 COIs to provide SMEs access to facilities and experts across industries covering aquaculture, energy, electronics, supply chain management, environment and water, food, complementary health products, and precision engineering. With selected COIs, SMEs may participate in Enterprise Innovation Scheme to receive 400% tax deductions on expenditure on qualifying innovation projects, up to an expenditure cap. Between 2016 and 2020, the COI hosted at institutes of higher learning and A*STAR research institutes have engaged 3,000 SMEs, resulting in 300 innovation projects, including IP licensing, product co-development and co-innovation, technology translation and adoption (Venkateshwaran, 2022).

IPI

In 2011, IPI was set up as a subsidiary of Enterprise Singapore to become an innovation catalyst that creates opportunities for enterprises to grow beyond boundaries. IPI provides enterprises with access to innovative ideas and technologies through its global innovation networks. It facilitates and supports enterprises' innovation processes, including commercialization and go-to-market strategies. In 2023, it engaged more than 290 companies, facilitated 167 collaboration projects, worked with 39 innovation advisors, created 2370 expected jobs, with SGD350 million attributable revenue (IPI, 2023).

See Table 19 for a summary of systemic policy instruments.

MPTC

SIMTech is A*STAR research institute that develops high-value manufacturing technology for companies operating the precision engineering, aerospace, marine and offshore, automotive, electronics, logistics, medical technology, general manufacturing and other services sectors. SIMTech helps companies, especially SMEs move up the value chain through its centers such as the Manufacturing Productivity Technology Centre (MPTC). Launched in 2011, MPTC encourage industries to use technologies and techniques to enhance productivity, sustainability and economic growth. Its capabilities include digital transformation and productivity improvement powered by artificial intelligence (AI) and machine learning, cyber physical production system, data analytics and industrial automation. By 2016, MPTC has served more than 1,000 companies, facilitated more than 1,400 technology adoptions, and trained more than 1,000 professionals, managers, executives and technicians (PMETs).

TABLE 19

SUMMARY OF SYSTEMIC POLICY INSTRUMENTS

No	Innovation intermediaries/ programs	Impact	Objective	Mechanism
1	SME Centres (e.g. SME Centre @SICCI, SME Centre @SMCCI, SME Centre @SCCCI, SME Centre @SMF, SME Centre @ASME)/ Enterprise Singapore 2013	Collectively, the SME Centres island-wide have assisted over 28,000 SMEs and initiated 13 new GBUs in 2019.	To provide targeted support for promising micro and small enterprises, by helping them deepen their capabilities in productivity, internationalization, and innovation, to accelerate transformation and business growth. SME Centres provide better coordination between SMEs and large multinational and domestic firms.	Business advisors at the SME Centres will provide enhanced support to SMEs: a) One-on-one in-depth business diagnosis b) Development of detailed business plans (e.g. in business/ digital transformation, talent development, internationalization) c) Business coaching (e.g. how to develop more effective sales pitch) d) Implementation of growth roadmaps/initiatives, including identifying the relevant programs and referrals to suitable partners.
2	Centres of Innovation/ Enterprise Singapore 2006	Between 2016 and 2020, the COIs at institutes of higher learning and A*STAR research institutes have engaged 3,000 SMEs, resulting in 300 innovation projects.	Give SMEs access to resources such as laboratory facilities and training and consultancy services at local institutes of higher learning and public research institutes to work on new projects.	COIs will advise SMEs on innovation projects, ranging from technology translation and adoption to IP licensing, product co-development and co-innovation.
3	IPI, a subsidiary of Enterprise Singapore 2011	In 2023, IPI engaged over290 companies, facilitated 167 collaboration projects, worked with 39 innovation advisors, created 2370 expected jobs, with SGD350 million attributable revenue.	Become an innovation catalyst that creates opportunities for enterprises to grow beyond local boundaries, including the IP of overseas universities and research institutes.	IPI accelerates the innovation process of enterprises through access to its global innovation ecosystem and advisory services.
4	Manufacturing Productivity Technology Centre (MPTC), at A*STAR Singapore Institute of Manufacturing Technology (SIMTech) 2011	Since 2016, MPTC served over 1,000 companies, facilitated more than 1,400 technology adoptions, and trained more than 1,000 professionals, managers, executives and technicians (PMETs)	Encourage industries to use technologies and techniques to enhance productivity, sustainability and economic growth	MPTC works with SMEs to adopt A*STAR technologies and capabilities in automation, systems and processes to achieve productivity improvements through transformation.

Source: Enterprise Singapore (2024j); Venkateshwaran (2022); IPI (2023)

Case Studies

This section highlights case studies of two Singapore SMEs in the manufacturing industry, that had benefited from their partnership with the MPTC.

The first company was contract development manufacturer Racer Technology, that provides custom design, engineering and manufacturing of electronics, IoT, and medical devices. Established in 1995, Racer Technology was a pioneer in the development of medical devices, that contributed to 65% of its revenue (Heng, 2018). Subject to stringent testing and certification requirements, taking medical devices to market would not only take a long time, but also demand significant investments. In 2016, after a business mission trip organized by Enterprise Singapore to Germany to learn about Factory 4.0, where the production process incorporated digital technologies, Racer's co-founder and CEO Mr. Willy Koh started looking for a partner to help them implement this concept in the company (Heng, 2018). Koh found SIMTech MPTC, which helped Racer implement solutions in three aspects: equipment effectiveness, inspection and operation management.

In 2017, SIMTech's Overall Equipment Efficiency Monitoring System (OEEMS) was installed at Racer to replace its manual calculation of machine efficiency with automatic computation and display of real-time information on machine yield and efficiency. Data on machine utilization and downtime could determine buffer capacity to support planning. Racer went on to implement SIMTech's mobile workflow application called the Mobile Workflow System (wfMOBILE) to support its quality inspection functions, enabling it to be among the first in Singapore to be certified ISO13485. To enhance its operation management, Racer adopted SIMTech's Manufacturing Operations Management (MOM) and Inventory Tracking System (ITS) to plan and track orders easily. Partnership with SIMTech has facilitated the adoption of advanced manufacturing technologies and Industry 4.0 practices, significantly enhancing Racer's production capabilities and operational efficiency. By leveraging SIMTech's data analytics, automation, and AI-driven solutions, Racer streamlined processes, reduced costs, and improved product quality. Key improvements included a 21% increase in throughput, reduction in mold setup time by 39% to 63%, 94% increase in manpower efficiency for quality control staff, and a 70% increase in manpower water efficiency for planners (SIMTech, 2021). In addition, shifting from CNC milling to casting reduced component costs by over 90%. With support from SIMTech, Racer was able to achieve notable cost savings and strengthen its competitive positioning within the high-value manufacturing sector. "We are on a constant prowl for trend-setting technologies as well as products with strong commercialization potential, and SIMTech, being our technological partner, has been supporting us in putting a dent in the universe", said Koh (SIMTech, 2019).

For more than a decade, Koh has been active in mentoring other SMEs in the domain of medical technology (MedTech), that refers to the devices deployed in the healthcare systems for patient care, diagnosis, treatment and enhancement of a person's health. Today, about 40 companies had benefited from his mentorship, and collectively formed the Singapore MedTech Consortium (SIMTech, 2019).

The second company was contract manufacturer Banshing Industrial Company Ltd, that manufactures precision plastics injection molding and metal stamping components, precision mold and die fabrication for the precision engineering industry. Incorporated in 1975, Banshing started as a plastic injection molding house, serving only one client Sanyo Electric Company Ltd. Four decades later, Banshing became an international corporation, with a staff strength of 1,000 across four manufacturing plants in Singapore, Penang (Malaysia), Zhuhai (China) and Shanghai (China).

The company aimed to move up the value chain from providing component manufacturing services to full product manufacturing services, focusing on design and development with advanced materials and manufacturing.

Banshing believed in investment in local operations and local talent. "We want to train our workforce to be aligned with Industry 4.0 given that Singapore is gravitating towards the Smart Nation vision. And Smart Manufacturing Operations (S-MOM) and Overall Equipment Effectiveness Monitoring System (OEEMS) form the bedrock of Industry 4.0 in Banshing", said the Director of Banshing, Mr. Alvin Cheng (SIMTech, 2019).

To achieve its goals, Banshing collaborated with SIMTech to integrate the latter's S-MOM and OEEMS with its existing Enterprise Resource Planning (ERP) system.

S-MOM provided real-time monitoring of production processes, furnishing data to produce customized reports to streamline production. For example, the system can generate a report to track scraps and materials that have been left over from production for disposal. Such automated monitoring also reduced errors arising from manual monitoring. Implemented across eight machines, OEEMS reduced idle time loss by 96% from 112 hours to four hours per month, resulting in cost savings of SGD23,800 each month (A*STAR, 2020).

"Hooking up operational technology (OT) to IT systems is a concrete advancement towards digital transformation. Now accorded a bird eye's view, Banshing is able to visualize and target areas effectively for continuous productivity improvement," Mr. Cheng highlighted (SIMTech, 2019). These initiatives have moved Banshing closer to its long-term goals of becoming Original Design Manufacturer (ODM), owning brands instead of capacity. Its partnership with SIMTech has enabled Banshing to achieve 76% increase in throughput, 70% increase in manpower efficiency for production supervisors (SIMTech, 2019). Unlike Racer that was more diverse in the manufacturing clients it serves ranging from MedTech to precision engineering, Banshing was focused on precision engineering and achieved higher efficiency and throughput.

ANALYSIS OF INSTITUTIONS AFFECTING EFFECTIVENESS OF POLICIES

The Singapore government used a pragmatic approach to develop its national innovation policies. It recognized the importance of mission-oriented types of innovation policy (MOIP) to address its societal problems that are becoming increasingly complex, ambiguous and unstructured than those in the past decades. These problems are persistent and can range from ageing population to climate change, calling for solutions that require not only technological changes, but also behavioral and institutional transformations. To address such challenges, the government adopted a type of MOIP that has an overarching mission-oriented strategic framework to structure the interactions between economic and societal missions involving the triple helix institutions—government, industry, academia—and the fourth helix—the civil society—with a 'whole-of-government approach (Larrue, 2021; Cheah & Phua, 2022). Following the review of Singapore's early national science and technology (S&T) plans from 1991 to 2005, several key recommendations were provided by the Ministerial Committee on R&D and endorsed by the government. First, an overarching structure should be established to "provide a coherent strategic overview of R&D at the national level, and to allocate funding to longer term R&D programmes" (MTI, 2006: 6). Second, research should concentrate on areas of economic impact to the country, e.g. interactive and digital media,

environment and water, as well as life sciences. Third, universities and public research institutes should build good research capabilities from basic to mission-oriented research to ensure conversion of good science into industry applications. Fourth, the industry should raise its R&D expenditure in Singapore to expand talent flow between industry and academia in open collaboration. Finally, the connection between public R&D performers and the industry should be intensified through co-funding to transfer knowledge from public research to businesses to expand their talent pool and technological knowledge base. Based on these recommendations, the government approved the S&T2010 Plan in 2006 with the commitment of SGD13.55 billion for R&D investments and the target of achieving gross expenditure on R&D of 3% of gross domestic product by 2010. These recommendations are game-changing, as they set the government on the trajectory of increasing the level of cross-ministerial /government coordination, building capacity of executing agencies, raising the level of trust between government and firms, and enhancing use of policies as levers to promote growth of target sectors and clusters.

Increasing cross-ministerial /government coordination

Cross-ministerial/government coordination is a key strength of Singapore's MOIP process. To ensure that national R&D projects are approved and implemented in a coherent manner, the government enacted the National Research Fund Act in 2006 to establish a new body known as the RIE Council (RIEC) chaired by the Prime Minister comprising the expanded triple helix actors—cabinet ministers, industry leaders, academia and scientists—to guide the government and its ministries in legislation and policymaking (Cheah et al., 2016). The National Research Fund Act also provided for the setup of the National Research Foundation (NRF) as a new department under the Prime Minister's Office to support the RIEC. The NRF Board was chaired by the Deputy Prime Minister and comprised the representatives from at least nine ministries, to facilitate coordination of RIE policies across the ministries and government agencies.

Building capacity of executing government agencies

To ensure that the government agencies produce outcome that is relevant to the country's mission, the government reconfigured its existing structures of innovation system by setting new ministries and merging existing ministries. For example, in 2020, the Ministry of the Environment and Water Resources was renamed to MSE to reflect its new role because 'sustainability has become an increasingly important part of our national agenda', as observed by the Prime Minister (Low, 2020). The new MSE would focus on providing a clean and sustainable environment, while ensuring resilient supply of safe water and food. To govern food safety and security from farm to fork, a new statutory board Singapore Food Agency (SFA) was enacted in 2019, based on the merger of food-related functions under existing statutory boards Agri-Food and Veterinary Authority (AVA), the Health Sciences Authority (HSA) and National Environment Agency (NEA) (Wong, 2018). Given their new roles, MSE and SFA played a crucial role in the Urban Solutions and Sustainability (USS) domain with the budget of SGD1 billion in RIE2020. Of this budget, SFA and A*STAR awarded over SGD50 million to more than 30 projects in the agri-food sector (MSE, 2021). The reconfiguration of executing government agencies show the agility of the government agencies in responding to changes, while the budget allocated for the agencies through RIE plan highlighted the resources that have been aside to build the capacity of the government agencies for their new/expanded roles (Cheah & Phua, 2022).

Enhancing use of policies as levers to promote growth of target sectors and clusters

In its RIE planning every five years, the National Research Foundation would identify broad technology domains that are of critical significance to address the challenges and opportunities of the key industry sectors and clusters, in consultation with its Scientific Advisory Board (SAB). The SAB comprised international experts in broad technology areas, who would meet annually to advise the National Research Foundation on its research plans and R&D outcome assessment. In RIE2020, research funds were prioritized and allocated to four strategic technology domains that are expected to achieve high impact: (a) Advanced Manufacturing and Engineering (AME) at SGD3.3 billion, Health and Biomedical Sciences (HBMS) at SGD4 billion, Urban Solutions and Sustainability (USS) at SGD0.9 billion, and Services and Digital Economy (SDE) at SGD0.4 billion. The activities in the four strategic technology domains were coordinated with horizonal programs to optimize efficiency in resource utilization. For example, to fuel the growth of Singapore's manufacturing and engineering sectors for RIE2020, eight industry verticals (e.g. electronics, aerospace) and four enabling technology areas (e.g. additive manufacturing, robotics) were identified in the AME domain. The national research agency A*STAR under the Ministry of Trade and Industry (MTI) played a key role in administering grant calls open to all public R&D performers to propose new research ideas to support future industry needs. For example, A*STAR launched in 2020 a public-private platform Model Factory that would enable more than 100 companies with over 2,500 technologies to improve operational efficiency and productivity (NRF, 2020: 14).

Raising level of trust between government, firms and academia

The National Research Fund Act provided for the set up the National Research Fund (SSO, 2007), with the objective of providing funds to spur (a) the building of innovative products, processes and services, (b) R&D investments by public and private sectors to raise the nation's competitiveness, (c) technological capability of public and private sectors through innovation, and (d) a supportive environment for translating technological knowledge into new products and processes (MOF, 2006). To coordinate the programs across the academic, government and industry helix structures, the RIEC and National Research Foundation adopted a portfolio approach by assigning pre-allocated proportions of funding by project type ranging from small-scale investigator-led academic research to develop a strong science knowledge base through mid-sized multi-disciplinary research to build good science in strategic areas, to mid-sized grants to build centers of excellence. Such portfolio approach enabled the government to explore novelty in their responses to societal challenges. For RIE2020, the RIEC/National Research Foundation adopted (a) the top-down approach of setting research directions and (b) the bottom-up approach of soliciting ideas from existing academia and firms. For example, a national program in artificial intelligence AI.SG was launched by the NRF in 2017 to develop AI capabilities in the country. Set up as a multi-agency initiative, AI.SG engaged over 300 companies and launched more than 60 projects by 2020 on key sectors such as healthcare and finance (NRF, 2020).

CONCLUSION AND POLICY RECOMMENDATIONS

University-Regional/Industry Collaboration

Industry-academia collaboration is a crucial driver of innovation and economic development. These partnerships significantly bridge the gap between industry needs and academic research, facilitating the advancement of new technologies. Universities should establish regional linkages and networks to leverage the spatial proximity to other research institutions, industries, policy, and regional management, such as within clusters or through other collaborative activities (Koschatzky & Stahlecker, 2010). Universities are often the source of cutting-edge research, but with effective collaboration with industry, these innovations are open to the academic sphere and reach the market. By establishing joint research centers and promoting co-funded projects between universities and industry players, Singapore can create a robust channel for translating research outputs into marketable innovations.

For instance, Germany's Fraunhofer Society, a network of research institutes specializing in applied sciences, provides a successful model for transferring knowledge from academic research to industry, particularly in sectors like automotive engineering and renewable energy (Koschatzky & Stahlecker, 2010). The success of the Fraunhofer model is primarily attributed to its close collaboration with industry partners, leading to significant technological advancements and commercial applications. Singapore has already taken steps to promote such collaboration by developing Research Centres of Excellence (RCEs). Singapore can further enhance its RCEs by embedding industry experts within academic teams and focusing on applied research that directly addresses industry needs. More details of policy recommendations are provided below:

1. *Industry-Research Institution/University Collaboration:* This includes expanding funding and support for joint research programs involving academic institutions and industry partners. This might involve increasing the number of RCEs and promoting the development of industry-specific research centers. Providing more targeted incentives for industry participation in academic activities can foster greater collaboration. This may involve tax incentives or the creation of special grants to encourage industry investment (Enterprise Singapore, 2024k). Moreover, incorporating feedback mechanisms where academic and industry partners can provide input on the collaboration process will help identify areas for improvement and ensure that both parties' needs are met.

2. *Strengthening Public-Private Partnerships (PPP):* Enhancing PPPs in R&D is crucial for driving innovation. Singapore should continue to support and expand initiatives like the Global Innovation Alliance (GIA) that promote international innovation cooperation. By linking Singaporean researchers and companies with global partners, these collaborations can lead to the development of globally competitive innovative solutions (MTI, 2019).

3. *Sector-Specific Collaboration:* Due to the distinct characteristics and needs of different industries, the government should consider these differences in their strategies. Singapore should develop industry-specific collaboration strategies. For instance, in the biomedical sector, partnerships could focus on translational research that bridges the gap between laboratory discoveries and clinical applications. In the tech industry, collaborations could target the development of new digital technologies and platforms. Tailoring collaboration efforts to the unique demands of each industry will ensure that research outputs are highly relevant and immediately applicable, fostering the development of industry clusters to promote sectoral growth (SG Green Plan, 2024a, b, c).

By expanding joint research programs, incentivizing industry participation, and strengthening public-private partnerships, Singapore can accelerate the development and commercialization of new technologies. Drawing on successful models from other countries, Singapore has the potential to further solidify its position as a global leader in innovation and technological advancement.

Increasing Demand-Side Policy Instruments

Demand-side policy instruments play a pivotal role in fostering innovation, particularly among SMEs and startups. By increasing support for innovation across various sectors, these instruments can significantly enhance the vitality and competitiveness of these enterprises. Public procurement, in particular, is a powerful tool for stimulating innovation by generating demand for new products and services. In Singapore, expanding the existing "Tender Lite" program to specifically target innovative SMEs and startups could encourage the development of novel solutions tailored to public sector needs. By earmarking a portion of public procurement for innovative products, the government can provide these enterprises with a guaranteed market, thereby mitigating the risks associated with bringing new products to market.

The European Union's Pre-Commercial Procurement (PCP) and Public Procurement of Innovative Solutions (PPI) programs offer valuable insights. In PCP, public procurement entities purchase R&D services from multiple competing suppliers to compare alternative solutions and identify the most cost-effective one that meets their needs. This approach has significantly facilitated the entry of startups and SMEs into the public procurement market, thereby promoting innovation within these enterprises (European Commission, 2024).

Similarly, the use of innovation vouchers for SMEs has proven successful in countries like the UK and the Netherlands. As highlighted in the European Commission's analysis, these vouchers are designed to help companies, particularly SMEs, invest in innovative solutions and services or acquire machinery that supports innovation. This initiative has successfully fostered collaboration between SMEs and knowledge institutions, leading to increased R&D activities and greater innovation within the SME sector (European Commission, 2024).

Integrating more demand-side strategies into Singapore's existing policy framework is essential for driving the innovation and growth of SMEs and for the creation of new technologies. These measures can play a critical role in advancing technological development and economic growth, ensuring that Singapore maintains its position as a global leader in innovation.

The Development of Workforce and Human Capital

The continual development of the workforce, particularly high-skilled employees, is crucial for maintaining Singapore's position as a global leader in innovation and economic growth. As workplace skills evolve, the Singapore government has implemented policies to promote continuous learning, such as the Skills Future Singapore initiative (SkillsFuture Singapore, 2024). The importance of human capital development is a key component of economic strategies in many developed economies.

For example, Germany's dual system of vocational training is characterized by collaboration between SMEs and publicly funded vocational schools. This system combines company-based apprenticeships with school-based vocational education, achieving significant success in cultivating a skilled workforce that meets industry demands (Thelen, 2004). This model has greatly contributed to Germany's reputation as a global leader in manufacturing and engineering. The system allows

smooth transitions between school and work, significantly reducing unemployment rates. Due to strong government support, employers and other social partners have high levels of involvement. Germany's renowned Federal Institute for Vocational Education and Training (BIBB) and a nationwide network of small research centers focus on various aspects of the vocational training system, offering valuable insights that can be adapted and adopted by Singapore to enhance its human capital development.

Similarly, South Korea has substantially invested in education and training, particularly in science and technology, to support its rapid economic development. The Human Resources Development Service of Korea (HRD Korea), a government organization under the Ministry of Employment and Labour, opened a new training center in March 2013 called the Global Institute for Transferring Skills (GIFTS). This center's primary functions include providing programs to support technical and vocational skills for both Korean youth and international guests. South Korea also has several professional HRD organizations, such as the Korea Association of Human Resource Development (KAHRD), the Korean Society for Training and Development (KSTD), and the Korean Society for Learning and Performance (KSLP) (Lim & Cho, 2015). These organizations are crucial in advancing HRD research and practice through conferences, journals, and collaborative research activities. The emphasis on continuous learning, technology integration, and professional development in South Korea ensures its workforce remains competitive globally.

Drawing on these international experiences, Singapore should consider the following policy recommendations to strengthen its human capital development further:

1. *Expand Sector-Specific Training Programs:* Tailoring training programs to the specific needs of different industries will ensure that workers acquire the most relevant skills. This approach can mirror Germany's dual education system, aligning educational outcomes with industry requirements to enhance employability and productivity (Thelen, 2004).

2. *Establish Vocational Training Institutions:* Strengthening institutions that support workforce development, such as education and vocational training centers, is crucial for sustaining long-term economic growth. These institutions must be equipped with the resources and autonomy to innovate and adapt to changing economic needs.

3. *Increase Investment in STEM Education:* This will not only support existing high-tech industries but also prepare a workforce for emerging sectors such as artificial intelligence, biotechnology, and renewable energy.

By expanding joint research programs, incentivizing industry participation, and strengthening public-private partnerships, Singapore can accelerate the development and commercialization of new technologies. Learning from successful models in other countries, Singapore has the potential further to solidify its global leadership in innovation and technological advancement.

Sustainability and Green Innovation

Investing in green technologies to promote sustainable innovation is crucial for Singapore's long-term economic and environmental sustainability. As climate change and resource depletion become increasingly pressing, the demand for sustainable development is growing. Investment in research and development for renewable energy and sustainable technologies is essential. This includes R&D in solar and wind energy to reduce reliance on fossil fuels, improving energy efficiency in

the construction and manufacturing industries, and enhancing the recycling and reuse of materials. The implementation of these alternative solutions will also promote green employment opportunities (Consoli, et al., 2016).

Sweden's Strategic Innovation Programs (SIP) may serve as an excellent model for sustainable innovation in Singapore. Funded by the Swedish Innovation Agency (Vinnova), the Swedish Energy Agency (Energimyndigheten), and the Swedish Research Council for Sustainable Development (Formas), the SIPs foster collaboration among various stakeholders to strengthen specific fields, seek sustainable solutions to global societal challenges, and enhance Sweden's international competitiveness. SIP has facilitated the development of innovative solutions in energy efficiency, urban transportation, and waste management, which have been commercialized and implemented on a large scale (Ashiem, et al., 2011). This collaborative approach has driven significant advancements in sustainable energy and life sciences, positioning Sweden as a leader in these areas.

Singapore can draw on Sweden's approach by expanding its Enterprise Sustainability Program to provide more comprehensive support for collaborative R&D projects focused on sustainability. This could involve establishing specialized innovation clusters focused on specific areas such as renewable energy, energy-efficient buildings, or sustainable agriculture.

REFERENCES

A*STAR (2024) *National Survey of Research, Innovation and Enterprise in Singapore 2021*. Agency for Science, Technology and Research Singapore: https://www.a-star.edu.sg/News/national-survey-of-rie

A*STAR (2020) This Singapore SME is Riding Waves of Innovation to Industry 4.0, A*STAR News. November 10, 2020. https://www.a-star.edu.sg/News/a-star-innovate/innovates/innovate/this-singapore-sme-is-riding-waves-of-innovation-to-industry-4.0

Asheim, B. T., Boschma, R. & Cooke, P. (2011) Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional Studies*, 45(7), 893-904. https://www.tandfonline.com/doi/abs/10.1080/00343404.2010.543126.

b2Match (2024) *Joint Innovation with Singapore - Partner Matching Platform*. b2Match. https://joint-innovation-with-singapore.b2match.io/page-1921

Chan, G. (6 June 2024) NUS retains 8th spot in global university rankings, NTU rejoins top 20. *The Straits Times*. https://www.straitstimes.com/singapore/nus-retains-8th-spot-in-global-university-rankings-ntu-rejoins-top-20

Cheah, S., Ho, Y. P. & Lim, P. (2016) Role of public science in fostering the innovation and startup ecosystem in Singapore. *Asian Research Policy, 7*(1), 78-93. https://www.kistep.re.kr/arpIssue.es?act=content_view&list_no=132&act=content_view&mid=a20802000000

Cheah, S. & Phua, L. H. (2022) Mission-Oriented Innovation Policies in Singapore: Research, Innovation and Enterprise Planning and National Innovation Challenges. *Asian Research Policy, 13*(1), 42-55. https://www.kistep.re.kr/arpIssue.es?act=view&list_no=36&mid=a20802000000&nPage=&skeyWord=&skeyField=

Chernyshenko, O. S., Uy, M. A., Jiang, W., Ho, M. H. R., Lee, S. P., Chan, K. Y., & Yu, K. Y. T. (2015). *Global Entrepreneurship Monitor 2014 Singapore Report*. Singapore: Nanyang Technological University. https://www.gemconsortium.org/report/gem-singapore-2014-report

Consoli, D., Marin, G., Marzucchi, A. & Vona, F. (2016) Do Green Jobs Differ from Non-Green Jobs in Terms of Skills and Human Capital? *Research Policy*, 45(5), 1046-1060. https://doi.org/10.1016/j.respol.2016.02.007.

DealstreetAsia (2023) *Singapore Venture Funding Landscape 2023*. DealstreetAsia (2023). https://www.startupsg.gov.sg/public/2024-04/Singapore%20Venture%20Funding%20Report%202023.pdf

Enterprise Singapore (2021) *Enterprise Financing Scheme - Factsheet*. Enterprise Singapore. https://www.mti.gov.sg/-/media/MTI/COS-2021/Factsheets/7-EFS-VD_MTI-COS-2021-Media-Factsheet.pdf

Enterprise Singapore (2024a) *Productivity Solutions Grant*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/productivity-solutions-grant

Enterprise Singapore (2024b) *SkillsFuture Enterprise Credit*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/skillsfuture-enterprise-credit

Enterprise Singapore (2024c) *Enterprise Development Grant*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/enterprise-development-grant

Enterprise Singapore (2024d) *Enterprise Sustainability Programme*. Enterprise Singapore. https://www.enterprisesg.gov.sg/grow-your-business/boost-capabilities/sustainability/enterprise-sustainability-programme

Enterprise Singapore (2024e) *Co-Innovation Programmes*. Enterprise Singapore. https://www.enterprisesg.gov.sg/grow-your-business/innovate-with-us/market-access-and-networks/global-innovation-alliance/cip-programmes

Enterprise Singapore (2024f) *Local Enterprise and Association Development Programme*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/local-enterprise-and-association-development-programme

Enterprise Singapore (2024g) *SEEDS Capital*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/seeds-capital

Enterprise Singapore (2024h) *Enterprise Financing Scheme - Venture Debt*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/enterprise-financing-scheme---venture-debt

Enterprise Singapore (2024i) *Market Readiness Assistance Grant*. Enterprise Singapore. https://www.enterprisesg.gov.sg/financial-support/market-readiness-assistance-grant

Enterprise Singapore (2024j) *SME Centre Enhancement - Partners for Business Growth*. Enterprise Singapore. https://www.mti.gov.sg/-/media/MTI/COS-2020/Microsite/Factsheets/ESG-Media-Fact-Sheet-on-SME-Centre-Enhancement-at-MTI-COS.pdf

Enterprise Singapore (2024k) *Enhancing SME Competitiveness Through Innovation: The Role of Government Grants and Support*. Enterprise Singapore. https://www.enterprisesg.gov.sg

European Commission (2024) Innovation Vouchers: An Analysis of European Programs Supporting SMEs. *European Journal of Innovation Management, 27(*2), 88-104, European Commission. https://ec.europa.eu. from https://ec.europa.eu

GoBusiness (2024a) *About Government Assistance*. GoBusiness Singapore. https://www.gobusiness.gov.sg/gov-assist/

GoBusiness (2024b) *Grants*. GoBusiness. https://www.gobusiness.gov.sg/gov-assist/grants/

Heng, J. (2018) *Running the technology race*. The Business Times, October 8, 2018. https://www.businesstimes.com.sg/singapore/smes/leaders-transformation/running-technology-race

Huang, C. (27 February 2023) Govt tender process to be simplified for SMEs, more weight given to sustainability. *The Straits Times*. https://www.straitstimes.com/singapore/politics/govt-tender-process-to-be-simplified-for-smes-more-weight-given-to-sustainability

IMDA (2023) *Singapore Digital Economy Report 2023*. IMDA. https://www.imda.gov.sg/-/media/imda/files/infocomm-media-landscape/research-and-statistics/sgde-report/singapore-digital-economy-report-2023.pdf

IPI (2023) *Year-In-Review 2023*. IPI Singapore. https://www.ipi-singapore.org/YIR-2023/

Jacob, M., Dahlstrand, A. L. & Maren, S. (2016) *RIO Country Report 2015: Sweden*. IDEAS. https://ideas.repec.org/p/ipt/iptwpa/jrc101217.html

Koschatzky, K. & Stahlecker, T. (2010) The changing role of universities in the German research system: engagement in regional networks, clusters and beyond (No. R2/2010). *Arbeitspapiere Unternehmen und Region*. https://www.econstor.eu/bitstream/10419/45026/1/64745050X.pdf.

Larrue, P. (2021) The design and implementation of mission-oriented innovation policies: A new systemic policy approach to address societal challenges. *OECD Science, Technology and Industry Policy Papers 100*, OECD Publishing.

Lim, C. P. (2016) *Global Innovation Index 2016*. WIPO. https://www.wipo.int/web/office-singapore/w/news/2016/news_0009

Lim, D. H. & Cho, D. (2015) Graduate HRD Programs in South Korea. *Advances in Developing Human Resources*, 17(2), 196-212. https://core.ac.uk/download/pdf/215302904.pdf.

Linkflow Capital (10 July 2024) Linkflow Capital: SME Loan Interest Rates Spike to 8.16% in 2023, Average Loan Quantum Drops 42%. *Media OutReach Newswire*. https://www.media-outreach.com/news/singapore/2024/07/10/311236/linkflow-capital-sme-loan-interest-rates-spike-to-8-16-in-2023-average-loan-quantum-drops-42/

Liu, S., Lee, J. & Qian, J. (2023) *Impact Evaluation of SMEs Go Digital Programme* [Feature Article]. Economic Survey of Singapore First Quarter 2023. Ministry of Trade and Industry. https://www.mti.gov.sg/-/media/MTI/Resources/Economic-Survey-of-Singapore/2023/Economic-Survey-of-Singapore-First-Quarter-2023/FA_1Q2023.pdf

Low, M. (2020) Commentary: This new Ministry of Sustainability and Environment looks pretty promising. Channel News Asia. 29 July 2020. https://www.channelnewsasia.com/commentary/ministry-sustainability-environment-singapore-grace-fu-climate-714276

MOF (3 April 2006) *Second Reading Speech by Mr. Raymond Lim, Second Minister for Finance and Foreign Affairs on the National Research Fund Bill 2006 at The Parliament*. Ministry of Finance. https://www.mof.gov.sg/news-publications/speeches/Second-Reading-Speech-by-Mr-Raymond-Lim-Second-Minister-for-Finance-and-Foreign-Affairs-on-the-National-Research-Fund-Bill-2006-at-The-Parliament-3-Apr-2006

MSE (10 May 2021) *Written Reply to Parliamentary Question on Sustainability under RIE2025 by Ms. Grace Fu, Minister for Sustainability and the Environment*. Ministry of Sustainability and the Environment. https://www.mse.gov.sg/resource-room/category/2021-05-10-written-reply-to-pq-on-sustainability-under-rie2025/

MTI (2006) Science & Technology 2010. Ministry of Trade and Industry. https://www.mti.gov.sg/-/media/MTI/Resources/Publications/Science-and-Technology-Plan-2010/s-and-t-plan-2010.pdf?la=en&hash=3C049B5029181CBE68BD2F57F126675D

MTI (19 November 2018) *Written reply to PQ on startups*. Ministry of Trade and Industry. https://www.mti.gov.sg/Newsroom/Parliamentary-Replies/2018/11/Written-reply-to-PQ-on-startups

MTI (2019) *Economic Survey of Singapore Third Quarter 2019* [Feature Article]. Ministry of Trade and Industry. https://www.mti.gov.sg/Resources/Economic-Survey-of-Singapore/2019/Economic-Survey-of-Singapore-Third-Quarter-2019

MTI (3 October 2022) *Written reply to PQ on EDG and PSG take-up*. Ministry of Trade and Industry. https://www.mti.gov.sg/Newsroom/Parliamentary-Replies/2022/10/Written-reply-to-PQ-on-EDG-and-PSG-take-up

NRF (2020) *RIE2025 Handbook*. National Research Foundation. https://file.go.gov.sg/rie-2025-handbook.pdf

Quek, C. (24 February 2020) Govt's S$300 million injection into deep-tech scheme will benefit Singapore. But some concerns remain. *TODAY Online*. https://www.todayonline.com/commentary/govts-s300-million-injection-deep-tech-scheme-will-benefit-singapore-some-concerns-remain

SEEDS Capital (2024) *Our Co-Investment Model*. SEEDS Capital. https://www.seedscapital.sg/about-us/our-co-investment-model/

SG Green Plan (2024a) *Our Targets*. SG Green Plan. https://www.greenplan.gov.sg/targets/

SG Green Plan (2024b) *Overview*. SG Green Plan. https://www.greenplan.gov.sg/overview/

SG Green Plan (2024c) *Singapore's Green Economy: Strategic Initiatives for Sustainable Growth*. SG Green Plan. https://www.greenplan.gov.sg

SIMTech (2019) *Our Transformation Journeys – Partnership for Productivity Impact*. https://pubhtml5.com/zlck/ajjg/Our_Transformation_Journeys_-_Partnership_for_Productivity_Impact/57

Singapore Tourism Board (2023) *Local Enterprise and Association Development (LEAD) Programme*. Singapore Tourism Board. https://www.stb.gov.sg/content/stb/en/assistance-and-licensing/grants-overview/local-enterprise-association-development-programme-lead.html

SingStat (2023) Singapore's Enterprise Landscape 2023. Department of Statistics Singapore. https://www.singstat.gov.sg/modules/infographics/economy#enterprise

SingStat (2024a) *Enterprise Landscape By SMEs And Non-SMEs* by SingStat Table Builder. Department of Statistics Singapore. https://tablebuilder.singstat.gov.sg/table/TS/M600981

SingStat (2024b) *Multifactor Productivity: Contributions To Growth In Real GDP* by SingStat Table Builder. Department of Statistics Singapore. https://tablebuilder.singstat.gov.sg/table/TS/M014981

SingStat (2024c) *Research And Development Expenditure By Sector* by SingStat Table Builder. Department of Statistics Singapore. https://tablebuilder.singstat.gov.sg/table/TS/M081321

SkillsFuture Singapore (2024) *Building a Future-Ready Workforce: Skills Development and Lifelong Learning*. SkillsFuture Singapore. https://www.skillsfuture.gov.sg

SPRING Singapore (24 July 2017) *SPRING and IE Jointly Supported 23 Trade Associations and Chambers to Help More than 8,300 SMEs Build Stronger Capabilities*. SPRING Singapore. https://www.nas.gov.sg/archivesonline/data/pdfdoc/20170724011.htm

SSG (23 March 2023) *Strong participation in SkillsFuture Programmes; SSG seeks to do more with enterprises*. SkillsFuture. https://www.skillsfuture.gov.sg/newsroom/strong-participation-in-skillsfuture-programmes-ssg-seeks-to-do-more-with-enterprises

SSO (2007) National Research Act 2006. Singapore Statutes Online. https://sso.agc.gov.sg/Acts-Supp/17-2006/Published?DocDate=20060515&ProvIds=P1III-#pr10-

Startup SG (2024) *Startup SG Equity*. Startup SG. https://www.startupsg.gov.sg/programmes/4895/startup-sg-equity

Statista (2024) *Crowdsourcing - Singapore*. Statista: https://www.statista.com/outlook/dmo/fintech/digital-capital-raising/crowdfunding/singapore

Teo, M., Loo, A. & Kuan, M. L. (2019) *Returns To Research And Development (R&D) Among Firms In Singapore* [Feature Article]. Ministry of Trade and Industry. https://www.mti.gov.sg/-/media/MTI/Resources/Economic-Survey-of-Singapore/2019/Economic-Survey-of-Singapore-Third-Quarter-2019/FA_3Q19.pdf

Thelen, K. (2004) *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States, and Japan*. ResearchGate: https://www.researchgate.net/publication/37155345_How_Institutions_Evolve_The_Political_Economy_of_Skills_in_Germany_Britain_the_United_States_and_Japan

Toh, B., Koh, W. J. & Feng, A. (2021a) *ECONOMIC SURVEY OF SINGAPORE Third Quarter 2021*. Ministry of Trade and Industry. https://www.mti.gov.sg/-/media/MTI/Resources/Economic-Survey-of-Singapore/2021/Economic-Survey-of-Singapore-Third-Quarter-2021/FullReport_3Q21.pdf

Toh, B., Koh, W. J. & Feng, A. (2021b) *IMPACT OF ENTERPRISE SINGAPORE'S GRANTS ON FIRMS' REVENUE AND EXPORTS. ECONOMIC SURVEY OF SINGAPORE Third Quarter 2021*. Ministry of Trade and Industry. https://www.mti.gov.sg/-/media/MTI/Resources/Economic-Survey-of-Singapore/2021/Economic-Survey-of-Singapore-Third-Quarter-2021/FA_3Q21.pdf

USPTO (2024a) *Patenting By Geographic Region (State and Country), Breakout By Geographic Region*. U.S. Patent and Trademark Office Patent Technology Monitoring Team. https://www.uspto.gov/web/offices/ac/ido/oeip/taf/stcasg/sgx_stcorg.htm

USPTO (2024b) *Patenting By Ownership Location (State and Country), Breakout By Organizations and Domestic (U.S.) Inventor Share*. U.S. Patent and Trademark Office Patent Technology Monitoring Team. https://www.uspto.gov/web/offices/ac/ido/oeip/taf/ostcdshar/sgx_ostcorgdshar.htm

Venkateshwaran, S. (2 August 2022) 3,000 SMEs have engaged with Centres of Innovation, yielding 300 projects. *The Business Times*. https://www.businesstimes.com.sg/singapore/smes/3000-smes-have-engaged-centres-innovation-yielding-300-projects

Wong, D. (26 July 2018) New stat board Singapore Food Agency to be formed in April 2019; AVA will cease to exist. *The Straits Times*. https://www.straitstimes.com/singapore/environment/new-stat-board-singapore-food-agency-to-be-formed-in-april-2019-ava-will-cease

World Bank (2023) International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme. World Bank Group. https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=SG

World Bank (2024) *World Bank Enterprise Surveys*. World Bank Group: http://www.enterprisesurveys.org

WIPO (2023) *Global Innovation Index 2023*. WIPO: https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023/sg.pdf

Zhang, I. (14 July 2022) *Data Stories: H1 2022 Private Equity and Venture Capital Trends in ASEAN*. S&P Global Market Intelligence. https://www.svca.org.sg/sites/default/files/2022-09/Data%20Stories%20-%20H1%202022%20Private%20Equity%20Venture%20Capital%20Trends%20in%20ASEAN.pdf

Zhang, X. & Zhu, Y. (2021) *Innovation Capability of SMEs in Singapore*. Lee Kuan Yew School of Public Policy Asia Competitiveness Institute (ACI) Research Paper. https://lkyspp.nus.edu.sg/docs/default-source/aci/acirp202111.pdf

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THAILAND

Chapter 1
Introduction

1.1 Overview

Small and Medium Enterprises (SMEs) are pivotal to the economic fabric of many Asian countries, including Thailand. They contribute significantly to employment, innovation, and economic diversification. However, the post-pandemic landscape has posed unprecedented challenges to these enterprises, particularly in terms of productivity and innovation. As global economies strive to recover, enhancing the technological capabilities of SMEs has become a critical factor in ensuring their sustainability and growth.

In Thailand, SMEs account for approximately 99% of all enterprises, contributing to around 35% of the country's Gross Domestic Product (GDP) and employing over 80% of the workforce. Despite their significant role in the economy, Thai SMEs often struggle with limited access to advanced technologies, insufficient investment in research and development (R&D), and a lack of integration into global value chains. In addition, SMEs in Thailand face notable challenges in improving productivity. From 2006 to 2011, productivity for manufacturing firms, particularly in domestically oriented sectors, declined significantly. Thailand's SMEs still struggle with capital misallocation and weak competitive dynamics, limiting the impact of "creative destruction," where less efficient firms exit the market to make way for more productive ones (World Bank, 2020).

These challenges have been exacerbated by the COVID-19 pandemic, making it crucial for the Thai government to intensify efforts in supporting SME technological capability enhancement to drive productivity improvements.

1.2 Rationale for the Study

The COVID-19 pandemic disrupted key drivers of SME growth, particularly their participation in global value chains and access to foreign investment spillovers. These setbacks have highlighted the urgent need for strategic government intervention to enhance SME technological capabilities, ensuring both recovery and long-term resilience.

Recognizing these challenges, the Thai government has introduced initiatives to support SMEs. The Office of Small and Medium Enterprises Promotion (OSMEP) has implemented programs such as the SME Development Plan and the Productivity Improvement Program, which provide access to modern technologies, R&D support, and innovation incentives. Collaborations with academic institutions and international organizations further facilitate technology transfer and skill development, which are critical for SME growth.

According to the 2023 APO report, SMEs contribute 70% of employment in Asia and have traditionally relied on technological advancements through global value chain integration and foreign investment spillovers. The pandemic disrupted these mechanisms, affecting their ability to innovate and sustain productivity.

In response, Thailand has intensified efforts to modernize SMEs through policy initiatives like Thailand 4.0, which promotes innovation, digital transformation, and Industry 4.0 technologies. The adoption of automation, AI, and big data analytics is now central to improving SME productivity and competitiveness.

Given the critical role of SMEs in Thailand's economy, strategic support packages are essential to ensure not only recovery but long-term growth. This research aims to provide a comprehensive analysis of SME technological capabilities and offer actionable policy recommendations to strengthen innovation and competitiveness in both traditional and emerging industries.

1.3 Objectives of the Study

The main objectives of this research are threefold:

1. **Assessment of Current Capabilities:** To evaluate the existing technological capabilities and innovation ecosystems within Thai SMEs.
2. **Identification of Support Measures:** To identify effective measures and strategies that can enhance the technological and innovation capabilities of SMEs.
3. **Policy Recommendations:** To propose well-informed policy recommendations that can create an enabling environment for improving SME productivity and innovation through technological enhancement.

1.4 Scope of the Study

This study examines SME technological capabilities, the factors shaping their development, and the support measures needed to enhance them. It explores how SMEs can adapt and innovate in the post-pandemic economy, emphasizing technological upgrading as a pathway to long-term resilience. The study provides a detailed analysis of Thailand's SME technological capabilities, evaluating existing policies and regulations to identify strengths and gaps. It concludes with policy recommendations aimed at strengthening SME innovation, improving policy frameworks, and enhancing Thailand's broader innovation ecosystem.

1.5 Research Methodology

This study begins by defining key concepts such as productivity, labor productivity, multi-factor productivity, technological capability, and innovation. Productivity refers to how efficiently firms, industries, or economies generate output by utilizing labor, capital, and other inputs through technological advancements and improved business processes. Labor productivity measures output relative to the number of workers or hours worked, while total factor productivity evaluates the efficiency of labor and capital use. Technological capability consists of two components: production capability, which involves using existing technologies effectively, and innovation capability, which refers to the development of new technologies or improvements to existing ones.

The study takes a comprehensive approach, analyzing SME productivity and innovation trends over the past decade. It examines labor and multi-factor productivity growth and trends in new-to-firm innovation, product innovation, and business process innovation. Using data from Community Innovation Surveys (CISs) or similar sources, the research evaluates innovation activities, expenditures, revenue from innovative products, and barriers to innovation. A comparative analysis will be conducted between SMEs and large firms, startups and established companies, and foreign and local enterprises.

The policy analysis framework examines supply-side, demand-side, and systemic policies aimed at strengthening SME technological capabilities. Supply-side policies focus on R&D incentives, including tax benefits, grants, subsidies, low-interest loans, and venture capital funding. Demand-side policies create market opportunities for SMEs through government procurement, market promotion, and tax incentives. Systemic policies seek to improve collaboration between SMEs, universities, research institutions, and large firms, enhancing the overall innovation ecosystem.

The study assesses policy effectiveness by analyzing their content, implementation, and impact. This includes pre- and post-policy comparisons using indicators such as R&D investment growth, product and process innovation, skilled workforce recruitment, market expansion, and domestic value-added production. Data sources include government reports, policy evaluations, and firm-level interviews, incorporating both successful and less successful cases to identify best practices and gaps.

Institutional factors influencing policy effectiveness are also examined. This includes the capacity of government agencies, cross-ministerial coordination, trust between firms and government, and societal attitudes toward failure. The study also considers entrepreneurial dynamics and other factors affecting SME innovation policy implementation.

A mixed-methods approach integrates quantitative and qualitative research for a comprehensive analysis. The quantitative component assesses SME labor productivity and TFPG over the past decade using secondary data from government and industry reports. Key indicators, including labor and capital productivity and innovation outputs, are compared across sectors and firm sizes, with a specific focus on SMEs vs. large enterprises.

The qualitative component examines policy instruments introduced by the Thai government to enhance SME technological capabilities. In-depth interviews with government officials, SME owners, and industry representatives provide insights into policy effectiveness, implementation challenges, and overall impact on SME productivity. By combining statistical analysis and stakeholder perspectives, the study delivers a holistic understanding of SME technological development and policy impact in Thailand.

1.6 Organization of the report

The report is structured into five chapters, beginning with an **Introduction** that outlines the significance of SMEs in Thailand, the research rationale, and the objectives of the study. The second chapter provides **An Overview of Productivity and Innovation of SMEs**, examining the current state of SME productivity and the factors influencing their innovation capabilities. The third chapter presents an **Analysis of Contents, Implementation Mechanisms, and Effectiveness of Policy Instruments**, focusing on the policies designed to enhance technological capabilities and innovation within SMEs. The fourth chapter explores the **Institutions Affecting the Effectiveness of Policies**, analyzing the role of various institutions in shaping the success of these policy interventions. Finally, the report concludes with **Policy Recommendations**, synthesizing the findings and offering actionable insights to support the technological advancement and productivity growth of SMEs in Thailand. This research seeks to contribute to the ongoing discourse on SME development by providing evidence-based insights and recommendations that can guide policymakers in enhancing the technological capabilities and productivity of SMEs in Thailand.

1.7 Overviews of Thailand Innovation System that enhancing Productivity and Innovation of SMEs

Thailand's innovation system is designed to enhance SME technological capabilities through comprehensive policy frameworks, strategic plans, and institutional support. Key organizations such as the Ministry of Higher Education, Science, Research, and Innovation (MHESI), the National Higher Education Science Research and Innovation Policy Council (NXPO), and Thailand Science Research and Innovation (TSRI) coordinate efforts to drive a knowledge-based, innovation-driven economy. Frameworks like the Thailand Science, Research, and Innovation Plan (2023-2027) and the Bio-Circular-Green Economy (BCG) Model (2021-2027) guide policies toward sustainable development, research commercialization, and technology integration (EC/OECD, 2024).

Financial support for SMEs is provided through programs like the National Innovation Agency (NIA) and the Program Management Unit for Competitiveness (PMU-C), which help businesses engage in R&D and scale their operations. Initiatives such as the DEPA Digital Transformation Fund and the Innovation-Driven Enterprises (IDE) Program support technology adoption, digital transformation, and deep-tech innovation. Tax incentives and matching fund programs further encourage public-private collaboration in R&D investment.

Research commercialization is a core focus, supported by the TRIUP Act B.E. 2564, which enables universities and public research institutions to establish holding companies for startup formation and innovation management. Innovation hubs like Thailand Science Park and the Eastern Economic Corridor of Innovation (EECi) promote academic-industry-government collaboration, particularly in fields like biotechnology, automation, and renewable energy.

Human resource development is another critical pillar. Education and training programs, such as the Industrial Postdoctoral and Graduate Research Program and STEM workforce promotion, aim to develop a skilled labor force capable of driving innovation and supporting high-tech industries. Platforms like Brighter Bee Talent Solution offer lifelong learning opportunities to enhance SME innovation capacity.

Global partnerships play a key role in facilitating knowledge exchange and technology transfer. Collaborations with international organizations such as the OECD and programs like the Circular Economy Innovation Ecosystem (CE Vision 2030) align Thailand's efforts with global sustainability goals and attract foreign direct investment in emerging green industries.

Despite these advancements, challenges remain. Research commercialization is still limited, and fragmented coordination across agencies weakens policy effectiveness. Skill gaps in the workforce hinder innovation adoption, and regional disparities persist, with urban areas like the Eastern Economic Corridor benefiting more than rural regions. Thailand also remains dependent on foreign technology in key sectors, despite efforts to foster domestic innovation.

While Thailand's innovation system is making progress with strong institutional support and sustainability-driven policies, addressing commercialization barriers, regional inclusiveness, skill development, and technological independence is essential. Strengthening coordination, expanding innovation efforts in underserved regions, and closing workforce skill gaps will be key to building a dynamic, innovation-driven economy.

1.8 Current Structure and Situation of SMEs in Thailand

SMEs are a vital part of Thailand's economy, contributing significantly to GDP and employment. Small enterprises (SEs) account for 14.4% of GDP, totaling 2,495,444 million baht in 2025 (OSMEP, 2023). These businesses are more established than micro-enterprises but still face challenges in scaling, innovation, and productivity growth. Medium enterprises (MEs) have a greater economic impact, contributing to 18.2% of GDP, or 3,161,113 million baht, with stronger market presence and better access to technology, allowing for higher productivity and innovation.

Overall, SMEs contribute to 35.2% of Thailand's GDP, with a 4.5% GDP growth rate in 2025. Growth has been driven by the retail, service, and manufacturing sectors, but SMEs continue to struggle with limited financial resources, rising operational costs, and slow technology adoption. The COVID-19 pandemic exacerbated these issues, particularly affecting tourism and export-driven SMEs, which are key to the country's economic ecosystem.

Innovation remains a significant challenge, particularly for small enterprises, which often lack R&D capacity, technology transfer, and collaboration with academic institutions. Medium enterprises, with better access to resources and technology, have a stronger ability to integrate innovations. Despite these challenges, opportunities exist, especially in the retail and service sectors, where consumer demand recovery and government support in tourism have provided a boost.

Several external factors continue to shape SME performance. High inflation, rising raw material costs, and global economic pressures have negatively impacted SME profitability. Access to funding remains a barrier, restricting investment in technology and innovation. However, the recovery of the tourism sector and government-led consumer spending initiatives have provided growth opportunities, particularly for service and retail SMEs.

To enhance productivity and innovation, SMEs require greater access to capital, technology, and incentives for R&D collaborations. Strengthening these areas will help SMEs become more competitive and resilient, enabling them to thrive in both domestic and international markets.

Chapter 2
An Overview of Productivity and Innovation of SMEs

This chapter examines the productivity and innovation landscape of SMEs in Thailand, highlighting key insights into their performance compared to other firms. It begins with an analysis of TFPG, using data from the Report on Productivity and Performance of the Industrial Sector (2018–2022) (OIE, 2024), published by the Office of Industrial Economics, Ministry of Industry. The chapter then explores labor productivity, drawing from the NESDC Economic Report and CEIC Data. It compares productivity levels between large firms and SMEs, foreign and local Thai firms, and established firms versus startups (operating for less than five years).

Additionally, it examines R&D and innovation activities within the industrial sector. Using data from the Report on the Survey on Research and Development and Innovation Activities in the Industrial Sector of Thailand (2011–2017) (NXPO, 2024) and the Report on the Survey of Research and Development Data and Innovation Activities of the Private Sector for 2022 (NRCT, 2024), the chapter provides a comprehensive view of how these factors drive technological capabilities and productivity growth among SMEs in Thailand.

2.1 Analysis of Past Surveys and Study: Labor productivity and TFP

2.1.1 The Analysis of Total Factor Productivity Growth (TFPG) of SMEs

This study relies on primary data from the Report on Productivity and Performance of the Industrial Sector, published by the Office of Industrial Economics, Ministry of Industry, Thailand. Table 2.1 and Figure 2.1 present key economic indicators for Thailand's manufacturing sector (2018–2022). These include Value-Added and TFPG, along with contributions from labor, capital, labor quality, capital quality, other quality factors, and market conditions. These metrics provide insights into productivity trends and the drivers of growth in Thailand's manufacturing industry over the past five years.

TABLE 2.1

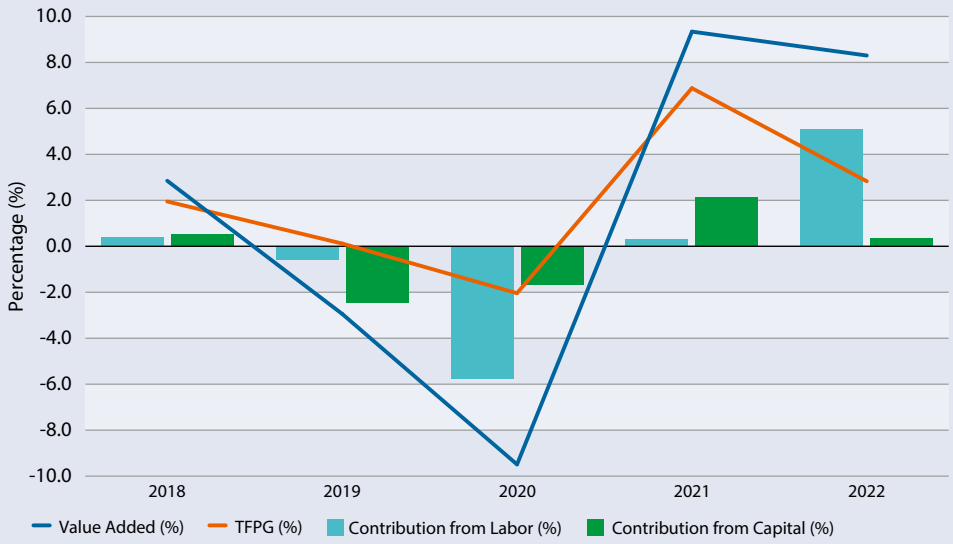
SUMMARY OF VALUE ADDED, TFP GROWTH, AND THEIR COMPONENTS IN THAILAND'S MANUFACTURING SECTOR (2018-2022)

Year	Value Added (%)	Contribution from Labor (%)	Contribution from Capital (%)	TFPG (%)	Contribution from Labor Quality (%)	Contribution from Capital Quality (%)	Other Quality Factors (%)	Market Conditions (%)
2018	2.85	0.38	0.52	1.95	1.09	0.86	N/A	N/A
2019	-2.94	-0.59	-2.47	0.12	-0.91	1.03	N/A	N/A
2020	-9.49	-5.77	-1.68	-2.04	-0.08	-1.96	2.48	-5.02
2021	9.34	0.31	2.15	6.88	0.33	0.08	-0.24	6.71
2022	8.30	5.10	0.37	2.83	-0.03	0.54	-6.15	8.47

Source: Report on productivity and performance of the industrial sector (2018-2022). Office of Industrial Economics, Ministry of Industry, Thailand.

FIGURE 2.1

VALUE ADDED, TFPG, AND CONTRIBUTIONS FROM LABOR AND CAPITAL (2018-2022)



Source: Report on productivity and performance of the industrial sector (2018-2022). Office of Industrial Economics, Ministry of Industry, Thailand.

Figure 2.1 presents Value Added (%), TFPG (%), and contributions from Labor and Capital (%) from 2018 to 2022. The line graphs track Value Added and TFPG, while the bar charts illustrate Labor and Capital contributions for each year.

In 2021 and 2022, Thailand's economy experienced a strong recovery, mainly due to favorable market conditions. While labor and capital inputs improved, productivity gains were driven by external factors rather than structural improvements in efficiency or quality.

Despite growth in Value Added, challenges remained in labor and capital quality. In 2022, negative contributions from other quality factors weakened TFPG, highlighting underlying inefficiencies that could impact long-term growth.

The severe contraction in 2020 exposed Thailand's economic vulnerability to external shocks. Market conditions played a major role in productivity declines, while innovation and other factors provided only minimal resilience. Widespread inefficiencies led to declines in both labor and capital contributions.

Although 2021 and 2022 showed economic resilience, sustaining long-term growth requires structural improvements. Reducing reliance on market-driven recoveries and focusing on innovation, labor quality, and capital efficiency will be crucial. Table 2.2 summarizes Value Added, TFPG, and their key components in Thailand's manufacturing sector (2018–2022).

TABLE 2.2

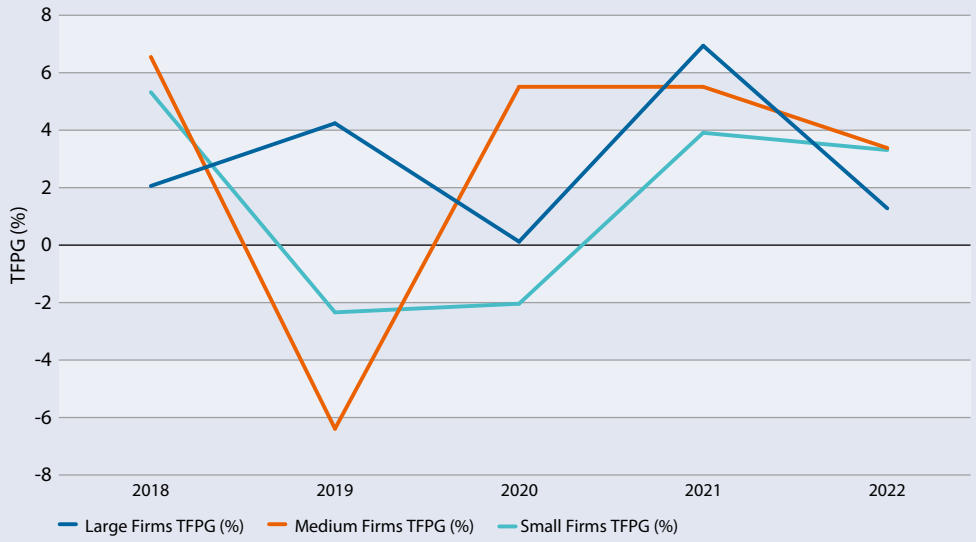
TFPG FOR LARGE, MEDIUM, AND SMALL FIRMS (2018-2022)

Year	Firm Size	Value Added (%)	Contribution of Labor (%)	Contribution of Capital (%)	TFPG (%)	Labor Quality Contribution (%)	Capital Quality Contribution (%)	Other Factors Contribution (%)	Market Conditions Contribution (%)
2018	Large	2.83	0.09	0.69	2.06	0.49	0.87	2.11	-1.41
	Medium	7.68	0.24	0.89	6.55	1.88	1.72	1.45	1.50
	Small	9.46	1.07	3.07	5.32	0.25	1.22	2.60	1.25
2019	Large	4.24	-0.18	0.40	4.24	1.57	1.65	1.02	2.00
	Medium	-7.89	-0.63	-0.87	-6.39	0.67	-0.74	-3.82	-1.50
	Small	-6.82	-3.38	1.10	-2.34	0.90	-1.45	-2.20	1.01
2020	Large	4.45	-0.91	1.03	0.12	0.84	0.52	-2.10	1.00
	Medium	6.55	0.52	1.03	5.51	1.38	1.08	1.90	1.15
	Small	-8.52	-5.77	-1.68	-2.04	-1.96	0.65	1.02	-1.75
2021	Large	10.64	1.46	2.24	6.94	1.84	1.73	2.75	0.62
	Medium	6.83	0.80	0.52	5.51	1.60	1.42	2.00	1.00
	Small	3.73	0.15	-0.33	3.91	1.43	1.38	1.85	0.75
2022	Large	8.57	6.89	0.40	1.28	-0.19	0.85	4.56	-4.10
	Medium	7.80	4.20	0.22	3.38	-0.63	0.15	3.82	-0.74
	Small	7.57	3.87	0.38	3.31	-0.46	1.51	2.54	0.67

Source: Report on productivity and performance of the industrial sector (2018-2022). Office of Industrial Economics, Ministry of Industry, Thailand.

FIGURE 2.2

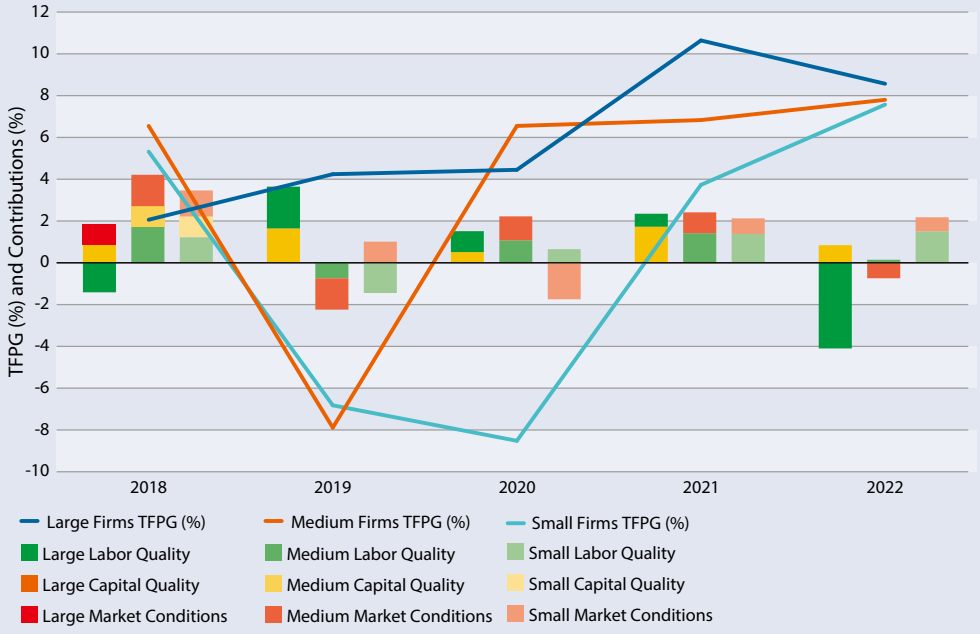
TOTAL FACTOR PRODUCTIVITY GROWTH (TFPG) FOR LARGE, MEDIUM, AND SMALL FIRMS (2018-2022)



Source: Report on productivity and performance of the industrial sector (2018-2022). Office of Industrial Economics, Ministry of Industry, Thailand.

FIGURE 2.3

TOTAL FACTOR PRODUCTIVITY GROWTH (TFPG) AND SOURCES OF CONTRIBUTION FOR LARGE, MEDIUM, AND SMALL FIRMS (2018-2022)



Source: Report on productivity and performance of the industrial sector (2018-2022). Office of Industrial Economics, Ministry of Industry, Thailand.

Figure 2.3 illustrates TFPG trends across different firm sizes from 2018 to 2022. Large firms showed greater resilience, while medium and small firms experienced more fluctuations. The line graphs track TFPG, while the stacked bars break down contributions from labor quality, capital quality, and market conditions for each year. The data highlights the crucial role of market conditions in driving productivity growth, particularly during recovery and downturn periods. While labor and capital quality improvements are essential for long-term growth, market factors often dictate short-term productivity shifts.

Key Drivers of TFPG

1. Market Conditions: The Primary Driver: Market conditions played a dominant role in shaping TFPG. Favorable conditions boosted productivity, especially during recovery years like 2021, when post-pandemic demand, improved trade, and economic reopening led to strong rebounds across all firm sizes. However, during downturns, such as 2020, adverse market conditions severely impacted TFPG. This was particularly damaging for small and medium firms, which struggled more than large firms due to limited resources and weaker financial buffers.

2. Labor Quality: Workforce Development and Its Impact: Labor quality—defined by skills, training, and experience—also influenced TFPG. In 2018 and 2021, investments in workforce development contributed positively to productivity, particularly for large firms with more training resources. However, during downturns like 2020, labor quality declined, negatively affecting TFPG, especially for small and medium firms that had fewer resources to retain or upskill workers. This underscores the importance of continuous workforce development to sustain long-term productivity.

3. Capital Quality: The Role of Technology and Investment: Capital quality—relating to efficiency and advancement of machinery, technology, and equipment—was another key driver. In years of strong investment, such as 2018 and 2021, firms benefited from higher capital efficiency, which boosted productivity growth. However, during economic contractions (2019–2020), lack of investment in new capital or reductions in capital efficiency weakened TFPG, particularly for medium and small firms. This highlights the critical role of continuous investment in technology to sustain competitiveness.

The Role of Innovation and Technology

Innovation and technological capability significantly impact TFPG, helping firms adapt and thrive in changing economic conditions. In 2021, firms that invested in digital tools, automation, and new technologies saw productivity gains, even with the same or fewer resources. This demonstrates how technology streamlines operations, reduces costs, and improves efficiency.

Conversely, in 2020, SMEs lacking investment in technology suffered steeper declines in TFPG. The combination of labor quality deterioration and outdated capital equipment made it harder to maintain productivity. Meanwhile, firms that had already adopted advanced technologies remained more resilient to economic shocks. This highlights the importance of consistent investment in innovation, not only for productivity growth but also for mitigating downturn risks.

In summary, market conditions emerged as the dominant driver of TFPG, especially during recovery periods when favorable economic environments boosted productivity across all firm sizes. Labor quality played a key role in sustaining productivity growth, though it was more vulnerable to decline during downturns, particularly for small and medium firms. Capital quality

was critical for long-term productivity, especially when firms invested in advanced technology. However, during economic downturns, lack of capital investment weakened productivity. Together, these drivers shaped TFPG trends in Thailand's manufacturing sector, fluctuating based on external economic conditions and internal investment in workforce and technology development.

2.1.2 The Analysis of Labor productivity

Labor productivity measures output per worker or per hour worked. Over the past decade, Thailand's productivity has followed a mixed trajectory (see Table 2.3 and Figure 2.4).

From 2014 to 2019, productivity grew steadily, driven by advancements in manufacturing and services. These sectors saw significant improvements, contributing to overall economic growth. In 2020, productivity sharply declined due to the COVID-19 pandemic, which disrupted economic activities across multiple sectors. From 2021 to 2023, post-pandemic recovery has been uneven. While gradual improvements occurred in 2021 and 2022, growth in 2023 remained slower than expected, reflecting ongoing economic challenges affecting Thailand's recovery.

TABLE 2.3

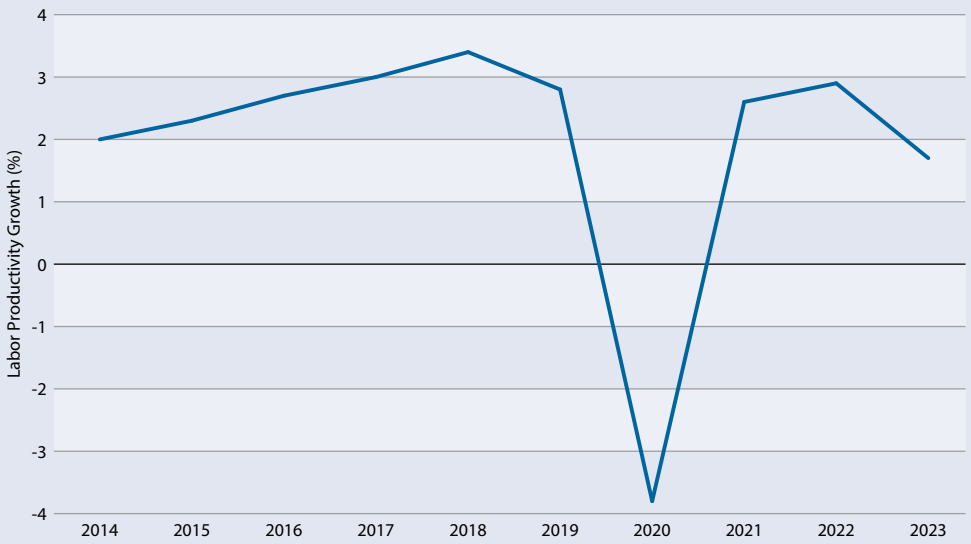
LABOR PRODUCTIVITY GROWTH (2014-2023)

Year	Labor Productivity Growth (%)
2014	2.0%
2015	2.3%
2016	2.7%
2017	3.0%
2018	3.4%
2019	2.8%
2020	-3.8%
2021	2.6%
2022	2.9%
2023	1.7% (Estimated)

Source: NESDC Economic Report, CEIC Data

FIGURE 2.4

OVERALL LABOR PRODUCTIVITY GROWTH IN THAILAND (2014-2023)



Source: NESDC Economic Report, CEIC Data

Labor Productivity Growth in Thai SMEs

There is no specific public data on labor productivity growth for SMEs from sources like NESDC or CEIC. However, SMEs play a crucial role in the Thai economy, making it essential to analyze their productivity trends. Several factors influence SME labor productivity growth. Access to capital is a major challenge, as SMEs often struggle to secure financing, limiting their ability to invest in technology and productivity-enhancing tools. Technology adoption is another key factor, with smaller firms typically slower in implementing new technologies, reducing their potential efficiency gains.

Labor skills also play a significant role. Many SMEs lack resources for advanced workforce training, leading to lower labor quality compared to larger firms. Additionally, the sectoral focus of SMEs affects productivity growth. Many are concentrated in traditional industries like agriculture and retail, where productivity tends to grow more slowly than in technology-driven sectors.

Labor Productivity by Sector

Table 2.4 and Figure 2.5 provide a sectoral analysis of labor productivity trends, based on NESDC and CEIC data. The agriculture sector consistently shows the lowest productivity levels, mainly due to reliance on traditional farming methods, low investment in technology, and global price fluctuations. While there has been some growth, progress remains slow. The manufacturing sector has been a key driver of productivity growth, benefiting from technological advancements and automation. However, 2020 saw a sharp decline due to global supply chain disruptions caused by the pandemic. The services sector, particularly tourism and retail, has shown strong productivity growth. Although 2020 brought a severe downturn, digitalization and the return of tourism have helped the sector recover. The construction sector has maintained steady productivity levels, though it lags behind manufacturing and services. Government infrastructure projects have provided some stability, but the sector remains vulnerable to economic fluctuations. The wholesale

and retail trade sector has consistently performed well, driven by strong domestic consumption and digital transformation in retail operations.

SMEs vs. Large Firms

Over the past 10 years, SMEs have made productivity gains, despite the setbacks caused by COVID-19. However, large firms consistently outperform SMEs, largely due to better access to capital, advanced technology, and skilled labor. To close the gap, SMEs need to invest more in technology, workforce development, and efficient business practices. Strengthening these areas will enhance productivity, boost competitiveness, and support long-term economic growth.

TABLE 2.4

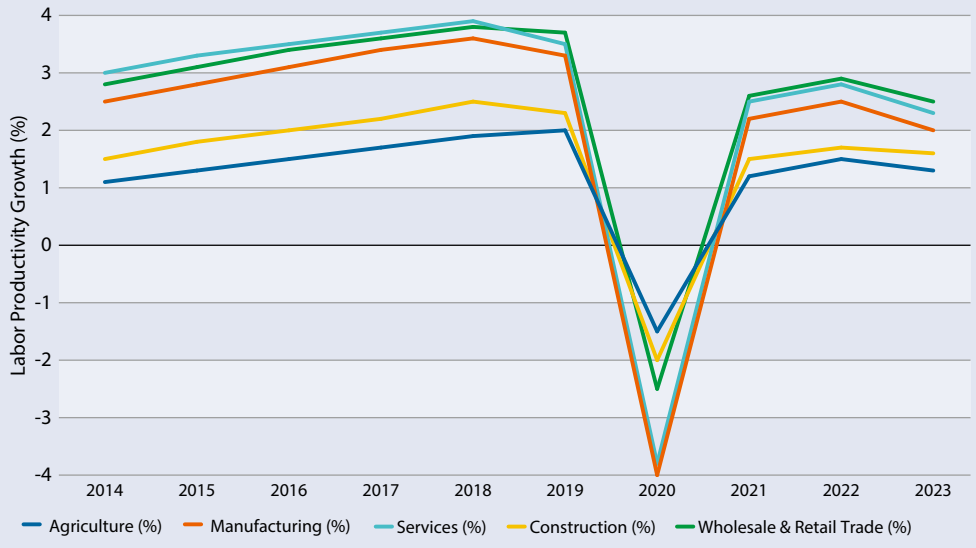
LABOR PRODUCTIVITY GROWTH BY SECTOR (2014-2023)

Year	Agriculture	Manufacturing	Services	Construction	Wholesale & Retail Trade
2014	1.1%	2.5%	3.0%	1.5%	2.8%
2015	1.3%	2.8%	3.3%	1.8%	3.1%
2016	1.5%	3.1%	3.5%	2.0%	3.4%
2017	1.7%	3.4%	3.7%	2.2%	3.6%
2018	1.9%	3.6%	3.9%	2.5%	3.8%
2019	2.0%	3.3%	3.5%	2.3%	3.7%
2020	-1.5%	-4.0%	-3.8%	-2.0%	-2.5%
2021	1.2%	2.2%	2.5%	1.5%	2.6%
2022	1.5%	2.5%	2.8%	1.7%	2.9%
2023	1.3% (Est.)	2.0% (Est.)	2.3% (Est.)	1.6% (Est.)	2.5% (Est.)

Source: NESDC Economic Report, CEIC Data

FIGURE 2.5

LABOR PRODUCTIVITY GROWTH BY SECTOR IN THAILAND (2014-2023)



Source: NESDC Economic Report, CEIC Data

Key Trends in TFPG and Labor Productivity (2018–2022)

Thailand's TFPG and labor productivity fluctuated across large, medium, and small firms between 2018 and 2022, reflecting the impact of economic cycles, investment patterns, and firm characteristics on productivity growth.

Impact of Economic Cycles

Productivity trends closely followed economic conditions. During 2019 and 2020, TFPG and labor productivity declined sharply due to COVID-19 and broader economic downturns, affecting firms of all sizes. However, as the economy rebounded in 2021, significant productivity improvements were observed. This pattern highlights the importance of market conditions in driving productivity growth, even for firms with strong R&D and innovation strategies. Economic instability limits the ability of firms to translate internal efficiency into sustained productivity gains, reinforcing the need for macroeconomic stability as a foundation for growth.

Role of R&D and Innovation

Investment in R&D and innovation was a major factor influencing TFPG and labor productivity, particularly for large and medium-sized firms. These firms were able to leverage technological advancements and process improvements to enhance productivity during economic recoveries. In contrast, small firms showed inconsistent productivity gains, as their limited financial and human resources made it difficult to implement new technologies effectively. This suggests that while R&D and innovation are critical for productivity growth, their impact depends on a firm's ability to access and integrate these advancements.

Foreign Ownership and Firm Resilience

Foreign-owned firms, particularly large ones, demonstrated greater resilience in TFPG trends. Their ability to access global best practices, advanced technologies, and financial stability allowed them to mitigate the effects of economic downturns and recover more quickly. Medium-sized foreign firms also benefited from foreign ownership but displayed greater volatility in TFPG, indicating that external market shocks still significantly impact them despite their access to foreign expertise.

Firm Age and Stability

Older firms exhibited more stable TFPG trends, as their experience, established business practices, and financial stability allowed them to maintain productivity more effectively. Large firms, which typically have longer operating histories, demonstrated consistent productivity growth. In contrast, small firms, which often have shorter operating histories, showed greater volatility. This suggests that younger firms face greater challenges in sustaining productivity growth, particularly in times of economic uncertainty, reinforcing the importance of long-term strategic planning and operational efficiency.

Industry-Specific Trends

Productivity trends varied by industry, with some sectors being more affected by economic downturns than others. Export-dependent industries such as automotive and electronics suffered the most during downturns due to high fixed costs and global supply chain disruptions. Industries that invested in automation and digital transformation, however, managed to sustain or even improve productivity. Medium-sized firms, in particular, saw significant gains when leveraging technology, demonstrating the importance of continuous investment in innovation to maintain competitiveness.

Strategies for Building Resilience

To build resilience against external shocks, firms, especially SMEs, must take proactive steps to strengthen their business models. Diversifying markets can help reduce reliance on a single revenue source, making firms less vulnerable to economic downturns. Investing in flexible production systems allows firms to respond quickly to shifting demand, improving overall efficiency. Strengthening supply chain networks ensures greater stability in times of disruption, allowing firms to maintain steady operations even during crises. Additionally, enhancing technology adoption and workforce skills is critical for sustaining long-term productivity growth, enabling firms to compete more effectively in a rapidly changing economic landscape.

Policy Recommendations

The volatility of TFPG among small firms underscores the need for targeted policy support to improve their productivity and stability. Providing easier access to financing would enable SMEs to adopt new technologies and modernize their operations. Stronger incentives for R&D investment would encourage firms to focus on long-term innovation, driving sustained productivity growth. Programs that help SMEs integrate into global value chains would expand their market opportunities, reducing their reliance on domestic demand alone. Establishing tax incentives and fostering partnerships with academic institutions would further support knowledge transfer and technological advancement, ensuring that firms have the resources to innovate effectively.

Macroeconomic policies aimed at stabilizing the business environment—such as counter-cyclical fiscal measures and trade facilitation—are crucial for maintaining steady productivity growth across firms of all sizes. A well-structured policy framework that supports innovation, financial access, and workforce development will be essential in ensuring that both large and small firms can sustain growth and competitiveness in an evolving global economy.

In addition, data from ***APO Productivity Databook 2023*** shows that Thailand's per-worker labor productivity, measured in GDP at constant prices per worker (2021 PPP), has steadily increased from $6.4K in 1970 to $33.0K in 2021. This growth reflects significant economic progress, driven by industrialization and economic expansion in the 1990s, 2000s, and 2010s. However, growth has slowed in recent years, signaling challenges such as economic structural shifts, labor market constraints, and the difficulty of sustaining rapid growth in a mature economy.

Per-hour labor productivity, measured as GDP per hour worked, also improved consistently, rising from $2.6 in 1970 to $16.3 in 2021. The strongest gains occurred in the 1990s and 2010s, with a 20.2% increase between 2010 and 2021. However, growth fluctuated, with a sharp decline between 2019 and 2020 due to the COVID-19 pandemic, followed by a partial recovery in 2021. These variations highlight the impact of economic cycles and external shocks on productivity.

TFPG from 1970 to 2021 has been highly volatile, with periods of both positive and negative growth. While TFPG saw modest gains in the early years, it experienced sharp declines in the 1980s and 1990s, followed by rebounds in the late 1980s and early 2000s. Since 2010, TFPG has remained low, averaging just 0.4% annually from 2015 to 2021.

Over the entire period, TFPG has averaged only 0.1% annual growth, showing weak contributions to overall productivity improvements. While TFPG played a role in certain decades, particularly in the late 1980s and early 2000s, its overall contribution to total labor productivity growth was just

3%. This indicates that structural challenges have limited Thailand's ability to achieve sustained productivity gains, despite periods of strong economic growth.

2.2 Analysis of Thailand R&D and Innovation surveys

This study will use data from the 2022 Survey on Research and Development (R&D) and Innovation Activities of the Private Sector to examine SME innovation in Thailand. The survey provides insights into R&D spending, innovation efforts, and challenges across sectors. By analyzing this data, the study aims to understand how SMEs invest in R&D, the impact of COVID-19 on innovation, and the role of government support in driving technological development. The findings will help assess the current state of SME innovation and identify strategies to improve their competitiveness through innovation.

Table 2.5 shows that most SMEs and startups in Thailand are locally owned. Among non-startup SMEs, 3,033 are Thai-owned, compared to 277 foreign-owned. Similarly, among SME startups, 58 are Thai companies, while only 9 are foreign owned. Larger firms show a different pattern. Non-startup large firms include 1,371 Thai-owned companies and 314 foreign-owned ones. Large startups are relatively rare, with 12 Thai-owned and 6 foreign-owned. This suggests that Thai ownership dominates both SMEs and startups, while foreign ownership is more prevalent among larger, well-established firms.

TABLE 2.5

FIRM DISTRIBUTION BY SIZE, STARTUP STATUS, AND OWNERSHIP TYPE

Size	Startup	Foreign	Thai	Total
Large	Established	314	1,371	1,685
Large	StartUP	6	12	18
SMEs	Established	277	3,033	3,310
SMEs	StartUP	9	58	67
	Total	606	4,474	5,080

Source: Report on the survey of R&D data and innovation activities of the private sector 2022, NRCT

Sectoral Distribution of Thai and Foreign-Owned Firms

Among established Thai-owned firms, manufacturing is the dominant sector, with 1,025 companies, followed by 238 in services and 108 in wholesale/retail. Similarly, among foreign-owned non-startups, manufacturing leads with 280 firms, though their presence in services and wholesale/retail is smaller.

For startups (less than five years old), both Thai and foreign-owned firms remain concentrated in manufacturing. However, Thai-owned startups are also present in services and wholesale/retail, with five firms in each sector. Foreign-owned startups are fewer and focus primarily on manufacturing.

R&D Engagement Across Firm Types

Table 2.6 highlights that large Thai-owned companies are the most active in R&D, with 913 firms investing in research and development, reflecting their strong commitment to innovation. Foreign-owned large firms also engage in R&D but at a lower level, with 179 companies participating.

Among SMEs, the pattern changes significantly. While 1,025 Thai-owned SMEs conduct some R&D, a much larger group, 2,066 firms, do not invest in research. Foreign-owned SMEs are the least engaged, with only 89 firms active in R&D, while 197 firms report no R&D activity.

These figures indicate that R&D investment is concentrated among large firms, particularly Thai-owned companies, while smaller firms, especially foreign-owned SMEs, show limited engagement in innovation activities.

TABLE 2.6

FIRMS WITH IN-HOUSE R&D: DISTRIBUTION BY SIZE AND OWNERSHIP TYPE

Size	Thai	No R&D	In-House R&D	Total
Large	Foreign	141	179	320
Large	Thai	470	913	1,383
SMEs	Foreign	197	89	286
SMEs	Thai	2,066	1,025	3,091
	Total	2,874	2,206	5,080

Source: Report on the survey of R&D data and innovation activities of the private sector 2022, NRCT

Overview of R&D and Innovation Activities of Thai SMEs in 2022

Technological Activities

SMEs and large firms engage in technological activities differently. Larger companies focus on purchasing equipment, adopting external technology, and hiring technical experts. They emphasize quality control and innovation-driven training, ensuring long-term productivity gains.

SMEs, while also participating in these areas, tend to focus on process improvement, product design, and targeted innovation training. However, their efforts are constrained by limited resources. Thai-owned companies are more engaged in technology adoption, product design, and quality control, while foreign-owned firms focus on fewer innovation tasks.

Established firms invest more in equipment, external technologies, and quality control, reflecting their broader innovation capacity. Startups, still in early development stages, have a narrower focus on innovation, prioritizing specific technological improvements.

R&D Activities

R&D engagement varies by company type. Among Thai-owned startups, 4 out of 12 conduct R&D, showing early innovation trends. Foreign-owned startups, however, report no R&D activity, possibly prioritizing market entry over research efforts.

Both large firms and SMEs rely mainly on in-house R&D, with little outsourcing. Many companies report zero in-house R&D, with 1,114 large firms and 2,794 SMEs not engaging in research. Those that do invest in R&D prefer internal innovation over outsourcing.

Forms of R&D Activities

Larger firms conduct more in-house R&D, while SMEs rely on external organizations for research. SMEs outsource domestically due to resource constraints, whereas larger firms maintain self-sufficient R&D strategies.

Thai-owned companies engage in both internal and outsourced R&D, showing flexibility in leveraging external expertise. Foreign-owned firms participate less actively in R&D, indicating a more limited approach. Established companies also invest more heavily in R&D compared to startups, which focus on early-stage growth rather than research.

R&D Spending and Benefits

SMEs and larger firms allocate R&D funds differently. SMEs adjust spending based on immediate market needs, prioritizing product improvements and cost reduction. In contrast, large firms maintain stable R&D investment, focusing on long-term innovation.

Thai-owned companies tend to react to market shifts, adjusting R&D spending to meet demand. Foreign-owned firms follow a more consistent investment strategy, prioritizing steady development over reactive adjustments. Established companies allocate more resources to R&D and generate more revenue from innovation than startups.

Funding Sources for R&D and Innovation

SMEs rely primarily on internal funding, with limited access to government grants, private sector funding, or international support. Larger firms use a broader range of external funding options, allowing for greater innovation investment.

Thai-owned firms depend heavily on internal financing, while foreign-owned firms access slightly more external support. Established companies benefit from diverse funding sources, while startups struggle to secure external backing, limiting their innovation capacity.

Outsourcing R&D to Overseas Agencies

Large firms outsource R&D abroad due to staff shortages, inadequate infrastructure, and urgent research needs. They also engage in international collaborations more frequently than SMEs.

Thai-owned firms face broader R&D challenges, including skilled labor shortages and regulatory constraints, prompting greater involvement in international research. Foreign-owned firms engage less in outsourced R&D, suggesting a narrower research approach.

Product and Service Innovation

Large Thai-owned firms lead in product and service innovation, with 157 companies reporting improvements. Foreign-owned large firms are less engaged, with 58 reporting innovation efforts. SMEs, regardless of ownership, participate less in new product development.

Revenue from new or improved products is significantly higher for large firms, while SMEs see lower income growth from innovation. Thai-owned companies are more proactive in introducing new products, while foreign-owned firms and startups focus less on product development.

Process Innovation

Thai-owned firms, particularly SMEs, are more engaged in process innovation. Among large firms, 40 have improved production processes, and 41 have introduced new operational systems. Foreign-owned firms show less process innovation, with only 4 out of 181 making improvements.

Thai-owned SMEs are more active in adopting new production methods, while foreign-owned SMEs show minimal process innovation. This suggests Thai-owned firms prioritize operational efficiency more than foreign-owned firms.

Key Drivers of R&D and Innovation

Large Thai-owned firms are more proactive in expanding product lines, entering new markets, and improving quality. 253 companies reported product diversification efforts, alongside regulatory compliance and workplace safety improvements.

Foreign-owned firms and startups engage less in strategic innovation, suggesting a more cautious or resource-constrained approach. Thai-owned SMEs focus on cost reduction and quality improvement but lag in environmental initiatives and global expansion.

Collaboration in Development Activities

Thai-owned firms, particularly large ones, engage more in collaborative innovation. While 335 large Thai firms report no collaboration, some partner with universities and research institutes. Foreign-owned large firms show less participation, with only 1-2 companies engaging in partnerships.

Thai-owned SMEs also demonstrate higher collaboration rates, working with external businesses and institutions. Foreign-owned SMEs, however, show minimal participation, indicating a weaker role in Thailand's innovation ecosystem.

Cooperation in R&D and Innovation

Thai-owned firms, especially large ones, actively collaborate with customers, suppliers, and universities. 303 large Thai companies work with customers, and 24 engage with trade associations.

Foreign-owned firms, particularly SMEs, engage less in collaborative R&D, suggesting a more independent approach. Thai-owned SMEs maintain moderate collaboration, while startups remain in the early stages of network building.

Barriers to Innovation

Larger firms face high R&D costs, skilled labor shortages, and regulatory challenges, while SMEs struggle with funding access and market competition.

Thai-owned companies encounter broader innovation barriers, including uncertain demand and regulatory hurdles. Foreign-owned firms report fewer obstacles, suggesting they face fewer domestic constraints.

Established firms deal with a wider range of R&D challenges, while startups, still in early growth phases, report fewer innovation barriers.

Intellectual Property (IP) Protection

SMEs are more active than large firms in securing IP protection, including patents, trademarks, and copyrights. Larger firms also engage in IP filing, but SMEs see it as a strategic priority.

Thai-owned companies prioritize formal IP protection, while foreign-owned firms participate less. Established firms focus on securing innovation, whereas startups, due to their early-stage focus, show minimal involvement in IP protection.

Collaboration with Government Research Institutions and Universities

Large firms are more engaged in formal R&D collaborations, such as joint research, consultancy, and government support programs. SMEs, while involved, focus more on hiring consultants and using external tools.

Established firms benefit more from R&D partnerships, while startups remain less engaged due to limited resources. Thai-owned companies are more proactive in joint research and consulting, while foreign-owned firms show lower participation.

Key Factors Affecting Business Growth in 2022

SMEs prioritize immediate concerns like market competition, COVID-19 impacts, and economic conditions. Larger firms focus on long-term strategies, including government support and technological advancements.

Thai-owned firms emphasize technological progress and macroeconomic trends, while foreign-owned firms prioritize skilled labor and government support. Startups focus on future growth factors, while established firms navigate current disruptions such as market challenges and supply chain disruptions.

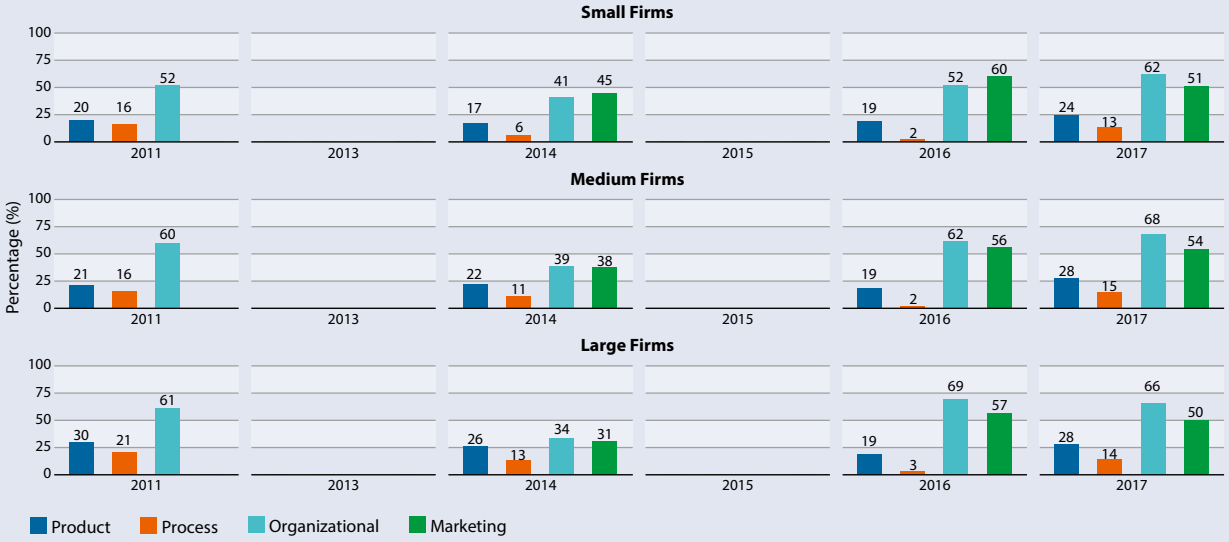
2.2.2 R&D and Innovation Activities of SMEs in the Industrial Sector of Thailand (2011-2017)

The 2011–2017 Survey on R&D and Innovation Activities in Thailand's Industrial Sector highlights a significant increase in innovation adoption across small, medium, and large firms. Manufacturing firms saw greater engagement in R&D, along with a rise in product, process, organizational, and marketing innovations.

In 2014, small firms slightly outpaced large firms in innovation implementation. However, by 2016–2017, the gap narrowed, with both groups showing similar innovation levels. Large firms focused more on product and process innovations, while small firms prioritized marketing innovations (See Figure 2.6).

FIGURE 2.6

PRODUCT, PROCESS, ORGANIZATIONAL, AND MARKETING INNOVATION OF SMALL, MEDIUM, AND LARGE FIRMS (2011-2017)

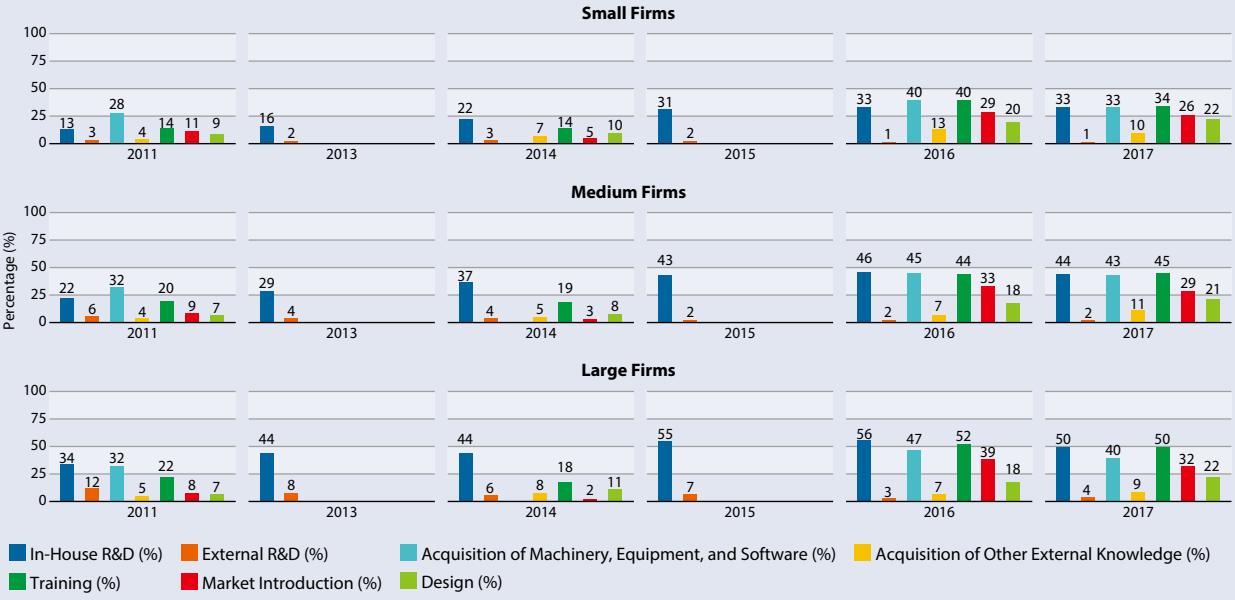


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Large firms invested more heavily in R&D compared to small and medium-sized firms, with in-house R&D being their primary approach. Smaller firms, however, focused more on training and acquiring new machinery or equipment to drive innovation, rather than direct R&D investment (See Figure 2.7).

FIGURE 2.7

R&D AND INNOVATION ACTIVITIES OF SMALL, MEDIUM, AND LARGE FIRMS (2011-2017)

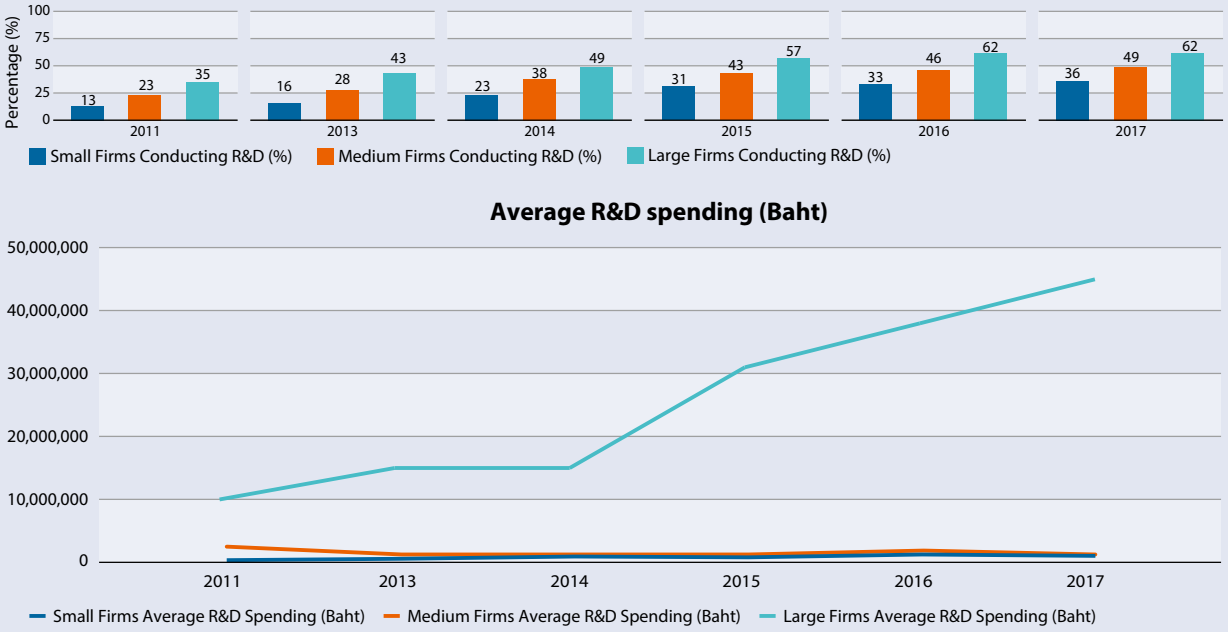


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Average R&D spending increased over time, with large firms seeing the sharpest rise. Small firms were more likely to collaborate with customers and local suppliers, while large firms primarily partnered with parent companies. Collaboration with public research institutions and universities remained low across all firm sizes (See Figure 2.8).

FIGURE 2.8

AVERAGE R&D SPENDING (BAHT) OF SMALL, MEDIUM, AND LARGE FIRMS (2011-2017)

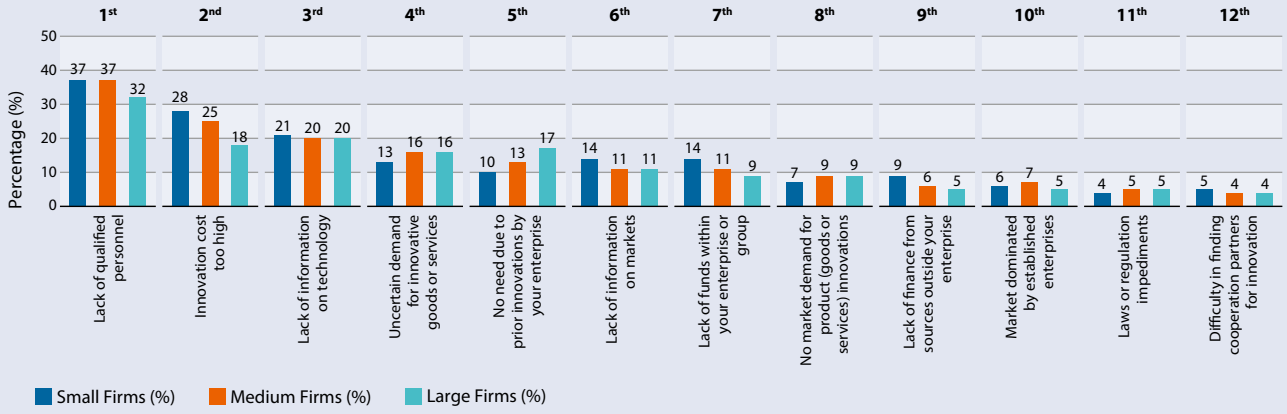


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Small firms faced greater obstacles in innovation, including a lack of qualified personnel, high costs, and limited internal funding. Large firms encountered fewer constraints, with many citing a lack of necessity for further innovation due to prior investments. These differences highlight the resource gap between firm sizes in driving innovation (See Figure 2.9).

FIGURE 2.9

CHALLENGES TO INNOVATION OF LARGE AND SMALL, MEDIUM, AND LARGE FIRMS (2011-2017)

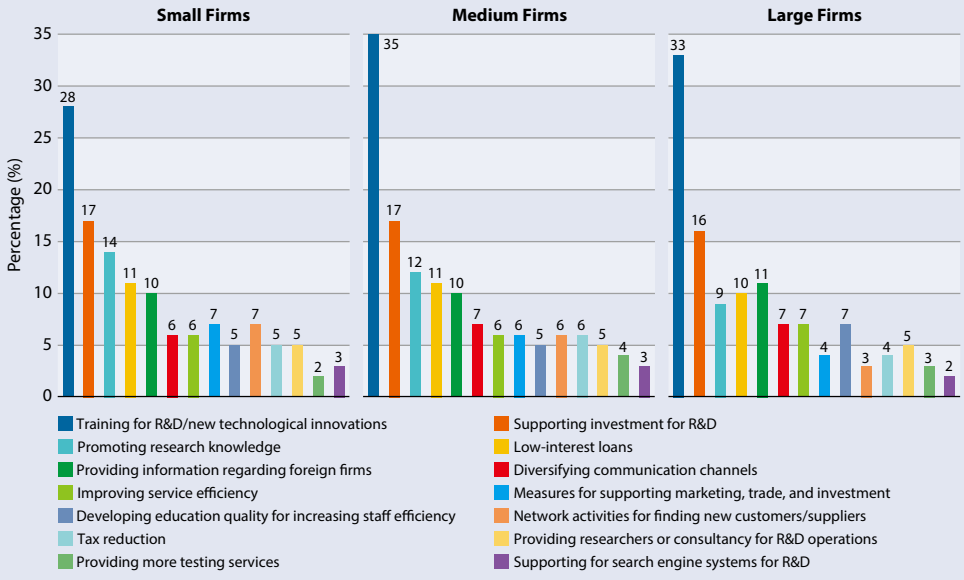


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Programs like ITAP, Thailand Tech Show, and low-interest loans played a crucial role in supporting innovation. Small firms benefited the most from these financial and technical aids, while large firms were generally less reliant on government programs (See Figure 2.10).

FIGURE 2.10

IMPACT OF GOVERNMENT SUPPORTS ON INNOVATION OF SMALL, MEDIUM, AND LARGE FIRMS (2017)

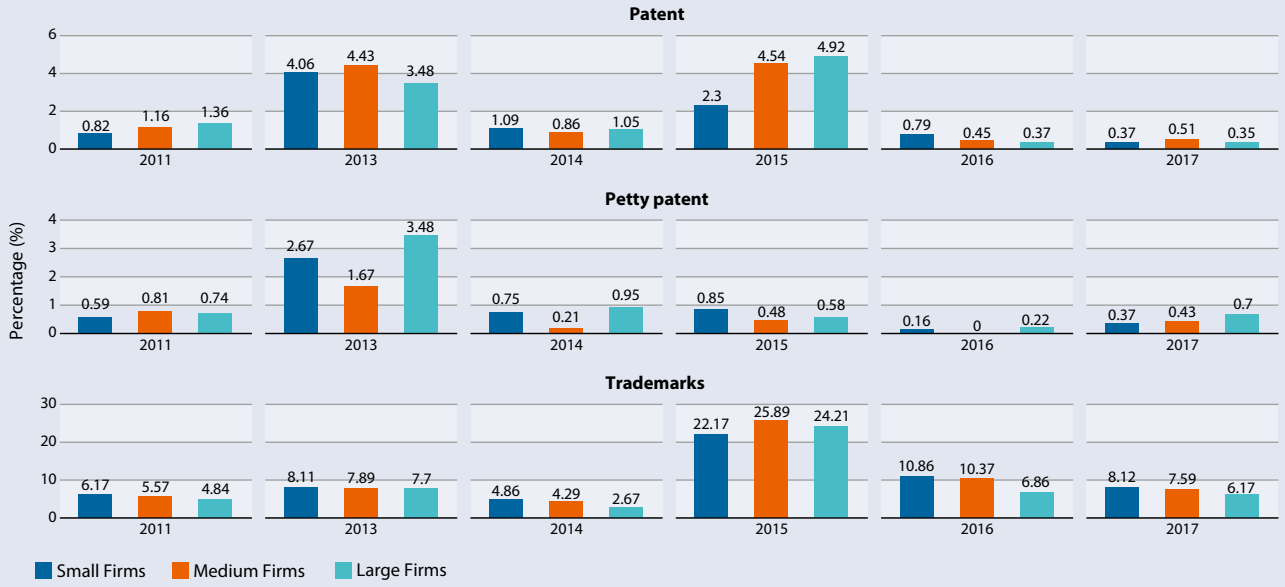


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Large firms were more active in patent and trademark filings, though innovation protection efforts grew across all firm sizes from 2011 to 2017 (See Figure 2.11).

FIGURE 2.11

PATENT, PETTY PATENT, AND TRADEMARK ACTIVITIES OF SMALL, MEDIUM, AND LARGE FIRMS (2011-2017)



Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

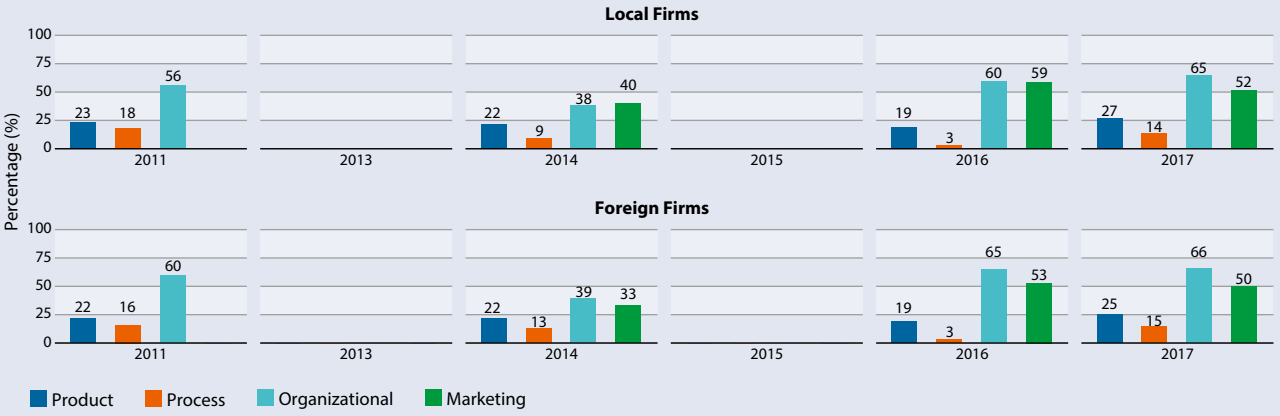
Participation in government-supported projects increased over time, reflecting the growing role of the government in fostering innovation, particularly among SMEs. While large firms lead in technological innovation and R&D spending, SMEs focus more on marketing innovations and training, with government support playing a crucial role in overcoming resource constraints.

The 2011–2017 Survey on R&D and Innovation Activities highlights key differences in innovation by firm ownership. Foreign firms consistently outperformed local firms in innovation activity throughout this period.

Foreign firms had a higher share of innovation adoption, implementing product, process, organizational, and marketing innovations more frequently than local firms. They focused more on product and process innovations, while local firms emphasized organizational and marketing innovations (See Figure 2.12).

FIGURE 2.12

TYPE OF INNOVATION OF LOCAL AND FOREIGN FIRMS (2011-2017)

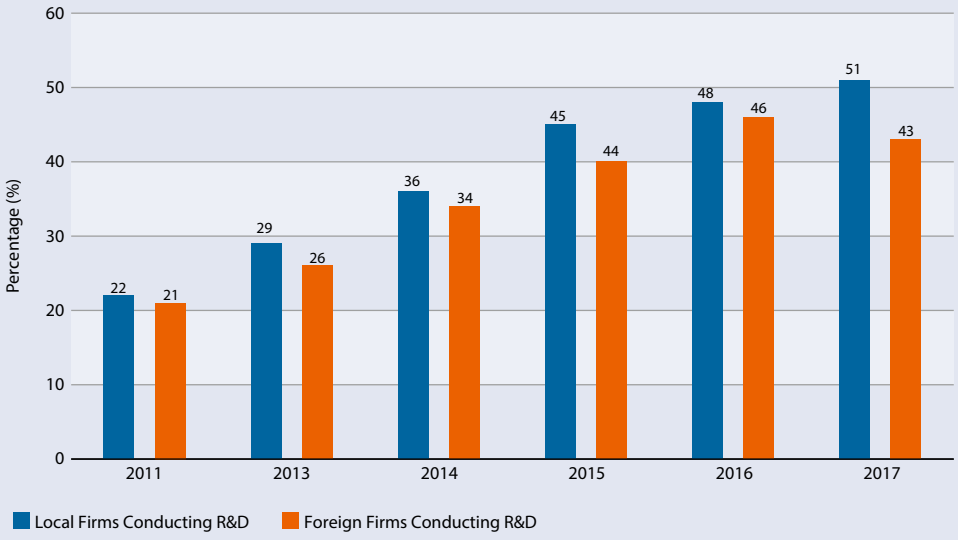


Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

Local firms are significantly more likely to invest in R&D compared to foreign firms. In 2017, 51% of local firms conducted R&D, whereas only 43% of foreign firms did. This indicates that local firms are more committed to developing new technologies and innovations through internal research activities. (See Figure 2.13).

FIGURE 2.13

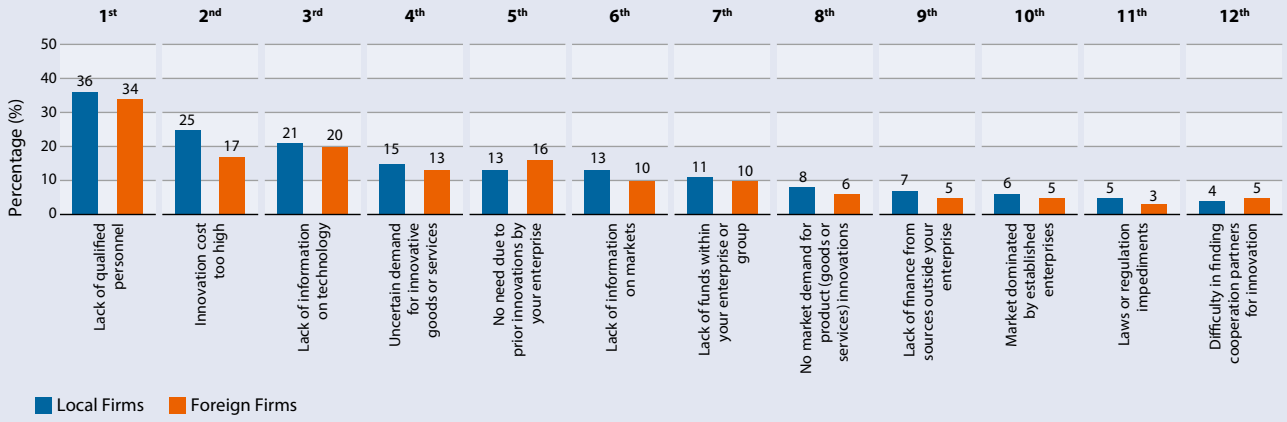
THE SHARE OF LOCAL AND FOREIGN MANUFACTURING FIRMS WHO CONDUCTED R&D (2011-2017)



Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

FIGURE 2.14

FACTORS HAMPERING INNOVATION (HIGH IMPACT), 2017



Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

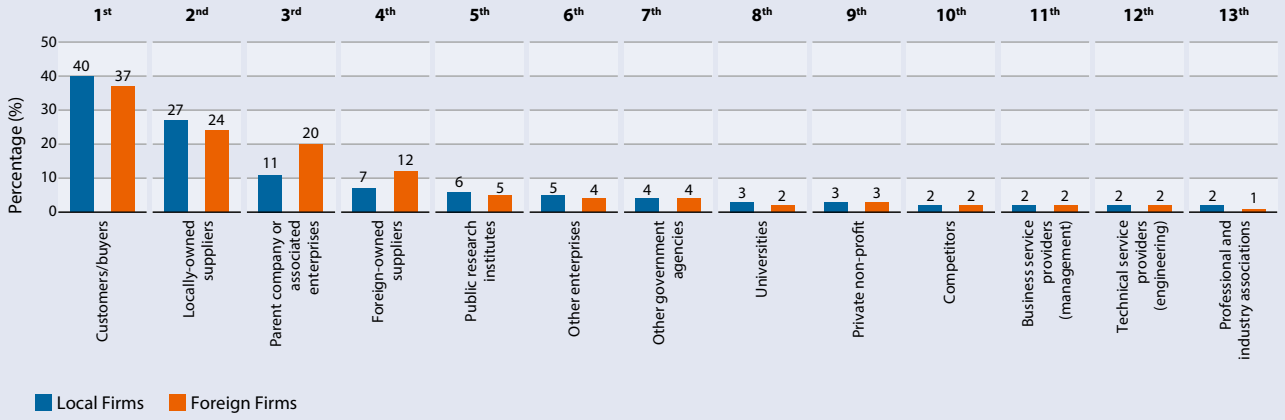
Both local and foreign firms face barriers to innovation, though the challenges differ. Local firms struggle with a lack of qualified personnel, high innovation costs, and limited internal funding, making it harder to sustain long-term innovation efforts. Foreign firms, while less constrained by these factors, still face high innovation costs and market uncertainty regarding demand for new goods and services. These differences highlight the need for tailored support strategies to address the specific innovation challenges faced by each group (See Figure 2.14).

Foreign firms primarily collaborate with parent companies and foreign-owned suppliers, enhancing their innovation capabilities through access to global expertise and advanced technology. Local firms, in contrast, rely more on customers and locally-owned suppliers for innovation partnerships, focusing on market-driven and supply-chain-based innovations.

Despite these differences, collaboration with public research institutes and universities remains low for both groups, indicating an untapped opportunity for strengthening industry-academia partnerships (See Figure 2.15).

FIGURE 2.15

IMPORTANT PARTNERS FOR INNOVATION COLLABORATION OF LOCAL AND FOREIGN FIRMS (2017)



Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

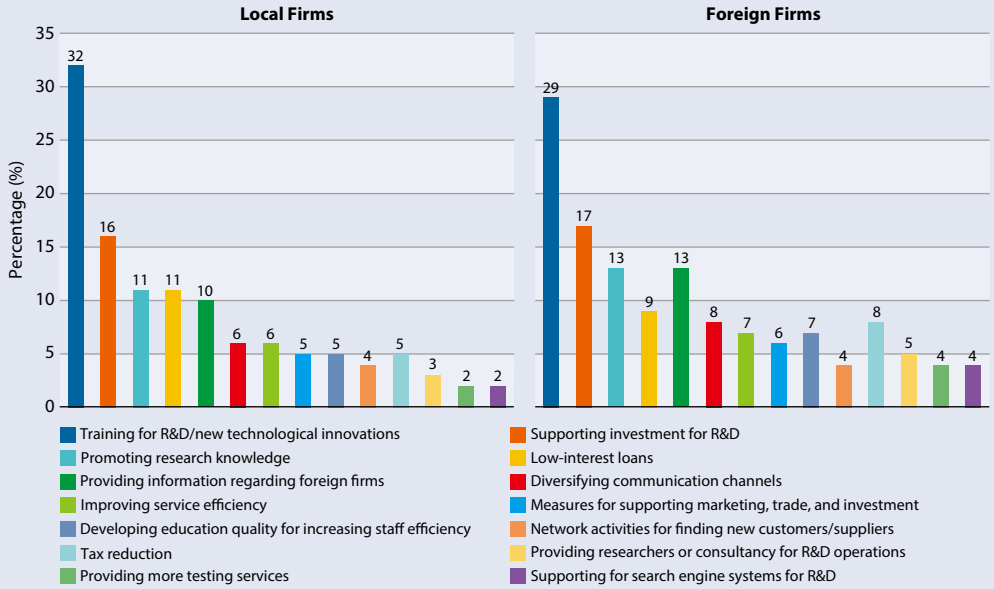
While foreign firms are generally more innovative, local firms benefit significantly from targeted government support programs such as the Innovation Technology Assistance Program (ITAP) and the Zero interest loan initiative. These programs provide financial aid, consultancy, and low-interest loans, helping local SMEs adopt new technologies and enhance innovation.

In contrast, foreign firms benefit more from Board of Investment (BOI) incentives, which play a crucial role in supporting their innovation activities in Thailand.

Overall, government support programs have a positive impact, particularly on local firms' innovation capabilities. Low-interest loans and ITAP initiatives have helped smaller local firms overcome financial and human resource limitations, driving technological development (See Figure 2.16).

FIGURE 2.16

IMPACT OF GOVERNMENT SUPPORT (HIGH IMPACT, 2017)



Source: The Survey on R&D and Innovation Activities in the Industrial Sector (2011-2017), NXPO

These insights illustrate the contrasting approaches to innovation between foreign and local firms in Thailand. Foreign firms lead the way in technological innovation and R&D spending, while local firms rely more on government support to address their limitations in resources and capabilities.

In summary, SMEs play a crucial role in Thailand's economy but face lower productivity growth, slower technology adoption, and limited R&D engagement compared to larger firms. These challenges have been further exacerbated by the COVID-19 pandemic, which significantly affected their ability to innovate and remain competitive.

Several key obstacles hinder SME innovation. Resource constraints, high innovation costs, limited access to skilled labor, and external funding make it difficult for SMEs to invest in new technologies and scale their businesses. Without adequate support, these firms struggle to compete in both domestic and international markets.

To improve technological capabilities and productivity, SMEs require a combination of supply-side, demand-side, and systemic support. Supply-side policies, such as financial assistance, R&D funding, and technology adoption programs, can help businesses access the resources they need to innovate. Demand-side measures, including market access improvements, competitiveness incentives, and public procurement opportunities, can create a stronger business environment for SMEs. Additionally, systemic support, such as collaboration networks with research institutions and regulatory improvements, can reduce barriers to innovation.

While these coordinated efforts are essential, Thailand must enhance its institutional capability to ensure policies are effectively implemented. Without strong policy execution and efficient support mechanisms, SMEs may struggle to fully benefit from these initiatives. Strengthening institutional capacity will be key to driving productivity growth, fostering innovation, and enhancing SME competitiveness in the long term.

Chapter 3
Analysis of contents, implementation mechanisms, and effectiveness of policy instruments for enhancing technological capabilities and innovation of SMEs

This chapter provides a comprehensive analysis of the policy instruments designed to enhance the technological capabilities and innovation of SMEs in Thailand. It critically examines both supply-side and demand-side policy instruments, exploring various mechanisms such as tax incentives, grants, low-interest loans, direct equity participation, and indirect financial support through government-linked venture capitals. This chapter also delves into financial and non-financial assistance aimed at training skilled workers, scientists, and other key personnel crucial for firm innovation. On the demand side, it considers strategies to create markets for innovative SME products, government procurement practices, and initiatives to stimulate private sector demand for innovative goods and services.

Furthermore, the chapter evaluates systemic policy instruments that promote better coordination between SMEs and universities, public research institutes, large multinational enterprises, and domestic firms, as well as policies to strengthen innovation intermediaries. Each policy instrument is analyzed in terms of its content, implementation, and effectiveness, providing a detailed understanding of how these instruments contribute to the technological advancement and productivity improvement of SMEs in Thailand.

We have gathered numerous reports on policy instruments aimed at enhancing the technological capabilities and innovation of SMEs in Thailand (Chulalongkorn University Research Team, 2022; NXPO, 2021; NXPO, 2020; BOI, 2022; Intarakumnerd and Wonglimpiyarat, 2012). We conducted interviews with government officials and policymakers to gain insights into the policy content, implementation, effectiveness, and suggestions for improvement related to these measures. From our investigation, there are a total of 4 demand-side policy instruments, 26 supply-side policy instruments, and 9 systemic policy instruments. These instruments collectively target various areas of innovation, from fostering market demand to strengthening the innovation ecosystem and enhancing business capabilities.

Demand-side policy instruments focus on stimulating market demand for innovation, primarily managed by organizations like the DITP (Department of International Trade Promotion), Ministry of Commerce, and NSTDA, targeting export-oriented businesses, innovators, and technology developers.

Supply-side policy instruments, administered by agencies such as various universities and agencies under the Ministry of Higher Education, Science, Research and Innovation (MHESI), Thailand Board of Investment (BOI), Digital Economy Promotion Agency (DEPA), and National Innovation Agency (NIA), aim to enhance innovation capacity through financial support, tax incentives, and talent development, with a focus on high-skilled workers, investors, SMEs, and innovation-driven enterprises (IDEs).

Systemic instruments, led by NIA, NSTDA, and OSMEP, work to strengthen the overall innovation ecosystem by fostering collaboration between SMEs, startups, researchers, and public institutions, supporting cross-sector partnerships and improving the regulatory environment to drive innovation across industries.

Table 3.1 shows measure, type of policy instruments, organization, target group, and incentives & key activities of policy instruments for enhancing technological capabilities and innovation of SMEs in Thailand.

TABLE 3.1

SUMMARY OF MEASURE TYPE, ORGANIZATION, TARGET GROUP, AND KEY ACTIVITIES OF POLICY INSTRUMENTS FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION OF SMES

Measures	Type	Organization	Target Group	Key Activities
Demand-side policy instruments				
Thailand Trust-Mark	Demand-side	DITP, Ministry of Commerce	Export-oriented businesses	Certification mark to boost trust in Thai products globally, aiding in market expansion
Thai Innovation List Measure	Demand-side	NSTDA, Budget Bureau	Innovators and technology developers	Certification of innovative products and services for government procurement.
DEPA Digital Transformation Fund	Demand-side	DEPA	SMEs adopting digital tech. to improve operations & competitiveness.	Offering matching grants, collaborating with digital providers, and promoting digital literacy.
DEPA Mini Voucher for SMEs	Demand-side	DEPA	MSMEs needing support for digital tech. adoption.	Providing vouchers to subsidize digital tools and partnering with accredited technology providers.
Supply-side policy instruments				
DEPA Digital Startup Fund	Financial Support	DEPA	Digital startups in early & growth stages: healthcare, tourism, agriculture, smart technologies.	Providing financial support, mentorship, and networking opportunities through a competitive selection process.
Regional Market Validate	Financial Support	NIA	SMEs aiming to new regional, national, international markets	Up to 75% of project value (max 1.5 million THB), 1-year duration, to support business expansion and market entry
Thematic Innovation Grant	Financial Support	NIA	IDEs in food, agriculture, circular economy, clean energy, digital, EV	Up to 75% of project value (max 5 million THB), 3-year duration, to test and improve market feasibility of innovation
MIND	Financial Support	NIA	Innovation-based businesses seeking strategic or operational consult	Up to 50% of consultancy costs (max 1,000,000 THB), 1-year, to hire consultants for business growth
Standard Testing	Financial Support	NIA	IDE needing product registration standard certification	Up to 50% of project value (max 1.5 million THB), 1-year duration, for testing and certification
Market Expansion	Financial Support	NIA	Innovation-based businesses looking to expand into new target markets	100% for public sector clients, 50% for private clients, max 2 million THB, 1-year duration, to expand market reach
Matching Interest for Working Capital	Financial Support	NIA	Innovation-based businesses with market-ready products/services	Up to 75% of interest and fees (max 1.5 million THB), 1-year duration, to improve liquidity for growth
Corporate Co-funding	Financial Support	NIA	Startups with potential for commercial success	Up to 5 million THB, 5-year duration, to leverage government and private funding for business growth

Measures	Type	Organization	Target Group	Key Activities
Zero Interest Loan rate	Financial Support	NIA	Startups, SMEs for innovation, tech. development, or commercialization.	Providing zero-interest loans to startups & SMEs to support innovation, tech. development, commercialization
BOI's Matching Fund	Financial Support	BOI	Thai Startups in Targeted Industries (EVs, smart electronics, biotech, medicine)	Startups receive funding between 20 to 50 million THB through a co-investment model with private VCs, as well as visa and work permit facilitation for foreign experts.
Credit Guarantee Program	Financial Support	TCG	SMEs, Startups, Innobiz	Loan guarantees for SMEs and startups; loans up to 40 million THB
Capital Market Fundraising Promotion Project (PP-SME)	Financial Support	SEC	SMEs looking to raise capital	Support for SMEs to access funding through the capital market, including advisory services & regulatory support.
Convertible Debenture	Financial Support	SEC	SMEs, Institutional Investors, Private Equity, Venture Capital	Offers convertible debentures that allow debt to be converted into equity, providing flexible financing options with deferred equity dilution.
University Holding Company	Financial Support	Various universities and agencies under MHESI	University-based startups, Spin-offs, Research institutions	Provides financial support, equity investments, and commercialization assistance for university-based startups and spin-offs.
STI coupon for OTOP Upgrade	Financial Support	MHESI, NSTDA	OTOP (One Tambon One Product) Entrepreneurs	Providing S&T consultancy services and financial support (as science coupons) to help OTOP businesses enhance product quality and innovation.
TED Fund	Financial Support	MHESI	Startups, SMEs, Entrepreneurs in technology and innovation sectors	Provides grant & seed funding to support the development and commercialization of technology-based and innovative enterprises.
Innovation One Fund	Financial Support	FTI and TSRI	SMEs and Technology Startup	Invests in tech startups to provide SMEs with advanced technology solutions
Global Talent Visa	Human Resource	BOI	High-skilled workers, investors, executives, innovators	Provides long-term visas for high-skilled workers, executives, investors & families, and work permit exemptions.
Talent Mobility	Human Resource	Various agencies under MHESI	Researchers and industry partners	Provides programs to encourage the mobility of skilled talent between academia and industry to support innovation and technology transfer.
IP Advisory Center (IPAC)	Human Resource	DIP	SMEs, inventors, and researchers	Offers consultation on IPR, including patent searches, IP strategy development, and support for international IP protection.
SMEs Coach	Human Resource	OSMEP	SMEs in the early stages of growth	Provide business coaching, training, strategic guidance, networking opportunities, and support for innovation.
Thailand Plus Package	Tax Incentive	Revenue Department	Firms in high-tech and innovation-driven sectors	Provide a 200% corporate income tax deduction for firms that invest in the development of high-skilled manpower
Accelerated Depreciation Rate for R&D equipment	Tax Incentive	Revenue Department	Companies involved in R&D, Innovation-driven enterprises	Allows companies to depreciate R&D equipment at an accelerated rate, reducing tax liabilities & improving cash flow for R&D investments.
Capital Tax Gain Exemption	Tax Incentive	Revenue Department	Investors, Venture Capital firms, Startups	Provides exemption of capital gains tax on investments in startups, IDEs, and VC funds.
R&D Tax Incentive Program (RDI 200%)	Tax Incentive	Revenue Department & NSTDA	Companies involved in R&D, including SMEs	Corporate income tax exemption for 200% of expenses on R&D innovation, and NSTDA provides certification for R&D activities.
BOI Tax Incentive for SMEs	Tax Incentive	BOI	SMEs with at least 51% Thai ownership, operating in BOI-promoted sectors	Supports SMEs in upgrading technology and productivity through investment in new machinery, with at least 50% of total machinery being new.

Measures	Type	Organization	Target Group	Key Activities
Systemic Instruments				
Business Innovation Center (BIC)	Systemic	NSTDA	Tech entrepreneurs and SMEs	Provides mentorship, business workshops, connection to researchers, investors, funding & market, and intensive project evaluation to bring their ideas to products
Thailand Science Park (TSP)	Systemic	NSTDA	Researchers and technology developers	Provides space, services, and funding for R&D activities within Thailand Science Park.
Industry Transformation Center (ITC)	Systemic	Ministry of Industry, MHESI, MDES	Manufacturing SMEs	Provides technical and financial support for SMEs to adopt advanced manufacturing technologies.
NSTDA Investment Section (NIS)	Systemic	NSTDA	IDEs, Research spin-offs	Provides capital for scaling technology ventures, promotes collaboration between academia & industry, mentorship, and access to resources.
Thailand Tech Show	Systemic	NSTDA	Innovators, SMEs, Investors	Organizes technology transfer events to showcase and commercialize research outcomes, including licensing opportunities.
Industrial Technology Assistance Program (ITAP)	Systemic	NSTDA	SMEs and large firms	Provides financial support for up to 50% of costs to hire consultants for technology & product development
STI coupon for OTOP Upgrade	Systemic	MHESI	OTOP (One Tambon One Product) Entrepreneurs	Provides S&T consultancy services and financial support to help OTOPs enhance product quality and innovation.
Tech2Biz	Systemic	NXPO	SMEs and IDE	Online platform that facilitates the matching of technology needs and innovations between technology providers and technology seekers.
Business Development Services (BDS) Market	Systemic	OSMEP	SMEs	Offering a marketplace for business development services e.g. consultancy, training, & financial advice, connecting SMEs.

3.1 Demand-side Policy Instruments

A **demand-side policy instrument** refers to a policy measure designed to stimulate or influence the demand for goods, services, or innovations. Unlike supply-side policies, which focus on enhancing the capacity to produce, demand-side instruments aim to create market demand by promoting the adoption and consumption of specific products or services. These policies encourage consumers, businesses, or the public sector to buy or invest in innovative products, sustainable goods, or technology-driven solutions.

Examples of demand-side policy instruments include subsidies, tax incentives, certifications, grants, and public procurement policies that motivate users to adopt new technologies or environmentally friendly products. By driving demand, these policies help create markets for innovative offerings, reduce the risks for producers, and support overall economic and technological development

Thailand Trust Mark

Policy Content: The Thailand Trust Mark (T-Mark) is designed to enhance the global reputation of Thai products by certifying them as high-quality, trustworthy goods. The policy focuses on using T-Mark certification as a tool to build credibility in international markets, particularly for export-oriented businesses. By ensuring that certified products meet high standards in quality, sustainability, and social responsibility, the T-Mark aligns with Thailand's broader goal of increasing exports and becoming a global trade leader. For SMEs, the T-Mark provides crucial

benefits such as enhanced market exposure, consumer trust, and increased international competitiveness. Certified SMEs gain access to trade activities and promotional support from the Department of International Trade Promotion (DITP), helping them connect with global markets. The certification assures consumers of superior product quality, environmentally responsible production, and ethical business practices, boosting brand credibility and sales. Additionally, the T-Mark encourages SMEs to improve production standards, fostering long-term business growth and competitiveness in the global economy.

Policy Implementation: T-Mark certification is carried out by the Department of International Trade Promotion (DITP), which rigorously evaluates businesses before awarding the certification. While the process is thorough, ensuring that only top-quality products receive the mark, it poses challenges for smaller enterprises, especially SMEs, that may lack the resources or technical capacity to meet the stringent criteria. The centralization of the implementation under DITP also means that the process is somewhat rigid, limiting flexibility and accessibility for different business sizes or sectors.

Policy Effectiveness: The T-Mark elevates the status of Thai products in international markets, promoting exports, and improving the global reputation of Thai goods. By ensuring that certified products meet high standards in quality, sustainability, and social responsibility, the T-Mark enhances consumer trust and helps businesses expand into global markets. As of June 2023, approximately 851 companies have been awarded certifications across various sectors, including food, heavy industry, lifestyle products, fashion, and services such as health, international education, and medical services. However, its effectiveness is somewhat limited by the high barriers to gaining certification, which restrict its reach to a small number of larger businesses. To maximize its impact, the program could introduce tiered certification levels or provide technical and financial support to SMEs, helping them meet the criteria and gain access to the benefits of T-Mark certification (P. Tippakoon, personal communication, September 29, 2024).

Suggestions for Improvement: To enhance the T-Mark program, a more inclusive approach should be adopted by introducing tiered certification levels to accommodate businesses of varying sizes. Technical assistance programs and financial incentives should be provided to help SMEs meet certification criteria, broadening participation and improving industry standards. Simplifying the application process, increasing awareness through outreach programs, and establishing continuous feedback mechanisms would further enhance accessibility and effectiveness. These improvements would enable more businesses to benefit from the T-Mark, strengthening Thailand's global trade position and boosting the reputation of Thai products internationally.

Thai Innovation List Measure

Policy Content: The Thai Innovation List Measure aims to promote the adoption of innovative products and services by certifying them through NSTDA and the Budget Bureau. This certification allows innovators to receive official recognition for their products, improving their visibility and marketability in both domestic and international markets. The Thai Innovation List supports SMEs by facilitating their access to government procurement opportunities. Products and services developed through Thai R&D can be listed for up to eight years, during which government agencies can procure them through special procurement specifications. This exposure not only increases sales but also enhances the credibility of SMEs, encouraging further innovation and contributing to Thailand's economic growth.

Policy Implementation: The Thai Innovation List is implemented through a structured process managed by NSTDA and the Budget Bureau. Innovative products and services developed from Thai research and development are submitted to NSTDA for evaluation against specific eligibility criteria, including Thai ownership, compliance with industrial standards, and quality assurance. Upon passing NSTDA's assessment, the Budget Bureau reviews the pricing and, if approved, includes the products or services in the Thai Innovation List for a maximum of eight years. While this centralized implementation ensures a high level of quality for certified innovations, the process can be cumbersome and difficult for smaller innovators to navigate. The requirement for extensive documentation and adherence to strict criteria can act as a barrier to entry for businesses with limited resources. Additionally, awareness of the program may be lower among smaller firms or those in more remote regions.

Policy Effectiveness: The measure boosts the market presence of certified innovations, helping companies gain credibility and enhancing their commercialization potential. However, the specific number of firms participating in the Thai Innovation List Measure is not publicly disclosed. Its effectiveness is diminished by the limited participation of smaller firms due to the stringent certification process. Broader awareness and simplified procedures could increase participation, allowing more firms to benefit from the innovation list (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvement: To improve this policy, the certification process could be simplified or made more flexible for smaller firms, perhaps by introducing different certification tiers based on the size or stage of development of the innovation. Offering pre-certification guidance or technical assistance could also help smaller firms meet the requirements. NSTDA should establish clear guidelines for innovation levels, improving product standards, aligning supplier qualifications with bidding requirements, ensuring transparent pricing, standardizing product information, and enhancing oversight mechanisms, would strengthen the program's integrity and broaden participation among SMEs.

DEPA Digital Transformation Fund

Policy Content: The DEPA Digital Transformation Fund aims to support businesses, particularly SMEs, in adopting digital technologies to enhance their operations and competitiveness. It focuses on promoting digital literacy, technological innovation, and aligning business practices with Thailand's digital economy vision. The fund addresses critical gaps in digital adoption among traditional businesses.

Policy Implementation: The fund is implemented through a structured grant program where eligible businesses can apply for financial assistance. In 2025, it will provide support to SMEs with a maximum funding limit of 200,000 baht per business for up to 100 SMEs per year in the form of a matching fund. It also collaborates with digital technology providers to offer tailored solutions for business needs. However, challenges in the implementation include limited awareness of the program among potential beneficiaries and insufficient outreach to smaller enterprises in remote areas.

Policy Effectiveness: As of 2021, DEPA has supported over 900 development projects through its Digital Transformation Fund. The fund has encouraged digital transformation in some SMEs, leading to improved efficiency and competitiveness. However, the scale of its impact remains constrained due to limited funding and coverage, leaving significant portions of the business community untapped. Furthermore, the adoption of advanced technologies is still uneven, with most beneficiaries focusing on basic digital solutions.

Suggestions for Improvement: To enhance the effectiveness of the DEPA Digital Transformation Fund, its funding should be increased to cover a larger number of businesses and support advanced technology adoption. Improved outreach and awareness campaigns are necessary to ensure that SMEs, especially in regional areas, are informed about the program. Establishing partnerships with private technology firms and industry associations could further extend the program's reach and impact. Lastly, incorporating regular impact assessments and feedback mechanisms would help refine the program and align it with the evolving needs of businesses (C. Chinaprayoon, personal communication, September 18, 2024).

DEPA Mini Transformation Voucher for MSMEs

Policy Content: The DEPA Mini Transformation Voucher aims to support micro, small and medium enterprises (MSMEs) in adopting digital technologies to improve their operations and competitiveness. It provides financial assistance in the form of vouchers to subsidize the cost of acquiring digital tools and services. This policy aligns with Thailand's digital economy vision and focuses on reducing barriers to digital adoption for small businesses.

Policy Implementation: The voucher program is implemented through a simple voucher system where eligible businesses apply for funding to offset digital technology costs. The program provides grants covering up to 100% of actual expenses, with a maximum limit of 10,000 baht per MSME. Entrepreneurs can choose from a variety of digital technology services, such as OCR systems for digitizing documents, business analytics platforms, and intelligent enterprise management systems. Partnerships with accredited technology providers ensure the availability of quality solutions.

Policy Effectiveness: The voucher program has introduced digital technologies to many small businesses, helping them streamline operations and increase efficiency. In 2022, the voucher program supported 13,119 MSMEs, vendors, and farmers, and helped 371 factories and MSMEs improve their efficiency through digital technologies. The program also extended its reach to 25 provinces, driving digital adoption and enhancing market competitiveness nationwide. However, its overall impact is limited by the relatively small voucher amounts, which are often insufficient for more comprehensive digital transformation.

Suggestions for Improvement: To improve the DEPA Mini Transformation Voucher, the voucher value should be increased to cover a broader range of digital solutions, including advanced tools and services. Enhanced promotion and outreach efforts are needed to raise awareness among small businesses, particularly in regional areas. Expanding partnerships with private technology providers and regional digital hubs can ensure better access to solutions. Finally, implementing a monitoring and evaluation framework can help assess the program's impact and guide future improvements (C. Chinaprayoon, personal communication, September 18, 2024).

Table 3.2 shows the analysis of each demand-side policy instrument considering the dimensions of policy content, policy implementation, and policy effectiveness, along with suggestions for improvements.

TABLE 3.2

ANALYSIS OF DEMAND-SIDE POLICY INSTRUMENTS CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Policy Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Thailand Trust Mark (TTM)	Enhances global reputation of Thai products through certification, promoting high quality, sustainability, credibility in exports.	Managed by DITP with a rigorous evaluation process; challenges exist for SMEs due to strict criteria and centralized implementation.	Strengthens Thai product recognition globally; 851 companies certified by 2022, but high entry barriers limit SME participation.	Introduce tiered certification, provide SME support, simplify applications, enhance outreach, and establish feedback mechanisms.
Thai Innovation List Measure	Promotes adoption of certified innovative products, enhancing SME visibility and access to government procurement.	Managed by NSTDA and Budget Bureau; requires strict evaluation, Thai ownership, and compliance with industrial standards.	Boosts market presence and credibility but has limited SME participation due to stringent certification requirements.	Simplify certification, introduce tiered levels, offer technical assistance, and enhance transparency and oversight.
DEPA Digital Transformation Fund	Supports SMEs in digital adoption to enhance operations and competitiveness	Provides up to 200,000 baht per SME for 100 businesses annually; collaborates with tech providers	Supported 900+ projects, improved SME efficiency but impact remains limited due to funding constraints	Increase funding, enhance outreach, build private partnerships
DEPA Mini Transformation Voucher for MSMEs	Supports MSMEs in digital adoption through vouchers.	Grants cover up to 100% of expenses (max 10,000 baht per SME); partnerships with tech providers	Helped 13,119 small businesses and 371 SMEs but limited by small voucher amounts.	Increase voucher value, enhance outreach, expand tech partnerships

Demand-side policy instruments stimulate market adoption of innovative products, sustainable goods, and digital technologies by offering incentives such as financial support, tax benefits, and certifications. These measures help reduce risks for producers, enhance credibility, and encourage businesses and consumers to invest in advanced solutions. Certification-based initiatives aim to boost product reputation and marketability, yet strict eligibility criteria often pose challenges for smaller enterprises. Financial support programs promote digital transformation among businesses by subsidizing technology adoption, but limited funding and low awareness restrict their overall impact. To improve effectiveness, simplifying application processes, expanding financial assistance, introducing more flexible qualification criteria, and increasing outreach efforts can enhance accessibility, particularly for smaller businesses. Strengthening collaboration between public and private sectors, aligning support mechanisms with industry needs, and incorporating feedback-driven improvements will further drive innovation and economic competitiveness.

3.2 Supply-side Policy Instruments

Supply-side policy instruments are designed to enhance the capacity of producers, businesses, and the economy to innovate, grow, and increase productivity. These policies typically focus on improving the conditions for businesses to produce goods and services more efficiently, often by reducing costs, improving infrastructure, enhancing access to resources, and fostering innovation.

Key examples of supply-side policies include grants for business expansion, policies that facilitate access to skilled labor, such as talent visas and tax incentives for R&D, subsidies for technological innovation. Supply-side policies also include investments in infrastructure, education, and training to improve the overall productive capacity of the economy. The goal of these policies is to boost competitiveness, stimulate innovation, and promote long-term economic growth by strengthening the supply base of the economy.

The supply-side policy instruments focus on various types of support, administered by key organizations such as DEPA, NIA, and BOI. These programs target diverse groups including IDEs, Thai startups in industries like EVs and smart electronics, early-stage and growth-stage startups, digital startups in sectors like agriculture, health, and education, as well as SMEs, researchers, and firms developing innovative products. For example, BOI's programs generally focus on startups and innovation-driven enterprises, while DEPA targets entrepreneurs and digital startups across key sectors. NIA's programs support innovative firms and SMEs, with a focus on fostering collaborative innovation between businesses and researchers.

3.2.1 Financial support measures

DEPA Digital Startup Fund

Policy Content: The DEPA Digital Startup Fund provides financial support to digital startups especially in two stages: for early-stage startups (up to 3 years old), with funding up to 1 million baht (70:30 ratio), and for growth-stage startups (up to 5 years old), with funding up to 5 million baht (70:30 ratio). Target industries include public services, healthcare, tourism, agriculture, education, smart cities, MarTech, FinTech, AI, blockchain, and Web 3.0.

Policy Implementation: DEPA collaborates with startup ecosystems and employs a competitive selection process to allocate funds. The implementation involves identifying startups with high growth potential, providing financial aid, and offering additional non-financial support, such as mentorship and networking opportunities. Challenges include limited scalability and resource allocation for more significant impact.

Policy Effectiveness: In 2022, the fund supported 142 startups, enabling them to raise over 1.15 billion baht and helping 6 to secure Series A funding to expand internationally. Additionally, 10 startups gained access to government procurement opportunities. However, its overall reach and impact remain modest compared to the growing demand from startups. The limited funding amount often restricts its ability to sustain startups for extended periods.

Suggestions for Improvement: To improve the DEPA Digital Startup Fund, the scale of funding should be increased to provide startups with sufficient capital for sustained growth and operations. Stronger collaboration with private venture capital firms could enable co-investment opportunities, leveraging greater resources for startups. Regular performance reviews of funded startups should be introduced to monitor progress and ensure effective outcomes. Expanding mentorship and capacity-building initiatives alongside financial support would further enhance startup capabilities.

Finally, fostering stronger regional and global networking opportunities could better integrate Thai startups into broader ecosystems, increasing their competitiveness and market reach (C. Chinaprayoon, personal communication, September 18, 2024).

NIA's Regional Market Validate *(Matching Grant for Innovation Development)*
Policy Content: NIA's Regional Market Validate focuses on validating the market potential for innovations in regional markets, encouraging the adoption of new products and services beyond Thailand's urban centers. It aims to promote regional development by introducing innovations to a broader audience in less-developed areas. The program provides consulting services to help these businesses develop and adapt their innovations to meet regional market demands.

Policy Implementation: NIA implements Regional Market Validate through a structured six-month process. In the initial three months, participants will receive consultations focused on product development and target customer validation. This is followed by an additional three months dedicated to refining the product and business model based on market feedback. The program connects innovators with regional stakeholders, funds market trials, and provides mentorship to ensure the products meet local demands. It acts as a bridge between businesses and regional markets, helping to adapt innovations to local needs while offering financial and advisory support.

Policy Effectiveness: The program has expanded the market reach for some innovations, especially in regional areas, but its impact is somewhat limited due to regional infrastructure constraints and capacity gaps. While there has been progress in validating products, the program's effectiveness is hindered by uneven participation across different regions (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: To enhance its reach, the program should increase awareness in regional areas and improve regional infrastructure support to facilitate product trials. It could also expand the scope to include more sectors, such as digital technologies, and strengthen collaboration with local businesses to better align innovations with market needs.

NIA's Thematic Innovation *(Matching Grant for Innovation Development)*
Policy Content: The program promotes R&D in strategic sectors like digital economy, green tech, and sustainable development. It supports collaboration between businesses and research institutions to address national challenges and drive innovations aligned with long-term development goals.

Policy Implementation: NIA offers grants for R&D projects targeting government priority areas, providing funding, mentorship, and project monitoring to ensure feasibility and commercialization. The program focuses on companies, research institutes, and startups within these sectors.

Policy Effectiveness: The program has fostered innovation in key sectors, resulting in market-ready products. However, challenges include a complex application process, limited SME awareness, and difficulties in scaling innovations internationally. Success often depends on businesses meeting high sectoral standards (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: Simplify the application process, increase SME outreach, and raise program awareness. Flexibility in funding criteria would allow for more diverse projects. Offering tailored support services, such as mentorship and networking opportunities, can further

assist businesses in successfully entering and competing in regional markets. Strengthening post-grant support, including commercialization guidance and international market access, could boost scalability and sustainability.

NIA's MIND (Financial Support for Technical Assistance)

Policy Content: MIND aims to enhance innovation by providing businesses with expert advisory services to support the business development of innovative products and services. The program connects businesses with specialized consultants who can offer tailored advice and guidance on innovation strategies, technology commercialization, R&D management and business expansion, particularly in industries with high growth potential.

Policy Implementation: NIA implements MIND by selecting and matching businesses with consultants who have expertise in specific sectors. The program offers financial support to cover consulting fees and facilitates collaboration between businesses and experts. It also organizes workshops and events to help businesses understand the value of consulting in innovation processes. Monitoring and evaluation are conducted to ensure that businesses benefit from the expertise provided.

Policy Effectiveness: MIND has helped several businesses gain valuable insights and improve their innovation capabilities. It has contributed to better decision-making in R&D, product development, and market entry strategies. MIND has enabled startups and SMEs to refine their business models and enhance their technological capabilities. However, its reach is somewhat constrained by limited funding and participation numbers. Increasing awareness and improving accessibility for more early-stage entrepreneurs could further amplify its impact. There is also a need for more widespread awareness of the program's benefits (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: To improve MIND, NIA could increase the number of consultants available and offer a wider range of expertise in emerging fields such as AI, digital transformation, and green technologies. Expanding outreach efforts to raise awareness, particularly among SMEs, and simplifying the application process would help increase participation. NIA should increase funding and broaden participation to reach a larger number of early-stage entrepreneurs. Additionally, raising awareness about the program and improving accessibility can further amplify its impact.

NIA's Standard Testing (Matching Grant for Standard Testing)

Policy Content: NIA's Standard Testing program is designed to support businesses in enhancing their product quality and ensuring compliance with industry standards. The program offers matching grants to cover a portion of the costs associated with standard testing procedures, thereby assisting companies in meeting regulatory requirements and improving their market competitiveness. By alleviating some of the financial burdens of standard testing, NIA aims to encourage more enterprises to pursue rigorous quality assurance practices. It targets sectors like manufacturing, food, and health tech, aiming to enhance product credibility and market competitiveness.

Policy Implementation: This program provides matching grants to cover a portion of the costs associated with standard testing, thereby assisting companies in meeting regulatory requirements and improving their market competitiveness. The implementation process involves businesses applying for the grant, undergoing an evaluation process, and, upon approval, receiving financial

assistance to offset testing expenses. This approach not only alleviates the financial burden on companies but also encourages adherence to industry standards, fostering a culture of quality and innovation within Thailand's business ecosystem.

Policy Effectiveness: By providing financial assistance for standard testing, the program has enabled companies to meet regulatory requirements and improve market competitiveness. However, specific data on the number of firms assisted and the measurable outcomes achieved through this program are not readily available. However, participation is low, especially among smaller firms, due to limited awareness and the complexity of the process (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: NIA could increase awareness through outreach, simplify the certification process, expand lab partnerships, and offer more financial support to SMEs. Additionally, training on standards and certification would help businesses understand their long-term benefits.

NIA's Market Expansion (Financial Support for Market Expansion)

Policy Content: The Market Expansion program provides financial support to innovative businesses aiming to commercialize their products and services. This initiative offers grants covering up to 50% of project costs, with a maximum of 2 million baht per project for private organizations, to facilitate market testing and product improvement. The program's objective is to assist businesses in reaching new customer bases and enhancing their market presence.

Policy Implementation: NIA organizes market exploration activities, such as trade missions and exhibitions, and provides funding to SMEs for participation. It also facilitates partnerships with international buyers and distributors to expand market reach. The implementation process involves businesses applying for the grant, undergoing an evaluation process, and, upon approval, receiving financial assistance to offset expenses related to market entry and expansion.

Policy Effectiveness: The measure has helped SMEs gain exposure in new markets, though results vary by industry. NIA supports over 3,133 innovative projects with a total investment of approximately 3.58 billion baht, leading to an overall investment value of around 50.3 billion baht. While some SMEs have expanded their market presence, many face challenges in sustaining growth due to limited resources and follow-up support (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: NIA should implement a comprehensive strategy that includes increased funding, expanded participation, and improved accessibility for early-stage entrepreneurs. Additionally, fostering partnerships with international markets and providing mentorship opportunities can further support businesses in their expansion efforts. NIA should enhance post-event support for SMEs, offer more personalized market research, and extend funding to cover logistics costs.

NIA's Working Capital Interest (Matching Grant for Working Capital's Interest)

Policy Content: This measure provides financial support to SMEs by matching their interest payments for working capital loans. The aim is to reduce the financial burden on businesses seeking to improve their cash flow, especially for those investing in technology, innovation, and expansion.

Policy Implementation: NIA offers a "Matching Interest for Working Capital" program designed to alleviate financial burdens for startups and SMEs. This initiative provides partial support for interest payments on working capital loans, covering up to 75% of the interest and related fees, with a maximum of 1.5 million baht per project for a duration of one year. By reducing the cost of borrowing, the program aims to enhance liquidity for innovative businesses, enabling them to focus resources on growth and development activities.

Policy Effectiveness: The policy has helped many SMEs by making working capital more accessible, especially for those in innovation-driven sectors. However, its reach is somewhat limited due to eligibility criteria and the complexity of the application process. Some SMEs struggle with the administrative burden (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: Streamlining the application process, offering clearer eligibility guidelines, and expanding the program to cover a wider range of industries would increase participation. Additionally, offering longer-term support or interest rate reductions for sustained innovation would enhance the program's impact.

NIA's Corporate Co-funding (Co-Investment)

Policy Content: The Corporate Co-funding program offers matching funds to businesses that have secured investments from recognized investors, with the NIA contributing up to 50 million baht per enterprise. This initiative aims to enhance the competitiveness of Thai startups in targeted industries by increasing liquidity and providing additional financing. By collaborating with both public and private funding sources, NIA seeks to support activities related to business growth, such as product development, marketing, capacity expansion, and intellectual property management.

Policy Implementation: NIA collaborates with private investors to support startups and innovative businesses. The program offers recoverable grants, investing up to 10 million baht per startup, particularly targeting those at the seed to pre-series A stages. These funds are expected to be returned to NIA within five years, ensuring a sustainable funding cycle. NIA has partnered with nine investors registered as co-investment partners, aiming to strengthen local startup capital and enhance competitiveness at the international level. This collaborative approach not only provides financial support but also facilitates access to mentorship and networks, fostering the growth and scalability of Thai startups.

Policy Effectiveness: The program has been able to attract private sector investment into high-risk innovation projects, particularly in tech-driven industries. However, the program's reach is limited, as it mostly benefits companies with already established connections to large corporations. Smaller firms or startups with less visibility may struggle to access these co-funding opportunities (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: Broader outreach and better matchmaking between SMEs and potential corporate partners could increase the program's effectiveness. Simplifying the application and vetting process would also help more companies participate, especially those in nascent or underrepresented sectors. Expanding the program to cover more diverse industries and types of innovation would further increase its impact.

NIA's Zero Interest Loan (Financial Support for Loan's Interest)

Policy Content: NIA offers a "Zero Interest Loan" program designed to alleviate financial burdens for startups and SMEs. This initiative provides interest-free loans to support working capital needs, enabling businesses to focus on growth and innovation without the immediate pressure of interest repayments. By offering these zero-interest loans, NIA aims to enhance liquidity for innovative enterprises, facilitating their development and competitiveness in the market. The goal is to alleviate financial barriers for businesses that may have limited access to traditional financing options, thereby fostering innovation and competitiveness.

Policy Implementation: In collaboration with nine financial institutions, including Bangkok Bank, Kasikorn Bank, and Siam Commercial Bank, NIA covers loan interest for approved projects for up to three years, with a maximum support of 5 million baht per project. Eligible projects must have secured loans from participating banks and are responsible for providing collateral.

Policy Effectiveness: This program has helped ease the financial burden on startups and SMEs, enabling them to invest in R&D and commercialization activities without the additional strain of interest payments. However, some businesses may still face challenges in meeting the loan eligibility criteria or in securing long-term sustainability after the loan period ends (C. Limapornvanich, personal communication, September 18, 2024).

Suggestions for Improvement: The program could benefit from expanding its eligibility criteria to include more types of businesses, particularly those in less-developed regions or sectors that are not traditionally seen as "innovative." Additionally, providing follow-up support, such as mentoring or continued access to funding, could help businesses scale and ensure long-term success. Simplifying the loan application process and ensuring greater awareness could also improve participation.

BOI's Matching Fund

Policy Content: BOI has introduced a matching fund program under the National Competitiveness Enhancement for Targeted Industries Act to bolster high-potential startups in targeted industries. This program provides financial support ranging from 20 to 50 million baht per startup, matching the amount these companies have secured from venture capital funds. The aim is to enhance the competitiveness of Thai startups, enabling them to expand their operations and compete on an international scale.

Policy Implementation: BOI matches a certain percentage of private investments, focusing on startups and high-tech industries. To qualify, startups must be legally established in Thailand with at least 51% Thai ownership, and the founders must hold a minimum of 60% of the shares. Additionally, eligible startups should operate within designated target industries, such as digital technology, electronics, modern vehicles, agriculture, food, medicine, biotechnology, and robotics. They must also have secured at least 15 million baht from a venture capital firm registered with NIA. Other than financial assistance, BOI offers tax incentives and streamlined visa and work permit processes for foreign experts employed by these startups.

Policy Effectiveness: The Matching Fund program, launched in August 2024, is still in its early stages. That year, only five million baht was allocated to the fund. While funds have stimulated growth in targeted industries, participation has been limited by the narrow sectoral focus and the complexity of the application process (S. Thunyawong, personal communication, September 20, 2024).

Suggestions for Improvements: Broaden the scope of eligible industries to include a wider range of innovative sectors and simplify the application process to encourage greater participation, particularly from startups and SMEs. Establishing specialized business service units to offer consulting, marketing, and financial planning assistance can further aid startups and SMEs.

Credit Guarantee Program

Policy Content: The Credit Guarantee Program is designed to enhance SMEs' access to financing by mitigating lenders' risks. The Thai Credit Guarantee Corporation (TCG), a state-owned entity under the Ministry of Finance, plays a pivotal role by providing credit guarantees to SMEs lacking sufficient collateral, thereby facilitating their ability to secure loans from financial institutions.

Policy Implementation: Administered by TCG, the program helps SMEs access financing by covering a portion of the risk for lenders, making it easier for small businesses to obtain loans. When an SME applies for a loan but lacks sufficient collateral, TCG can provide a guarantee to the lending institution, covering a significant portion of the loan amount. This guarantee reduces the lender's risk exposure, encouraging them to extend credit to SMEs that might otherwise be deemed too risky. In the event the SME defaults, TCG compensates the lender for the guaranteed portion of the loan. This mechanism not only facilitates increased lending to SMEs but also promotes economic growth by enabling these enterprises to invest in expansion and innovation.

Policy Effectiveness: In 2023, TCG approved loan guarantees totaling 114,025 million baht, enhancing liquidity for SMEs and generating 470,388 million baht in economic benefits. The program supported 99,298 SMEs in securing new loans, with 80% being MSMEs. The program has improved SME access to credit, but awareness remains low among many SMEs, particularly those in regional areas and smaller urban centers (P. Tippakoon, personal communication, September 29, 2024).

Suggestions for Improvements: TCG should operate with the agility of a private firm while functioning as a government body. Increase awareness of the program through targeted campaigns aimed at SMEs, particularly in underserved regions. Streamlining the application process could also encourage greater participation.

Capital Market Fundraising Promotion Project for SMEs (PP-SME)

Policy Content: The Capital Market Fundraising Promotion Project for SMEs (PP-SME) is a collaborative initiative between Thailand's Securities and Exchange Commission (SEC) and the Office of Small and Medium Enterprises Promotion (OSMEP) aimed at facilitating capital market access for SMEs and startups. This program enables eligible companies to raise funds through private placements of newly issued shares or convertible debentures without the need for prior SEC approval. This initiative aims to streamline the fundraising process, reduce regulatory burdens, and enhance the ability of SMEs and startups to secure necessary capital for growth and innovation.

Policy Implementation: Eligible companies must first register with OSMEP and prepare a comprehensive factsheet detailing their business operations, financial status, securities information, and associated risks. Fundraising is conducted through private placements, targeting specific investor groups such as institutional investors, private equity, venture capital, angel investors, and the company's own employees or directors. Notably, this process exempts participants from the need for prior SEC approval, streamlining the fundraising procedure and reducing regulatory burdens. By adhering to these guidelines, SMEs and startups can efficiently raise capital to support their growth and innovation initiatives.

Policy Effectiveness: Approximately 10 SMEs were preparing to utilize this program for fundraising, with expectations to access capital markets by 2021. Detailed statistics on firm participation have not been publicly disclosed. The project helps some SMEs access the capital market, but the process remains complex, and many SMEs struggle with the requirements for participation (S. Lim, personal communication, September 19, 2024).

Suggestions for Improvements: PP-SME should streamline the registration process, expand investor outreach, and provide advisory services to help SMEs navigate fundraising. Increasing awareness through workshops and improving post-funding support can boost participation. Additionally, implementing a monitoring framework will ensure the program adapts to evolving SME needs, making capital market access more efficient and impactful.

Convertible Debenture Program

Policy Content: A convertible debenture is a type of debt instrument that can be converted into equity shares of the issuing company under predefined conditions. This financial instrument offers advantages such as gradual dilution of ownership and potential improvement in the debt-to-equity ratio upon conversion. This program offers funding to innovative businesses through convertible debentures, which can be converted into equity at a later stage. It provides flexible financing for high-growth companies while giving investors the potential for equity ownership.

Policy Implementation: To issue convertible debentures, SMEs must comply with regulations set by the Securities and Exchange Commission (SEC) and the Office of Small and Medium Enterprises Promotion (OSMEP), including registering with the Capital Market Fundraising Project for SMEs (PP-SME) and preparing a comprehensive factsheet for investors. Eligible investors typically include institutional investors, venture capitalists, private equity firms, angel investors, and the company's own directors and employees. This program provides SMEs with an alternative means to raise capital while offering investors the opportunity to convert debt into equity, aligning the interests of both parties.

Policy Effectiveness: By enabling SMEs to access capital through private placements of convertible debentures, the policy has facilitated increased investment opportunities. However, specific data on the policy's effectiveness and the number of SMEs that have utilized this mechanism is currently limited. Convertible debentures provide flexible financing for high-growth firms, although participation varies depending on the conversion terms and the perceived risk by investors (P. Tippakoon, personal communication, September 29, 2024).

Suggestions for Improvements: While allowing SMEs to issue convertible debentures, it is recommended to streamline the regulatory framework to reduce procedural complexities and costs associated with fundraising. This includes simplifying documentation requirements and expediting approval processes. Increasing awareness among SMEs about the benefits and procedures of issuing convertible debentures can encourage more enterprises to utilize this financing option. Implementing these strategies can improve SMEs' access to capital markets, fostering their growth and contribution to the economy.

University Holding Company (UHC)

Policy Content: This regulation allows universities to create holding companies to invest in innovative startups and spin-offs, facilitating the commercialization of university research and technology. A university holding company is a business entity separate from universities or state research institutions, functioning as a professional investment manager to commercialize research outputs. It manages investments to establish spin-offs from university research, expand entrepreneurial research, and bring innovations to market. These companies enable universities to access resources and connect with industries, while providing financial support with greater flexibility.

Policy Implementation: UHC involves universities setting up holding companies that operate separately from their parent institutions, allowing for professional management and commercialization of research outputs. These holding companies support the creation of innovation-driven enterprises by providing financial resources, access to university facilities, and industry connections. The policy also encourages joint investments with private sector partners, fostering collaboration between academia and industry.

Policy Effectiveness: UHC has linked research to market opportunities, supporting startups and spin-offs in bringing innovations to market. It has also encouraged universities to become more proactive in translating research into commercial ventures and engaging with industries. As of 2024, 11 universities have established holding companies. These companies have supported at least 80 innovation-driven businesses, with investments exceeding 300 million baht. Several universities and state institutions are in the process of studying and setting up their own holding companies.

Suggestions for Improvements: Since this mechanism is still in its early stages, many universities have only recently established their university holding companies, which need to be strengthened to build sufficient expertise. These companies must excel in investment analysis, market evaluation, sourcing funds, and building connections with investors and corporations to best support spin-offs and startups. Expanding the range of investment sectors and providing more direct mentorship opportunities could further enhance the effectiveness of this program (S. Lim, personal communication, September 19, 2024).

STI Coupon for OTOP Upgrade

Policy Content: The STI Coupon for OTOP Upgrade is an initiative by Thailand's NSTDA aimed at enhancing the quality and competitiveness of products under the One Tambon One Product (OTOP) program. This program provides support to local entrepreneurs by offering coupons that can be used to access science, technology, and innovation (STI) services. These services include product development, quality improvement, packaging design, and marketing strategies, all tailored to elevate local products to meet higher market standards and expand their reach both domestically and internationally.

Policy Implementation: Managed by government agencies, the STI Coupon program offers financial and technical support to OTOP producers, helping them enhance product quality and competitiveness through the adoption of new technologies.

Policy Effectiveness: The program has improved the quality of OTOP products, but access remains limited, especially for producers in more regional and underserved areas (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvements: Increase the availability of STI coupons and simplify the application process to reach more OTOP producers. Expanding the range of services covered by the coupons to include digital marketing and e-commerce training could further boost product competitiveness. Implementing a streamlined application process and providing clear guidelines would encourage more participation. Regular monitoring and evaluation of the program's impact can help identify areas for improvement and ensure that the support provided aligns with the evolving needs of OTOP producers.

TED Fund

Policy Content: The Technology and Innovation-Based Enterprise Development Fund (TED Fund), operating under Thailand's Ministry of Higher Education, Science, Research, and Innovation, is dedicated to fostering innovation-driven enterprises. The fund offers financial support, mentorship, and networking opportunities to students, recent graduates, and startup entrepreneurs, enabling them to commercialize their research and innovations. TED Fund provides financial support, seed funding, and grants to startups, SMEs, and research-driven enterprises focused on technology and innovation.

Policy Implementation: TED Fund has provided financial support to startups, university spin-offs, and SMEs engaged in innovation, with strong ties to academic institutions. However, smaller firms and early-stage startups face challenges accessing funds, and post-commercialization support is limited, hindering long-term scaling.

Policy Effectiveness: In 2024, TED Fund supported 264 projects nationwide with over 232 million baht in funding. Looking ahead, the fund aims to support an additional 270 projects across 13 innovative sectors, with a budget exceeding 273 million baht—a 17.6% increase from the previous year. However, its impact is diminished in supporting enterprises beyond initial stages, particularly in scaling and expanding internationally (S. Pittayasophon, personal communication, September 19, 2024).

Suggestions for Improvement: TED fund should expand financial support mechanisms, such as increasing funding allocations and introducing matching fund projects in collaboration with venture capitalists. The application process should be simplified to make it more accessible, particularly for smaller startups and early-stage businesses. Providing post-commercialization support, such as mentorship, funding for scaling, and assistance with international expansion, would help companies sustain growth beyond initial funding. Outreach should be expanded to ensure that more companies, especially those in emerging sectors, can benefit from TED Fund's support.

The Innovation One Fund

Policy Content: The Innovation One Fund, launched in April 2023 by the Federation of Thai Industries (FTI) in collaboration with Thailand Science Research and Innovation (TSRI), is a 1-billion-baht initiative aimed at enhancing the competitiveness of SMEs through partnerships with technology startups. The fund focuses on supporting next-generation technology startups that provide innovative solutions tailored to SMEs' needs, ultimately driving technological advancement and economic growth in Thailand. The fund prioritizes sectors aligned with Thailand 4.0, including automation, AI, digital transformation, clean energy, and smart manufacturing.

Policy Implementation: The fund operates as a venture capital-style investment, with a planned three-year initial phase and a target of investing in at least five tech startups in the first year. Eligible startups are assessed based on their alignment with SME needs, business feasibility, and profitability potential. FTI collaborates with leading venture capital firms such as InnoSpace and CU Enterprise to facilitate startup selection and investment management. The initiative also promotes industry-academia collaboration, linking SMEs with university-based tech incubators for knowledge transfer.

Policy Effectiveness: The fund has expanded SME access to technology-driven solutions, helping small businesses integrate advanced technologies into their operations. Early results indicate increased partnerships between SMEs and startups, leading to improved productivity, digital transformation, and business expansion opportunities. However, the scale of investment and speed of fund disbursement remain areas of concern, with only a limited number of startups benefiting so far.

Suggestions for Improvement: The fund should broaden eligibility criteria to include a wider range of technology providers that cater to SMEs. Streamlining the investment approval process and providing clearer guidelines would improve fund accessibility. Additionally, integrating government co-funding or tax incentives for participating in SMEs could enhance adoption. Establishing a structured mentorship and capacity-building program for startups and SMEs would further accelerate technology commercialization.

Table 3.3 shows financial support measures regarding policy content, policy implementation, policy effectiveness, and suggestions for improvements.

TABLE 3.3

ANALYSIS OF FINANCIAL SUPPORT MEASURES CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Policy Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvements
BOI's Matching Fund	Matching private investment in targeted industries such as EVs and electronics.	Private investment matched by BOI to stimulate growth in key sectors.	Stimulating growth but limited participation due to narrow focus.	Broaden industry scope and simplify application process.
DEPA Digital Startup Fund	Funding for digital and tech startups.	Administered by DEPA for digital startups.	Nurtured growth of digital startups, but limited sectoral reach.	Expand reach to more sectors within the digital economy.
Regional Market Validate	Tests products/services in regional markets.	Pilot testing, market research, funding support.	Support for market entry, but market/product fit varies.	Improve market selection and enhance post-validation support.
Thematic Innovation Grant	Supports R&D in strategic sectors for national goals.	Grants for R&D with funding and mentorship.	Achievements in some key sectors, limited by complex process.	Simplify applications, increase awareness, and enhance post-grant support.
MIND	Provides expert advisories for innovation in growth sectors.	Matches businesses with consultants and offers funding.	Improved decisions, but limited reach and awareness.	More consultants, expand outreach, and more financial support.

Policy Instrument	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvements
Standard Testing	Offers testing and certification services.	Provides access to testing labs and certification.	Improved market access, but low awareness.	Improve accessibility and raise SME awareness.
Market Expansion	Supports market entry locally and internationally.	Grants for market entry & expansion activities.	Helps expansion, but low participation from SMEs.	Expand outreach and support for emerging sectors.
Matching Interest for Working Capital	Provides working capital for innovation.	Matches businesses with financial institutions.	Assists working capital needs, but low participation.	Increase awareness and simplify processes.
Corporate Co-funding	Encourages corporate investment in innovation.	Co-investment with tax incentives.	Drives private investment, but SMEs struggle to find partners.	Strengthen incentives and improve matchmaking for SMEs.
Zero Interest Loan	Provides interest-free loans for innovation and R&D.	Interest-free loans for innovative businesses.	Support for innovation, but eligibility and loan size are limiting.	Expand loan caps and improve access for diverse industries.
Credit Guarantee Program	Credit guarantees for SMEs to secure financing.	Credit guarantees facilitated through TCG for SME loans.	Improved SME access to credit but awareness remains low.	Increase awareness of credit guarantees among SMEs.
Capital Market Fundraising Promotion Project (PP-SME)	Support for capital market fundraising for SMEs.	SME-focused capital market fundraising assistance.	Helping SMEs raise capital but needs simplification.	Simplify the fundraising process for better SME participation.
Convertible Debenture	Funding through convertible bonds for high-growth companies.	Funding through convertible bonds to promote flexible financing.	Flexible financing has helped high-growth firms, though participation varies.	Clarify terms for conversion and increase promotional efforts.
University Holding Company	Investment through university holding companies.	University-led investment in commercialization.	Linking research to market but complex processes limit adoption.	Strengthen their holding companies' expertise and expand support mechanisms.
STI coupon for OTOP Upgrade	Support for upgrading OTOP products through STI coupons.	STI coupons for enhancing the quality of OTOP products.	Improved product quality for OTOP but requires more accessible support.	Provide additional support to help regional OTOP producers.
TED Fund	Provides funds to startups, SMEs, and research-driven enterprises focused on tech innovation, promoting R&D, prototyping, and commercialization.	Funds early-stage companies and work with universities but faces challenges in accessibility and lacks post-commercialization support.	Fostering innovation and improving competitiveness but limited in long-term scaling and global market expansion.	Simplify application process and post-commercialization support, enhance capacity building, and expand outreach to ensure greater participation.
Innovation One Fund	1-billion-baht fund supports SMEs via tech startup partnerships	Managed with VC firms like InnoSpace & CU Enterprise, linking SMEs with tech incubators.	Boosted SME access to advanced tech, driving digital transformation and productivity.	Expand eligibility, streamline approval, and establish mentorship programs.

The agency adjusts its support measures in response to the evolving situation and the development level of SMEs and the business ecosystem to ensure maximum effectiveness. For example, at the end of 2024, NIA discontinued two SME support measures, the Innovation Coupon (offered grants up to 1,500,000 baht per project) and the Open Innovation Grant (covered up to 75% of project costs (max 1,500,000 baht) for one year, supporting innovation businesses in developing, testing, and commercializing prototypes), integrating them into its existing programs. NSTDA has also discontinued several measures, including the Research Gap Fund, the Low-Interest Loan Support Program for Technology Development, and the Company Directed Technology Development Program (CD). NIA merged the Innovation Coupon and Open Innovation Grant into existing programs, while NSTDA discontinued several initiatives, including the Research Gap Fund and the Low-Interest Loan Support Program for Technology Development, to optimize resource allocation and improve policy impact.

In summary, financial support measures have evolved to align with changing economic conditions and business ecosystem needs. While these initiatives have successfully supported startups in scaling operations and securing additional funding, challenges such as limited accessibility, complex application processes, and insufficient post-funding support remain. To enhance effectiveness, agencies should simplify funding procedures, expand eligibility, increase collaboration with private investors, and strengthen post-funding assistance, including mentorship and international expansion support. Grants and loans help firms reduce costs, gain knowledge, and enhance innovation, but their success varies depending on individual firm capabilities. Successful research grants require not just funding but also strong collaboration to ensure commitment and shared goals. A shift in perspective on grants and loans is needed, emphasizing risk acceptance and improved support. While agencies aim for high success rates, research inherently involves risks, and financial support alone does not guarantee success. A shift in perspective is needed to accept these risks. Agencies can better stimulate demand and enhance program effectiveness.

3.2.2 Human Resource Support measures

Global Talent Visa

Policy Content: The Global Talent Visa, part of the revamped Long-Term Resident (LTR) Visa program, aims to attract skilled professionals, investors, and high-net-worth individuals to Thailand. The updated visa program offers benefits such as the removal of income requirements for wealthy applicants, eased corporate sponsorship criteria, and expanded eligibility for skilled professionals in various sectors. By facilitating the entry and residence of global talent, the LTR Visa program can indirectly benefit SMEs in Thailand by providing access to a larger pool of skilled professionals and potential investors. This influx of talent and capital can enhance innovation, competitiveness, and business growth within the SME sector.

Policy Implementation: Global Talent Visa is managed by the BOI. Eligible applicants must submit an application through the official LTR Visa portal or a Thai embassy. Required documents include proof of qualifications, employment records, financial statements, and health insurance. Once approved, applicants can collect their visa and digital work permit from the One-Stop Service Center or a Thai consulate.

Policy Effectiveness: As of January 2025, Thailand's LTR Visa program has granted over 6,000 visas, with Europeans comprising the largest group at 2,500 recipients, followed by 1,080 Americans, 610 Japanese, 340 Chinese, and 280 Indian nationals. However, regulations need to

align with other immigration policies to improve its impact further (S. Thunyawong, personal communication, September 20, 2024).

Suggestions for Improvements: Streamlining application procedures to reduce processing times and administrative burdens for applicants. Additionally, implementing targeted marketing campaigns can raise awareness among potential high-skilled professionals and investors about the benefits of the LTR Visa. Establishing support services, such as dedicated help desks or online portals, can assist applicants throughout the process, ensuring a smooth transition for foreign talent and investors into Thailand.

Talent Mobility *(Personnel Mobility Program for Enhancing Research & Innovation)*
Policy Content: The Talent Mobility Program is designed to strengthen the connection between universities, public research institutes, and private sector enterprises, particularly SMEs, to enhance technological development and innovation. By facilitating the movement of researchers, faculty members, and students into the private sector, the program provides SMEs with access to scientific expertise, cutting-edge technology, and research-driven solutions to industrial challenges. This initiative aims to foster a strong university-industry linkage, promote technology transfer, and support collaborative R&D activities that directly benefit SMEs. Additionally, the program plays a crucial role in building a regional innovation ecosystem that aligns with local industrial needs while also creating opportunities for young researchers and students to gain practical experience in solving real-world technological problems.

Policy Implementation: In terms of implementation, the program has established Talent Mobility Facilitation Centers across four key regions—Chiang Mai University, Khon Kaen University, Prince of Songkla University, and King Mongkut's University of Technology Thonburi—to provide logistical and strategic support for university-industry collaborations. It has expanded its reach through the Talent Mobility Network, which includes 27 institutions, enabling a nationwide framework for technology transfer. The program has integrated with Innovation & Technology Assistance Program (ITAP) to ensure that SMEs receive not only research support but also financial assistance for innovation. To facilitate researcher mobility, regulatory adjustments have been introduced to ease collaboration between academia and industry, while funding mechanisms cover research grants, compensation for researchers and their universities, and financial support for students participating as research assistants. Additionally, pre-mobility training helps researchers understand industrial challenges before they begin fieldwork, ensuring that their expertise are well-aligned with industry needs. The program also includes specialized initiatives, such as the R&D Talent Development Program for the food industry and the Cross-Border Talent Mobility scheme, which enables international collaboration for technology exchange.

Policy Effectiveness: The program has driven innovation and industrial problem-solving. Between 2013 and 2023, it facilitated 658 collaborative research projects between academia and the private sector, mobilizing 1,107 researchers and involving 1,048 students in research activities. Most projects (69-85%) focused on R&D, with additional efforts in technical problem-solving, technology management, and testing for industrial standards. The initiative has particularly benefited the manufacturing sector, which accounted for 40% of participating firms, followed by wholesale and retail (25%), professional and scientific services (6%), and agriculture (4%), with other industries making up 26%. The program also leveraged a mix of public and private sector funding to support these activities. After the closure of its initial phase in 2023, the Office of the National Higher Education, Science, Research, and Innovation Policy Council (NXPO) has taken

over its leadership to ensure that Talent Mobility remains a key policy tool for fostering university-industry collaboration and driving innovation in SMEs (S. Pittayasophon, personal communication, September 19, 2024).

Suggestions for Improvements: Expanding industry participation beyond SMEs to sectors like green technology, AI, and digital transformation, along with increased financial incentives such as matching grants and tax benefits, will further enhance the program. Establishing structured career pathways, industry-academia fellowships, and relocation support can attract more researchers, while transitioning from short-term projects to long-term university-industry partnerships through joint research centers and industry-funded Ph.D. programs will ensure sustainability. A key challenge now is that young faculty members lack industry experience and guidance, making mentorship programs, talent-matching platforms, and university-based clearing houses essential for easing their transition into private-sector collaboration. Strengthening pre-mobility training, industry needs assessment, and performance-based metrics will improve alignment with business demands, while international collaboration and talent exchange will integrate Thailand into the global innovation ecosystem. Reforming university regulations on faculty-industry engagement, leveraging digital platforms for talent matching, and increasing student involvement through internships and co-funded projects will further strengthen the program's impact. These improvements will drive technological advancement, SME competitiveness, and Thailand's innovation-driven economic growth.

IP Advisory Center (IPAC)

Policy Content: IPAC, operating under the Department of Intellectual Property (DIP), offers guidance to individuals and businesses on various aspects of intellectual property (IP) rights. Services include assistance with IP registration processes, information on IP laws and regulations, and strategies for IP protection and enforcement. IPAC aims to enhance understanding and management of IP assets among Thai entrepreneurs and innovators, thereby promoting innovation and safeguarding creations. IPAC provides businesses with advisory services related to IP management. The goal is to improve IP awareness and encourage businesses to leverage their innovations through proper IP management.

Policy Implementation: IPAC offers services such as IP registration assistance, legal consultations, and strategies for IP protection and enforcement. By educating SMEs on the importance of safeguarding their innovations and creations, IPAC helps these businesses enhance their competitiveness in both domestic and international markets.

Policy Effectiveness: IPAC has raised the awareness of IP protection. Until 2020, more than 46,447 people had used the services of IPAC. However, SMEs often struggle to utilize the services due to a lack of knowledge or resources. Many SMEs are still not fully aware of the potential benefits of IP management, limiting the program's overall impact (P. Tippakoon, personal communication, September 29, 2024).

Suggestions for Improvements: IPAC could increase its outreach efforts, particularly targeting smaller businesses and startups. Offering more accessible resources, such as simplified guides and workshops tailored to SMEs, would improve their ability to manage IP effectively. Additionally, providing more hands-on assistance could help bridge the resource gap for these firms. Implementing user-friendly digital platforms for IP registration and protection can further streamline processes, making it more accessible for businesses to safeguard their innovations.

OSMEP's SME Coach

Policy Content: OSMEP offers an SME Coach program designed to support SMEs in enhancing their business operations. It provides SMEs with access to experienced coaches who offer guidance on various aspects of business management, including digital transformation, business modeling, and strategic planning. The program aims to equip SMEs with the necessary knowledge and skills to navigate the modern business landscape. Participants benefit from tailored mentorship, enabling them to implement best practices and innovative strategies to improve their competitiveness and sustainability.

Policy Implementation: SMEs can participate in the SME Coach program by first verifying their business status through the SME One ID system, accessible at https://oneid.sme.go.th/ or via the SME Connext application. Once registered, SMEs can apply for the SME Coach program, where they will be matched with experienced coaches who provide guidance on various aspects of business management, including digital transformation, business modeling, and strategic planning.

Policy Effectiveness: A network of 563 expert coaches provides personalized advisory services and training via a platform that connects SMEs to the right experts. By October 2024, 502 SMEs had benefited from consultations and development support. The program supports SMEs in improving efficiency and competitiveness through its specialized and tailored approach, though scalability and outreach to remote regions remain challenges (W. Opasvadhana, personal communication, October 2, 2024).

Suggestions for Improvement: The program should strengthen coordination among various government agencies involved in SME support. Expanding the program's focus to include support for innovative startups and addressing emerging trends such as digitalization and sustainable practices can better align the program with the evolving needs of SMEs.

Table 3.4 shows the analysis of human resource policy instruments considering the dimensions of policy content, policy implementation, policy effectiveness, and suggestions for improvements.

TABLE 3.4

ANALYSIS OF HUMAN RESOURCE POLICY INSTRUMENTS CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Measure	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Global Talent Visa	Offers long-term visas to high-skilled workers, investors, and executives to attract global talent to Thailand.	Administered by BOI with a focus on attracting skilled workers to critical sectors such as technology and R&D.	Over 6,000 visas issued as of 2025, but better regulatory alignment is needed.	Streamline application process, enhance marketing campaigns, and establish support services for applicants.
Talent Mobility	Strengthens university-industry collaboration by placing researchers in SMEs. Fosters knowledge transfer.	Operates through Talent Mobility Facilitation Centers and integrates with ITAP to provide funding and support for researcher mobility.	Facilitated 658 projects, mobilized 1,107 researchers and 1,048 students, benefiting manufacturing and R&D sectors.	Expand industry participation to AI, green tech, and digital transformation; introduce long-term university-industry partnerships.
IP Advisory Center (IPAC)	Provides IP registration support, legal consultation, and enforcement strategies for businesses.	Offers advisory services, legal assistance, and educational programs on IP management.	Raised awareness but limited impact on SMEs due to lack of knowledge and resources.	Expand outreach to SMEs, offer simplified guides, digital platforms for IP registration, and more hands-on assistance.
OSMEP's SME Coach	Provides SMEs with expert coaching in business management, digital transformation, and strategic planning.	SMEs register via SME One ID system and are matched with expert coaches for personalized guidance.	563 expert coaches provided support to 502 SMEs as of October 2024, but limited reach in remote areas.	Strengthen coordination among agencies, expand support for startups, and include sustainability and digitalization topics.

In summary, human resource support measures aim to attract skilled professionals, enhance university-industry collaboration, improve intellectual property awareness, and provide tailored business coaching. Efforts to bring in global talent have facilitated the entry of thousands of professionals and investors, though regulatory alignment and streamlined application processes are needed. Programs connecting researchers with businesses have successfully supported knowledge transfer and innovation, yet expanding industry participation in emerging fields like AI and green technology would enhance their impact. IP advisory services have increased awareness but remain underutilized by smaller businesses due to accessibility and knowledge gaps, requiring broader outreach and digital support. Business coaching initiatives have helped enterprises improve operations and competitiveness, though challenges remain in scaling support to remote areas. To increase effectiveness, these measures should streamline administrative processes, expand awareness campaigns, strengthen partnerships across industries, and integrate long-term collaboration strategies to drive innovation and economic growth.

3.2.3 Tax Incentive Measures

Thailand Plus Package *(Tax incentives promoting high-skilled manpower development)*

Policy Content: The Thailand Plus Package, introduced in 2019, is an investment promotion policy designed to attract FDI, enhance technological capability, and develop high-skilled manpower to strengthen Thailand's position as a regional hub for advanced industries. Led by BOI, MOF, MOI, and MHESI, the policy focuses on boosting investment, workforce development, and R&D collaborations in automotive (EVs), digital technology, biotechnology, automation, and AI-driven industries.

Policy Implementation: The package supports SMEs through 250% corporate tax deduction for companies investing in STEM workforce training through certified programs by MHESI and 150% corporate tax deduction for hiring high-skilled STEM employees in target industries. Cross-organizational coordination occurs through BOI-led working groups that include representatives from the Revenue Department, NSTDA, MHESI, and DSD. Monitoring mechanisms includes regular reporting by firms receiving tax benefits, audits by the Revenue Department, and progress evaluations conducted by BOI.

Policy Effectiveness: The package has increased SME participation in EV, semiconductor, and automation supply chains, driven workforce upskilling through 200% tax deductions, and improved R&D access and technology transfer. However, limited awareness, high compliance burdens, and weak technology transfer remain challenges. As of early 2025, 74 companies have participated, certifying 3,700 STEM jobs and offering 600+ training courses through 58 centers, reinforcing high-skilled workforce development.

Suggestions for Improvement: Simplifying applications through a one-stop digital portal with automatic pre-qualification, improving funding access via a Thailand Plus SME Fund and low-interest loans, strengthening industry-academia collaboration by requiring foreign firms to subcontract R&D to Thai SMEs and offering 250% tax deductions for joint research.

Accelerated Depreciation Rate for R&D equipment

Policy Content: The Accelerated Depreciation Rate for R&D Equipment, provided by the Revenue Department, aims to incentivize businesses to invest in R&D by allowing faster tax deductions on capital expenditures for R&D-related equipment. Under this measure, companies can immediately depreciate 40% of the equipment's cost in the first year, with the remaining 60% depreciated over its useful life according to standard rates. This policy is designed to reduce the financial burden of investing in innovation, encourage technological advancements, and enhance the competitiveness of Thai industries by promoting R&D-driven growth.

Policy Implementation: The Revenue Department offers tax incentives to encourage R&D investment, including an accelerated depreciation allowance for R&D equipment. Businesses can depreciate 40% of the cost of qualifying new machinery and accessories on the acquisition date, with the remaining 60% depreciated over its useful life. To qualify, equipment must be exclusively for R&D, new (not second-hand), have a useful life of at least two years, and cost at least 100,000 Thai Baht. Companies can claim an extra 100% deduction for R&D expenditures incurred in Thailand, covering technology and innovation-related projects conducted through approved government agencies or private entities. These measures aim to lower the financial burden of R&D activities and promote technological advancement in Thailand.

Policy Effectiveness: The program has been significant in encouraging businesses to invest in research and development. By allowing firms to initially depreciate R&D equipment at 40% of the cost, with the remaining balance depreciated at a maximum rate of 20% per annum, the policy has incentivized companies to adopt advanced technologies and innovate.

Suggestions for Improvement: The measure should broaden eligibility criteria to cover a wider range of industries and R&D activities, encouraging greater investment in innovation. Increasing awareness and accessibility, particularly for SMEs, through targeted outreach programs will ensure more businesses benefit from the incentive. Simplifying administrative procedures will reduce the compliance burden, making it easier for companies to claim the tax benefit.

Capital Tax Gain Exemption

Policy Content: The Revenue Department, under the Ministry of Finance, offers Capital Gains Tax Exemptions to encourage investment in specific sectors and through financial instruments. Notably, gains from the sale of shares in companies listed on the Stock Exchange of Thailand are exempt from personal income tax, promoting investment in the Thai stock market. Additionally, to stimulate investment in targeted industries such as technology and science, the government provides income tax exemptions for capital gains arising from the disposal of direct and indirect investments in qualifying startup companies. These exemptions are available to both Thai and foreign investors, subject to conditions like holding the investment for a minimum period and ensuring the company derives a significant portion of its income from qualified activities. These policies aim to foster economic growth by incentivizing investments in strategic sectors.

Policy Implementation: To encourage investment in specific sectors, the government has implemented tax incentives that can benefit SMEs. For instance, under Royal Decree No. 750, effective from June 15, 2022, to June 30, 2032, both Thai and foreign investors are exempt from income tax on capital gains arising from the disposal of direct and indirect investments in startup companies operating in targeted industries. To qualify, investors must hold shares for at least 24 months, and the companies must derive at least 80% of their income from eligible activities in the two consecutive accounting periods prior to the sale. This exemption aims to stimulate investment in sectors such as technology and science, thereby fostering innovation and growth among SMEs.

Policy Effectiveness: Thailand's Capital Gains Tax Exemption policies aim to stimulate investment in specific sectors, such as technology and science, by providing tax exemptions on gains from the disposal of shares in qualifying companies. These measures are designed to encourage long-term investments in sectors deemed crucial for economic development.

Suggestions for Improvement: The measure should broaden the scope of eligible investments to include a wider range of industries and asset classes, thereby encouraging more diverse investment activities. Additionally, simplifying the qualification criteria and administrative procedures can make it easier for investors to understand and access these exemptions.

R&D Tax Incentive Program (RDI 200% Deduction)

Policy Content: The R&D Tax Incentive Program, commonly referred to as the RDI 200% deduction, is designed to encourage businesses, including SMEs, to invest in R&D activities. This incentive aims to reduce the financial burden associated with R&D investments, thereby promoting innovation and enhancing the competitiveness of Thai businesses. This program is particularly

beneficial for SMEs seeking to develop new products, processes, or services, as it provides significant tax savings that can be reinvested into further innovation efforts.

Policy Implementation: Firms can claim a 200% tax deduction on qualifying R&D expenditures, allowing them to deduct twice the amount of their actual R&D expenses from their taxable income. The RDI 200% deduction not only applies to traditional R&D but also process improvement and application development. Committees or experts evaluate proposals, but the approval process can be lengthy, often taking up to six months due to incomplete forms and exaggerated budgets. Large companies benefit the most due to their familiarity with government processes, while SMEs lack awareness and struggle with proposal preparation. Monitoring is informal due to limited resources.

Policy Effectiveness: The measure has resulted in the approval of 6,182 R&D projects with a total investment value of 22,940 million baht since its inception in 2002. The sectors benefiting the most from this measure include pharmaceuticals and chemicals, agriculture, construction and building materials, plastic products, paper and printing, and food and animal feed. This program has helped SMEs innovate.

Suggestions for Improvement: The program should simplify the application process to reduce administrative burdens, making it more accessible for SMEs with limited resources. Additionally, broadening the scope of eligible R&D activities to encompass a wider range of innovative projects can encourage more SMEs to participate. Implementing targeted awareness campaigns will inform SMEs about the benefits and procedures of the program, promoting increased utilization.

BOI Tax Incentive for SMEs

Policy Content: BOI provides tax benefits to SMEs to encourage investment, innovation, and competitiveness. Eligible SMEs can receive corporate income tax exemptions for up to 8 years, 50% tax reductions for additional years, import duty exemptions on machinery and raw materials, and other non-tax incentives such as facilitation in work permits and visas for foreign experts. The incentives focus on high-tech, innovation-driven, and environmentally friendly industries, supporting SMEs in upgrading their technological capabilities and integrating into global value chains.

Policy Implementation: The incentives work by offering tax exemptions and reductions to eligible SMEs, allowing them to enhance their technological capabilities and expand their businesses. Once an SME applies and gets approval from the BOI, it gains access to various benefits, including corporate income tax (CIT) exemptions for up to 8 years, a 50% CIT reduction for an additional 5 years, and import duty exemptions on machinery and raw materials used in production. These incentives are particularly beneficial for SMEs investing in R&D, innovation, automation, and digital transformation. In addition to tax benefits, BOI-approved SMEs can also access non-tax incentives such as simplified processes for obtaining work permits and visas for foreign specialists. This is especially useful for SMEs that need foreign expertise to develop advanced technologies or expand their market reach. Moreover, businesses that contribute to environmental sustainability, smart farming, digital transformation, and high-tech industries may receive extra incentives beyond the standard benefits.

Policy Effectiveness: By leveraging BOI incentives, SMEs can reduce operational costs, invest in advanced technologies, and improve their market positioning. However, the success of these policies varies among SMEs, depending on their awareness of the incentives, ability to meet eligibility criteria, and capacity to navigate the application processes. Continuous efforts to streamline procedures and raise awareness are essential to maximize the benefits for SMEs.

Suggestions for Improvement: BOI should enhance accessibility and awareness of the incentives, simplifying the application process, and providing targeted support for high-potential sectors. Additionally, it is recommended to offer tailored incentives for SMEs engaging in research and development, technology adoption, and innovation. BOI should strengthen collaboration between government agencies, financial institutions, and SMEs.

Table 3.5 shows the analysis of tax incentive instruments considering the dimensions of policy content, policy implementation, policy effectiveness, and suggestions for improvements.

TABLE 3.5

ANALYSIS OF TAX INCENTIVE INSTRUMENTS CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Measure	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Thailand Plus Package	Attract FDI, boost tech & skilled manpower, led by BOI, MOF, MOI, MHESI. For EVs, digital tech, biotech, automation, AI.	250% CIT deduction for companies investing in STEM workforce training through certified programs by MHESI & 150% CIT deduction for hiring high-skilled STEM employees.	Boosted SME tech, upskilled workforce, improved R&D access. 74 firms, 3,700 STEM jobs, but challenges include low awareness, high compliance, and weak tech transfer.	Simplify applications via one-stop portal and expand funding & low-interest loans.
Accelerated Depreciation Rate for R&D Equipment	Encourages R&D investment by allowing 40% immediate depreciation and the remaining 60% over useful life.	Businesses can depreciate 40% of qualifying new R&D equipment in the first year and the rest over time. Equipment must be new and cost at least 100,000 baht.	Helps businesses reduce R&D costs and adopt advanced technologies.	Expand eligibility to more industries, increase SME awareness, and simplify administrative procedures.
Capital Tax Gain Exemption	Exempts capital gains tax for investors in targeted industries to promote investment and economic growth.	Investors holding shares in startups for at least 24 months qualify for tax exemption if 80% of company revenue comes from eligible activities.	Encourages long-term investments in innovation and high-tech sectors.	Expand eligibility to more industries, simplify application procedures, and increase investor awareness.
R&D Tax Incentive Program (RDI 200%)	Allows businesses, including SMEs, to deduct 200% of R&D expenditures to promote innovation.	SMEs can claim 200% deductions for certified R&D projects conducted through approved agencies.	Encourages SME investment in R&D, with over 6,182 R&D projects benefiting.	Simplify application process, broaden eligible R&D activities, and increase awareness campaigns.
BOI Tax Incentives for SMEs	Offers tax exemptions, reductions, and import duty waivers for SMEs investing in technology, innovation, and global competitiveness.	SMEs approved by BOI receive up to 8 years of corporate tax exemptions, import duty waivers, and non-tax incentives.	Helps SMEs reduce costs, upgrade technology, and improve competitiveness, though awareness and application complexity remain challenges.	Streamline application processes, improve SME awareness, and provide tailored incentives for R&D and innovation.

In summary, tax incentives aim to encourage investment in R&D, innovation, and high-tech industries by offering accelerated depreciation, tax exemptions on capital gains, enhanced deductions for research expenditures, and targeted benefits for businesses investing in technology. Allowing businesses to immediately depreciate a significant portion of R&D equipment costs has helped reduce financial burdens, though expanding eligibility and simplifying administrative requirements could improve accessibility. Tax incentives for R&D motivate SMEs to increase investment, especially if the tax reduction is more predictable. Policy effectiveness is hindered by complex requirements, a tax authority culture that prioritizes investigation over support, and a lack of trust among firms who perceive the incentives as a tax collection tool rather than genuine support. Ultimately, tax incentives alone do not drive R&D investment; management commitment remains the key factor. Strengthening these incentives by improving outreach, simplifying procedures, and ensuring alignment with business needs will maximize their economic impact and foster a more competitive innovation ecosystem.

3.3 Systemic Policy Instruments

Systemic policy instruments are policies designed to enhance the broader innovation ecosystem, addressing the interconnections between various players, such as government agencies, private sector firms, academia, and civil society. These policies are essential in creating an environment where innovation can flourish through collaboration, knowledge sharing, and resource mobilization.

Systemic policy instruments play a vital role in strengthening the overall innovation ecosystem in Thailand. However, their effectiveness is often hindered by fragmented implementation, bureaucratic delays, and a lack of strategic alignment across various stakeholders. Improvements in coordination, transparency, and financial support are key to maximizing the impact of these policies. By streamlining processes, enhancing partnerships, and offering targeted incentives, Thailand can improve the performance of its systemic policy instruments and create a more conducive environment for innovation and economic growth.

Business Innovation Center (BIC)

Policy Content: The Business Incubation Center (BIC) under NSTDA supports technology-driven entrepreneurs from idea development to market entry through mentorship, funding, investor connections, and business development programs. Since 2002, BIC has played a crucial role in Thailand's startup ecosystem, offering incubation programs like youth startup idea camps, TED Fund fellowships, and the Techbiz Starter Program, alongside acceleration initiatives such as co-incubation, food accelerators, and startup vouchers to enhance scalability.

Over the years, BIC has evolved to align with technological advancements and economic shifts. From 2008 to 2012, it focused on early-stage incubation, expanding in 2013 to include sector-specific acceleration programs. In 2016-2017, it launched BOOST UP, aimed at scaling high-potential startups through investor partnerships. Between 2018 and 2019, BIC integrated sustainable innovation under Thailand's Bio-Circular-Green (BCG) Economy Model, supporting biotechnology, clean energy, and smart industries. The COVID-19 pandemic (2020-2021) led to a shift toward virtual incubation, digital acceleration, and crisis recovery efforts. By 2023, BIC had emphasized global expansion, facilitating international business matchmaking and networking to strengthen Thai startups' global competitiveness. BIC continues to refine its incubation and acceleration strategies, ensuring long-term sustainability and innovation-driven growth in Thailand's startup ecosystem (S. Huabsomboon, personal communication, October 2, 2024).

Policy Implementation: BIC provides comprehensive support to SMEs by offering consultancy services, access to technical experts, and connections to testing laboratories. BIC assists SMEs in technology and innovation implementation, facilitating R&D collaborations, and promoting technology transfer. Additionally, the center organizes events like the Thailand Tech Show and NSTDA Investors' Day to foster R&D collaboration, investment, and networking opportunities for SMEs. Through these initiatives, BIC aims to enhance the competitiveness and innovation capabilities of Thai SMEs. By integrating these resources and initiatives, BIC creates a conducive environment that fosters the growth and competitiveness of SMEs within Thailand's innovation ecosystem.

Policy Effectiveness: BIC has supported over 200 firms through its various programs, including the Young Technopreneur Development Program, Incubation Program, and Food Accelerator Program. Over 40 startup companies participated in an annual business incubation initiative under the BIC. These companies engaged in various technologies, including software, IT, digital technology, nanotechnology, and biotechnology (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvements: NSTDA should focus on capacity building for business incubators, particularly within universities. This involves conducting comprehensive assessments of benchmark performance against international standards and providing tailored recommendations for improvement. Additionally, fostering collaborations between academia, industry, and government can create a more robust support system for startups. Implementing these strategies can strengthen Thailand's innovation ecosystem and increase the success rate of new businesses.

Thailand Science Park

Policy Content: Thailand Science Park (TSP), managed by NSTDA, offers a comprehensive policy framework to support SMEs in R&D and innovation. The park provides state-of-the-art infrastructure, including wet and dry laboratories, office spaces, and specialized facilities, to foster technological advancements. TSP offers value-added services such as mentorship programs, business development assistance, and networking opportunities to enhance SME competitiveness. The park's strategic location near academic institutions further enriches the innovation ecosystem, providing SMEs with access to a skilled talent pool and cutting-edge research.

Policy Implementation: The park offers facilities and support services to businesses engaged in R&D across various industries. It also fosters collaboration between the private sector, academia, and government agencies. SMEs apply their business plan and company profile for evaluation. If approved, the SME finalizes agreements and sets up operations within the park, gaining access to laboratories, office spaces, and research collaborations.

Policy Effectiveness: As of 2024, TSP housed over 90 companies, with approximately 30% being international firms such as Sumitomo, Zoetis, and Haydale. These companies engage in various R&D activities across sectors like biotechnology, electronics, and materials science. However, access barriers exist for smaller firms, which may lack the resources or knowledge to fully utilize the park's offerings. The benefits of the park are currently more concentrated among larger, well-established companies (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvements: NSTDA should strengthen collaboration between TSP and regional innovation clusters. This approach can facilitate the sharing of resources, knowledge, and best practices, thereby fostering innovation and competitiveness among SMEs across different regions. Additionally, implementing targeted support programs within TSP that address the specific needs of SMEs, such as access to advanced technologies, mentorship, and funding opportunities, can further bolster their growth and development.

STI Coupon for OTOP Upgrade

Policy Content: The STI Coupon for OTOP Upgrade is an initiative by the Ministry of Higher Education, Science, Research and Innovation aimed at enhancing the quality and competitiveness of local One Tambon One Product (OTOP) products. The program provides support in six key areas: improving raw material quality, optimizing production processes, developing product standards, designing packaging, enhancing product quality, and fostering innovation. By leveraging science, technology, and innovation, the initiative seeks to elevate OTOP products to meet higher market standards and increase their appeal to consumers.

Policy Implementation: Implementation has enhanced product quality and increased marketability for OTOP entrepreneurs by providing targeted consultancy.

Policy Effectiveness: The program has successfully assisted numerous local entrepreneurs in improving various aspects of their products, including raw material quality, production processes, product standards, packaging design, and overall innovation. The program faced challenges in scalability and continued support post-consultation (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvement: The program should increase funding allocations to support a larger number of local entrepreneurs. Expanding the range of services covered by the coupons to include digital marketing and e-commerce training could further boost product competitiveness. Implementing a streamlined application process and providing clear guidelines would encourage more participation.

NSTDA Investment Section (NIS)

Policy Content: The NSTDA Investment Center (NIC), now known as the NSTDA Investment Section (NIS), is a unit under NSTDA dedicated to promoting investment in science and technology sectors. NIS supports SMEs by co-investing in technology-driven startups and facilitating the commercialization of research outcomes. The center focuses on businesses that leverage Thai innovations or NSTDA-developed technologies, aiming to generate clear economic and social benefits for the country. By providing financial backing and strategic partnerships, NIS enables SMEs to advance their technological capabilities and enhance their competitiveness in both domestic and international markets.

Policy Implementation: SMEs can collaborate with the NIS by engaging in joint R&D projects, seeking co-investment opportunities, and participating in business incubation programs. NIS offers support through various initiatives, including the Company Directed Technology Development Program (CD), which provides funding and technical assistance for SME-led R&D projects but the CD program is end in 2018. By partnering with NIS, SMEs can enhance their technological capabilities and accelerate the commercialization of their innovations.

Policy Effectiveness: As of December 2023, NIS has established joint ventures with a total of 22 companies, with an investment amount of approximately 675.23 million baht. Currently, there are 9 active joint venture companies with a total investment of 569.10 million baht, However, the investment scale of NIS is too limited to significantly impact Thailand's innovation ecosystem. (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvement: NIS should increase the scale of investments to create a more substantial influence on Thailand's innovation ecosystem. Strengthening collaborations with universities and research agencies can improve technology transfer services to SMEs, thereby fostering innovation and competitiveness. Additionally, enhancing science and technology infrastructure, including both physical facilities like science parks and non-physical aspects such as legal frameworks and financial support, can further encourage private sector investment in research and technological development.

Thailand Tech Show

Policy Content: The Thailand Tech Show is an annual event organized by NSTDA to bridge the gap between research and industry. The event offers investment pitching sessions, providing a platform for Thai researchers to present their groundbreaking work to potential investors and business partners. By bringing together researchers, businesses, and investors, the Thailand Tech Show fosters a vibrant innovation ecosystem.

Policy Implementation: The show has connected innovators, SMEs, and investors, facilitating knowledge transfer and creating investment opportunities for innovative technologies. It offers a platform for SMEs to showcase their innovations, engage in investment pitching sessions, and explore collaboration opportunities with researchers and investors.

Policy Effectiveness: In 2024, the event showcases over 180 innovations and technologies from 33 organizations, ready for investment and commercialization. The event organizes Investment Pitching, a platform for Thai researchers to present their groundbreaking work to potential investors and business partners (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvement: NSTDA should expand its scope by incorporating more interactive workshops and panel discussions that address current industry challenges and solutions. Additionally, fostering greater collaboration with international research institutions and technology firms can attract a more diverse range of innovations and investment opportunities. Establishing a structured feedback mechanism allows SMEs to voice their specific challenges and requirements, enabling organizers to tailor support services effectively.

Industrial Technology Assistance Program (ITAP)

Policy Content: Provides financial support of up to 50% for SMEs and large firms to hire consultants to enhance their technological capabilities.

Policy Implementation: ITAP is implemented by NSTDA to enhance the technological capabilities of SMEs. ITAP provides access to a network of over 1,300 technical experts from universities and science and technology agencies. These experts assist businesses in identifying technical solutions and offer consultation throughout the implementation process to ensure successful outcomes. The program's scope includes technological consultancy services, joint research and development projects, science and technology acquisition programs, and training workshops. ITAP operates

through 10 regional nodes, linking with local universities and institutions to support SMEs across various regions. Funding subsidies are typically provided on a 50:50 cost-sharing basis between the program and participating enterprises.

Policy Effectiveness: ITAP has supported over 4,000 projects, involving more than 1,300 experts working with private sector firms. The program supports a wide range of projects, from process improvement to reengineering, but its broad scope can lead to unclear objectives. Some SMEs were not able to fully benefit due to limited internal capabilities to implement the recommendations provided by consultants. Monitoring is done through documentation and company visits, though support is not always guaranteed through all project phases. Many SMEs are unaware of available financial schemes, and better awareness could help them prepare for program applications. Expert selection needs improvement to enhance project success. (S. Huabsomboon, personal communication, October 2, 2024).

Suggestions for Improvement: ITAP should expand the program's scope and funding to reach a larger number of SMEs across diverse industries. This includes increasing the budget allocation to support more comprehensive technological development projects. Additionally, fostering stronger collaboration between SMEs and research institutions can facilitate the transfer of advanced technologies and innovative practices. Implementing targeted training programs to build technical and managerial capacities within SMEs will further enable them to effectively adopt and utilize new technologies. Streamlining administrative procedures and providing clear guidelines can also enhance accessibility and participation in the program.

Industry Transformation Centers

Policy Content: Industry Transformation Centers (ITC) are an integrated service center in Thailand designed to enhance the country's industrial sector. ITCs provide integrated services, including product development assistance, technological solutions, and human resource support programs, all aimed at facilitating the transition of Thai industries towards the Thailand 4.0 economic model.

Policy Implementation: Operated by the Ministry of Industry with support from MHESI and MDES, the centers offer hands-on support to SMEs looking to modernize their operations, particularly through advanced technology adoption. The Ministry of Industry has established a network of 22 ITCs nationwide, with the main center located in Bangkok. These centers aim to support SMEs in enhancing their products, technology, and human resources.

Policy Effectiveness: ITCs have supported over 1,000 firms through various initiatives aimed at enhancing their technological capabilities and competitiveness. ITCs offer various resources, including co-working spaces, meeting rooms, business lounges, and business libraries, designed to assist SMEs in enhancing their operations and competitiveness. However, there has been limited adoption due to awareness gaps and resource constraints (S. Tanthikul, personal communication, September 18, 2024).

Suggestions for Improvements: Simplifying access to the centers' services could also help more firms benefit. ITCs should enhance regional innovation ecosystems by expanding collaboration between SMEs, research institutions, and technology hubs to drive knowledge transfer and industrial upgrading. Strengthening digital infrastructure and smart manufacturing adoption will support SMEs in integrating Industry 4.0 technologies.

Tech2Biz

Policy Content: Tech2Biz is an initiative by NXPO designed to bridge the gap between technological innovations and commercial enterprises. It serves as a platform that connects researchers, innovators, and entrepreneurs, facilitating the transformation of research outcomes into marketable products and services. By fostering collaborations among academia, industry, and investors, Tech2Biz aims to accelerate the commercialization of innovations, thereby enhancing Thailand's competitiveness in the global market. The platform offers resources such as technology proposals, infrastructure support, funding opportunities, and news updates to support the development and scaling of innovative ventures.

Policy Implementation: Tech2Biz offers a platform to access cutting-edge technologies and collaborate with researchers, thereby enhancing their innovation capacity. By connecting SMEs with academic and research institutions, the initiative enables businesses to leverage scientific advancements to develop new offerings or improve existing ones, ultimately increasing their competitiveness in the market. The platform offers resources such as technology proposals, infrastructure support, funding opportunities, and news updates to support the development and scaling of innovative ventures.

Policy Effectiveness: Tech2Biz has facilitated the participation of over 500 firms. It has improved collaboration between universities and industries, supported SMEs in adopting innovative practices to enhance competitiveness, and upgraded workforce skills for research and innovation activities, contributing to Thailand's innovation ecosystem (S. Pittayasophon, personal communication, September 19, 2024).

Suggestions for Improvement: Tech2Biz should enhance technology commercialization by fostering stronger university-industry collaborations, ensuring that research outputs align with market needs. Expanding funding mechanisms such as venture capital partnerships and innovation grants will help startups and SMEs scale technological solutions. Streamlining intellectual property (IP) policies and providing legal advisory support can facilitate smoother technology transfers. Simplifying regulatory processes and providing support mechanisms can help innovation-driven enterprises scale more efficiently.

Business Development Service (BDS) Market

Policy Content: OSMEP has developed the Business Development Service (BDS) Market, an online platform designed to enhance the competitiveness of micro, small, and medium-sized enterprises (MSMEs). The BDS Market connects MSMEs with accredited service providers offering a range of business development services, including technology applications, financial accounting, and product design.

Policy Implementation: The BDS Market originally subsidized juristic or natural micro enterprises that are registered to do business with government agencies. MSMEs with the income not exceeding 1.8 million baht per year at 80% but not exceeding 50,000 baht, while MSMEs in the manufacturing sector with the annual income not exceeding 100 million baht and other sectors not exceeding 50 million baht per year receive subsidies at 80% but not exceeding 100,000 baht. Medium-sized enterprises in the manufacturing sector, those with an income not exceeding 500 million baht per year, and other sectors not exceeding 300 million baht per year receive subsidies at 50%, but not more than 200,000 baht.

Policy Effectiveness: Delivered through partnerships with private providers and agencies, the program connects MSMEs to tailored services via platforms, events, and workshops, addressing various business maturity stages. By July 2024, 2,368 MSMEs participated, with 2,525 proposals submitted. The program has improved MSME access to business services, boosting operations and competitiveness. However, awareness, affordability, and reluctance to invest in non-essential services remain challenges (W. Opasvadhana, personal communication, October 2, 2024).

Suggestions for Improvement: The BDS Market should focus on fostering collaborative innovation ecosystems by enhancing public-private partnerships, linking MSMEs with universities, research institutes, and technology hubs to drive knowledge transfer. Expanding digitalization support can enable MSMEs to integrate advanced technologies and boost productivity. Additionally, simplifying regulatory frameworks and improving access to financial incentives (such as grants and low-interest loans) can lower barriers to innovation adoption. Strengthening international market access programs will also help MSMEs scale beyond domestic markets.

Table 3.6 shows an analysis of each systemic policy instrument considering the dimensions of policy content, policy implementation, and policy effectiveness, along with suggestions for improvements.

TABLE 3.6

ANALYSIS OF SYSTEMIC POLICY INSTRUMENTS CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Measure	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Business Innovation Center (BIC)	Supports tech-based startups through mentorship, funding, and market access.	Provides consultancy, connects SMEs to technical experts, and organizes events for R&D collaboration.	Supported 200+ firms, with 40+ startups in incubation programs.	Strengthen university-linked incubators, improve benchmarking, and enhance academia-industry-government collaboration.
Thailand Science Park	Provides infrastructure, labs, and business development services for R&D-focused SMEs.	Offers office space, research collaborations, and networking opportunities.	Hosts 90+ companies, but mainly benefits technology startups.	Improve collaboration with regional innovation clusters and create SME-focused support programs.
STI Coupon for OTOP Upgrade	Enhances OTOP products in raw materials, production, standards, and innovation.	Provides targeted consultancy for quality and competitiveness improvements.	Assisted many local entrepreneurs but faces scalability issues.	Increase funding, expand services, and streamline application process.
NSTDA Investment Section (NIS)	Co-invests in tech startups and commercial research for SMEs.	Offers joint ventures, business incubation, and R&D support.	Invested in 22 companies with 675M baht, but impact on ecosystem remains limited.	Increase investment scale, boost university collaboration, and enhance infrastructure.
Thailand Tech Show	An annual event connecting researchers, SMEs, and investors for tech commercialization.	Organize investment pitching and showcases innovations.	Features 180+ innovations from 33 organizations annually.	Add interactive workshops, and expand international partnerships.
Industrial Technology Assistance Program (ITAP)	Provides 50% funding for SMEs hiring consultants for technology upgrades.	Links SMEs with 1,300+ experts, funds R&D, training, and innovation projects.	Supported 4,000+ projects but SMEs struggle with implementation.	Expand funding, strengthen SME-research collaborations, and offer targeted training programs.
Industry Transformation Center (ITC)	Supports industrial sector modernization via technology adoption and skill development.	Operates 22 centers nationwide to assist SMEs with product development and digitalization.	Assisted 1,000+ firms but adoption remains low due to awareness gaps.	Simplify service access, improve digital infrastructure, enhance SME-research partnerships.
Tech2Biz	Bridges research and business for tech commercialization.	Connects SMEs with researchers and funding opportunities.	500+ firms engaged, and improved university-industry linkages.	Expand funding, simplify IP regulations, and streamline scaling-up processes.
BDS Market	Online platform linking SMEs with accredited business service providers.	Subsidizing MSMEs with co-payment assistance (50-80%, up to 200,000 THB) to improve product /service standards, marketing channels, productivity	2,368 MSMEs participated, 2,525 proposals submitted, but affordability remains a challenge.	Strengthen public-private collaboration, improve digitalization support, and increase market access.

In summary, systemic policy instruments play a crucial role in strengthening Thailand's innovation ecosystem by facilitating collaboration among government agencies, private sector firms, academia, and research institutions. However, challenges such as fragmented implementation, bureaucratic inefficiencies, and limited financial support hinder their full potential. Initiatives such as business incubation, science parks, and investment facilitation centers provide structured support for startups and SMEs, helping them access funding, mentorship, and research infrastructure. Programs aimed at fostering public-private partnerships, such as the Thailand Tech Show and ITAP, have successfully connected businesses with researchers and investors, though greater accessibility for SMEs is needed. Additionally, investment-focused initiatives like the NSTDA Investment Section and capital tax exemptions incentivize technology-driven entrepreneurship but require broader funding and policy alignment. To enhance their impact, Thailand's systemic policy instruments should streamline processes, expand collaboration between academia and industry, and improve financial accessibility for startups and SMEs. Strengthening regional innovation clusters, simplifying regulatory frameworks, and enhancing digital transformation initiatives will further support long-term competitiveness and economic growth.

Conclusions

The policy instruments for enhancing technological capabilities and innovation of SMEs are administered by various government agencies, including DITP, NSTDA, BOI, NIA, DEPA, and OSMEP, with the goal of fostering innovation, strengthening R&D, and enhancing SME competitiveness. These initiatives focus on expanding market access (e.g., Thai Innovation List Measure, Thailand Tech Show), promoting digital adoption (DEPA Digital Transformation Fund), advancing technological innovation (Thematic Innovation Grant), and strengthening global trade opportunities (Thailand Trust-Mark). Over time, these policies have evolved to incorporate green technology, digital transformation, and international expansion, with some financial incentives being discontinued or consolidated into broader programs to optimize resource allocation (e.g., NIA Open Innovation Program and NSTDA's Business Incubation Center).

Implementation varies across programs, employing grants, tax incentives, direct funding, incubation, and acceleration initiatives. Effective execution requires coordination among government agencies, universities, and private sector stakeholders. Some programs, such as TED Fund, have structured monitoring mechanisms, including self-assessments, periodic progress reports, and third-party evaluations to ensure transparency. However, only a few programs, such as ITAP, conduct mid-term and final evaluations, resulting in inconsistencies in data collection and performance tracking. While some programs (e.g., those from NIA, DEPA, and OSMEP) show statistical data on participant engagement, others—particularly tax incentives and financial support measures—are either not systematically monitored and evaluated or have evaluation results that are not publicly disclosed, making it difficult to assess their long-term impact effectively.

The effectiveness of these policies is evaluated by analyzing firms' performance before and after receiving support. Many initiatives have led to increased R&D investment (Tax Incentive Program), product innovation (Business Incubation Center), business process improvements (Digital Transformation Program), and workforce expansion (Talent Mobility). Some programs have enabled firms to access new markets (Thai Tech Show, T-Mark) and move toward high-value-added production (STI Coupon for OTOP Upgrade). However, low participation rates in certain programs stem from strict eligibility requirements, complex application processes, and limited awareness among SMEs. While financial support mechanisms such as DEPA Mini Voucher and DEPA Digital Startup Fund have helped startups secure funding, others, like the BOI Matching Fund, struggle with scalability and post-funding sustainability.

To improve policy effectiveness, agencies should simplify application processes, increase outreach efforts, and expand financial support for SMEs. Adjustments such as tiered certification systems, technical assistance, and streamlined eligibility criteria would enhance accessibility. Strengthening public-private partnerships, aligning policies with industry needs, and incorporating post-funding support—including mentorship and global networking opportunities—would further drive long-term innovation and economic growth. Finally, enhancing monitoring mechanisms and improving data collection practices would increase transparency and accountability in policy implementation.

Table 3.7 presents an analysis of demand-side, supply-side, and systemic policy instruments, evaluating their policy content, implementation mechanisms, effectiveness, and areas for improvement.

TABLE 3.7

ANALYSIS OF DEMAND-SIDE, SUPPLY-SIDE, AND SYSTEMIC POLICY INSTRUMENTS CONSIDERING DIMENSIONS OF POLICY CONTENT, IMPLEMENTATION, AND EFFECTIVENESS

Policy Type	Policy Content	Policy Implementation	Policy Effectiveness	Suggestions for Improvement
Demand-side	Promote market demand for innovative products through certifications, financial incentives, and promotional measures (e.g., T-Mark, Mini Voucher). Target market adoption and provide grants to SMEs for innovation.	Implemented by agencies like DITP, NSTDA, and DEPA, these programs provide certifications, financial support, and promotional assistance to help companies succeed in the market.	Promoting demand for innovative products but hindered by stringent certification processes and limited outreach. SME adoption has been limited by complexity and low awareness.	Streamline certification processes and increase outreach efforts to broaden adoption, especially for SMEs. Simplify processes and improve promotion to encourage more participation.
Supply-side: Financial support Measures	Provide direct financial support, grants, low-interest loans, and co-investment funds to encourage business R&D and technology adoption (e.g., DEPA Digital Transformation Fund, NIS).	Administered by BOI, DEPA, NSTDA, and NIA through direct grants, matching funds, and low-interest financing programs. These funds help SMEs and startups invest in innovation.	Increased private-sector R&D investment and innovation projects but mainly benefited larger firms. SMEs still struggle with access to funding due to complex eligibility criteria.	Simplifying application processes, expanding financial support coverage, providing targeted funding for early-stage startups.
Supply-side: Human Resource Support measures	Support workforce development through talent mobility programs, skills training, and university-industry collaboration (e.g., Global Talent Visa, Talent Mobility).	Managed by NIA, BOI, and universities, these programs attract skilled professionals, provide training, and create pathways for industry-academic collaboration.	Improved industry-academia linkages and workforce skills in key sectors, but regulatory complexity and lack of incentives for SMEs limit effectiveness.	Expand industry participation, provide structured career pathways, and offer more financial incentives (e.g., tax benefits for hiring skilled persons).
Supply-side: Tax Incentive Measures	Reduce financial burden on firms through R&D tax deductions, investment incentives, and accelerated depreciation (e.g., RDI 200%).	Revenue Department & BOI provide tax breaks, accelerated depreciation, R&D-related exemptions to encourage private-sector investment in technology.	Reducing costs for firms investing in R&D but mainly utilized by large firms, with SMEs facing administrative challenges in accessing benefits.	Simplify eligibility criteria, increase SME awareness of available tax benefits, and introduce incentives tailored specifically for SMEs.
Systemic	Foster collaboration between businesses, academia, and government agencies to strengthen the innovation ecosystem. Systemic instruments provide infrastructural support, create networks for collaboration, and support cross-sector partnerships.	Managed by NIA, NSTDA, OSMEP, and related agencies to create innovation platforms, partnerships, and foster collaboration between industry, academia, and government.	Promoting cross-sector collaboration, but challenges remain in scaling partnerships across industries. Small firms and underrepresented sectors face difficulties in accessing systemic programs.	Simplifying application processes, increasing funding, and offering flexible collaboration opportunities across industries.

Chapter 4
Institutions affecting the effectiveness of policies

This chapter delves into the crucial institutional factors that influence the effectiveness of policy implementation (Intarakumnerd and Wonglimpiyarat, 2012; Intarakumnerd and Goto, 2016; Intarakumnerd, 2015). It examines the capacity of government agencies to execute policies efficiently and explores the importance of cross-ministerial and inter-agency coordination in ensuring cohesive policy outcomes. The chapter also considers the level of trust between government agencies and firms, highlighting how this relationship impacts policy success.

Additionally, it discusses the attitudes of policymakers towards assisting firms and the implications of adopting selective policies targeting specific sectors, clusters, or products. The societal attitude towards failure and its role in shaping an innovation-friendly environment is also analyzed. The chapter addresses the availability of opportunity-based entrepreneurs, emphasizing their significance in driving economic growth and innovation within the framework of effective policy implementation. This chapter shows the roles of intermediaries—such as public research institutes (PRIs), sector-specific agencies and private intermediaries—in enhancing innovation and technological development among SMEs. Finally, it shows the influence of institutional factors on the effectiveness of policies aimed at enhancing SMEs' innovation through two case studies: the TED Fund and NIA's Social Innovation Projects. Here's how these factors have impacted the initiation, planning, and implementation of these policies:

4.1 Capacity for Executing Government Agencies

The capacity of government agencies is critical for effective policy implementation. In Thailand, many agencies face resource constraints, limited expertise, and staffing shortages, which hinder their ability to manage and monitor programs efficiently. For example, NSTDA staff, responsible for overseeing the R&D tax incentive scheme, struggles with low staffing levels, delaying application processing and project monitoring.

Limited staffing, technical expertise gaps, and inadequate infrastructure create inefficiencies, reducing SME participation in support programs. Agencies with stronger capacities execute policies more effectively, leading to better outcomes. However, inconsistent funding and a lack of centralized authority have resulted in fragmented and inconsistent policy implementation (P. Tippakoon, personal communication, September 29, 2024).

Demand-side policies, such as the Thailand Trust Mark, depend on agency capacity for smooth execution. Strong agency capability ensures timely certification processes, while weaker capacity leads to delays and lower SME participation. Agencies with adequate resources can better assist firms in navigating demand-driven incentives.

Supply-side policies, like the Industry Transformation Center and Business Innovation Center, also require strong agency capacity. Well-resourced agencies process applications efficiently, manage tax breaks, and provide firms with access to talent and capital. Conversely, agencies with limited capacity struggle with slow approvals and underutilized incentives, reducing the impact of these policies on SME innovation (S. Huabsomboon, personal communication, October 2, 2024).

Systemic policies, such as iTAP, rely on agencies to coordinate academia, industry, and government partnerships. High-capacity agencies sustain these initiatives over time, strengthening collaboration. Weak capacity limits their effectiveness, weakening Thailand's innovation ecosystem.

Key institutions like NIA, NSTDA, and OSMEP have the expertise to drive innovation but face challenges such as limited funding, bureaucratic hurdles, and resource shortages. By pooling resources and integrating funding and innovation schemes, they could enhance efficiency and better support technological advancement (S. Pittayasophon, personal communication, September 19, 2024).

To improve agency effectiveness, Thailand must increase resources for key agencies, including budget enhancements, staffing, and technical training. Continuous training programs should develop staff expertise in project management, monitoring, and evaluation. Streamlining bureaucratic processes would also help reduce policy execution delays, ensuring stronger innovation support for SMEs.

4.2 Level of Cross-Ministerial/Agency Coordination

Effective cross-ministerial coordination is essential for policies requiring collaboration across multiple government bodies. In Thailand, ministries such as the Ministry of Science and Technology, Ministry of Industry, and Ministry of Finance attempt to coordinate efforts, but challenges remain. Weak collaboration can lead to overlapping responsibilities, conflicting policies, and inefficient resource allocation. Strengthening cooperation between the Revenue Department and other ministries could enhance the effectiveness of tax incentive schemes (S. Pittayasophon, personal communication, September 19, 2024).

Poor coordination often creates gaps in SME support programs, making it difficult to integrate financial and technological assistance effectively. Fragmented efforts reduce the impact of policies designed to boost SME growth and innovation.

Demand-side policies, such as the DEPA Mini Voucher and Digital Transformation Fund, rely on smooth inter-ministerial coordination. When ministries align, policies are cohesive and easier for businesses to navigate. Without strong coordination, conflicting regulations and fragmented policies confuse businesses and weaken policy effectiveness (C. Limapornvanich, personal communication, September 19, 2024).

Supply-side policies, like the Global Talent Visa and Thematic Innovation Grant, require strong collaboration. Effective coordination between immigration authorities and industry regulators ensures that skilled professionals can enter Thailand without bureaucratic delays, supporting firms' innovation capacities. Poor coordination leads to regulatory barriers and inefficiencies that limit policy benefits.

For systemic policies such as the Thailand Tech Show, cross-ministerial cooperation is critical to fostering knowledge transfer and innovation. When ministries work together, systemic policies strengthen the entire innovation ecosystem. Without coordination, knowledge-sharing efforts become isolated, limiting long-term impact.

Despite ongoing efforts to align innovation policies, challenges persist. Overlapping responsibilities, poor communication, and inconsistent policy objectives create barriers to effective implementation. These gaps result in contradictions between policies and disjointed support for SMEs.

To improve cross-ministerial coordination, Thailand should establish a central coordinating body or task force. This entity would align objectives, streamline communication, and prevent policy overlaps. Regular inter-ministerial meetings and joint planning sessions could enhance collaboration and shared accountability. A shared digital platform for real-time information exchange would further improve coordination, ensuring smoother execution of innovation policies.

4.3 Level of Trust Between Government Agencies and Firms

Trust between government agencies and firms is critical for policy success. However, trust levels vary, with some firms doubting the efficiency of government support. Concerns over bureaucratic inefficiencies and unclear benefits often deter firms from participating in government programs (W. Opasvadhana, personal communication, October 2, 2024).

Many firms remain skeptical about the government's commitment to innovation. Complex regulations and fears of penalties make businesses hesitant to engage. Some view the government as more focused on tax collection than fostering R&D. This mistrust lowers participation in key initiatives, such as R&D tax incentives, reducing policy effectiveness.

For demand-side policies, trust plays a crucial role. High trust encourages SMEs to engage in programs like the Thai Innovation List Measure, leading to wider adoption. When trust is low, firms hesitate, fearing the government may not deliver on promised benefits. This reluctance weakens policy impact.

Trust is equally important in supply-side policies. When firms believe that agencies will efficiently manage programs like BOI's Startup Support Program or Talent Mobility, they are more likely to apply. Without trust, firms opt out, limiting the reach and success of these incentives.

Systemic policies also rely on trust. Programs like NSTDA's Business Innovation Center and OSMEP's SME Coach depend on collaboration between industry and academia. High trust fosters active participation, strengthening partnerships. Without it, firms avoid engagement, weakening policy outcomes (W. Opasvadhana, personal communication, October 2, 2024).

Building trust requires transparency. Clear communication on policy objectives, eligibility, and expected outcomes is essential. Creating feedback mechanisms where SMEs can provide input—and see their concerns addressed—builds confidence.

Public-private partnership forums can further enhance trust. Regular dialogue between government and businesses fosters collaboration and ensures policies better serve industry needs. Strengthening these relationships will improve policy effectiveness and drive innovation.

4.4 Attitude of Policymakers on Helping Firms and on Having Selective Policies

Policymakers in Thailand have taken a mixed approach to supporting firms through selective policies. While targeted incentives exist, resources are often spread too broadly, diluting the impact of any single initiative. To achieve better results, policymakers must focus on key sectors where support can drive substantial innovation and growth.

Selective policies play a crucial role in shaping innovation policy. Programs like the STI policy provide targeted incentives to industries such as automotive and electronics. While these policies strengthen strategic industries, they can also create imbalances, leaving other sectors underserved. Overemphasizing established industries risks missing opportunities in emerging fields and smaller firms.

Policymaker attitudes directly impact demand-side policies. Those who prioritize innovation support initiatives like the DEPA Digital Transformation Fund and Mini Voucher, which provide meaningful benefits for SMEs. More cautious policymakers, however, may opt for conservative policies that fail to meet SME needs effectively.

Supply-side policies, such as the BOI's Matching Fund and NIA's Thematic Innovation Grant, also reflect policymakers' openness to innovation. Support for skilled immigration and international talent acquisition strengthens these programs, while risk-averse attitudes limit their impact.

Systemic policies rely on policymakers who value collaboration and long-term development. When innovation ecosystems are prioritized, initiatives like the Business Innovation Center thrive. However, conservative attitudes can stifle these efforts, reducing policy effectiveness (S. Huabsomboon, personal communication, October 2, 2024).

There is growing recognition in Thailand of the need for more targeted support, particularly in high-tech sectors like EV manufacturing and digital technologies. Concentrating resources on sectors with strong potential for technological advancement leads to more impactful results. However, selective policies must align with market demand, business opportunities, and Thailand's competitive strengths to maximize effectiveness (S. Pittayasophon, personal communication, September 19, 2024).

While high-tech sectors should remain a priority, traditional and low-tech industries also need support. Policymakers should conduct sectoral assessments to identify areas where technology upgrades can enhance productivity and competitiveness. Tailored support programs should address the unique challenges and opportunities within these sectors.

A balanced approach—targeting high-potential industries while ensuring broad-based technological development—will strengthen Thailand's innovation ecosystem and drive long-term economic growth.

4.5 Societal Attitude to Failure

In Thailand, societal attitudes toward failure have traditionally been conservative, favoring low-risk ventures. This mindset influences entrepreneurs' willingness to pursue innovation, which often involves uncertainty. Encouraging a more accepting attitude toward failure could drive greater experimentation and innovation among SMEs.

A cultural reluctance to embrace failure can hinder entrepreneurial risk-taking. When failure is stigmatized, firms are less likely to take bold steps in R&D and technological advancement. Many hesitate to join government programs that require significant upfront investments with uncertain returns (S. Juasrikul, personal communication, September 18, 2024).

Societal perceptions directly impact demand-side policies. A culture that tolerates failure enables SMEs to engage with initiatives like the DEPA Mini Voucher and Digital Transformation Fund. However, if failure is seen as a stigma, firms become risk-averse, reducing policy effectiveness (S. Huabsomboon, personal communication, October 2, 2024).

Supply-side policies, such as university holding companies and TED Fund, thrive in environments that accept failure as part of the innovation process. When failure is normalized, businesses are more willing to experiment. If failure is feared, firms avoid these programs, weakening their impact (S. Lim, personal communication, September 19, 2024).

Systemic policies, such as the Thailand Tech Show, depend on firms' willingness to participate in collaborative, high-risk innovation projects. If failure is accepted as part of growth, these programs flourish. If not, participation drops, limiting the development of innovation ecosystems.

Negative societal attitudes toward failure discourage risk-taking and slow innovation. This can result in lower SME participation in high-uncertainty programs, weakening the effectiveness of innovation policies (S. Juasrikul, personal communication, September 18, 2024).

Changing this mindset is crucial. Promoting failure as a learning experience, rather than a stigma, will encourage more SMEs to take risks. Public campaigns showcasing entrepreneurs who overcame setbacks can reshape perceptions. Integrating innovation and risk management education into schools and universities will also help shift attitudes. By fostering a culture that views failure as a steppingstone to success, Thailand can unlock greater innovation potential and strengthen its SME sector.

4.6 Availability of Opportunities-Based Entrepreneurs

The availability of opportunity-based entrepreneurs—those who start businesses to capitalize on market opportunities rather than out of necessity—is critical for driving technological innovation among Thai SMEs. While Thailand has a relatively high rate of entrepreneurial activity, many businesses are necessity-driven, which limits their willingness to invest in long-term R&D and innovation initiatives.

The Global Entrepreneurship Monitor (GEM) 2023/24 report highlights that financial constraints, limited access to mentorship, and weak entrepreneurial networks remain significant barriers to fostering opportunity-driven entrepreneurship in Thailand. Compared to regional peers, Thailand ranks low in entrepreneurial ecosystem strength, with key constraints including insufficient financing, lack of skilled professionals, and regulatory hurdles. These factors reduce the effectiveness of government policies aimed at enhancing SME technological capabilities. Policies such as digital transformation grants, startup incentives, and innovation support funds are more effective when opportunity-driven entrepreneurs actively engage. However, the lack of a strong entrepreneurial base results in low participation rates and limited policy impact.

Demand-side policies, such as the DEPA Mini Voucher and Digital Transformation Fund, are most effective when opportunity-driven entrepreneurs actively engage. High levels of entrepreneurship increase participation, maximizing the impact on technological innovation. A weak entrepreneurial base, however, limits policy uptake and effectiveness.

Supply-side policies, like the Capital Market Fundraising Promotion Measure (PP-SME), benefit from entrepreneurs seeking to capitalize on market opportunities. Without a strong pool of opportunity-driven businesses, these policies fail to drive innovation at scale.

Systemic policies, such as the NSTDA Investment Section and Business Innovation Center, rely on entrepreneurs willing to collaborate and engage with the innovation ecosystem. A lack of entrepreneurial activity reduces the success of these long-term initiatives.

Thailand's growing opportunity-driven entrepreneurship base, especially in tech-driven sectors, has been supported by startup incubators and accelerators. These entrepreneurs are more likely to engage with government innovation policies and benefit from initiatives that advance technology and commercialization.

To further strengthen this ecosystem, access to funding, mentorship, and networking must improve. Expanding incubator and accelerator programs will nurture high-potential startups, while increasing seed funding and venture capital will provide critical early-stage support.

Additionally, fostering connections between startups and established businesses will enhance mentorship and collaboration, creating a more dynamic and innovative entrepreneurial environment (S. Juasrikul, personal communication, September 18, 2024).

Table 4.1 highlights how institutional factors shape the effectiveness of demand-side, supply-side, and systemic policies aimed at enhancing technological capabilities among SMEs. Strengthening opportunity-driven entrepreneurship is key to ensuring these policies deliver maximum impact.

TABLE 4.1

INSTITUTIONAL FACTORS IMPACTING DEMAND-SIDE, SUPPLY-SIDE, AND SYSTEMIC POLICIES FOR ENHANCING TECHNOLOGICAL CAPABILITIES AND INNOVATION AMONG SMES

Institutional Factor	Impact on Demand-Side Policies	Impact on Supply-Side Policies	Impact on Systemic Policies
Capacity of Government Agencies	High-capacity agencies ensure effective implementation of demand-side policies, such as **Thailand Trust Mark**. Limited capacity results in inefficiencies, like delays and overly complex procedures, reducing SME engagement and policy impact.	Strong capacity enables smoother implementation of supply-side policies like **NSTDA's Business Innovation Center**. Limited capacity can lead to slow fund disbursement and weak follow-up support for firms.	Effective systemic policies, like **NSTDA's ITAP, OSMEP's BDS Market, and SME Coach**, require robust agency capacity for coordinating stakeholders and fostering collaboration across sectors. Limited capacity hinders long-term sustainability of systemic programs.
Cross-Ministerial Coordination	Effective coordination between ministries (e.g., **Thailand Trust Mark**) enhances the coherence of demand-side policies across multiple sectors. Poor coordination creates disjointed efforts and inconsistencies in certification and market support policies.	Strong cross-ministerial coordination is key to supply-side policies like **Talent Mobility or Global Talent Visa**, ensuring smooth visa processing and alignment with industry needs. Poor coordination leads to delays and regulatory conflicts.	Systemic policies demand extensive coordination, such as the **NSTDA Business Innovation Center**, which links academia, industry, and government. Poor coordination weakens knowledge transfer and reduces policy effectiveness.
Trust Between Government Agencies & Firms	High trust encourages firms to engage in demand-side policies like the **DEPA Mini Voucher and Digital Transformation Fund**, leading to higher policy uptake and impact. Low trust results in limited firm participation in certification or grant programs, reducing effectiveness.	Trust between firms and agencies is crucial for supply-side policies like BOI's **Startup Support Program** or **Talent Mobility**, as it affects firms' willingness to comply with requirements and claim incentives. Low trust leads to underutilization of incentives.	Trust is fundamental in systemic policies like **IP Management and Technology Transfer Units, OSMEP's BDS Market** and **SME Coach** where collaboration between various stakeholders is key. Low trust reduces participation in events and hampers policy outcomes.
Attitude of Policymakers	Policymakers with a positive attitude towards innovation push forward demand-side policies like the **DEPA Mini Voucher and Digital Transformation Fund** with bold goals and adequate resources. Conservative attitudes lead to weaker, less impactful policies.	Positive attitudes toward innovation help drive supply-side policies like BOI's **Matching Fund** or NIA's **Thematic Innovation Grant**, encouraging openness to skilled immigration. Risk-averse policymakers limit the scope of such policies, reducing their potential impact.	Policymakers' attitudes toward collaboration influence the effectiveness of systemic policies like **BIC**. Supportive attitudes foster partnerships, while conservative views may limit collaboration opportunities.
Societal Attitudes Towards Failure	Societal acceptance of failure encourages firms to take advantage of demand-side policies like **Thai Innovation List Measure**. Negative attitudes limit firms' willingness to engage with high-risk innovation opportunities.	Societal acceptance of failure helps firms take risks with supply-side incentives like **University Holding Companies** or **TED Fund**. Negative views lead to more conservative approaches, reducing innovation and experimentation among SMEs.	Systemic policies rely on societal attitudes toward risk and failure, with positive views encouraging greater firm participation in initiatives like the **Thailand Tech Show**. Negative attitudes discourage experimentation and risk-taking.
Availability of Opportunity-Based Entrepreneurs	High levels of opportunity-based entrepreneurship enhance the effectiveness of demand-side policies like the **DEPA Mini Voucher and Digital Transformation Fund**, driving higher engagement. Low entrepreneurial activity leads to limited policy impact.	Opportunity-based entrepreneurs are key drivers of supply-side policies, as seen in the uptake of the **Capital Market Fundraising Promotion Project (PP-SME)**. Low availability of such entrepreneurs reduces the policy's ability to stimulate innovation.	Systemic policies like **NSTDA Investment Section (NIS)** thrive when opportunity-based entrepreneurs engage with R&D and commercialization initiatives. Low levels of entrepreneurship weaken the ecosystem and reduce policy outcomes.

Institutional factors in Thailand have had both positive and negative impacts on firms' innovation and technological learning (See Table 4.2). Limited capacity in government agencies, coupled with inadequate resources and fragmented policy implementation, weakens the effectiveness of innovation policies. Weak cross-ministerial coordination further complicates execution, leading to policy overlaps and inefficiencies. Low trust between firms and government agencies discourages SME participation in innovation programs, reducing policy impact. Cultural attitudes that stigmatize failure make entrepreneurs hesitant to take risks. Broad, unfocused policymaker strategies dilute the effectiveness of selective innovation initiatives. These factors hinder long-term innovation growth.

Despite these challenges, Thailand has made progress. Opportunity-driven entrepreneurs are increasing, and proactive agencies like NIA, DEPA and NSTDA play a crucial role in strengthening the innovation ecosystem. Their targeted support and specialized expertise help drive technological advancement. Addressing these institutional barriers is essential. Strengthening government agencies, improving policy coordination, and fostering trust will enhance policy effectiveness. Shifting cultural perceptions to accept failure as part of innovation will encourage greater entrepreneurial risk-taking. Supporting entrepreneurs and refining selective policymaking will also be key. Overcoming these challenges will create a stronger foundation for SME innovation, driving economic growth and global competitiveness.

TABLE 4.2

IMPACT OF INSTITUTIONAL FACTORS ON FIRMS' INNOVATION AND TECHNOLOGICAL CAPABILITY LEARNING

Institutional Factor	Positive Impact	Negative Impact
Capacity of Executing Government Agencies	Specialized agencies like NIA, DEPA, and NSTDA support SMEs through programs like Talent Mobility, enhancing innovation and technological learning.	Limited staffing and resources in the R&D Certification Committee Secretariat delay the processing of tax incentives, reducing SME participation in innovation policies.
Cross-Ministerial/ Agency Coordination	Effective collaboration in programs like the Thailand Tech Show promotes seamless integration of innovation support mechanisms across ministries.	Poor coordination between the Revenue Department and Ministry of Industry hampers the implementation of tax incentives, creating policy overlaps and inefficiencies.
Trust Between Government Agencies and Firms	High trust in agencies like BOI encourages firms to engage with programs like the BOI's Startup Support Program, improving policy uptake and fostering collaboration.	Low trust in bureaucratic processes deters firms from participating in R&D tax incentive programs, fearing inefficiencies and lack of tangible support.
Policymakers' Attitude on Supporting Firms and Selective Policies	Targeted incentives in the EV sector under the STI policy drive technological advancements in strategic industries like automotive and electronics.	Broad allocation of resources across initiatives dilutes impact, as seen in programs attempting to support multiple sectors without a focused strategy.
Societal Attitude Toward Failure	Programs like TED Fund thrive in an environment where failure is seen as a learning opportunity, encouraging SMEs to experiment with new technologies.	Stigmatization of failure discourages participation in high-risk programs like the Thai Innovation List Measure, limiting innovation and technological learning.
Availability of Opportunity-Based Entrepreneurs	Incubators and accelerators, such as the NIA's Startup Thailand Program, support opportunity-driven entrepreneurs in leveraging government resources for innovation.	Necessity-driven entrepreneurs in traditional sectors often avoid long-term R&D investments, reducing engagement with systemic initiatives like the NSTDA Investment Section.

4.7 Roles of Intermediaries in SMEs' Technological Capability and Productivity Development

Intermediaries such as public research institutes (PRIs) and industry associations play a critical role in fostering innovation and technological development among SMEs. As highlighted by Intarakumnerd and Chaoroenporn (2013), these intermediaries act as essential connectors, bridging gaps between government agencies, universities, and private firms. By facilitating collaboration, they help SMEs overcome common challenges such as limited access to resources, technological know-how, and market opportunities.

Different industries require distinct types of intermediaries to fulfill specific roles. In high-tech industries, public research institutes and international industry associations serve as brokers, linking transnational corporations with local firms and ensuring they stay updated on rapid technological advancements. In mid-tech sectors, public development agencies act as knowledge facilitators, leveraging expertise from larger corporations to strengthen local suppliers' capabilities. Meanwhile, local industry associations play a mediating role, resolving conflicts and fostering cooperation among domestic firms.

Public development agencies provide essential resources and technological support to local firms. At the same time, industry associations coordinate collective efforts, helping businesses achieve shared goals such as improved sustainability practices and enhanced market access.

The effectiveness of these intermediaries depends on their ability to align their roles with industry-specific needs. Their success in supporting SMEs hinges on fostering an ecosystem where knowledge transfer, skill development, and cross-sector collaboration can thrive.

Table 4.3 presents an analysis of sector-specific agencies under the Ministry of Industry, focusing on their contributions to technological capability enhancement and productivity improvement for SMEs.

TABLE 4.3

ANALYSIS OF SECTOR-SPECIFIC AGENCIES UNDER THE MINISTRY OF INDUSTRY SUPPORTING TECHNOLOGICAL CAPABILITY ENHANCEMENT AND PRODUCTIVITY IMPROVEMENT FOR SMES

Agency	Role	Example of Project
Thailand Textile Institute (THTI)	Supports SMEs in the textile sector by providing technological development, innovation, and efficiency improvements.	**Sustainable Textile Production Program** – Helping SMEs adopt eco-friendly production method, sustainable technologies to reduce waste and improve quality.
National Food Institute (NFI)	Assists food industry SMEs in enhancing product quality, food safety, and introducing new innovations.	**Food Product Development and Innovation** – Supporting SMEs with product development, packaging, and safety certification to meet international standards.
Electrical and Electronics Institute (EEI)	Supports SMEs in adopting new electrical and electronic technologies, especially in automation and energy efficiency.	**Smart Manufacturing Implementation** – Assisting SMEs in the electrical sector with automation technologies and IoT applications to improve productivity.
Thailand Automotive Institute (TAI)	Enhances technological capabilities in the automotive sector, focusing on R&D, technology transfer, and manufacturing process improvement.	**Automotive Parts Supplier Development Program** – Assisting SMEs in improving the quality and precision of their auto parts through technology upgrades.
Iron and Steel Institute of Thailand (ISIT)	Helps SMEs in the steel sector optimize their manufacturing processes and adopt advanced production technologies.	**Steel Manufacturing Process Improvement** – Supporting SMEs in improving steel production through technology adoption, process automation.
Construction Institute of Thailand (CIT)	Provides support for construction-related SMEs, helping them adopt new construction technologies and improve their productivity.	**Construction Technology Upgradation** – Assisting SMEs in the construction sector to adopt modern technologies like modular construction and 3D printing.
Plastics Institute of Thailand	Focuses on improving the competitiveness of SMEs in the plastics industry by promoting technological innovation and sustainable practices.	**Plastics Recycling Technology Initiative** – Supporting SMEs in the plastics industry with recycling technology and sustainable manufacturing practices.
Institute of SMEs Development (ISMED)	Enhances the technological capabilities and competitiveness of SMEs across various sectors through capacity-building programs and support services.	**SME Technology Upgradation Program** – Providing consulting services, R&D support, and financial assistance for SMEs to adopt new technologies and improve productivity.
Thailand Productivity Institute (FTPI)	Aims to increase SME productivity through tools and strategies such as lean management, quality improvement, and process optimization.	**Productivity Enhancement Workshops** – Providing training on lean production techniques, waste reduction, and improving efficiency through quality management systems.
Management System Certification Institute (MASCI)	Supports SMEs by offering certifications that enhance their management systems and improve product quality.	**ISO 9001 Certification Support** – Helping SMEs improve their quality management systems by guiding them through the ISO 9001 certification process.
Thai-German Institute (TGI)	Supports SMEs with technology transfer, industrial development, and fostering innovation in collaboration with Germany.	**Industry 4.0 for SMEs** – Assisting SMEs in adopting Industry 4.0 technologies such as automation, robotics, and data-driven decision-making.

Sector-specific agencies under the Ministry of Industry play a vital role in enhancing SME productivity and technological capabilities. These agencies focus on technology adoption, R&D, certification, and productivity improvement. Organizations like EEI, TAI, and THTI help SMEs integrate automation and sustainable technologies, while NFI, TAI, and THTI support R&D initiatives to drive innovation. Agencies such as MASCI and ISMED assist SMEs in achieving international certifications and quality standards, boosting their competitiveness. FTPI and ISMED provide training and advisory services to enhance operational efficiency and reduce production waste, ensuring SMEs remain competitive in global markets.

According to Intarakumnerd (2013), public and private intermediaries should have a clear division of labor. Public intermediaries should focus on policy formulation, human resource development, and infrastructure provision, which serve as public goods essential for sectoral advancement.

Several PRIs and universities significantly contribute to SME technological development. NSTDA focuses on commercializing R&D and upgrading industrial technology across multiple sectors. TISTR specializes in applied research and sustainable practices to improve SME productivity. NIA serves as a key innovation enabler, linking SMEs with funding, research institutions, and collaborative networks to facilitate technological adoption. TSP provides essential R&D infrastructure and resources, supporting SMEs in scaling their innovations. DEPA drives digital transformation, integrating advanced digital tools into SME operations. OSMEP leads government-backed programs to enhance technological capabilities, productivity, and innovation among SMEs.

Chulalongkorn University's Innovation Hub bridges academia and industry, facilitating research commercialization and technological advancement. The Program Management Unit for Competitiveness (PMU-C) connects research with market applications, offering funding for applied research and establishing pilot plants that help SMEs scale production with reduced risks. Sector-specific programs in healthcare, agriculture, and tourism further address unique technological needs, fostering targeted innovation.

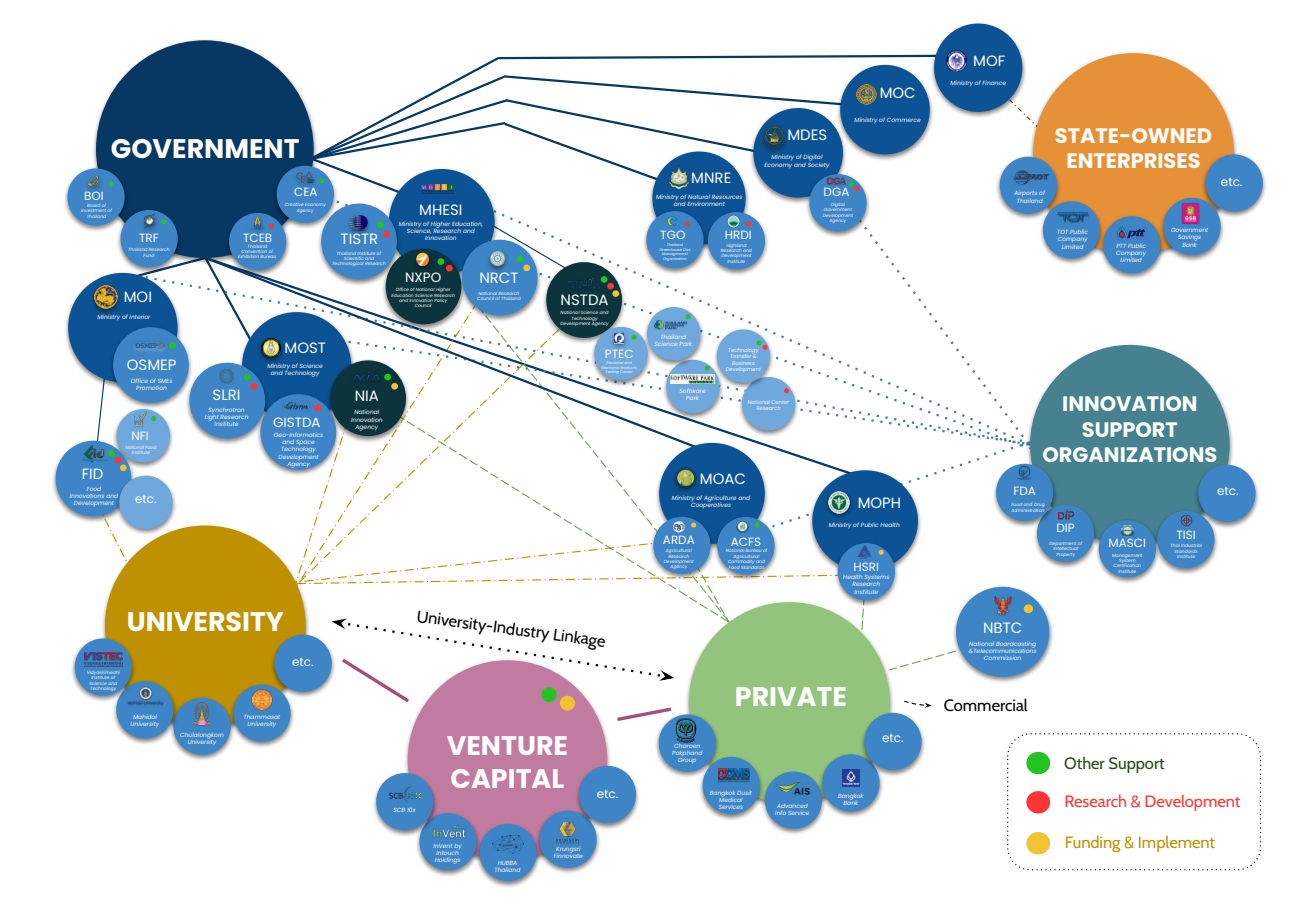
While public intermediaries focus on infrastructure and policy, private intermediaries actively promote technological know-how, capability-building, and trust within industries. Organizations like the Federation of Thai Industries (FTI), Thai Chamber of Commerce (TCC), and Federation of Thai SME Association (FTA) drive Industry 4.0 adoption by providing resources and training in automation and digital manufacturing. TCC's SME Productivity and Innovation Enhancement Initiative supports SMEs through workshops on digital tools, improving efficiency and market competitiveness.

Industry-specific associations further bolster SME technological growth. Thai Automobile Parts Manufacturers Association (TAPMA) supports SME suppliers in the automotive sector through initiatives like the Automotive Parts Technology Upgrade Program, helping them adopt advanced manufacturing technologies. Thailand Tech Startup Association (TTSA) fosters tech startups and SMEs by providing mentorship, funding, and networking opportunities through its Tech Startup Ecosystem Support Program (S. Juasrikul, personal communication, September 18, 2024).

Thailand's innovation ecosystem is extensive, comprising government agencies, private sector organizations, VC firms, research institutions, and academia. Figure 3.1 illustrates how these entities collaborate to drive SME innovation, ensuring technological growth and competitiveness across industries.

FIGURE 4.1

INNOVATION ECOSYSTEM IN THAILAND



Source: Thailand innovation toolkit (2022), Board of Investment of Thailand.

4.8 The Case Studies

This report utilizes two case studies to demonstrate how institutional factors influence the effectiveness of policies aimed at enhancing SME innovation. The selected case studies focus on TED Fund and NIA's Social Innovation Projects. The details of each case study are as follows.

4.8.1 TED Fund

The first case study examines TED Fund, established in 2016 under Thailand's Ministry of Higher Education, Science, Research, and Innovation (MHESI). The fund plays a crucial role in supporting entrepreneurs in technology and innovation by reducing investment risks and promoting the commercialization of research.

TED Fund offers a range of tailored programs designed to meet different business needs. The Ideation Incentive Program (IDEA) provides up to 100,000 baht for developing mockups and business plans. The Proof of Concept (POC) Program offers up to 1,500,000 baht to support prototype development. For businesses looking to scale, the TED Market Scaling Up (TMS) program provides funding of up to 2,000,000 baht to facilitate market expansion and business growth.

These initiatives are specifically designed to help startups and SMEs grow and integrate into the market. By providing financial support at different stages of business development, TED Fund reduces barriers to entry and encourages technological innovation.

To evaluate TED Fund's impact, we conducted interviews with top innovation projects supported in fiscal year 2023. Our focus was on projects that generated the highest economic and social impact to assess how institutional factors influenced their success or failure.

Project Name: Real-Time Coding and Knowledge Skill Management Platform
Recipient Company: Quest Edtech Co., Ltd.
Support: TED Fund through the Science Park Network, Phase 2
Project Location: Bangkok, Thailand

Quest Edtech Co., Ltd. developed an innovative platform focused on teaching real-time coding and knowledge skill management. The platform uses artificial intelligence (AI) for performance evaluation and blockchain technology for secure tracking of skill transactions. Its primary goal is to align learners with technological career paths within the Quest Network ecosystem. Additionally, the company collaborates with leading Thai universities, such as Thammasat University and King Mongkut's Institute of Technology Ladkrabang, as well as high schools, to provide training in automation, coding, and metaverse development. During the COVID-19 pandemic, Quest Edtech launched **duPhonics**, an online English learning platform for young children, which became popular for enhancing children's confidence in communication.

Before receiving support from TED Fund, Quest Edtech faced several challenges. The platform struggled to expand its reach, particularly in creating advanced curricula for high school and university students. Additionally, skepticism among new users regarding the platform's effectiveness hindered customer acquisition, despite positive feedback from existing users. The limited scope of its offerings also prevented the platform from fully addressing the educational needs of diverse audiences.

Quest Edtech received a grant of USD 80,000 from TED Fund for its blockchain-backed workforce management app. With TED Fund's support through the Science Park Network, Phase 2, Quest Edtech achieved significant progress. This funding has enabled Quest Edtech to develop a real-time coding talent platform that offers a full-stack automated teaching curriculum. Technological advancements included the integration of AI and blockchain systems, enhancing the platform's functionality and user engagement. New features, such as automation training and multilingual options (English, Thai, and Chinese), were added to meet the growing demands of the technology job market. Partnerships with educational institutions allowed the company to extend its reach, providing coding and metaverse training to students and addressing a broader range of learning needs.

TED Fund's support influenced Quest Edtech's decision-making in multiple ways. The funding enabled the company to enhance its technological capabilities, incorporating advanced features that improved platform performance and appeal. It also fostered a mindset shift toward innovation, with a focus on developing cutting-edge tools like automation modules and expanding the curriculum. Additionally, collaborations facilitated by the Science Park Network strengthened the company's R&D initiatives and market presence. The funding further allowed Quest Edtech to address operational limitations, enabling the development of more complex and customized offerings.

Despite these achievements, the project encountered challenges. The metaverse-based learning modules were too basic for advanced learners, limiting adoption by high school and university students. Additionally, the skepticism of new users about the platform's effectiveness continued to hinder rapid market penetration.

In conclusion, TED Fund's support was instrumental in Quest Edtech's ability to scale operations, integrate advanced technologies, and expand market reach. By addressing its current challenges and implementing strategic recommendations, Quest Edtech can continue to drive innovation in education, enhance its impact, and achieve long-term sustainability in the competitive edtech landscape.

Project Name: Bioelectric Circuit Wastewater Treatment System - Clean, Odorless, and Toxin-Free Water for Better Quality of Life and Environmental Sustainability
Recipient Company: Inno Green Tech Co., Ltd.
Support: TED Fund through the Science Park Network, Phase 2 (POC Program)
Project Location: Songkhla, Thailand

Inno Green Tech Co., Ltd. developed the **Bioelectric Circuit Wastewater Treatment System**, an innovative solution designed to treat industrial wastewater using microbial fuel cell technology. This system transforms wastewater with organic compounds into clean, odorless, and toxin-free water while generating electricity as a by-product. The innovation is tailored to industrial applications, capable of treating over 1,000 cubic meters of wastewater per day. With its strong patent portfolio and inclusion in Thailand's Innovation Catalogue for eight years, the system has established credibility and has addressed wastewater issues for 10 industrial clients, including starch and palm oil manufacturers.

Before receiving TED Fund support, the company faced several challenges. It struggled to scale its innovation for larger industrial applications and adapt its technology to complex wastewater types, such as those from waste-cleaning factories. Additionally, the company encountered trust issues from potential customers, many of whom had negative experiences with other providers offering ineffective wastewater treatment solutions. Organizationally, the company lacked expertise in finance and marketing, which hindered its ability to create value and communicate its offerings to the market.

With TED Fund support, provided through the Science Park Network (Phase 2) under the POC Program, the company achieved significant milestones. The funding enabled technological advancements, allowing the innovation to treat higher wastewater volumes and adapt to varying industrial needs. The company's inclusion in Thailand's Innovation Catalogue further bolstered its credibility, helping expand its client base. It also developed structured pricing packages and explored service-oriented business models, such as offering wastewater treatment as a service rather than just selling equipment. These changes not only enhanced recurring revenue potential but also strengthened customer relationships.

TED Fund measures significantly influenced the company's decision-making and operational strategies. The support encouraged the company to refine its technology, focus on research and development (R&D), and collaborate with regional science parks and academic institutions to customize solutions for diverse wastewater compositions. Additionally, TED Fund's recommendations emphasized the importance of hiring marketing and financial specialists, helping the company improve its business operations and customer outreach. This guidance encouraged a shift in mindset, prioritizing structured business strategies and long-term innovation management.

Despite its achievements, the company continued to face challenges. A lack of in-house expertise in finance and marketing delayed some operational priorities as the management team worked to upskill themselves. Customer skepticism, rooted in negative experiences with other providers, remained a barrier to building trust and securing new contracts.

Looking ahead, Inno Green Tech plans to expand its wastewater treatment services to additional industries, such as waste-cleaning and livestock operations. The company also aims to develop an online management platform to streamline client interactions and reduce the need for on-site visits. Furthermore, it plans to establish a production facility for wastewater treatment inoculants to meet growing demand and improve scalability.

In conclusion, TED Fund's support was instrumental in transforming Inno Green Tech's innovation into a scalable, market-ready solution. With its expanded capabilities and strategic approach, the company is well-positioned to address industrial wastewater challenges, foster environmental sustainability, and achieve long-term business growth.

Project Name: Smart Car Insurance Command Center System
Recipient Company: IOAD Co., Ltd.
Support: TED Fund through the Science Park Network, Phase 2 (POC Program)
Project Location: Bangkok, Thailand

IOAD Co., Ltd. developed the **Smart Car Insurance Command Center System**, an innovative IoT-based solution that transforms vehicles into smart cars. The system features advanced accident analysis and autonomous emergency response capabilities. In severe accidents, it automatically alerts rescue teams, even if the driver is incapacitated. For minor accidents, the system enables drivers to notify insurance companies directly. This innovation streamlines post-accident processes for vehicle owners and supports operational needs for car rental companies by monitoring and maintaining their fleets. Additionally, the system is used by the Metropolitan Electricity Authority to track energy usage and gather data from electric vehicles, which currently constitutes a major revenue stream for the company.

Before receiving support from TED Fund, IOAD faced numerous challenges. The COVID-19 pandemic disrupted its sales efforts, particularly in the rental car market, where potential deals were canceled. Intellectual property theft was another significant issue, as companies copied IOAD's ideas after they were pitched. Competition from low-cost Chinese alternatives further complicated market entry. Internally, the company lacked sufficient funding and expertise in marketing, which hindered its ability to scale operations and reach new customers effectively.

TED Fund's support through the Science Park Network (Phase 2) provided IOAD with the resources and guidance needed to address these challenges. The project achieved a total economic and social impact of 38 million baht. Technologically, the company enhanced its IoT devices to support additional functionalities, such as electric vehicle energy monitoring. This refinement enabled partnerships with major institutions, including the Metropolitan Electricity Authority. The fund's support also facilitated the development of structured business strategies, helping the company adapt to changing market demands and differentiate its offerings. Despite initial setbacks, IOAD initiated plans to re-enter the rental car market and expand its product range.

With TED Fund's guidance, IOAD refined its business model, identifying strengths and weaknesses and implementing actionable strategies. Emphasis on developing unique selling propositions helped the company compete with lower-cost alternatives. Furthermore, TED Fund's recommendations to improve project pitching and product dashboards enhanced IOAD's ability to present its solutions to investors and clients. The support also encouraged the company to hire marketing specialists and explore new business models, such as transitioning to a marketplace approach, which would mitigate intellectual property risks and standardize pricing.

Despite these achievements, IOAD faced ongoing challenges. Intellectual property theft and competition from Chinese products remained significant obstacles. Additionally, limited marketing expertise and insufficient funding continued to constrain the company's ability to expand operations and penetrate new markets.

Looking ahead, IOAD plans to re-enter the rental car market with its smart insurance system and launch a car-sharing platform in collaboration with the Provincial Electricity Authority by late 2023. In 2024, the company aims to diversify further by producing drones for disaster relief for the Royal Thai Air Force and expanding into international markets, particularly in the Middle East. Plans are also underway to enhance the product line with new accessories and adopt a marketplace model to better safeguard intellectual property and attract a broader customer base.

In conclusion, TED Fund's support has been pivotal in enabling IOAD Co., Ltd. to refine its innovation, overcome market challenges, and diversify its offerings. By implementing TED Fund's recommendations and leveraging its expanded capabilities, IOAD is well-positioned for sustained growth, innovation, and market expansion in the competitive IoT and smart systems sector.

Project Name: Development of Rice Cream for the Elderly and Diabetics
Recipient Company: Rice Factory Co., Ltd.
Support: TED Fund Batch 3 through the Ideation Incentive Program (IDEA)
Funding Amount: Up to 100,000 baht
Project Location: Nakhon Phanom Province, Thailand

The **Development of Rice Cream for the Elderly and Diabetics** project, initiated by Rice Factory Co., Ltd., is an innovative venture supported under TED Fund Batch 3 through the Ideation Incentive Program (IDEA). This funding program provided the company with a grant of up to 100,000 baht to develop a prototype and complete a comprehensive business plan. The project, based in Nakhon Phanom Province, transforms organic rice into a low-glycemic index (GI) powder (GI 50–53) using a heat-treatment process and spray-drying technology. This product caters to diabetics and the elderly, offering versatile applications such as porridge, rice-based beverages, and thickening agents for various foods. Additionally, the company partnered with local community enterprises in northeastern Thailand, including groups in Roi Et Province, to source rice and create new market opportunities for farmers. In response to the COVID-19 pandemic, the company also developed online sales channels to reach a broader audience.

Before receiving TED Fund support, Rice Factory Co., Ltd. faced significant challenges. Limited production capacity, due to small-scale machinery and storage facilities, hindered the company's ability to fulfill large orders and maximize profits. Workforce availability was inconsistent, as many employees were seasonal farmers who often prioritized agricultural duties over production schedules. Additionally, financial constraints following investments in

new machinery during the pandemic created cash flow issues, making it difficult to procure raw materials and sustain operations.

TED Fund's support proved transformative. The project achieved a total economic and social impact of 27.92 million baht by 2023. The grant facilitated the development of a prototype and a detailed business plan, enabling the company to refine its production processes and expand its product offerings. Partnerships with local community enterprises not only provided a reliable source of organic rice but also contributed to regional economic development by generating additional income for farmers. Online sales channels were also established, allowing the company to reach health-conscious consumers alongside its initial target market of diabetics and elderly individuals.

TED Fund's measures had a significant impact on the company's strategic decisions and operational improvements. The support enabled the company to enhance its technological capabilities by optimizing production methods and increasing product quality. By fostering a clearer understanding of the target market, the fund's guidance encouraged the company to develop new products, such as rice-based beverages and protein powders, catering to a wider audience. The funding also allowed the company to adopt innovative pricing strategies and refine its branding, ensuring better alignment with market demands.

Furthermore, TED Fund's influence shifted the company's mindset toward innovation and strategic planning. The emphasis on creating a comprehensive business plan encouraged a more structured approach to operations, helping the company address inefficiencies and capitalize on growth opportunities. The support also highlighted the importance of market diversification and collaboration, encouraging the company to pursue partnerships and expand its customer base.

Despite its achievements, the company faced ongoing challenges. The small size of its machinery and storage facilities limited production capacity, making it difficult to meet growing demand. The reliance on a predominantly farmer-based workforce resulted in seasonal labor shortages, further disrupting operations. Financial constraints persisted, as cash flow issues affected the company's ability to procure raw materials and invest in expansion. Additionally, the company needed to refine its pricing strategy and establish a clearer market position to maximize revenue and build customer trust.

Looking ahead, Rice Factory Co., Ltd. plans to invest in larger machinery to increase production capacity and meet higher demand. The company aims to diversify its product line by developing rice-based beverages and protein powders, appealing to health-conscious consumers beyond its original target market of diabetics and elderly individuals. A key focus will be refining its pricing strategy by adopting a model that differentiates between new and existing customers, ensuring sustainable revenue growth. Additionally, the company intends to seek advisors to support fundraising efforts and establish partnerships with investors to drive further expansion.

TED Fund's support was instrumental in enabling Rice Factory Co., Ltd. to overcome initial challenges and achieve substantial economic and social impact. By addressing production inefficiencies, expanding market reach, and fostering collaboration with community enterprises, the company has established itself as a key player in the health and wellness food sector. The strategic guidance provided by TED Fund has helped the company adopt a focused and adaptive approach, laying a strong foundation for sustained growth and innovation. Through continued investment in technology, market diversification, and strategic partnerships, Rice Factory Co., Ltd. is well-positioned to drive future success and contribute to the well-being of its target audiences.

Project Name: Jasmine Flower Extract Shot Drink for Anxiety Relief
Recipient Company: GreenTech BioLab Co., Ltd.,
Support: TED Fund Batch 3 through IDEA
Funding Amount: Up to 100,000 baht
Project Location: Nakhon Phanom Province, Thailand

The **Jasmine Flower Extract Shot Drink for Anxiety Relief** project, led by GreenTech BioLab Co., Ltd., was supported under TED Fund Batch 3 through IDEA, receiving a grant of up to 100,000 baht. The project aimed to develop an innovative jasmine flower extract shot drink designed to reduce anxiety. It was a groundbreaking initiative, introducing a novel product to the global market. Utilizing advanced extraction techniques, the company created a safe and effective drink, which also served as a foundation for future applications, such as the extraction of other herbs or flowers for medical uses.

Before receiving TED Fund support, the company faced challenges in bringing its concept to life. Developing a scalable and marketable prototype proved difficult due to limited resources and a lack of a comprehensive business strategy. Furthermore, the absence of marketing expertise hindered the company's ability to identify and target the right consumer base effectively.

TED Fund support marked a turning point for the project. With the funding, the company developed a functional prototype and refined its business plan. Despite initial setbacks with the Shot Drink product, which encountered issues related to weight and limited appeal as a pharmacy item, the company adapted by shifting its focus to a concentrated jasmine extract product designed to aid sleep. This strategic pivot resulted in the creation of a certified product now sold in pharmacies, receiving positive feedback from customers with sleep difficulties. Additionally, the company established contractual agreements with local farmers, ensuring a steady supply chain while also contributing to the local economy.

TED Fund's support played a pivotal role in shaping the company's strategic decisions and fostering its growth. The grant enabled the refinement of the jasmine extraction process, resulting in a high-quality product. This technological advancement also positioned the company to explore broader applications, such as the extraction of other herbs and flowers for medical and therapeutic uses. The company demonstrated adaptability by transitioning from the Shot Drink to a more marketable product, a concentrated jasmine extract for sleep enhancement. This pivot underscored the influence of TED Fund support in fostering a culture of innovation and responsiveness to market feedback. TED Fund encouraged the development of a clear business model and a market-oriented approach. This guidance facilitated a strategic shift from a research and development focus to a marketing and sales emphasis, enabling the company to better align its operations with consumer demands. Although the company did not specifically expand its R&D or engineering teams, it significantly improved its operational efficiency and management by aligning its innovation processes with market requirements. The fund's measures instilled a mindset focused on continuous learning and adaptation.

Despite the progress made, the company faced challenges such as product weight, limited distribution channels, and a lack of marketing expertise. The heavy weight of the Shot Drink increased transportation costs and was inconvenient for consumers, leading to its limited success. Additionally, the company struggled to secure pharmacy distribution due to perceptions that the product was more suited as a gift item than a medical product.

Looking forward, the company plans to focus on consumer education to build confidence in its products. It also intends to shift its primary business focus from research and development to marketing and sales to better meet its objectives and cater to its target market. Furthermore, the company aims to develop a robust business model and enhance its branding to establish a stronger presence in the market.

TED Fund's support proved instrumental in enabling the company to navigate initial obstacles and align its innovation with market demands. By encouraging strategic pivots, refining technological processes, and fostering business clarity, the fund significantly influenced the company's trajectory. These measures cultivated a culture of adaptability, innovation, and customer-centric development, ensuring the company's sustainability and success in the competitive market.

Table 4.4 highlights how TED Fund's institutional factors, including resource allocation, strategic guidance, and collaborations, influenced the success or challenges of various innovation projects. Despite significant support, persistent challenges underscore the need for ongoing refinement in institutional strategies to ensure sustainable impact.

TABLE 4.4

COMPARATIVE ANALYSIS OF CASE STUDIES' OUTCOMES AND HOW TED FUND'S INSTITUTIONAL FACTORS AFFECTED SUCCESS/FAILURE

Project Description and Outcome	How TED Fund's Institutional Factors Affected Success/Failure
Real-Time Coding and Knowledge Skill Management Platform: Developed by Quest Edtech Co., Ltd., the platform utilizes AI and blockchain technology for real-time coding education. It collaborates with Thai universities to provide coding and metaverse training.	TED Fund's Science Park Network (US$ 80,000) facilitated technological upgrades, enabling the integration of AI and blockchain. Institutional support fostered university partnerships and curriculum development. However, gaps in addressing advanced learners' needs limited broader adoption.
Bioelectric Circuit Wastewater Treatment System: Created by Inno Green Tech Co., Ltd., the system treats industrial wastewater using microbial fuel cells, converting organic compounds into clean water while generating electricity.	TED Fund's support enabled technological scaling and inclusion in Thailand's Innovation Catalogue. Institutional factors emphasized R&D collaborations and hiring financial and marketing experts. Trust issues with potential clients remained a hurdle despite the support.
Smart Car Insurance Command Center System: IOAD Co., Ltd. developed IoT-based accident analysis and emergency response systems, transforming vehicles into smart cars. The innovation serves car rental firms and the Metropolitan Electricity Authority.	TED Fund financial support covers R&D costs. It helped refine IoT functionalities, support EV-related data monitoring, and promoted structured business planning. TED Fund has offered technical assistance to ensure the development and implementation of the system. TED Fund has supported IOAD in expanding the market both domestically and internationally.
Development of Rice Cream for the Elderly and Diabetics: Initiated by Rice Factory Co., Ltd., this project converts organic rice into low-GI powder for versatile applications like porridge and beverages.	TED Fund provided resources for prototype development and market alignment ensuring the product meets high standards of quality & safety. Institutional guidance fostered market diversification & community partnerships.
Jasmine Flower Extract Shot Drink for Anxiety Relief: GreenTech BioLab Co., Ltd. developed an innovative jasmine extract drink aimed at reducing anxiety, later pivoting to a concentrated extract for sleep enhancement.	Institutional support facilitated prototype refinement and market pivoting. However, challenges in distribution and marketing expertise persisted. TED Fund's emphasis on adaptability enabled the company to shift focus and gain traction in pharmacies while fostering a customer-centric approach.

In summary, TED Fund's institutional factors significantly influenced the success and challenges of the supported projects by providing critical resources, fostering strategic collaborations, and emphasizing innovation and adaptability. Through initiatives like the Science Park Network, the fund enabled technological advancements, market diversification, and partnerships with academic institutions, addressing specific project needs such as prototype development and market alignment. However, persistent challenges, including operational constraints, trust issues, competition from low-cost alternatives, and gaps in marketing expertise, revealed limitations in institutional strategies. While the fund facilitated pivotal shifts, such as product pivots and enhanced business models, its support underscored the importance of continuous improvement in addressing nuanced barriers to ensure long-term success and sustainability.

We also conducted interviews with the owners of 11 TED Fund-supported projects that were discontinued during fiscal year 2024. These discussions revealed the challenges and factors leading to their cancellation, along with recommendations for TED Fund, as detailed in Table 4.5.

TABLE 4.5

ASSESSMENT OF TED FUND-SUPPORTED PROJECTS: FISCAL YEAR 2024 - PROJECT OVERVIEW, CHALLENGES AND CANCELLATION FACTORS, AND RECOMMENDATIONS

Project Description	Challenges and Cancellation Factors	Recommendations for TED Fund
Project A: Platform using satellite and sensor data to calculate greenhouse gas reductions, allowing farmers to trade carbon credits through e-wallets.	**Internal:** Insufficient budget, delayed fund disbursement. **External:** High competition, lack of confidence in high-risk investments.	Simplify and accelerate fund disbursement, collaborate with banks for funding access, enhance TED Fund staffing and processes.
Project B: Machine Learning platform for personalized tracking and promoting early childhood reading development.	**Internal:** Limited knowledge in business planning, delays in fund disbursement. **External:** COVID-19 pandemic disrupted operations.	Establish mentorship networks, streamline funding processes, provide co-working spaces, enhance project promotion.
Project C: Pore-tightening serum using microencapsulation of local herbal extracts for effective cosmetic applications.	**Internal:** Limited business planning knowledge, delayed fund disbursement, financial difficulties. **External:** Intense competition, COVID-19 pandemic disruptions.	Create mentorship networks, improve fund allocation processes, assist with marketing, provide ongoing guidance.
Project D: Payroll program simplifying personal income tax calculations and offering optimized financial planning.	**Internal:** Budget constraints for hiring, inefficient fund disbursement, misaligned funding cycles. **External:** None mentioned.	Digitize document management, allow fund allocation flexibility, streamline disbursement, provide clear funding guidelines.
Project E: Legal service platform utilizing law students to provide affordable contract drafting services while offering real-world experience.	**Internal:** Limited business knowledge, financial liquidity issues, concerns over social focus of business model. **External:** High competition, reliance on free AI tools.	Facilitate networking, assist with customer acquisition, improve participant selection process, strengthen follow-up mechanisms.
Project F: Modular footwear supporting circular economy through recyclable designs without adhesives.	**Internal:** Limited knowledge in pitching strategies, insufficient funding for advanced tools. **External:** COVID-19 pandemic, inefficient equipment leading to high raw material costs.	Provide advanced financial and marketing training, enhance funding support for tools, improve access to efficient technologies.

Project Description	Challenges and Cancellation Factors	Recommendations for TED Fund
Project G: High-protein snack bar from silkworm hydrolysate offering enhanced nutritional value.	**Internal:** Insufficient business planning knowledge, financial losses due to funding delays. **External:** Rising raw material costs, negative customer perception of taste and smell.	Expand advisory services, simplify funding processes, refine product development, enhance market strategy.
Project H: Platform connecting global students for knowledge exchange and career exploration.	**Internal:** Limited business and technical knowledge, financial liquidity challenges, delayed awareness of opportunity. **External:** COVID-19 pandemic disruptions.	Build knowledge-sharing networks, streamline funding, create co-working spaces, expand project visibility.
Project I: Industrial-scale innovation producing nanofiber filters meeting N95 standards for face masks and industrial use.	**Internal:** Lack of business expertise, insufficient marketing budget, financial liquidity issues. **External:** High competition, COVID-19 pandemic risks, consumer focus on price over quality.	Establish dedicated advisory units, increase marketing budget, introduce business development units, strengthen consultation mechanisms.
Project J: Machine automating hotel reception tasks, including payment processing and room key issuance.	**Internal:** Lack of expertise in program development and marketing, insufficient specialized personnel. **External:** Financial risks due to COVID-19 pandemic.	Establish units to support recruitment of specialized personnel, adjust funding policies to allow advance payments, allocate additional funding for hiring experts.
Project K: Uses calcium-rich extracts from fish bones for health supplements and crispy mackerel sticks with high nutritional value.	**Internal:** Limited business knowledge, extended time for product testing, delayed readiness. **External:** Regulatory hurdles in animal/human testing, concerns over international expansion.	Provide targeted business training, offer regulatory guidance, improve process management for trials, enhance communication systems.

TED Fund's institutional factors have a significant influence on the failure of supported projects as following:

1) **Fund Disbursement Processes** often lead to financial challenges. Delays in funding affected Projects A, B, C, and G, while D struggled with fiscal misalignment. These issues disrupt production and innovation timelines. Simplifying and accelerating fund disbursement, including offering upfront payments, could improve operational efficiency.
2) **Knowledge Transfer and Business Support** are critical but insufficient. Projects F, E, and K demonstrated strong technical skills but lacked strategic business planning and marketing expertise. Without adequate mentorship, they struggled to meet market demands. Establishing advisory networks and offering comprehensive training in business and financial strategies would address these gaps.
3) **Regulatory Guidance and Support** was a barrier for K, where navigating legal and testing requirements delayed progress. Providing targeted guidance for regulatory compliance is essential, especially for health and food-related innovations.
4) **Staffing and Specialized Personnel** posed challenges for Projects J and I, where the lack of skilled staff led to delays and quality issues. Mechanisms to recruit and fund skilled personnel could mitigate these bottlenecks.
5) **Communication and Coordination** gaps, seen in Projects B and H, caused inefficiencies and delays due to unclear guidelines and processes. Transparent communication and centralized platforms for updates would save time and reduce errors.
6) **Monitoring and Follow-Up** was insufficient for E, leading to misaligned goals and underperformance. Strengthening progress tracking and regular reviews would ensure projects stay on course.
7) **Budget Allocation and Flexibility** impacted Projects C and I, where strict budget rules limited dynamic resource allocation. Flexible funding tailored to marketing and commercialization needs is necessary for scalability.

In summary, TED Fund's inefficiencies in funding, mentorship, communication, and monitoring adversely affect project outcomes. Addressing these systemic issues with streamlined processes, expert guidance, and better communication can significantly enhance project success.

4.8.2 NIA's Social Innovation Projects

The second case study focused on NIA Social Innovation Projects, which aims to support social innovation projects across various sectors, including environmental conservation, education, healthcare, and sustainable agriculture. Projects can receive funding of up to 1.5 million baht. We conducted interviews with entrepreneurs of the top four projects in 2022 with the highest total economic and social impact value from commercial scaling to compare how the institutional factors of the NIA influenced the success of these projects.

Project Name: Moreloop - An Online Digital Marketplace for Production Waste in the Textile Industry
Recipient Company: Moreloop Co., Ltd
NIA Funding Amount: 715,000 baht (out of a total budget of 1,020,000 baht)

The Moreloop project, initiated by Moreloop Co., Ltd., is a pilot initiative in the textile and garment industry that addresses surplus fabric waste. Acting as an intermediary, Moreloop collects excess quality fabrics from garment factories and weaving mills and delivers them to customers at affordable prices. The project utilizes an online platform www.moreloop.ws to create a digital marketplace where small businesses can access premium materials in smaller quantities. This innovation not only resolves overstock issues for manufacturers but also meets the needs of businesses seeking sustainable and cost-effective solutions.

Support from the NIA was pivotal to the success of this project. With a grant of 715,000 baht (out of a total budget of 1,020,000 baht) and a dedicated team of five project members, Moreloop developed the digital platform to scale its operations effectively. NIA's support enabled Moreloop to achieve a total economic and social impact value of 125.05 million baht, comprising 56.81 million baht in economic impact and 37.16 million baht in social impact.

Prior to the NIA's support, Moreloop faced limited capacity to scale operations and lacked access to advanced digital platforms. Following the funding, the company developed a robust online marketplace, improving its R&D management and emphasizing sustainability and circular economy principles. The project led to reduced textile waste and the reuse of high-quality materials, lowering greenhouse gas emissions and conserving resources such as water, energy, and chemicals. These efforts not only contributed to environmental sustainability but also addressed corporate social responsibility by reducing landfill waste.

The social impacts of the project extended beyond sustainability. Moreloop enabled small businesses to access high-quality materials at affordable prices, fostering inclusivity in the industry. The initiative also shifted mindsets toward innovation and sustainability, encouraging the adoption of responsible practices. NIA's support influenced the company's decision to hire new engineers, establish R&D and engineering departments, and improve its technology management, ensuring the project's long-term viability and continuous improvement.

Project Name: Go Mamma - Taxi Booking Application for the Elderly with Tracking System
Recipient Company: Bangkok Nanny Center Co., Ltd
NIA Funding Amount: 810,000 baht (out of a total budget of 1,450,000 baht)

The Go Mamma project, developed by Bangkok Nanny Center Co., Ltd., is an innovative solution aimed at enhancing transportation accessibility, convenience, and safety for the elderly. The project offers a taxi booking application that integrates GPS technology and an information management

system to simplify booking processes, enable real-time route tracking, and maintain a database of elderly users for emergency assistance. The application is designed with a user-friendly interface tailored to elderly users, and drivers undergo special training to provide attentive and secure services. These features ensure family members' peace of mind while improving the independence and quality of life of elderly users.

Before receiving support from the NIA, the project faced challenges such as limited resources for scaling operations and investing in marketing, which hindered its economic and social reach. However, with NIA's financial support of 810,000 baht (out of a total budget of 1,450,000 baht), the project made significant advancements. This includes contributions to the digital economy, local job creation, and a reduction in economic inequality. Socially, the project has improved transportation safety and convenience for the elderly, eased family concerns with real-time tracking, and supported social welfare by reducing transportation costs and creating inclusive employment opportunities.

Technologically, NIA's support enabled the integration of advanced GPS and tracking features, improving the application's functionality and usability. The tailored design for elderly users, combined with driver training programs, ensured a user-centric approach that addressed the specific needs of this demographic. Organizationally, the project expanded its team to 10 members, developed new support structures, and improved application functionalities, which were previously constrained by resource limitations.

NIA's financial and strategic support encouraged the company to enhance its technological capabilities, adopt innovative approaches, and prioritize user-centric solutions. It also led to the hiring of new staff and the establishment of specialized teams to focus on application development and elderly user support. Although marketing efforts were limited due to budget constraints, the support enabled strategic outreach and set the stage for future growth.

Looking ahead, the project plans to expand its services to include bookings for local tourism and elderly-friendly activities, in addition to hospital visits. There is also a focus on improving personnel training and creating opportunities for the elderly to participate as drivers or caregivers, promoting inclusivity and social value. Recommendations for NIA include providing continued marketing support, fostering collaborations within the industry, and facilitating access to additional funding for further development and outreach.

Project Name: Noburo Grow - A System for Workforce Development in Finance, Work, & Sustainable Living
Recipient Company: Noburo Platform Co., Ltd.,
NIA Funding Amount: 1,207,500 baht (from a total budget of 1,979,000 baht)

Noburo Grow, developed by Noburo Platform Co., Ltd., is an innovative mobile application aimed at enhancing workforce skills and promoting sustainable living. The platform leverages behavioral economics and data analytics to create a comprehensive employee development system. Key features include online learning modules, task management aligned with organizational goals, a recognition and reward system (STAR), and real-time dashboards for monitoring employee performance and financial management. Building on the company's previous initiatives, Noburo Grow expanded its scope to include holistic employee development in areas such as health, relationships, and personal growth, beyond financial well-being.

Before receiving support from the NIA, Noburo Grow faced scalability challenges and limitations in its technological features. The project struggled to broaden its offerings to address diverse organizational needs. With NIA's financial support of 1,207,500 baht (from a total budget of 1,979,000 baht), the platform underwent significant enhancements. The platform has reduced labor costs, welfare management expenses, and training costs for both public and private organizations.

Socially, Noburo Grow has transformed employee development by addressing organizational inequality and promoting equitable systems. Employees now benefit from comprehensive training programs that enhance their financial management, work skills, and overall quality of life. The application has improved job satisfaction and productivity while creating healthier workplace cultures. The project's reach has expanded, with approximately 100 organizations adopting the platform to support their workforce.

Technologically, NIA's support facilitated the integration of advanced features, such as data analytics and behavioral economics principles, to improve engagement and outcomes. The addition of real-time dashboards has provided organizations with tools to track employee progress and align development goals with company objectives. The project also enabled the company to expand its team to 18 members, boosting its capacity to scale and enhance the platform's functionality.

NIA's financial aid and strategic backing encouraged the company to focus on holistic employee development, prioritize lifelong learning, and innovate its technology management systems. Additional resources allowed for workforce expansion and the creation of improved management tools, which strengthened the platform's market position and impact.

Project Name: KruLab - An Online Teacher Development Platform for Learning Management and Future-Oriented Career Guidance
Recipient Company: a-chieve Social Enterprise Co., Ltd.,
NIA Funding Amount: 1,032,850 baht (from a total budget of □1,676,600)

KruLab, developed by a-chieve Social Enterprise Co., Ltd., is an innovative online platform designed to enhance teacher development in learning management and career guidance. The platform creates a safe, interactive learning environment where students can build self-confidence, develop critical thinking skills, and engage in self-reflection. Tools such as the "Bread Doll" and "Career Heart Cards" are used to support self-discovery and career exploration, while experiential learning activities provide diverse and meaningful career experiences. KruLab aims to reduce educational inequality by delivering innovative curricula to schools nationwide and fostering collaboration among educators to exchange insights and adopt successful teaching models.

Before receiving support from NIA, KruLab faced challenges in scaling its innovative curricula and reaching schools across different regions in Thailand due to limited resources. However, with NIA's funding of 1,032,850 baht (from a total budget of 1,676,600 baht), the platform underwent significant development. The platform has reduced professional development costs for teachers, enhanced teaching efficiency, and contributed to local economic growth by improving workforce quality and fostering educational innovation.

Socially, KruLab has made substantial strides in addressing educational inequality. Over 1,900 teachers have gained access to diverse learning resources and innovative teaching methods, promoting lifelong learning and community engagement. The platform has improved professional

skills and creativity among teachers, leading to positive impacts on student learning outcomes. By reducing administrative burdens, the platform has enabled teachers to focus more on innovative and effective teaching practices.

Technologically, NIA's support allowed KruLab to develop an accessible online platform tailored to the needs of educators and schools. This platform has streamlined teaching processes, reduced paperwork, and provided tools to create flexible and creative learning environments. Organizationally, NIA's support facilitated the team growing to 12 members, strengthening operational capacity and enabling the platform to scale its impact across Thailand.

NIA's financial support enabled the organization to integrate technology into education, adopt collaborative learning models, and expand its team to manage the platform effectively. The project's outcomes have been transformative, with improved professional development opportunities for teachers, enhanced teaching quality, and reduced disparities in access to innovative educational resources.

Table 4.6 presents a comparative analysis of NIA's top social innovation projects in 2022, highlighting the influence of institutional factors on the success of policy implementation.

TABLE 4.6

COMPARATIVE ANALYSIS OF CASE STUDIES' OUTCOMES AND HOW NIA'S INSTITUTIONAL FACTORS AFFECTED SUCCESS/FAILURE

Project Description and Outcome	How NIA's Institutional Factors Affected Success/Failure
Moreloop: An Online Digital Marketplace for Production Waste in the Textile Industry. The project resolved surplus fabric waste by connecting textile manufacturers with small businesses via an online platform. It enabled access to high-quality surplus materials at affordable prices and contributed to sustainability efforts. **Outcome:** Reduced waste, lowered greenhouse gas emissions.	NIA funding (715,000 baht) allowed Moreloop to build a scalable digital platform and optimize resource use in the textile industry. Institutional support emphasized sustainability, innovation, and effective R&D management, resulting in long-term viability and improved CSR outcomes.
Go Mamma: Taxi Booking Application for the Elderly with Tracking System. The project improved accessibility and safety for elderly users through a user-friendly taxi booking application integrated with GPS and tracking systems. **Outcome:** Reduced transportation costs for users, enhanced social welfare, and created inclusive employment opportunities, benefiting families and elderly users.	NIA funding (810,000 baht) supported GPS integration and the creation of a user-friendly system for elderly users. While the project achieved safety and accessibility goals, limited marketing budgets underscored the need for ongoing outreach support.
Noburo Grow: A System for Workforce Development in Finance, Work, and Sustainable Living. The platform enhanced workforce productivity by providing online training, task management, and financial planning tools. It targeted employee well-being holistically, including health and personal development. **Outcome:** Reduced organizational labor costs, improved job satisfaction, and enabled holistic workforce development.	NIA funding (1,207,500 baht) facilitated workforce expansion, improved technological tools like data analytics, and promoted behavioral economics principles. Institutional support helped align the project with organizational needs, driving innovation, inclusivity, and workforce satisfaction.
KruLab: An Online Teacher Development Platform for Learning Management and Future-Oriented Career Guidance. The platform facilitated innovative teaching practices and career guidance, targeting reduced educational inequality nationwide. **Outcome:** Reached over 1,900 teachers, lowered professional development costs, and promoted creative and effective learning models.	NIA funding (1,032,850 baht) enabled the development of an accessible platform for teachers, promoting collaborative learning and reducing disparities. Support fostered educational equity, reaching underserved regions and addressing systemic challenges in teacher development.

Based on interviews with **NIA executives** (C. Limapornvanich, personal communication, September 18, 2024) and an analysis of case studies, we identified **seven key institutional factors** that influenced the success of **NIA-supported projects** during **fiscal years 2021–2022**. Our analysis highlights **distinct factors** that contributed to both **successful and unsuccessful projects** (See Table 4.7).

Successful projects benefited from **timely funding, resource availability, and proactive regulatory guidance**. These elements ensured that startups and SMEs could develop their innovations efficiently while maintaining compliance. Access to **expert mentorship and strategic networking** also played a crucial role. Companies that engaged with **industry experts and market leaders** were better positioned to refine their business models and secure market adoption. Additionally, projects that had **adequate infrastructure, strong marketing support**, and regular monitoring showed better progress. These factors helped align their innovations with **market needs and long-term growth potential**.

In contrast, projects that struggled faced **delayed or insufficient funding**. Without timely financial support, many initiatives failed to sustain development or scale effectively. **Unclear regulatory guidance and limited mentorship** further weakened these projects, making it difficult for teams to navigate compliance issues and refine their strategies. Infrastructure gaps and **weak marketing strategies** also hindered success. Projects lacking visibility and customer engagement struggled to gain traction, even when their technology had potential. Additionally, **poor stakeholder collaboration and resistance to adoption** created further roadblocks. When key partners and industry players were hesitant to support new innovations, projects faced significant implementation challenges. Addressing these **institutional gaps** can greatly enhance **project outcomes** and improve the overall effectiveness of **NIA's innovation policies**. Strengthening **funding mechanisms, regulatory support, mentorship programs, and market access initiatives** will help future projects achieve higher success rates.

TABLE 4.7

INSTITUTIONAL FACTORS INFLUENCING THE SUCCESS AND FAILURE OF NIA-SUPPORTED PROJECTS DURING FISCAL YEARS 2021–2022

Institutional Factor	Success Cases	Failure Cases
1. Funding Allocation and Support	- **Timely and Adequate Funding:** Enabled thorough research, development, and scaling efforts. - **Resource Availability:** Allowed hiring experts and purchasing necessary equipment.	- **Delayed Funding:** Hindered critical development stages and prototyping. - **Insufficient Budget:** Limited the scope of research and marketing activities.
2. Regulatory Guidance	- **Proactive Assistance:** Helped navigate complex approval processes, ensuring compliance and timely market entry. - **Knowledge Sharing:** Provided updates on regulatory changes affecting the project.	- **Lack of Clear Guidance:** Led to compliance issues and delays in obtaining necessary certifications. - **Overlooked Regulations:** Resulted in additional costs and time to rectify non-compliance.
3. Mentorship and Networking	- **Expert Mentorship:** Offered strategic advice and technical insights, enhancing product development. - **Industry Connections:** Facilitated partnerships and access to distribution channels.	- **Limited Support:** Teams lacked guidance to overcome technical and business challenges. - **Networking Shortfalls:** Missed opportunities for collaborations and endorsements.
4. Infrastructure and Resource Access	- **Access to Facilities:** Utilization of labs and testing centers accelerated development. - **Technical Support:** Availability of specialized equipment and software aided innovation.	- **Inadequate Infrastructure:** Lack of access to necessary facilities impeded progress. - **Resource Constraints:** Limited tools and technologies slowed down the development process.
5. Marketing and Commercialization Support	- **Strategic Marketing Assistance:** Helped in branding and reaching the target audience effectively. - **Market Research Support:** Provided insights into consumer behavior and market trends.	- **Insufficient Promotion:** Low visibility due to inadequate marketing efforts. - **Lack of Commercialization Strategy:** Difficulty in translating innovation into marketable products.
6. Monitoring and Follow-up	- **Regular Check-ins:** Allowed for timely adjustments based on performance metrics. - **Feedback Mechanisms:** Enabled iterative improvements and responsiveness to stakeholder needs.	- **Neglected Oversight:** Issues went unaddressed due to lack of monitoring. - **Missed Adaptation Opportunities:** Inability to pivot strategies based on market feedback.
7. Stakeholder Collaboration	- **Inclusive Engagement:** Collaboration with end-users and partners enriched the project. - **Supportive Ecosystem:** Leveraged relationships for resources and advocacy.	- **Isolation from Stakeholders:** Projects operated without essential input from key players. - **Resistance to Adoption:** Lack of stakeholder buy-in hindered implementation.

To enhance its effectiveness, NIA should consider several strategic recommendations derived from interviews and insights gathered from our case studies. These recommendations address the key challenges faced by grant recipients and aim to optimize the agency's role in fostering social innovation and sustainable development.

Marketing Support: Many grant recipients encounter difficulties in promoting their innovative products, particularly in highly competitive or emerging markets. To address this, NIA should provide more extensive marketing support through funding for promotional activities, participation in exhibitions, and enhanced online outreach. These measures will enable recipients to effectively reach target consumers, increasing product visibility and market penetration.

Financial Support: Limited access to funding remains a significant barrier for recipients in scaling and sustaining their innovations. NIA should facilitate connections between grant recipients and low-interest financial institutions or provide guidance on alternative funding sources. Initiatives such as business-matching events with investors can help ease financial burdens and enable businesses to pursue continuous innovation and expansion.

Research and Development Collaboration: To address the challenge of developing market-relevant and effective innovations, NIA should strengthen links between grant recipients and research institutions, universities, and specialized centers. Facilitating these collaborations will deepen product development and enhance recipients' competitiveness, leading to greater innovation success.

Standards and Certification: Achieving industry standards and certifications (e.g., ISO or specific sectoral certifications) is crucial for enhancing product credibility and consumer trust. NIA should establish programs to assist grant recipients in obtaining necessary certifications, enabling them to access international markets and improve their competitive standing.

Building Business Networks: NIA should foster business-matching events and create opportunities for recipients to collaborate on innovations and explore new markets. Establishing partnerships through such networks reduces risks and significantly increases commercial opportunities for grant recipients.

Project Integration and Resource Sharing: NIA should encourage the integration of projects with similar goals or expertise by promoting resource sharing and knowledge exchange. This approach will improve operational efficiency, reduce costs, and enhance the likelihood of project success.

Collaboration with Public and Private Sectors: Connecting grant recipients with both public and private sector organizations can unlock additional support in areas such as market access, innovation development, and investment partnerships. NIA should act as a liaison to bridge these connections effectively.

Flexible Support Processes: In response to dynamic business environments, NIA should implement more flexible support mechanisms. For instance, allowing online document submission to streamline administrative processes can reduce time and costs for recipients, ensuring uninterrupted project progress.

Establishing Advisory and Mentorship Networks: NIA should develop a network of industry experts to serve as advisors or mentors for grant recipients. Tailored guidance from these experts will bolster recipients' capabilities, particularly for complex projects involving new technologies or market expansion. This support minimizes risks associated with knowledge gaps or inexperience.

Innovation Cluster Programs: Creating innovation clusters can link businesses within the same or related industries. Through these clusters, participants can share knowledge, resources, and experiences while engaging in business-matching events, workshops, and seminars. This fosters collaboration, reduces redundancy, and creates opportunities for collective innovation development.

Knowledge Management: NIA should establish a knowledge repository that compiles case studies from past projects categorized by industry and challenges faced. Hosting knowledge-sharing sessions will enable recipients to learn from both successes and failures, fostering organizational learning and improving project implementation.

Chapter 5
Conclusion and Policy Recommendations

This report aims to assess the technological capabilities and innovation potential of SMEs in Thailand, identify effective support measures, and provide policy recommendations to enhance productivity and innovation through technological advancements. It begins with an overview of SME productivity and innovation, evaluating current capabilities and comparing SME performance to larger firms across various sectors. The report then delves into an analysis of policy instruments designed to improve technological capabilities, focusing on their content, implementation mechanisms, and effectiveness, while also examining the role of institutions, (such as the capacity of executing government agencies, level of cross-ministerial coordination, level of trust between government agencies and firms, attitude of policy makers, societal attitude to failure, and availability of opportunities-based entrepreneurs), in shaping the success of these policies. The conclusion presents actionable recommendations in three key areas: improving policy content by aligning with SME needs, refining implementation mechanisms for better accessibility and efficiency, and strengthening enabling institutions to foster a more dynamic innovation ecosystem. These improvements aim to create a supportive environment for SMEs, driving long-term growth and competitiveness in Thailand's economy.

5.1 An Overview of Productivity and Innovation of SMEs

The analysis of productivity and innovation trends among Thai SMEs highlights structural weaknesses that limit long-term growth. While total factor productivity growth (TFPG) fluctuated due to economic cycles, SMEs remained vulnerable to external shocks. Large firms demonstrated greater resilience, benefiting from stronger financial and technological resources, while SMEs struggled with labor quality and capital inefficiencies.

Labor productivity showed steady growth from 2014 to 2019, particularly in manufacturing and services, driven by digitalization and automation. However, the pandemic in 2020 caused a sharp decline, exposing SMEs' vulnerabilities. Post-pandemic recovery has been uneven, with larger firms adapting more effectively, while SMEs in traditional sectors continue to lag due to limited access to capital, training, and technology.

R&D and innovation surveys reveal a stark contrast between large firms and SMEs. Larger firms invest significantly in research, often benefiting from global partnerships, while SMEs focus on acquiring equipment and workforce training. Foreign firms lead in product and process innovation, but local firms engage more in R&D, supported by government initiatives. However, weak collaboration between SMEs and research institutions limits knowledge transfer and innovation diffusion.

The findings underscore the need for sustained investment in innovation, workforce development, and capital efficiency. While large firms and foreign enterprises drive technological advancements, SMEs require stronger support to overcome financial and technical barriers. Expanding access to funding, reducing bureaucratic hurdles, and fostering collaboration between SMEs, research institutions, and industry partners will be critical for Thailand's long-term innovation and productivity growth.

5.2 The Contents, Implementation Mechanisms and Effectiveness of Policy Instruments

Chapter 3 examines policy instruments aimed at enhancing the technological capabilities and innovation of Thai SMEs. The analysis covers 4 demand-side, 26 supply-side, and 9 systemic policy instruments, assessing their content, implementation, and effectiveness.

These policies, managed by agencies such as BOI, DEPA, NIA, and NSTDA, focus on promoting R&D, supporting digital transformation, expanding financial access, and strengthening university-industry linkages. Key performance indicators include SME participation in innovation projects, increased R&D investment, and competitiveness in strategic sectors like digital economy, electronics, EVs, biotech, and smart manufacturing. While some policies have evolved to improve incentives and expand eligibility, challenges such as regulatory complexity, limited SME awareness, and sectoral restrictions persist.

Implementation mechanisms include direct financial support through grants, loans, and matching funds, as well as tax incentives and skill development programs. Demand-side policies such as the Thailand Trust Mark, Thailand Innovation List, and DEPA Digital Transformation Fund promote Thai products internationally, support government procurement of local innovations, and drive SME digital adoption. Coordination between agencies is essential for managing and monitoring these initiatives. Programs like Talent Mobility facilitate university-industry collaboration, while BOI's matching funds encourage private co-investment. Systemic policies, including ITAP and Business Incubation Centers, provide structured support for startups and SMEs. However, inconsistent evaluation mechanisms, administrative burdens, and fragmented coordination across agencies reduce policy efficiency and impact.

The effectiveness of these policies varies. Financial instruments like the NIA Thematic Innovation Grant and DEPA Digital Startup Fund have helped startups scale, while tax incentives such as the RDI 200% tax deduction and BOI investment incentives have encouraged private-sector R&D. SMEs benefiting from these policies have shown growth in innovation, product development, and market expansion. However, challenges such as limited outreach, lack of policy integration, and bureaucratic inefficiencies constrain broader impact. Streamlining application processes, expanding funding access, and improving cross-agency collaboration are critical to strengthening SME-driven innovation and long-term economic growth. It is noteworthy that most policy instruments in Thailand are not systematically monitored and evaluated, or the evaluation results are not publicly disclosed.

5.3 Institutions Affecting Effectiveness of Policies

The effectiveness of policies aimed at enhancing SME innovation in Thailand is deeply influenced by institutional factors. The capacity of government agencies to execute policies effectively remains a challenge, as many agencies struggle with resource constraints, limited technical expertise, and bureaucratic inefficiencies. These limitations often lead to delays in fund disbursement, weak project monitoring, and reduced SME participation in support programs. Strengthening agency capabilities through increased funding, streamlined processes, and enhanced technical training is essential to improving policy execution.

Cross-ministerial coordination is another critical factor affecting policy outcomes. Weak collaboration between government agencies leads to overlapping responsibilities, conflicting regulations, and fragmented support for SMEs. Policies that require joint implementation, such as tax incentives and demand-side innovation measures, suffer from inefficiencies due to poor communication and misaligned objectives. Establishing a central coordinating body or digital platforms for real-time inter-agency collaboration could significantly improve policy coherence and efficiency.

Trust between government agencies and firms is a key determinant of policy success. Many SMEs remain skeptical about the effectiveness of government programs due to bureaucratic complexity, unclear benefits, and inconsistent implementation. This distrust discourages firms from engaging in government-led innovation initiatives. To rebuild trust, agencies must enhance transparency, simplify regulatory procedures, and establish mechanisms for industry feedback. Strengthening public-private dialogue through partnerships and innovation forums could also improve engagement and policy uptake.

Policymakers' attitudes toward supporting firms and implementing selective policies play a crucial role in shaping Thailand's innovation landscape. While selective policies that target high-tech industries, such as EV manufacturing and digital technologies, have yielded positive results, a lack of focus on traditional and low-tech industries has created imbalances. Policymakers must adopt a more inclusive approach, ensuring that innovation support extends to SMEs across various sectors. Tailoring policies to different industry needs and conducting sectoral assessments can optimize resource allocation and maximize impact.

Cultural attitudes toward failure also influence innovation-driven policies. In Thailand, failure is often stigmatized, discouraging entrepreneurs from taking risks. This cultural mindset limits participation in high-risk, high-reward initiatives, such as R&D-intensive projects and venture-backed startups. Promoting a culture that views failure as a learning opportunity—through public campaigns, educational reforms, and business mentorship programs—could encourage greater experimentation and innovation among SMEs.

The availability of opportunity-driven entrepreneurs is crucial for driving SME-led innovation. While Thailand has seen an increase in entrepreneurs starting businesses to capitalize on market opportunities, gaps remain in access to funding, mentorship, and business networks. Strengthening startup ecosystems through incubators, accelerators, and improved access to venture capital would enhance the impact of innovation policies. Ensuring that government programs cater to high-potential entrepreneurs across diverse sectors could also improve overall policy effectiveness.

Intermediaries such as public research institutes (PRIs), industry associations, and government agencies play a vital role in enhancing SMEs' technological capabilities and productivity. They bridge knowledge gaps, facilitate R&D collaboration, and provide industry-specific innovation support. Sector-specific agencies like THTI, NFI, and EEI offer SMEs technical assistance, product development support, and technology upgrades, while ISMED and FTPI focus on productivity enhancement and workforce training.

Public intermediaries such as NSTDA, NIA, and DEPA drive research commercialization, digital transformation, and industrial technology adoption. Meanwhile, private associations like FTI, TCC, and FTA help SMEs integrate Industry 4.0 capabilities through training and capacity-building programs. Universities and funding agencies, including Chulalongkorn Innovation Hub and PMU-C, connect academic research with market applications, equipping SMEs with the resources needed to scale their innovations.

Effective collaboration among these intermediaries ensures targeted support for SMEs, addressing industry-specific challenges and boosting competitiveness. To maximize impact, intermediaries must align their roles with sector needs, improve access to funding and expertise, and strengthen public-private partnerships to drive long-term technological growth.

Case studies of TED Fund and NIA's Social Innovation Projects illustrate how institutional factors shape policy implementation. TED Fund's targeted financial support has enabled startups to scale innovations yet delays in fund disbursement and gaps in business mentorship have hindered some projects. Similarly, NIA's support for social innovation projects has facilitated impactful solutions in sustainability, education, and public services, but challenges in marketing and regulatory compliance have limited their broader adoption. Strengthening institutional frameworks, refining support mechanisms, and addressing these structural barriers can significantly enhance the success of innovation policies.

Addressing these institutional challenges is critical for fostering a more robust innovation ecosystem in Thailand. Improving agency capacity, enhancing policy coordination, fostering trust, and supporting a culture of risk-taking will enable SMEs to drive technological advancements and sustain long-term growth.

5.4 Policy Recommendations

The policy recommendations from the report focus on improving the technological capabilities and innovation potential of SMEs in Thailand by addressing three main areas on how to improve policy content, policy implementation, and enabling institutions.

5.4.1 How to Improve Policy Content

To strengthen Thailand's SME innovation ecosystem, the following policy content improvements should be implemented:

1. Expand Eligibility and Industry Coverage

Many policy instruments currently emphasize high-tech sectors such as electronics, EVs, biotech, and digital startups, often limiting access for traditional industries like agribusiness, tourism, and manufacturing. To promote inclusive economic growth, the government should extend tax incentives and funding support to SMEs in agriculture, food processing, tourism, and creative industries, ensuring their participation in technological upgrades and innovation. Additionally,

dedicated funding programs should be established to help traditional SMEs integrate automation, digital tools, and sustainability-driven innovations into their operations. To further enhance accessibility, entry barriers for MSMEs and early-stage startups should be lowered by simplifying eligibility requirements for R&D tax credits and innovation grants, allowing more businesses to benefit from these policy measures.

2. Strengthen Integration Between Financial and Non-Financial Support

While financial incentives such as grants, loans, and tax deductions are available, many SMEs struggle with limited access to mentorship, commercialization support, and business development resources. To enhance impact, financial incentives should be linked to business development programs, ensuring that SMEs receiving tax benefits also gain advisory support for commercialization and market expansion. Additionally, structured mentoring and technical assistance should be provided, particularly for first-time applicants unfamiliar with R&D processes. A follow-up support mechanism is also essential to help SMEs transition successfully from receiving grants and loans to achieving sustainable commercial operations.

3. Increase Flexibility and Adaptability in Policy Design

Current policy frameworks are rigid, limiting their responsiveness to industry trends and emerging technologies. To enhance adaptability, periodic reviews of innovation policies should be conducted annually to align with SME needs and market demands. Tiered support models can be introduced, providing small-scale grants for early-stage businesses and larger co-funding opportunities for growth-stage firms.

4. Improve Policy Coordination and Reduce Bureaucratic Complexity

Many innovation policies function independently across government agencies, creating inefficiencies, overlaps, and approval delays. To improve execution, a centralized policy coordination platform should be established to integrate support programs across BOI, DEPA, NIA, NSTDA, and OSMEP, reducing duplication. A single-window application system would streamline access, allowing SMEs to apply for multiple incentives through a unified process. Additionally, structured inter-agency working groups should be formed to enhance cooperation, aligning strategies and funding priorities across departments for more effective policy implementation.

5. Enhance Outreach and Awareness Among SMEs

Many SMEs are unaware of available funding programs, tax benefits, and skill development initiatives, reducing policy impact. To improve accessibility, regional SME innovation hubs should be established to provide localized guidance, training, and funding access beyond Bangkok. A digital one-stop platform consolidating information on tax incentives, funding programs, and application processes would further streamline access. Additionally, targeted awareness campaigns through industry associations, chambers of commerce, and online platforms can boost SME participation and engagement with innovation policies.

6. Introduce Performance-Based Incentives

Policies should shift from upfront grants and tax deductions to performance-driven funding models, where firms receive additional support based on measurable milestones. These include successful commercialization of new technologies, expansion into high-value markets and global supply chains, and increased employment of skilled workers in R&D and innovation roles. This approach ensures that funding drives tangible innovation outcomes and long-term business growth.

Thailand can build a more inclusive, adaptive, and results-driven SME innovation ecosystem by expanding industry eligibility, enhancing financial and technical support, streamlining bureaucracy, and adopting performance-based incentives. However, policymakers should avoid one-size-fits-all approaches, excessive focus on high-tech sectors at the expense of incremental innovation, over-reliance on imported technology without local adaptation, and short-term priorities over long-term capacity building.

5.4.2 How to improve policy implementation mechanism

Improving the implementation mechanisms for policies aimed at enhancing technological capabilities and fostering innovation in SMEs requires a holistic approach addressing funding, regulatory processes, mentorship, infrastructure, marketing, and regional equity. The focus should be on enhancing coordination, reducing administrative barriers, fostering engagement, and expanding accessibility.

Funding Allocation and Support

Financial support tools such as credit guarantee schemes, venture capital funds, matching grants, and tax incentives can motivate SMEs to invest in R&D and adopt new technologies. We should not underfund SME innovation by allocating disproportionately low funding compared to large firms or government research projects and ensure that public funds for innovation are accessible to SMEs of all sizes. Responsible agencies such as TSRI, NIA, TED Fund, NSTDA, and PMUs should develop targeted funding mechanisms such as grants, loans, and venture capital for SME innovation projects and introduce innovation vouchers to help SMEs access R&D services from universities or research institutions. They should establish predictable funding timelines to ensure timely access to resources, minimizing delays during critical stages of development. Contingency budgets should be introduced to cover unforeseen expenses, with periodic reviews conducted to reallocate funds as needed throughout the project lifecycle. Programs like DEPA digital transformation fund should streamline application processes to reduce administrative burdens and increase participation.

Flexible and Impact-Oriented Budgeting

Budgeting practices must prioritize flexibility and measurable outcomes. Continuity of funding for successful initiatives, even during transitions between agencies, will maintain program momentum. Responsible agencies such as the Budget Bureau, TSRI, and various PMUs should implement multi-year funding models for deep-tech innovations to provide stability and foster private sector confidence. Replacing reimbursement-based funding with upfront grants or simpler conditions will reduce barriers for SMEs. Finally, shifting agency performance metrics from budget disbursement to measurable economic and social impacts will ensure higher-quality outcomes.

Regulatory Guidance

Responsible agencies such as OSMEP, BOI, and sector-specific agencies should create dedicated regulatory support units staffed by experts to assist SMEs in navigating complex approval processes. These agencies should develop comprehensive, up-to-date guides and offer workshops to ensure compliance with evolving regulations. Piloting integrated programs such as "sandbox" initiatives with specific objectives, timelines, and coordinated budgets would ensure continuity and scalability across multiple sectors. For example, *Thailand Trust Mark* program, inter-ministerial coordination should be strengthened to resolve certification complexities and improve overall processes. The *Thai Innovation List Measure* should develop sector-specific guidelines for certification to simplify compliance for diverse industries and include regular workshops to educate SMEs on application processes and regulatory requirements.

Absorptive Capacity, Mentorship, and Networking

SME absorptive capacity should be enhanced by investing in training and upskilling programs to enable SMEs to adopt and adapt new technologies, and by providing technical assistance and advisory services to improve SME innovation capabilities. However, relying solely on financial incentives to drive SME innovation should be avoided. The importance of capacity-building and networking support should be recognized and funding should be combined with mentorship and technical advisory services. Responsible agencies such as OSMEP, NSTDA, NIA, and other intermediaries should expand mentorship programs by recruiting experienced professionals to provide tailored guidance to SMEs. Networking opportunities should be facilitated through events, trade shows, and digital platforms to connect SMEs with industry stakeholders. An online mentorship platform could foster continuous collaboration and problem-solving, enhancing project outcomes. Initiatives like the *Business Innovation Center (BIC)* should expand mentorship programs by incorporating industry-specific experts and alumni of successful startups. Virtual networking platforms should be introduced for continuous engagement and knowledge sharing.

Infrastructure and Resource Access

Do not neglect regional inequities by focusing resources only on urban areas like Bangkok. Ensure that SMEs in regional areas have equal access to innovation support programs. Organizations under MHESI should invest more in shared facilities such as labs, testing centers, and resource hubs in underserved areas to reduce infrastructure constraints for geographically dispersed SMEs. Thailand should have more regional innovation hubs and incubators tailored to SMEs. Access to these resources should be subsidized to make them more affordable. Expanding regional innovation hubs would provide SMEs across the country with equitable access to vital tools and infrastructure. Programs like *Thailand Science Park* should establish regional hubs to expand access beyond Bangkok and offer shared equipment leasing models to reduce costs for smaller enterprises and researchers.

Marketing and Commercialization Support

Responsible agencies such as MHESI, OSMEP, and the Ministry of Commerce should collaborate with SMEs to design tailored commercialization strategies and enhance marketing grants for promotional activities such as trade fairs and digital campaigns. Support for market research should provide insights into consumer trends and preferences. For example, the *Thailand Tech Show* should include digital marketing training and tools for participants to enhance their ability to promote products and offer post-event support for follow-ups with potential investors and partners.

Monitoring and Follow-Up

Responsible agencies such as MHESI, NIA, NSTDA, and OSMEP should develop real-time tracking systems for monitoring progress and addressing challenges promptly. Regular evaluations and feedback loops should align programs like the *Zero Interest Loan Program* by introducing quarterly progress reporting tied to continued funding, with a dedicated advisory team to address challenges. Data from these reports should be used to refine future iterations of the program. Additionally, effective monitoring and evaluation mechanisms—drawing lessons from successful examples in South Korea and Taiwan—will ensure continuous improvement.

Stakeholder Collaboration

Intermediaries and sector-specific agencies should foster collaboration between government agencies, universities, and private firms to build a supportive ecosystem for innovation. SMEs should not be isolated from global innovation networks and markets, and they should be encouraged

to participate in international trade shows, R&D collaborations, and global supply chains. Therefore, collaboration between SMEs and large corporations, especially multinational corporations (MNCs), should be facilitated to enable knowledge and technology spillovers and create cluster programs to encourage industry-wide innovation. Programs should include stakeholder engagement plans to encourage buy-in from end-users and partners domestically and internationally. Awareness campaigns highlighting the value of innovation can further enhance stakeholder participation. Systemic policies like Business Innovation Center, ITAP, ITC, should establish multi-stakeholder advisory boards that include SMEs, universities, and private sector leaders to ensure diverse input on project alignment and resource allocation.

Regional Outreach and Equity

Organizations under MHESI, OSMEP, and other intermediaries should expand regional outreach by establishing local offices or innovation hubs to support SMEs in underserved areas. For example, the *STI Coupon for OTOP Upgrade* should deploy mobile consultancy units to regional areas to reach underserved entrepreneurs. Satellite offices should be established in collaboration with local chambers of commerce for ongoing support. This will ensure equitable access to government resources and services. Tailored promotional efforts, coupled with targeted support for smaller firms, will make innovation policies more inclusive and impactful.

Simplifying and Streamlining Processes

Creating complex bureaucracies with multiple, overlapping agencies and programs that confuse SMEs should be avoided, and communication should be clear clear, and procedures simple for SMEs to access innovation initiatives. Organizations under MHESI, OSMEP, and other intermediaries should promote simplification of procedures and inclusivity to increase accessibility for SMEs. For instance, the DEPA Mini Voucher, which provides grants for technological upgrades, requires a more straightforward application process. Clearer eligibility guidelines and reduced administrative burdens would enable smaller businesses to benefit more easily. Utilizing digital platforms can further minimize administrative burdens and improve accessibility. Intellectual property (IP) registration processes should be streamlined to help SMEs protect their innovations.

In summary, to enhance policy implementation, processes should be simplified by establishing clear and transparent criteria for accessing government programs and ensuring inclusivity for less resourceful SMEs. Developing regional innovation hubs can stimulate entrepreneurship and innovation across Thailand, particularly in underserved areas, by equipping local SMEs with access to critical knowledge, infrastructure, and resources. Policies should foster collaboration with the private sector to harness their expertise in innovation and address the risk-averse nature of financial institutions, thereby effectively supporting SME innovation initiatives.

5.4.3 How to improve enabling institutions

Thailand faces significant challenges in advancing SME innovation and technological capabilities. Institutional weaknesses, fragmented policies, and cultural barriers hinder progress, while slow structural adaptation limits long-term growth. Addressing these issues requires comprehensive reforms to create a more cohesive and supportive ecosystem.

Key Challenges to SME Innovation in Thailand:

Fragmented Bureaucracy and Policy Coordination

Thailand's innovation policies suffer from overlapping responsibilities among multiple agencies, leading to inefficiencies and redundancy. MHESI remains disconnected from core economic policy

making, while the Ministry of Industry places little emphasis on technological capability-building. Despite the National STI Act (2008) aiming to coordinate innovation efforts, weak implementation and monitoring have limited its impact. Poor cross-ministerial collaboration and minimal private sector engagement further undermine policy effectiveness.

Overemphasis on R&D and Limited Innovation Scope

Thailand's innovation policies focus too narrowly on R&D commercialization, overlooking crucial elements like design, production processes, and new business models. The government's reliance on neoclassical economic principles limits intervention, resulting in insufficient direct grants and selective financing. Many policies fail to cater to sector-specific needs or support emerging technologies, restricting broader innovation potential.

Cultural and Structural Barriers

Strict public fund utilization rules and corruption concerns discourage policymakers from approving financial support for high-risk ventures, such as startups. This risk aversion stifles innovation and limits support for SMEs. Additionally, rigid bureaucracy makes it difficult for firms to access funding, further slowing technological advancements.

Weak Entrepreneurial and Collaborative Networks

Thailand's entrepreneurship landscape is primarily necessity-driven, with limited opportunity-based innovation. Cultural norms discourage challenging established ideas, restrict creativity and risk-taking. Low trust among firms, universities, and research institutions weakens collaboration, preventing effective knowledge-sharing and technology transfer. Family-owned business networks dominate the economy, making it harder for external stakeholders to engage in meaningful partnerships.

Rigid and Outdated Policy Frameworks

Current innovation financing policies rely heavily on tax incentives, offering limited grants or equity financing for diverse innovation activities. Policies have not evolved in line with Thailand's economic development needs. Weak monitoring and evaluation mechanisms prevent the reallocation of resources to more effective initiatives, reducing long-term policy impact.

Recommendations for Strengthening SME Innovation in Thailand:

Enhance Policy Coordination and Institutional Efficiency

Thailand needs a centralized framework under the STI Act (2008) to align MHESI with economic ministries, ensuring cohesive policy development and execution. Stronger cross-ministerial collaboration will reduce redundancies and improve policy effectiveness. Investing in agency capacity—through staff training, digitalization, and streamlined processes—will further enhance operational efficiency. NSTDA, TSRI, and NXPO should take the lead in integrating STI policies with economic objectives.

Broaden Innovation Policy Beyond R&D

Innovation policies should support not only R&D but also process improvements, business model innovations, and incremental advancements. Agencies like MHESI, DEPA, TED Fund, and OSMEP should expand grants and financing options to include non-R&D innovation in sectors like digital services, advanced manufacturing, and sustainability. BOI should offer incentives for equity financing in non-R&D-driven innovation to support high-potential SMEs.

Encourage Risk-Taking and Flexible Funding

Rigid public finance rules discourage risk-taking and innovation. The Budget Bureau, TSRI, and other responsible agencies should introduce more flexible financing mechanisms, such as grants, public equity participation, and risk-sharing models. Regulations should normalize entrepreneurial failure as a learning process through awareness campaigns and educational programs. Organizations like the Thai Startup and TVCA can provide mentorship and advocacy to support a dynamic startup ecosystem.

Strengthening Collaboration Between SMEs, Universities, and Industry

Public and private sector collaboration is crucial for advancing innovation. Intermediaries like NIA, NSTDA, and DEPA should foster university-industry linkages through R&D partnerships and technology transfer programs. Innovation hubs such as EECi should be expanded to facilitate cooperation beyond family-owned business networks. More structured partnerships between academia, industry, and government will create stronger innovation ecosystems.

Promote Opportunity-Driven Entrepreneurship

To encourage innovation-driven SMEs, agencies like OSMEP and NIA should integrate entrepreneurship education with hands-on training in creativity and risk-taking. Expanding mentorship programs and increasing access to seed funding and regional innovation, especially in underserved regions—will cultivate high-growth enterprises. Programs like Startup Thailand, TED Fund, and DEPA's digital transformation initiatives should be leveraged to support emerging entrepreneurs.

Improve Policy Adaptability and Evaluation

Innovation policies must remain dynamic and responsive to changing economic and technological conditions. TSRI, NXPO, BOI, and OSMEP should establish mechanisms to phase out ineffective policies and reallocate resources toward high-impact initiatives. Multi-year funding models should replace short-term grants to provide more consistent support for long-term innovation projects. Regular policy reviews should incorporate feedback from SMEs to ensure alignment with their needs.

Increase Awareness and Accessibility of Innovation Support

Many SMEs lack awareness of available government support. Agencies under MHESI, the Ministry of Commerce, and the Ministry of Industry should create centralized information hubs to improve outreach. BOI's and OSMEP's One Stop Service Centers, along with private-sector networks like TCC and FTI, can help disseminate information more effectively. Tailored communication strategies should target different SME segments, ensuring broader participation.

In conclusion, Thailand must strengthen its national innovation system by fostering deeper collaboration between government, industry, and academia. Policy evaluation should be a continuous process, ensuring that measures are refined based on real-world feedback. Institutional capacity-building through targeted training and resource allocation will be essential for effective policy execution. However, new initiatives should only be launched when agencies have the necessary expertise and infrastructure to avoid inefficiencies and maximize impact.

5.5 Limitations of the Study and Suggestions for Further Study

The study faces limitations due to its reliance on secondary data from government and industry reports, which may not always be current or comprehensive. While qualitative interviews offer valuable insights, the small sample size and subjective feedback can limit the generalizability of findings. Additionally, the varied effectiveness of policies across sectors and regions makes it difficult to form broad conclusions. The study also underrepresents startups and firms in underserved areas, leading to an incomplete picture of the policies' reach. Finally, institutional and societal factors like trust between agencies and firms, and attitudes toward failure, need deeper exploration.

Future research should focus on addressing regional and sector-specific disparities by studying the impact of innovation policies in underserved areas. Expanding the sample size across industries and regions would provide a clearer understanding of how policies affect different SME segments. Investigating institutional factors, such as societal attitudes toward failure and trust between agencies and firms, could reveal systemic barriers to innovation. Incorporating real-time data and advanced analytics could also help policymakers adapt policies more effectively to emerging trends, ensuring ongoing relevance and impact.

References

Asian Productivity Organization. (2023). *APO Productivity Databook 2023*. Asian Productivity Organization.

Board of Investment of Thailand. (2022). *Thailand Innovation Toolkit*. Board of Investment of Thailand. Retrieved from https://www.boi.go.th/upload/content/Thailand_Innovation_Toolkit.

Chinaprayoon, C. (18 September 2024). Executive Vice President (Digital Ecosystem Promotion Unit), Digital Economy Promotion Agency (DEPA). *Personal interview*.

Chulalongkorn University Research Team. (2022). *The development and revision of the measures and mechanisms for building IDE entrepreneurs in Thailand*. Submitted to the Office of National Higher Education Science Research and Innovation Policy Council (NXPO).

EC/OECD. (2024). *STIP Compass Thailand Overview*. Retrieved 23 April 2024, from https://stip.oecd.org/stip/interactive-dashboards/countries/Thailand

Global Entrepreneurship Monitor. (2024). *GEM 2023/2024 Global Report: 25 years and growing*. Global Entrepreneurship Research Association. https://www.gemconsortium.org/report/51377

Huabsomboon, S. (2 October 2024). Director of Technology Business Incubation Center (BIC), National Science and Technology Development Agency (NSTDA). *Personal interview*.

Intarakumnerd, P. (2013). The roles of intermediaries in sectoral innovation systems in developing countries: Public organizations versus private organizations. *Asian Journal of Technology Innovation, 21*(1), 108–119. https://doi.org/10.1080/19761597.2013.810413

Intarakumnerd, P., & Chaoroenporn, P. (2013). The roles of intermediaries and the development of their capabilities in sectoral innovation systems. *Asian Journal of Technology Innovation, 21*(sup2), 99–114. https://doi.org/10.1080/19761597.2013.855218

Intarakumnerd, P., & Goto, A. (2016). *Technology and innovation policies for small and medium-sized enterprises in East Asia*.

Intarakumnerd, P., & Wonglimpiyarat, J. (2012). *Towards effective policies for innovation financing in Asia: A comparative study of Singapore, Taiwan, Malaysia, and Thailand*.

Intarakumnerd, P. (2015). Best policy practices in small and medium-sized enterprise innovation and technology transfer for ASEAN and East Asia. *ERIA Research Project Report FY2013 14*, 1-35.

Juasrikul, S. (18 September 2024). Director of Innovation-Driven Entrepreneurship Center, University of the Thai Chamber of Commerce. *Personal interview*.

Lim, S. (19 September 2024). Senior Director of Innovation Economic Policy Division, National Higher Education, Science, Research, and Innovation Policy Council (NXPO). *Personal interview*.

Limapornvanich, C. (18 September 2024). Head of Innovation Foresight, National Innovation Agency (NIA). *Personal interview*.

National Research Council of Thailand (NRCT). (2022). *Report on the survey of research and development expenditure and personnel in Thailand 2022*. Retrieved 1 August 2024, from https://catalog-data.nrct.go.th/dataset/randdindex

Office of Industrial Economics (OIE). (2018–2022). *Report on productivity and performance of the industrial sector 2018-2022*. Retrieved 1 August 2024, from https://www.oie.go.th/view/1/_TFP/TH-TH

Office of National Higher Education Science Research and Innovation Policy Council (NXPO). (2011–2017). *Report on the survey of research and development and innovation activities in the industrial sector of Thailand 2011-2017*. Retrieved 1 August 2024, from https://stiic.sti.or.th/work/rdi-survey-report-2018/

Office of National Higher Education Science Research and Innovation Policy Council (NXPO). (2021). *IDEs investment ecosystem: Accelerating Thailand scale-up nation 2030*.

Office of Small and Medium Enterprises Promotion (OSMEP). (2023). *MSME situation report 2023*. Retrieved 9 September 2024, from https://bds.sme.go.th/Knowledge/Detail/16

Opasvadhana, W. (2 October 2024). Director of SME Policy and Planning Department, Office of SMEs Promotion (OSMEP). *Personal interview*.

Pittayasophon, S. (19 September 2024). Senior Strategist Acting as President of the Office of the National Higher Education, Science, Research, and Innovation Policy Council (NXPO). *Personal interview*.

Thailand Board of Investment (BOI). (2022). *Thailand innovation toolkit*. Retrieved 1 August 2024, from https://www.boi.go.th

Tanthikul, S. (18 September 2024). Senior Expert, Office of Industrial Economics (OIE), Ministry of Industry. *Personal interview*.

Thunyawong, S. (20 September 2024). Investment Promotion Specialist, Board of Investment Office (BOI). *Personal interview*.

Tippakoon, P. (29 September 2024). Research Utilization and Policy. Delivery Unit, Thailand Science Research and Innovation (TSRI). *Personal interview*.

World Bank. (2020). *Thailand manufacturing firm productivity report*.

Appendix
List of Interviews

Interviewee	Date of Interview	Position and Organization
Chaiyatorn Limapornvanich	September 18, 2024	Head of Innovation Foresight, National Innovation Agency (NIA)
Chinawut Chinaprayoon	September 18, 2024	Executive Vice President (Digital Ecosystem Promotion Unit), Digital Economy Promotion Agency (DEPA)
Pakpoom Tippakoon	September 29, 2024	Research Utilization and Policy. Delivery Unit: RUPDU, Thailand Science Research and Innovation (TSRI)
Sakdipon Juasrikul	September 18, 2024	Director of Innovation-Driven Entrepreneurship Center at University of the Thai Chamber of Commerce
Samarnlak Tanthikul	September 18, 2024	Senior Experts, The Office of Industrial Economics (OIE), Ministry of Industry
Sansanee Huabsomboon	October 2, 2024	Director of Technology Business Incubation Center (BIC), The National Science and Technology Development Agency (NSTDA)
Sirinya Lim	September 19, 2024	Senior Director of Innovation Economic Policy Division, National Higher Education, Science, Research, and Innovation Policy Council (NXPO)
Siriporn Pittayasophon	September 19, 2024	Senior Strategist Acting as President of the Office of the National Higher Education, Science, Research, and Innovation Policy Council (NXPO)
Suwida Thunyawong	September 20, 2024	Investment Promotion Specialist, The Board of Investment Office (BOI)
Wannawat Opasvadhana	October 2, 2024	Director of SME Policy and Planning Department, The Office of SMEs Promotion (OSMEP)

TURKIYE

1. INTRODUCTION

Small and medium-sized enterprises (SMEs) have an important role in creating added value, providing employment, increasing national income, and spreading economic welfare to the lower classes of society.

Thanks to their dynamic structure and flexible working methods, SMEs can easily adapt to rapidly changing market conditions and technological innovations. They also play an important role in completing the supply chain by providing intermediate products to large companies. They support social development by contributing to the balance in income distribution and regional development by increasing employment and income in the regions where they are located.

Improving the technological capacities of SMEs and taking measures to increase productivity stand out as the key to overcoming the difficulties brought about by the COVID-19 pandemic, geopolitical tensions, and heightened risks in the global economy.

The sustainable and strong structure of SMEs is a priority policy objective of Turkiye. Through various incentive and financial support programs, state institutions aim to support the development of SMEs, increase their R&D expenditure and innovation capabilities, and make them competitive.

These objectives are given extensive coverage in the top policies, programs, and strategy documents published by the public authorities. Turkiye's 12th Development Plan, which is its vision document for 2024-2028, includes many policies and measures for SMEs. The main policies and measures are as follows (PSB, 2023):

- Visa application will be facilitated for talents with critical expertise in the field of technology and foreign entrepreneurs with innovative business models and high-technology based businesses within the framework of the reciprocity principle.
- The culture of cooperation in the entrepreneurship ecosystem will be promoted.
- In high-tech areas requiring technical guidance, enterprises, especially large enterprises, will be encouraged to provide guidance to entrepreneurs and SMEs.
- Mechanisms will be established to ensure the dissemination of good practice examples of companies with high productivity on a sectoral basis.
- In order for SMEs to be integrated into the supply chains of main industry manufacturers and large enterprises, their matching will be facilitated, and necessary quality, efficiency, capacity increases, and product development activities will be supported within the scope of supplier development processes.
- SMEs and entrepreneurs will be supported with a focused approach within the framework of criteria such as rapid growth, technology-oriented exports, operating in the field of high technology, and increasing productivity.
- Access to finance will be facilitated, and alternative and innovative financing methods will be promoted.
- Credit guarantee systems will be developed, and their use in financing innovative business models of enterprises and R&D, and innovation projects will be expanded.

The 2023 Industry and Technology Strategy Document of the Ministry of Industry and Technology (MoIT), which is one of the main actors in the development and implementation of industrial and technological policies, contains many objectives and policy targets for increasing the competitiveness of SMEs, developing support mechanisms in areas such as long-term financing, competence development, cooperation with universities, and promotion, in order to enable them to participate in global supply chains, and improving the human capital and technical capacity of SMEs (MoIT, 2019).

The Strategic Plan (2024-2028) of the Small and Medium-sized Enterprises Development Organization (KOSGEB), which acts with the mission of building a sustainable economic future by transforming SMEs into innovative, competitive, twin transformation and export-oriented structures, includes many targets and indicators under the following four main objectives (KOSGEB, 2023).

- Strengthening the entrepreneurship ecosystem and promoting innovative and technology-based entrepreneurship.
- Improving the institutional capacity of SMEs and strengthening their competitiveness.
- Ensuring the sustainability of SMEs.
- Ensuring the simplification, digitalization, and accessibility of KOSGEB by improving institutional capacity.

In the first part of the study, data on the productivity and innovation outlook of SMEs in Turkiye will be presented, support and incentive mechanisms applied to SMEs will be evaluated, and information about the actors involved in these mechanisms will be provided. In the second part, a general evaluation and policy recommendations will be offered.

2. AN OVERVIEW OF PRODUCTIVITY AND INNOVATION OF SMES

Similar to other large economies, SMEs in the Turkish economy are predominantly in the business sector, and as of 2022, there were 3,773,000 SMEs, accounting for 99.7% of total enterprises, 71% of employment, 36.4% of value added, 31.6% of exports, and 28.8% of R&D expenditures. As of 2023, 27.5% of bank loans and 35.7% of commercial loans were used by SMEs (TurkStat, 2024a; BRSA, 2024).

SMEs are classified according to their net sales revenue, financial balance sheet amounts, and number of employees. According to the Regulation on Small and Medium-Sized Enterprises, which was put into force by the Presidential Decree in 2023, enterprises with less than 250 employees and whose annual net sales revenue or financial balance sheet does not exceed 500 million Turkish Liras qualify as SMEs (KOSGEB, 2024).

Enterprises with less than 10 annual employees and whose annual net sales revenue or financial balance sheet does not exceed 10 million Turkish Liras are considered Micro Enterprises, enterprises with less than 50 annual employees and whose annual net sales revenue or financial balance sheet does not exceed 100 Turkish Liras are considered Small Enterprises, and enterprises with less than 250 annual employees and whose annual net sales revenue or financial balance sheet does not exceed 500 million Turkish Liras are considered Medium-Sized Enterprises (KOSGEB, 2024).

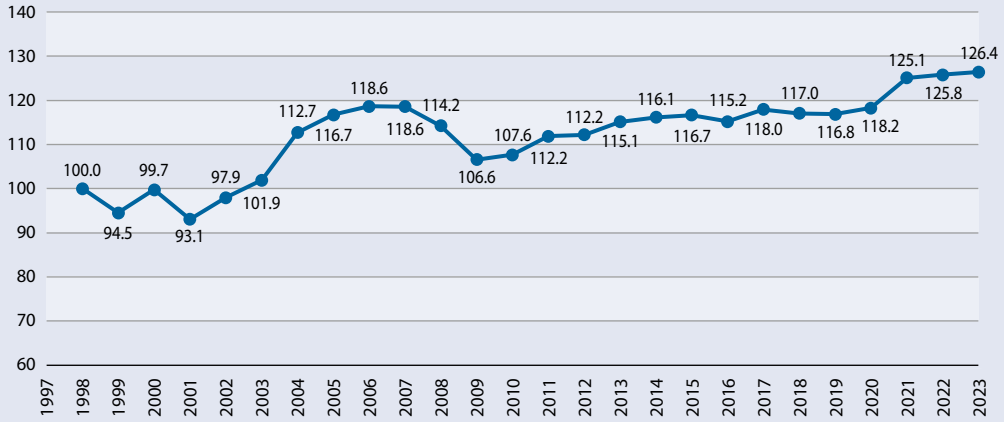
2.1 Productivity Statistics

Total Factor Productivity (TFP) values were calculated using the previously established capital stock series, along with employment and GDP series, covering the years 1998 to 2023.

If the TFP value in 1998 is set at 100, the value reached in 2023 is 126.4. It can be said that TFP has experienced an increasing trend since 2009. When examining recent years (2018-2023), an average growth rate of 1.2% has been achieved over the 6-year period. Therefore, it is observed that TFP growth began to accelerate after 2017 (Figure 1).

FIGURE 1

TOTAL FACTOR PRODUCTIVITY (TFP) VALUE BY YEAR (INDEX 1998=100)



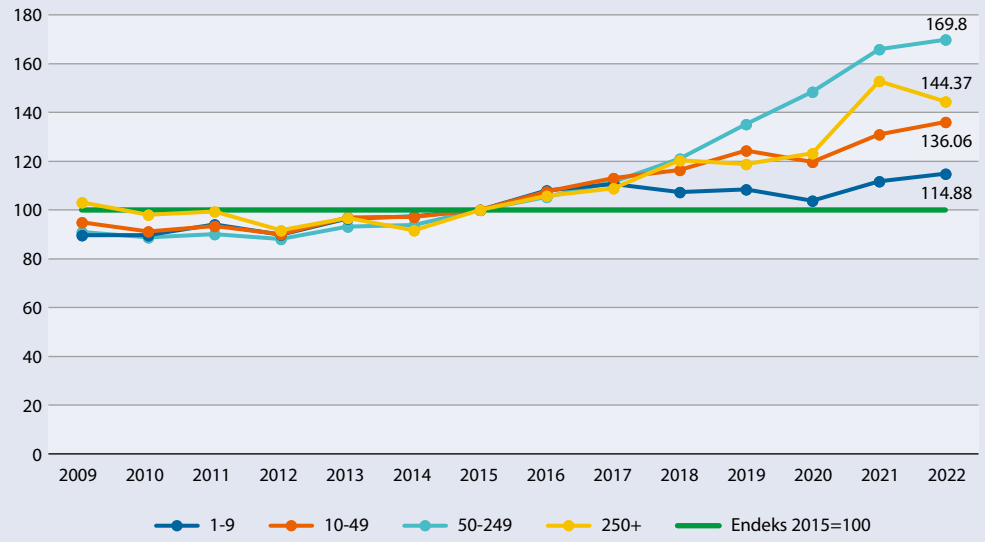
Source: Ministry of Industry and Technology. Analysis of Total Factor Productivity (TFP) and Sources of Growth in Turkiye with Inter-Country Comparisons (2024)

TFP Value added per employee refers to the monetary value obtained by dividing the value added at factor cost by the number of employees, and all non-agricultural sectors are included in the calculation of the index.

According to Figure 2, there is an increase in value added per employee in all classes according to scale between 2009 and 2022. The largest increase occurred in firms with 50-249 employees.

FIGURE 2

VALUE ADDED PER EMPLOYEE BY YEAR AND SIZE



Source: Ministry of Industry and Technology Productivity Statistics

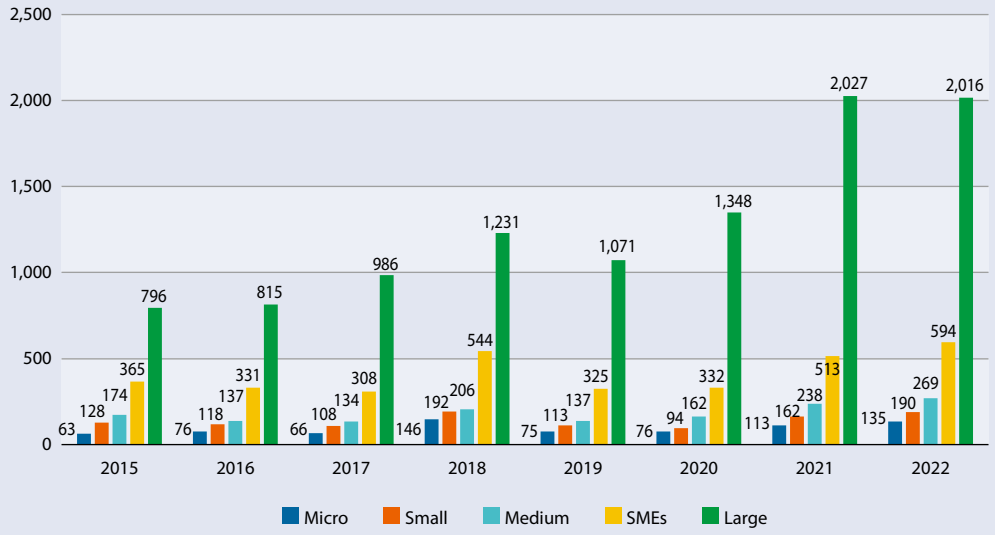
In 2022, "Electricity, Gas, Steam and Air Conditioning Production and Distribution," "Mining and Quarrying," "Information and Communication," and "Real Estate Activities" stood out as the sectors with the highest value added in SMEs and large-scale firms. In 2022, high-technology class had the highest value added per employee according to technology level, followed by medium-high, medium-low, and low technology classes (TurkStat, 2024a).

2.2 R&D Statistics

The number of patents registered is a key indicator of the level of R&D and innovation across firm sizes. As shown in Figure 3, the share of large-scale firms in the total number of patents in Turkiye has increased over the past years. Among SMEs, the share of medium-sized firms has also increased.

FIGURE 3

NUMBER OF PATENT REGISTRATIONS BY YEAR AND SIZE



Source: Turkish Statistical Institute (TurkStat) SMEs Statistics, 2022

According to Table 1, there has been a considerable increase in the number of R&D personnel of both SMEs and large firms between 2009 and 2022. For 2022, the total number of R&D personnel was 185,871 persons. Of these, almost 85,000 were employed in SMEs, and the share of SMEs in total R&D personnel of financial and non-financial companies was 45.5%.

TABLE 1

FINANCIAL AND NON-FINANCIAL CORPORATIONS R&D PERSONNEL BY SIZE

	Micro	Small	Medium	SMEs	Large	Total
2009	3,759	6,351	6,531	16,641	19,425	36,066
2010	4,304	7,115	8,416	19,835	23,236	43,071
2011	5,724	8,138	8,595	22,457	28,758	51,215
2012	5,978	9,076	9,640	24,694	32,541	57,235
2013	7,410	11,094	12,980	31,484	34,470	65,954
2014	7,187	12,196	12,633	32,016	38,266	70,282
2015	8,421	13,126	13,476	35,023	39,977	75,000
2016	8,324	13,195	14,157	35,676	45,953	81,629
2017	8,683	14,409	17,143	40,235	59,263	99,498
2018	11,862	18,997	24,659	55,518	60,758	116,276
2019	12,078	19,475	28,078	59,631	66,832	126,463
2020	12,889	22,260	31,959	67,108	73,496	140,604
2021	14,681	25,455	31,672	71,808	91,318	163,126
2022	16,772	30,294	37,491	84,557	101,314	185,871

Source: TurkStat SMEs Statistics, 2022

In 2022, the total gross domestic R&D expenditure was 7.267 million USD. Of this, 2.096 million USD was realized by SMEs, and the share of SMEs in gross domestic R&D expenditure of financial and non-financial companies was 28.8%. The distribution of gross domestic R&D expenditures of financial and non-financial companies by year and size is given in the table below.

TABLE 2

FINANCIAL AND NON-FINANCIAL CORPORATIONS' GROSS DOMESTIC EXPENDITURE ON R&D BY SIZE CLASS (MILLION USD)

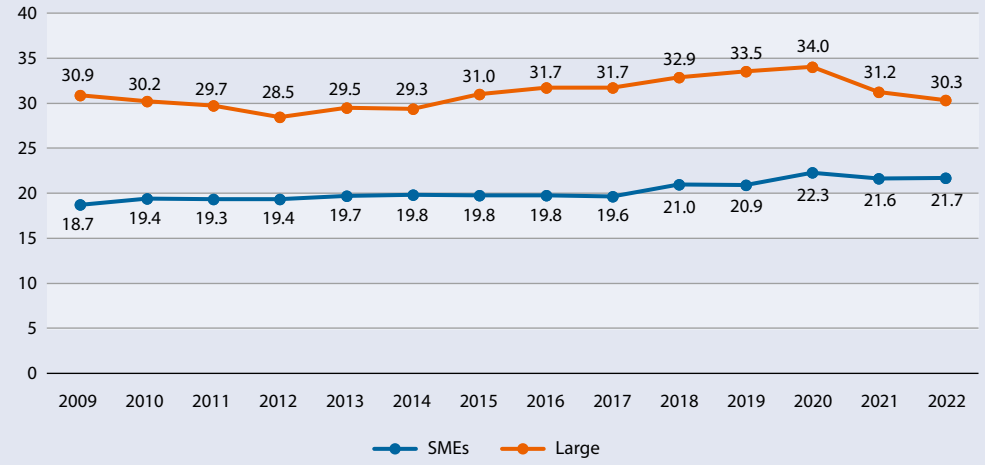
	Micro	Small	Medium	SMEs	Large	Total
2009	118	213	267	598	1,318	1,916
2010	133	215	336	684	1,837	2,520
2011	152	244	315	712	2,031	2,743
2012	172	284	380	836	2,301	3,137
2013	215	358	521	1,095	2,464	3,559
2014	186	399	527	1,112	2,768	3,880
2015	201	405	488	1,094	2,611	3,705
2016	221	423	548	1,192	3,154	4,346
2017	192	452	586	1,229	3,368	4,597
2018	237	580	720	1,538	3,235	4,773
2019	234	512	838	1,584	3,528	5,113
2020	224	510	903	1,637	3,341	4,977
2021	258	593	889	1,740	4,677	6,416
2022	265	741	1,090	2,096	5,171	7,267

Source: TurkStat SMEs Statistics, 2022

As revealed in Figure 4, the share of medium-high and high technology products in the total turnover of both SMEs and large-scale firms operating in the manufacturing industry has experienced a moderate increase between 2009 and 2022. Indeed, while the ratio for large firms in 2022 was almost at the same level as in 2009, it has increased from around 19% to 22% for SMEs.

FIGURE 4

RATIO OF HIGH TECHNOLOGY AND MEDIUM-HIGH TECHNOLOGY TURNOVER TO TOTAL TURNOVER BY SIZE (%)



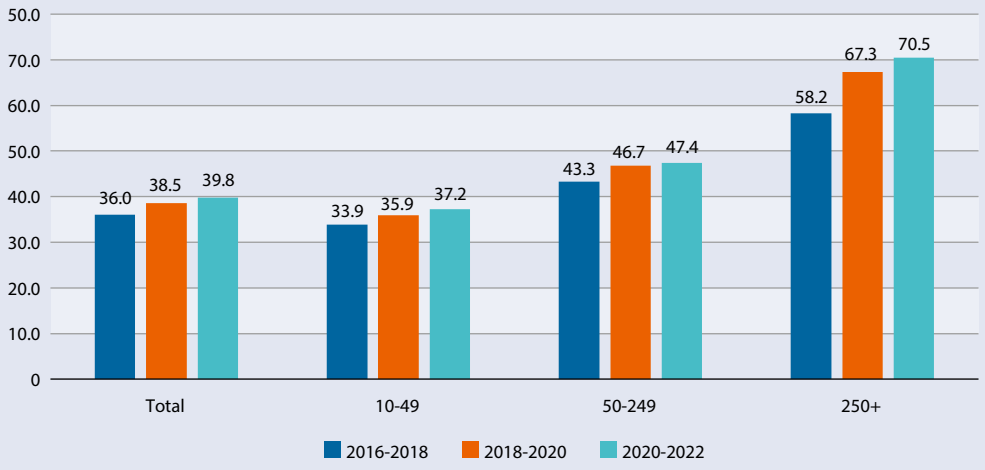
Source: TurkStat SMEs Statistics, 2022

2.3 Innovation Statistics

As seen in Figure 5, in the 3-year period covering 2020-2022, 39.8% of enterprises with 10 or more employees engaged in innovation activities. The figure also shows that the rate of firms engaging in innovation activities has increased in all firm size categories since 2016. The rate of enterprises engaged in innovation activities was 42.9% in the industrial sector and 36% in the service sector for the last period shown in the figure (TurkStat, 2024b).

FIGURE 5

ENTERPRISES ENGAGED IN INNOVATION ACTIVITIES BY NUMBER OF EMPLOYEES (%)

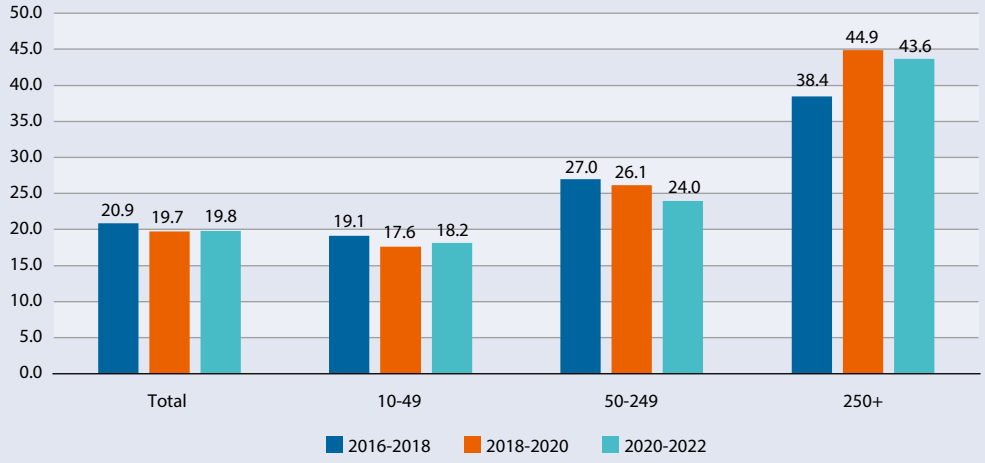


Source: TurkStat Innovation Survey, 2022

There has been a moderate decrease in the ratio of SMEs that engage in product innovation over the three-year period since 2016. In the three-year period from 2020 to 2022, 19.8% of enterprises with 10 or more employees engaged in product innovation activities, compared to 20.9% in the first period starting in 2016 (Figure 6).

FIGURE 6

PRODUCT INNOVATIVE ENTERPRISES BY NUMBER OF EMPLOYEES (%)

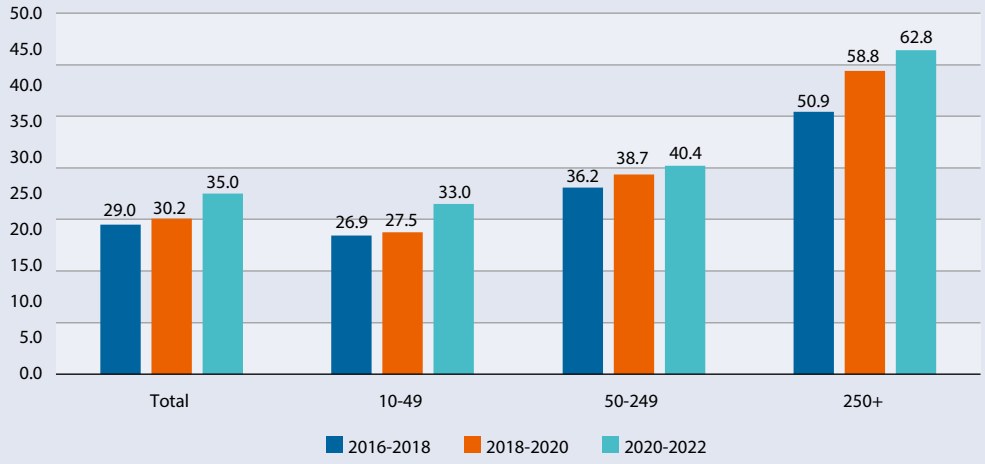


Source: TurkStat Innovation Survey 2022

As seen in Figure 7, there has been an increase in business process innovation activities among both SMEs and large firms over time. In the three-year period from 2020 to 2022, 35% of enterprises with 10 or more employees engaged in some form of business process innovation.

FIGURE 7

BUSINESS PROCESS INNOVATIVE ENTERPRISES BY NUMBER OF EMPLOYEES (%)

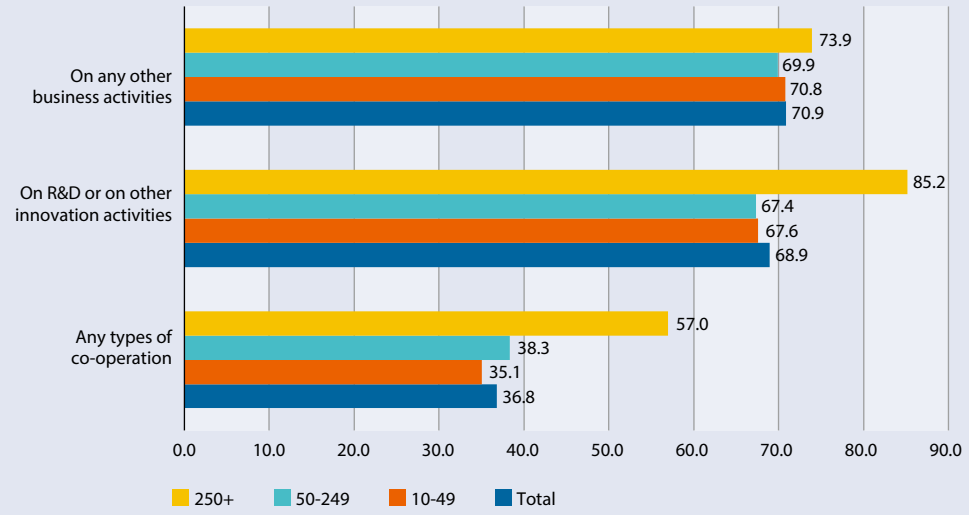


Source: TurkStat Innovation Survey 2022

In the period 2020-2022, 36.8% of enterprises (with 10 or more employees) engaged in innovation activities in cooperation with other enterprises, individuals, or organizations. While 68.9% of these enterprises cooperated in R&D or other innovation activities, 70.9% cooperated in other routine entrepreneurial activities. Large-scale enterprises collaborated more than SMEs (Figure 8).

FIGURE 8

COLLABORATION STATUS OF ENTERPRISES ENGAGED IN INNOVATION ACTIVITIES 2020-2022 (%)



Source: TurkStat Innovation Survey 2022
Note: Other activities include routine business activities of an enterprise, excluding R&D and innovation activities.

Table 3 summarizes the factors that encouraged Turkish firms to engage in environmental innovation during the period from 2020 to 2022. "High cost of energy, water, and materials" and "Improving the reputation of the enterprise" were reported by the highest proportion of SMEs as key drivers. In contrast, "Need to meet requirements for public procurement contracts" and "Voluntary actions or initiatives for environmental good practice within your sector" were the least influential factors for innovation (Table 3).

TABLE 3

FACTORS DRIVING ENVIRONMENTAL INNOVATION 2020-2022 (%)

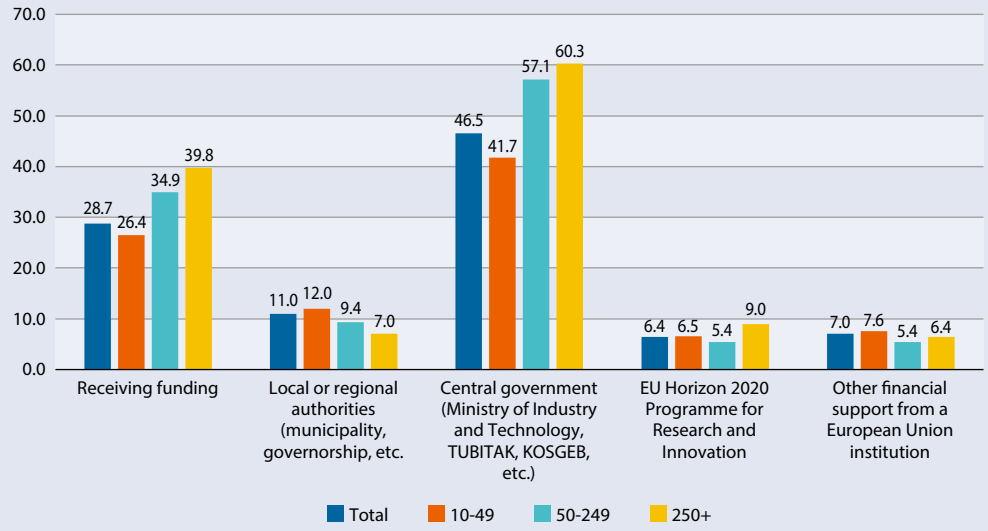
Factors driving environmental innovation	10-49	50-249	250+
Existing environmental regulations	29.2	34.4	43.4
Existing environmental taxes, charges, or fees	33.0	33.7	35.8
Environmental regulations or taxes expected in the future	28.1	33.3	39.9
Government grants, subsidies, or other financial incentives for environmental innovations	29.0	34.2	36.4
Current or expected market demand for environmental innovations	29.6	29.3	37.1
Improving your enterprise's reputation	37.5	45.3	52.2
Voluntary actions or initiatives for environmental good practice within your sector	21.5	24.0	31.9
High cost of energy, water, or materials	41.1	45.5	51.0
Need to meet requirements for public procurement contracts	20.3	17.5	24.5

Source: TurkStat Innovation Survey 2022

Turkish SMEs receive financial support primarily from public institutions related to the central government, followed by EU institutions and local authorities. For example, according to Figure 9, 26.4% of enterprises with 10-49 employees that engaged in innovation activities received financial support from Turkish or EU institutions.

FIGURE 9

SHARE OF SMES THAT HAVE ENGAGED IN INNOVATION ACTIVITIES AND RECEIVED FUNDING SUPPORT FROM DIFFERENT SOURCES, 2020-2022 (%)



Source: TurkStat Innovation Survey 2022

3. GOVERNMENT SUPPORT AND INCENTIVES

3.1. Supply Side Technology Policy

3.1.1 Tax Incentives

R&D activities are critical for innovation and sustainable economic growth. Tax incentives applied to encourage investments in R&D contribute to the improvement of competitiveness and technological capacity of enterprises. Tax incentives for R&D activities are considered indirect support.

3.1.1.1 R&D and Design Center Incentives

In Turkiye, R&D activities have been supported by a number of evolving tax incentives over time. The first incentive for R&D activities was introduced in 1986 with the tax deferral practice, and R&D activities have been given more importance since the 2000s. Importantly, the first comprehensive law aiming to support R&D activities in Turkiye, Law No. 5746 on Supporting Research and Development Activities, was enacted in 2008. The objectives of the law include the generation of technological knowledge, innovation in products and production processes, improvement of product quality and standards, increase in productivity, reduction of production costs, acceleration of technology-intensive production, and encouraging inflow of foreign direct investments in R&D. Some revisions have been made to the law over the years, and the general conditions required to benefit from the incentives in its current form are identified based on R&D and Design centers:

R&D Centers: R&D Centers are organized as a separate unit and located in a single campus or physical space, have 15 R&D personnel, and undertake domestic R&D or design projects and activities.

Design Centers: Design Centers are organized as a separate unit and located in a single campus or physical space, have 10 design personnel, and undertake domestic design projects.

TABLE 4

R&D INCENTIVES INFORMATION

Responsible Ministry	Incentive Instruments for R&D and Design Centers		Exemption Rate
Ministry of Industry and Technology Ministry of Treasury and Finance	R&D and Design Discount	Reduction of the R&D expenditures from the corporate tax base.	100%
	Income Tax Withholding Support	Income tax withholding support on employees' wages. This support is a discount shaped according to the education level of the employee.	80% (BSc) 90% (MSc) 95% (PhD)
	Social Security Premium Support (Employer's Share)	Social security premium support (employer's share) is exempted. Employer's share of the social security premium is normally 15.5% of the gross wage.	50%
	Stamp Duty Exemption	Stamp duty exemption for applicable documents.	100%
	Customs Duty Exemption	Customs duty exemption for imported products	100%
	Fundamental Sciences Employment Support	Two-year gross wage support for R&D personnel having a BSc degree (mathematics, physics, chemistry, biology).	Up to gross minimum wage per month

Source: Investment Office of the Presidency of the Republic of Turkiye, Investment Office Guide to State Incentives for Investments in Turkiye.

The application and approval procedures, as well as the monitoring and supervision of the activities of companies operating in R&D and Design centers, are managed by the Ministry of Industry and Technology. Companies applying through the online system undergo a preliminary (formal) examination by the ministry. Those that pass the preliminary examination are inspected on-site by experts with academic backgrounds in the field who prepare a report based on their findings. The report and related documents are evaluated by a commission that includes a Head of Department from the Ministry of Industry and Technology, a representative of the Ministry of Treasury and Finance, academicians, and sector representatives. The commission has the authority to grant activity permits. The Ministry also monitors the progress of R&D and design projects at regular intervals.

3.1.1.2 Technology Development Zone (TDZ) Incentives

The foundations of technology development zones in Turkiye were laid with the Fifth Five-Year Development Plan (1985-89) and under the title of "Science-Research-Technology" in said plan. The plan aimed to promote university-industry cooperation and establish advanced attraction centers across various sectors. Although TDZs were established during the 1980s and 1990s, they gained an official status with the adoption of the Technology Development Zones Law numbered 4691 in 2001. The law aimed to enhance the competitiveness of the industry by fostering the production and commercialization of technological information, improving product quality and standards in products and production methods, developing innovations that will increase productivity and reduce production costs, ensuring the adaptation of SMEs to new and advanced

technologies, providing job opportunities for researchers and accelerating the entry of foreign capital that will make advanced technology investments. In TDZs, the following companies can carry out activities:

- Domestic and foreign companies that want to realize R&D projects and use high/advanced technologies
- SMEs wishing to develop software or innovative technologies using the facilities of a university, an institute of advanced technology, or a public R&D center
- Companies established in KOSGEB's Technology Development Centers
- Young entrepreneurs with ideas that can be commercialized

TABLE 5

INCENTIVES FOR TECHNOLOGY DEVELOPMENT ZONES (TDZS) (VALID UNTIL 2028)

Responsible Establishment	Incentive Instruments for TDZs		Exemption Rate
Ministry of Industry and Technology Ministry of Treasury and Finance	Corporate Tax Exemption	Profits derived from software development, R&D, and design activities are exempt from income and corporate taxes.	100%
	VAT Exemption	Sales of application software produced exclusively in TDZs are exempt from VAT. (Ex: software for system management, data management, business applications, and different business domains, the internet, mobile phones, and military command and control systems). For the products procured on a project basis, there will also be VAT exemption.	100%
	Income Tax Withholding Support	Remuneration for R&D, design, and support personnel employed in the zone is exempt from all taxes. However, the number of support personnel covered by the exemption may not exceed 10% of the total number of those involved in R&D.	100%
	Social Security Premium Support (Employer's Share)	Social security premium support (employer's share) is exempted. Employer's share of the social security premium is normally 15.5% of the gross wage.	50%
	Stamp Duty Exemption	Stamp duty exemption for applicable documents.	100%
	Customs Duty Exemption	Customs duty exemption for imported products.	100%
	Fundamental Sciences Employment Support	Two-year gross wage support for R&D personnel having a BSc degree (mathematics, physics, chemistry, biology).	Up to gross minimum wage per month

Source: Investment Office of the Presidency of the Republic of Turkiye, Investment Office Guide to State Incentives for Investments in Turkiye.

TDZs can be established in or near universities, high technology institutes, or R&D centers or institutes. The management of the zone is conducted by management companies established as responsible joint stock companies. Managing companies are responsible for the evaluation of the suitability of each R&D or design project to be carried out exclusively in the region by the commission consisting of academicians and experts and monitoring the activities of entrepreneurs who want to take part in R&D or design activities in the region. In addition, the activities and practices of the management companies and entrepreneurs in the zone are supervised by the Ministry of Industry and Technology.

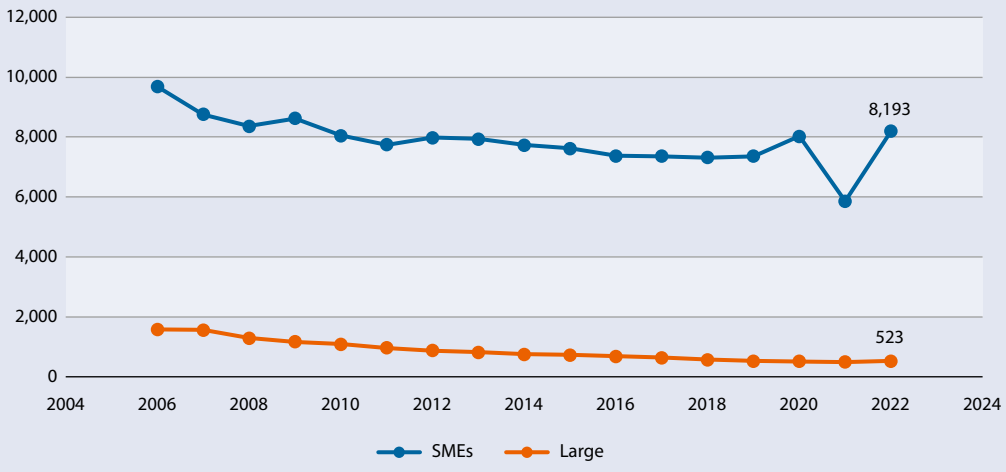
3.1.1.3 Effectiveness of Policy

R&D tax incentives have a significant impact on increasing Turkiye's innovation capacity. These incentives contribute to accelerating technological development in the private sector, thereby increasing the country's competitiveness at the global level. They provide significant financial advantages especially for companies operating in the field of technology. The tax reductions provided make R&D expenditures more economically attractive, while at the same time enabling the development of new inventions and products.

As can be seen from Figure 10, R&D incentives are also widely utilized by SMEs and more than 8000 SMEs benefited from the incentive to deduct R&D expenditure from corporate income in 2022.

FIGURE 10

NUMBER OF FIRMS BENEFITING FROM THE INCENTIVE FOR DEDUCTION OF R&D EXPENDITURES FROM CORPORATE INCOME BY YEAR AND SCALE



Source: Ministry of Industry and Technology Entrepreneur Information System

Information on 1,321 R&D Centers and 334 Design Centers operating in Turkiye is presented in Table 6. In particular, medium-sized SMEs established R&D and Design Centers and improved their productivity and technological capacities through innovative projects carried out in these centers.

TABLE 6

R&D AND DESIGN CENTERS INFORMATION

	R&D Center	Design Center
Number of Centers in Operation	1,321	334
Total Number of Personnel (including support staff)	85,795	8,212
License	52,724	5,264
Master's Degree	16,387	738
Doctorate and Above	1,627	46
Number of Projects (Completed)	66,149	13,251
Number of Projects (Ongoing)	14,569	2,235
Number of Patents	39,955	852
Registration	13,937	276
Application	26,018	576
Number of R&D Centers with Foreign/Foreign Partnership Structure	237	38

Source: Ministry of Industry and Technology Statistics

Looking at the sectoral distribution of R&D centers, the most prominent sectors are Machinery and Equipment Manufacturing with 170, Automotive Supply Industry with 138, Software with 122, and Computer and Communication Technologies with 89. When we look at the sectoral distribution of design centers, Textiles stands out with 54, then Engineering/Architecture with 44, Manufacturing Industry with 39, and Machinery and Equipment Manufacturing with 37 (MoIT, 2024a).

As of July 2024, there are a total of 102 TDZs in Turkiye, 90 of which are operational and 12 of which have ongoing infrastructure works.

TABLE 7

TECHNOLOGY DEVELOPMENT ZONES INFORMATION

Number of Companies	10.771
Number of Foreign/Foreign Partnered Companies	486
Number of Incubation Companies	2.962
Number of Companies with Academic Partners	2.061
Total Number of Personnel	113.065
R&D	96.526
Design	1.226
Support	7.472
Out of Scope	7.841
Number of Projects (Ongoing)	15.595
Number of Projects (Completed)	60.339
Total Exports (USD)	11, Milyar USD
Number of Patent Registrations (National/International)	1.939
Number of Patent Applications (Ongoing)	3.768
Software Copyright (Received)	1.431

Source: Ministry of Industry and Technology Statistics

When the sectoral distribution of the companies operating in TDZs is analyzed, 53.15% are computer programming activities (coding systems, databases, networks, web pages, etc., software and customer-specific software, etc.), 5.4% are other research and experimental development activities related to natural sciences and engineering (including agricultural research), and 3.17% are computer consultancy activities (providing expert opinion on hardware-related IT issues such as hardware requirements, determining computer requirements, planning and designing computer systems, etc.) (MoIT, 2024a).

TDZs are an extremely important model that enables SMEs to improve their innovation capacity. R&D support and infrastructure facilities in these zones accelerate SMEs' new product development processes and increase their competitiveness. TDZs can create networks with other companies, start-ups, and large-scale companies. These collaborations and networks offer the chance to create new business opportunities and increase market access capacity. They provide SMEs with opportunities to expand into international markets and join global business networks. This can increase the export capacity of SMEs and strengthen their international competitiveness. These advantages support SMEs in pursuing a sustainable growth strategy focused on efficiency by improving their technological competencies and contribute to economic development.

In the literature, there are many studies examining the effects of TDZs on firms and economic development in Turkiye. In the study conducted by Bilgin and Işık (2022), a content analysis of 55 academic publications published between 2004 and 2019 examining the techno-economic effects of TDZs was conducted. According to the results obtained:

- In 52.63% of the studies, TDZs have a positive impact on resident firms
- 42.11% had a lower-than-expected effect
- 5.26% had no significant effect.

In addition, it was determined in this study that the mechanisms of TDZs to support firms that want to produce innovation should be reviewed. Network effect, resources/opportunities offered by TDZs, and close connections with research institutions stand out as the influence mechanisms of TDZs on firms. The lowest influence mechanism is the prestige factor provided by being in a TDZ.

A study conducted by Şahin (2022) analyzed the financial data for the 2019-2020 period of a firm located in the TDZ and benefiting from incentives and support, and a firm operating in the same sector and not benefiting from any government incentives or support. As a result of the analysis, it was determined that the TFP of the firm that benefited from incentives and support was higher than the firm that did not benefit.

In research by Ulutaş (2020), he conducted interviews with the managers of 10 TDZ companies and found that the companies operating in the past, participating in these regions in order to benefit from the advantages of TDZs, used the advantages of the region more effectively because they were more experienced, and that the projects carried out by academicians were of higher quality.

The impact assessment study conducted by the Ministry of Industry and Technology in 2022 encompasses 114 companies that benefited from design center support between 2017 and 2019. This study was carried out using the before-after/difference-in-differences analysis method. The results revealed that firms benefiting from design center support increased their total assets on average by 9.47% annually, their domestic sales by 22.62%, their number of employees by 8.97%, and their total wages by 15.58% more than firms that did not receive support, two years after the assistance (MoIT, 2022a).

3.1.2 Grants and Loans

3.1.2.1 Programs of Grants and Loans

Grants and credit support for SMEs are provided by various institutions to support the growth of businesses, enhance their technological capacities, and increase their productivity. These supports help SMEs accelerate their digital transformation processes, produce innovative solutions, and strengthen their competitive power.

The main grant and support programs offered to SMEs are summarized in the table below:

TABLE 8

SME SUPPORT PROGRAMS

Program Name	Responsible Agencies	Policy Objectives	Sector	Support Type	Effective Period
Digital Transformation Support Program*	Ministry of Industry and Technology	Integrating technological products and solutions into business processes aims to improve the production and supply chain processes of businesses, increase their efficiency, gain a competitive advantage in the global market, and enhance Turkiye's technological capabilities to produce value-added products	Manufacturing	Credit Exemption Tax Incentives, etc.	2023-
Technology-Oriented Industrial Movement Program*	Ministry of Industry and Technology	Increasing the production of medium-high and high technology level, high value-added products, and the development of critical products for these sectors, along with the acquisition of new production opportunities and capabilities within this framework	Manufacturing	Credit Exemption Tax Incentives, etc.	2019-
SME R&D Start-up Support Program**	TÜBİTAK	The development of technology and innovation capacities in SMEs to make them more competitive, enabling them to conduct systematic projects and develop high-value-added products.	All sectors and all technology areas	Grant (75%) (Upper Limit)	2010-
Industrial R&D Projects Support Program**	TÜBİTAK	Supporting project-based research, technology development, and innovation activities of SMEs	All sectors and all technology areas	Grant (75%) (Upper Limit)	2010-
International Industrial R&D Projects Support Program**	TÜBİTAK	With the support provided to local organizations in Turkiye that conduct international R&D and innovation projects, the aim is to enhance technical competence and knowledge accumulation, as well as to facilitate access to international technology knowledge and technology transfer	All sectors and all technology areas	Grant (75%) (Upper Limit)	2010-
R&D, Innovation and Industrial Application Support Program***	KOSGEB	Ensuring that SMEs produce new products, new processes, information, and/or services	All sectors and all technology areas	Grant (75%-100%) (Upper Limit)	2010-2020
SME Development Support Program (KOBIGEL)***	KOSGEB	Increasing the share and effectiveness of SMEs in the economy, increasing their competitive power and the added value they provide	Manufacturing	Grant (60%-100%) Loan (Upper Limit)	2016-2021
Cooperation-Collaboration Support Program***	KOSGEB	The development of a collaborative working culture among SMEs, or with large enterprises, and the establishment of partnerships that provide mutual benefits and competitive advantage	Manufacturing	Grant (50%-70%) Loan (Upper Limit)	2010-2018
SME Digital Transformation Support Program***	KOSGEB	Developing and making business processes more efficient, increasing their competitiveness and increasing their share in the economy	Manufacturing	Loan	2024-

Source: * Ministry of Industry and Technology 2023 Annual Report
** TUBITAK Industrial Supports
*** KOSGEB Supports

Support programs implemented by the Ministry of Industry and Technology

The Digital Transformation Support Program: a firm operating in the manufacturing industry applies to the Ministry with an investment plan prepared by consultants. Those whose applications are deemed suitable are granted a Digital Transformation Center Certificate and become eligible for incentives and support for investment. The investment process is monitored through progress reports prepared by consultants at specified intervals (MoIT, 2024c).

Technology-Oriented Industrial Movement Program (HAMLE): a program developed to enhance the effectiveness of support and incentives provided by the Ministry and related organizations (TÜBİTAK and KOSGEB) by managing them through a single window. The program begins with a call from the Ministry, and project applications are submitted by firms for products included in the Priority Product List Communication published by the Ministry. Projects that pass the preliminary assessment phase are evaluated through assessment reports prepared by independent institutions, reviewed by the project commission and finally by the program committee. If deemed appropriate, an incentive certificate is issued, and the project becomes eligible to benefit from the support. To date, there have been 5 calls under the program, and 173 projects have been supported (MoIT, 2024d).

TUBITAK Support Programs

The SME R&D Initial Support Program, the Industrial R&D Projects Support Program, and the International Industrial R&D Projects Support Program, implemented by TÜBİTAK, have similar application and implementation phases. Project proposals are evaluated by experts, and suitable projects are supported. The firm executes the project, and monitoring is conducted every six months to facilitate support payments. A Project Final Report is prepared in the last phase of the project. In international projects, adherence to the international call program (such as a foreign project partner, project timeline, etc.) is also required (TUBITAK, 2024).

KOSGEB Support Programs

The R&D, Innovation and Industrial Application Support Program, SME Development Support Program (KOBIGEL), Cooperation-Collaboration Support Program, and SME Digital Transformation Support Program, implemented by KOSGEB, have similar application and implementation processes. An SME applies to KOSGEB with a project proposal, and the support process begins for projects approved by KOSGEB's board decision. The monitoring and evaluation of each project's activity stages and project outcomes are conducted during and after the project, in accordance with the project approved by the board. If it is assessed that there are issues significantly affecting the project's progress, necessitating its referral to the board, these issues are evaluated by the board, which then decides whether the project will continue or be terminated (KOSGEB, 2024b).

3.1.2.2 Effectiveness of Policy

The Ministry of Industry and Technology offers various incentives and support across different fields and plays a significant role in the planning, implementation, and evaluation of industry and technology policies. The Impact Evaluation Department within the Ministry analyses the effects of the incentives and support provided by the Ministry and its affiliated and related organizations and prepares an impact evaluation report.

In 2021, the Ministry of Industry and Technology prepared an impact assessment report on the SME R&D Initial Support Program implemented by TÜBİTAK. In the study, quantitative impact assessment methods were applied together using survey and focus group meeting methods. The findings of the study are summarized below (MoIT, 2021a):

- Summary of the program evaluation based on survey findings and focus group meetings:
  - Due to the varying levels of R&D maturity among firms of different scales and technology levels, there is a necessity to create firm-specific support packages when designing R&D support.
  - Approximately three-quarters of the firms benefiting from the support reported that their R&D investments continued/would continue even after the support ended, indicating that the provided R&D support has a significant impact on the sustainability of R&D activities.
  - 75% of the firms increased the number of their products and the technological intensity of their products with the support.
  - Approximately 65% of the firms entered new markets and accessed new R&D collaboration opportunities thanks to the support programs.

- From the quantitative impact assessment analysis using data from 5,347 firms:
  - An increasing and sustainable impact in terms of employment and value added per employee.
  - An increasing but non-continuous impact over time for export intensity.
  - A stronger impact in the manufacturing industry compared to non-manufacturing sectors.
  - A stronger positive impact on firms with 1-49 employees when analyzed in terms of the number of employees.

The R&D, Innovation Industrial Application Support Program implemented by KOSGEB consists of two sub-programs: The R&D and Innovation Support Program and the Industrial Application Support Program.

Under the R&D and Innovation Support Program, 5,576 projects from 4,989 beneficiaries have been supported. In the evaluation report published by KOSGEB in 2022, some key findings are:

- As of 2022, 89.5% of supported businesses are active.
- At the program's end year, compared to the year before the start year, 76.5% of beneficiaries increased their domestic sales, 67.6% increased their overseas sales, 79.1% increased their net sales revenue, 65.2% increased their R&D expenditures, and 71.8% increased their number of employees.
- The increase in domestic sales of supported enterprises was greater than that of unsupported enterprises by 44.1% one year after the program, 49.1% two years after, 46.8% three years after, and 63.5% four years after.

Additionally, the report indicates, based on interviews with firms, that the upper limits have become inadequate over time, and the competence of non-KOSGEB board members in project evaluation is insufficient.

In the evaluation report prepared regarding the SME Development Support Program (KOBIGEL) implemented by KOSGEB (2021), it is highlighted that:

- By the end of 2021, 10 calls were announced under the KOBIGEL program.
- In the call made in 2017 titled "Increasing the Share of High Technology and Value-Added Products in Production and Exports and SMEs," 1,167 enterprises were supported.
- 74% of the supported enterprises increased the number of markets in the 2018-2020 period following the support compared to the pre-support period.

- 68.1% of the supported enterprises exported to new countries in the 2018-2020 period following the support.
- As of November 2021, the closure rate was 0.9% for supported enterprises compared to 3.1% for unsupported enterprises.
- In terms of domestic sales amounts, while there was a 3.4-point difference in favor of unsupported enterprises in the support year, there was a 14.5-point difference in the first year after support and a 2.8-point difference in the second year after support in favor of supported enterprises.
- Regarding the contribution of the support, it was concluded that changes would occur in the investment amount and duration if enterprises did not receive support, and partial attribution was high.
- Interviews with firms emphasized that the support limits were inadequate for investments in digitalization and technological capacity development.

3.1.3 Equity Financing

3.1.3.1 Venture Capital

In modern economies, access to financial resources for investment and R&D expenditures is a significant need for SMEs, in particular for newly established companies including start-ups, which are the driving force of growth and innovation. Venture capital, one of these financing sources, not only provides resources to firms but also offers support in areas such as business networking, consultancy, and management.

In Turkiye, the development of venture capital ecosystems began in the 1990s with both regulatory arrangements and the creation of funds by public and private initiatives. The industry gained momentum after 2000 with funds established through private, public, and public-private partnerships. The Regulation on Individual Participation Capital, published in 2013, enabled individual investors (business angels) to transfer resources and experience to startup and growth-stage companies. Efforts to develop the venture capital ecosystem in Turkiye continue with incentives and support tools provided directly and indirectly by public institutions and organizations such as the Ministry of Industry and Technology, Ministry of Treasury and Finance, KOSGEB, TÜBİTAK, and funds established by the private sector.

Major venture capital funds established by the public or in partnership with the public are listed in the table below:

TABLE 9

VENTURE CAPITAL FUND INFORMATION

Fund Name	Partners	Purpose	Year of Foundation
Tech-InvesTR Venture Capital Support Program	TÜBİTAK Ministry of Treasury and Finance	Providing the capital that SMEs and early-stage technology-based companies that can add value to the national economy, will need in the commercialization process of their products and technologies resulting from R&D and innovation activities.	2018
Technology and Innovation Fund	Ministry of Industry and Technology Development and Investment Bank of Turkiye	Providing venture capital support to companies that carry out technology and innovation activities with growth potential.	2020
Regional Development Fund	Ministry of Industry and Technology Development and Investment Bank of Turkiye	Providing financing to medium-sized companies and regional SMEs focused on growth and development.	2019
Istanbul Regional Venture Capital Fund	Istanbul Development Agency	Providing financial support to startups in Istanbul.	2021
KOBI Venture Capital Investment Trust Inc.	KOSGEB, TOBB*, HALKBANK, TESK* and 16 Chambers of Industry and Commerce	Innovative SMEs that have difficulty accessing financing resources can realize product or service projects with a high competitive advantage that can contribute to the Turkish economy with capital and management support.	1999
Bilisim Vadisi Venture Capital Investment Fund	Ministry of Industry and Technology Albaraka Türk Participation Bank	Supporting startups operating in the field of civil technology (mobility, gaming, alternative energy, cybersecurity, agricultural technologies, etc.) from the seed stage to the series A stage.	2021
Turkish Growth and Innovation Fund	Ministry of Treasury and Finance KOSGEB European Investment Fund Turkish Industrial Development Bank	Supporting innovative, technology-based companies with growth potential.	2016

Source: Compiled using information from various websites.
Note: *TOBB: The Union of Chambers and Commodity Exchanges of Turkiye, TESK: Confederation of Turkish Tradesmen and Craftsmen

The operation of publicly owned or partnered venture capital fund support programs is carried out in cooperation with the institutions participating in the fund, and fund management is generally undertaken by independent fund managers. Funds established within the body of the Development and Investment Bank of Turkiye are managed by the fund management company established by the bank. Funds make investment decisions based on various criteria determined in accordance with the purpose of the fund and prepare reports on completed investments. The activities of the funds are subject to public and independent audit.

3.1.3.2 Effectiveness of Policy

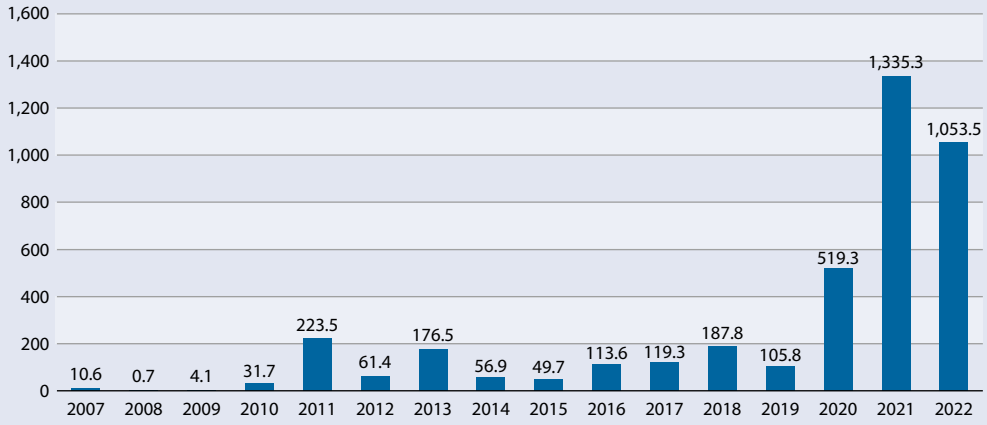
In Turkiye, apart from the funds owned or partnered by the public sector, there are many venture capital investment funds established by the private sector, thanks to tax advantages, and the number of these funds is increasing rapidly. 46 funds (mostly post-seed) with a total value of USD 861 million were established in 2020 and after (IOoT, 2023).

In 2021, a regulation was introduced to enable entrepreneurs to access equity-based crowdfunding to help them meet their financing needs. Following this regulation, 108 technology companies were funded through 21 platforms (IOoT, 2023).

OECD data shows that venture capital investments in Turkiye have increased significantly over the past decade and exceeded USD 1 billion by 2020. However, it should be noted that this is still quite a low level compared to the OECD average. As of 2022, the ratio of venture capital investments to GDP was 0.21 on average for OECD member countries, while this figure was only 0.0012 for Turkiye (OECD, 2024).

FIGURE 11

VENTURE AND GROWTH CAPITAL INVESTMENTS IN TURKIYE OECD DATA 2007-2022 (MILLION USD)



Source: OECD Financing SMEs and Entrepreneurs Scoreboard: 2023 Report

Investment support was provided to 182 ventures through the Technology and Innovation Fund, Regional Development Fund, Regional Venture Capital Fund Calls, and Informatics Valley Venture Capital Investment Fund, which are supported by the Ministry of Industry and Technology through funds and co-financing mechanisms. Within the scope of the Tech-InvesTR Venture Capital Support Program, Tech-InvesTR invested in 80 different ventures, and KOBİ Venture Capital Investment Trust invested in 10 ventures (MoIT, 2024e).

According to the annual report of SME Venture Capital Investment Trust Inc. for 2023, approximately 200 companies applied to invest in the fund between 2021 and 2023. However, none of them successfully completed all stages and qualified for investment. This situation both points to the need to review the fund mechanism and shows that companies do not have sufficient knowledge about venture capital and the fund system (KOBIVCIF, 2024).

In the literature, there is a limited number of studies analyzing the firms receiving investments from venture capital funds. In the study conducted by Baysoy ve Özkul on the case of METU Teknokent, it was revealed that the firms' level of knowledge on venture capital was insufficient and it was concluded that the most significant effects of venture capital on firms were observed in the areas of solving financing problems, increasing production, and increasing market share.

In her study conducted in 2015, Mengü examined the effects of venture capital investments on the financial performance of firms and determined that venture capital has a positive and statistically significant effect on the profitability of investee firms.

Venture capital investments in Turkiye have shown a significant increase since 2020. However, there are not enough studies in the literature on the effects of these investments on firms. This situation reveals that there is a clear need for a more comprehensive examination of the issue.

3.2. Demand Side Technology Policy

In Turkiye, various policy instruments have been used for SMEs to develop their institutional capacities by adapting to global dynamics. Demand-side policies such as public procurement have also been implemented recently. Today, public procurement is seen as a tool not only for meeting requirements but also to support domestic production and encourage innovation.

In 2014, with the Communique on Domestic Goods published by the Ministry of Industry and Technology, the principles for determining and certifying that a good is a domestic good (including a domestic software product) were determined. Within the scope of this communique, companies holding a domestic good certificate are provided with a price advantage of up to 15% in public procurement tenders. In addition, the TUR (technological product experience) Certificate, which can be used for five years, is issued by the Ministry of Industry and Technology for goods and services resulting from R&D projects, and the owners of such goods and services can participate in public tenders with this document without the need for experience criteria (MoIT, 2024h).

Launched in 2018, the Industry Cooperation Projects (SIP) use a technology-oriented project management approach instead of the classical procurement approach to enable public procurement to support R&D and localization. In these projects, in addition to the product to be procured, the systems, subsystems, and components that make up the product can be required to be designed and produced domestically, and domestic production is supported (MoIT, 2024i).

Increasing domestic technology production by supporting local sectors and initiatives through public procurement is widely covered in top policy documents. The Twelfth Development Plan (2024-2028) includes many policies and measures for this purpose, and the Strategic Plan of the Ministry of Industry and Technology (2024-2028) includes targets and indicators for using the public procurement system as a lever to increase domestic production, especially in priority sectors (MoIT, 2023).

Fairs, which are important events for the promotion and marketing of products and services, technological developments, information, and innovations, and the creation and development of cooperation and business contacts, are a costly and laborious process for SMEs. KOSGEB provides domestic fair support in the form of grants for SMEs. At the same time, refundable and non-refundable support is provided for certain expenses to improve the skills and capabilities of SMEs to open up to foreign markets and increase their foreign market shares (KOSGEB, 2024b).

3.2.1 Effectiveness of Policy

In Turkiye, more supply-side support and incentive policies have been implemented to support SMEs, but recently, demand-side policies have also been developed.

As of October 2024, 14,702 domestic goods certificates, which offer a price advantage in public procurement, were issued at all technology levels (TOBB, 2024). In 2023, in 6,885 (40.35%) of the 17,062 public procurement tenders open to foreign bidders, the tender documents stated that price advantage would be applied in favor of domestic bidders or domestic goods (in case of a combination of domestic and foreign goods) (PRA, 2024).

The TUR Certificate, which allows for participation in public tenders without a work experience certificate, was issued for 1386 products between 2014 and 2023. Of these certificates, 538 were issued for Software, 271 for Machinery and Equipment Manufacturing, and 128 for Electronics. Within the scope of SIP carried out under the coordination of the Ministry of Industry and Technology, four projects have been completed so far, and nine projects are in progress (MoIT, 2024i).

The impact assessment study conducted by the Ministry of Industry and Technology in 2022 consists of two parts. In the first part of the study, according to the analysis made with the data of 4,729 SMEs that benefited from the fair support between 2018-2020, it was determined that Domestic Fair Support is an application that has a positive impact on net sales, foreign sales, and the number of employees. In the second part, which includes the findings of the survey conducted for 707 SMEs, it is revealed that most of the enterprises stated that they increased their domestic sales and market shares and made new business contacts thanks to the Domestic Exhibition Support (MoIT, 2022c).

3.3. Systemic Technology Policy

Under the changing world conditions, improving the capacities of SMEs and achieving a competitive and efficient structure is a priority policy target for many countries. However, achieving this policy goal requires detailed studies covering many areas and a holistic perspective and cooperation between public institutions, universities, the private sector, and non-governmental organizations, which are the stakeholders of the ecosystem. In Turkiye, the institutional development of university-industry-private sector cooperation started in the 1990s. The main programs carried out in this field are as follows:

TABLE 10

POLICY SUPPORT PROGRAMS

Program Name	Responsible Agencies	Policy Objectives	Support Type
Model Factory Program*	Ministry of Industry and Technology	Increasing efficiency in production and accelerating the digital transformation process. Model Factory is a model financed and established by one or more institution/organization (such as international organizations, NGOs, etc.) that combines theoretical and practical training methods within the framework of experiential learning principles and operates according to the 'learn and transform' principle.	Grant (60%-100%) (Upper Limit) (Paid by KOSGEB)
Technology Transfer Offices Support Program**	TÜBİTAK	Supporting technology transfer offices that operate to contribute to the commercialization of knowledge and technologies produced in universities and technology development zones, and thus to the creation of economic, social, and cultural value.	Grant (40%-80%) (Upper Limit)
University-Industry Collaboration Support Program**	TÜBİTAK	Contributing to the commercialization of the know-how and technology in universities, research infrastructures, public research centers and institutes, established in Turkiye, by transforming project results into products or processes and transferring them to industry.	Grant (75%) (Upper Limit)
Industrial Innovation Network Mechanism (SAYEM) Support Program**	TÜBİTAK	Developing high-value-added products or product groups, which are the targets of the top policy documents for the industrial sector, by creating innovation platforms with the cooperation of the private sector, universities, and the public.	Grant (75%) (Upper Limit
Technology Development Center (TEKMER) Support Program***	KOSGEB	Ensuring the establishment and operation of structures that will provide pre-incubation, incubation, and post-incubation services to ensure the establishment and sustainability of enterprises in the field of R&D, innovation, and technological entrepreneurship in line with national plans and programs, in cooperation with the actors in the entrepreneurship ecosystem.	Refundable Non-refundable (Upper Limit)

Source: * Ministry of Industry and Technology 2023 Annual Report
** TUBITAK Industrial Supports
*** KOSGEB Supports

3.3.1 Effectiveness of Policy

In model factories, SMEs are provided with awareness training, experiential training, learn-transform programs, and project implementation services. Since 2015, eight model factories have been set up and become operational through national and international funds under the coordination of the Ministry of Industry and Technology. The setup work of another six model factories is ongoing (MoIT, 2024b).

It is assessed that the model factories are carrying out successful activities with the learn-transform method they follow, and it is planned to be disseminated nationwide. In 2022, a report was prepared evaluating the impact of model factory services. A survey was conducted with 91 individuals from 78 companies. According to the survey results (MoIT, 2022b)

- The level of satisfaction of companies with the services they received from the model factories is high.
- The average productivity gain levels of the companies have increased.
- The companies' capacity utilization, production per person, and capacity utilization have increased, while the cost per product has decreased.

In addition, it was emphasized in the survey that it would be beneficial to develop human resources in model factories and increase their cooperation with universities.

In the Evaluation of the Effectiveness of Technology Transfer Offices (TTOs) study conducted by the Ministry of Industry and Technology in 2021, it was evaluated that TTOs have problems in finding experienced human resources and human resources specialized in patents, commercialization, entrepreneurship, international projects, and internationalization. TTOs are highly dependent on support in terms of financial resources, but they have valuable and increasing contributions to the innovation ecosystem of the country (MoIT, 2021b).

4. INSTITUTIONS AFFECTING THE EFFECTIVENESS OF POLICIES

In Turkiye, increasing the capacities of SMEs, developing them, and achieving a sustainable structure have been defined as a primary policy goal. The establishment of KOSGEB in 1990 was a significant milestone for the support and development of SMEs. The Ministry of Industry and Technology is engaged in policy development and implementing support and incentive programs, the Ministry of Treasury and Finance provides tax incentives and financing, and institutions such as TÜBİTAK focus on R&D, technological development, and transformation. At the same time, the Development and Investment Bank of Turkiye works on financing and fund management.

The Ministry of Industry and Technology is implementing programs aimed at reducing regional disparities for SMEs, with local administrations, universities, and civil society organizations as stakeholders through development agencies. KOSGEB is a nationwide institution with units in all provinces and certain industrial zones, providing counselling and guidance services to SMEs through these units. It also enhances the capacities and skills of SMEs by offering both online and face-to-face training. Despite these initiatives, many SMEs lack competent personnel in digital technologies, struggle to develop business plans and projects, and are particularly inadequate in utilizing innovative financing instruments such as venture capital.

The Cooperation Support Program implemented by KOSGEB aims to foster a culture of collaboration between SMEs and large enterprises, establishing partnerships that provide mutual benefit and competitive advantage. The International Industry R&D Projects Support Program, administered by TÜBİTAK, allows SMEs to develop international R&D and innovation projects with foreign partners. TDZs have been established to facilitate university-industry cooperation and boost R&D and technology production, increasing their number to 90 active zones over the years.

Effective inter-institutional coordination in implementing support and incentive mechanisms is critical. TÜBİTAK and KOSGEB are related organizations of the Ministry of Industry and Technology, which enhances cooperation and coordination between them, leading to more effective collaboration in policy development and the implementation of support and incentive programs. For instance, within the HAMLE Program, the three institutions work together to provide support and incentives through a "single window" system while determining beneficiaries, support areas, and monitoring the system. The Ministry of Treasury and Finance coordinates with public institutions on the establishment and financing of venture capital funds, providing significant financial support to the Tech-InvesTR Venture Capital Support Program conducted in collaboration with TÜBİTAK.

Public institutions and organizations have long implemented support programs through instruments such as grants, loans, and tax incentives. Many institutions provide incentives to common sectors and fields of activity, leading to situations where the same projects from firms may receive support from different institutions, resulting in duplicate funding and inefficient use of public resources. Additionally, there is no unified follow-up of these supports, and their effects are generally not systematically analyzed. Established in 2022, the Directorate General for State Aids is tasked with creating a common database on support and coordinating impact assessment studies. This aims to monitor support and incentives from a single source and to prevent duplication. Public institutions and organizations are also required to prepare reports evaluating the impact of their incentives and support, and to submit these to the Directorate General. This process aims to analyze the effects of support and incentives, revise them, and eliminate ineffective ones.

While SMEs are willing and motivated to apply for projects, the same cannot always be said for following through and completing the process. Applications for support programs are often rejected due to not meeting eligibility criteria or other reasons, resulting in unsuccessful support processes. Simplifying the legislation and administrative processes regarding applications and support will enhance SMEs' ability to benefit from incentives more effectively.

Satisfaction surveys for the services of public institutions and organizations are conducted through the e-Government system, allowing entrepreneurs and SMEs to evaluate the services provided. Improvements in these services, based on evaluations, increase trust between SMEs and the public sector.

R&D expenditures in Turkiye have been steadily increasing in recent years, and by 2023, the ratio of R&D expenditure to Turkiye's GDP has reached 1.42%. The private sector leads R&D financing with a share of 52.6%, followed by the public sector at 33.1% and the higher education sector at 12.7% (TurkStat, 2024). The public sector's favorable stance toward R&D and its support through various instruments encourage the private sector to invest in R&D and technology.

Turkiye offers a favorable environment for opportunity-based entrepreneurship, characterized by its relatively young population, a growing start-up ecosystem, and a rapidly developing digital economy and e-commerce system. Although public support is crucial for entrepreneurs, the number of venture capital funds and angel investors—important sources of financing for opportunity-based entrepreneurship—has increased in recent years but has not yet reached a sufficient level compared to developed countries.

Like the majority of countries around the world, entrepreneurs in Turkiye experience fear of failure and social stigmatization when deciding to start a business. According to the "Entrepreneurship in Turkiye and International Comparison 2018" report, Turkiye ranks first in Europe for the proportion of entrepreneurs in the start-up stage, those who own new businesses, and early-stage entrepreneurs. The same report indicates that Turkiye has the highest proportion of individuals in Europe who state that the fear of failure does not deter them from starting a new business (YU, 2019). In his study, Arslan (2018) found that the relatively low fear of failure can be attributed to the socio-cultural infrastructure, with family and social environment serving as key factors that help mitigate this fear.

5. CASE STUDIES

In this part of the report, a case study was conducted on two firms that benefit from the incentives and support provided by public institutions and organizations. The firms analyzed have been operating in the manufacturing sector for many years. First, general information about the firms—such as their date of establishment, field of activity, and number of employees—is presented. Then, the types of incentives and support utilized by these firms, along with the purposes for which they are used, are explained. Finally, information on the effects of these incentives and support on the firms, as well as an evaluation of the applied support system, is presented. In the interviews with the firm representatives, the firms are referred to as Firm A and Firm B, as it was requested not to disclose their identification information.

5.1 Firm A

Firm A was established in 1988 and has been designing and manufacturing electronic devices for the industrial sector for 36 years. Operating in the generator, compressor, energy quality, power supply, and internet monitoring sectors, the firm conducts both the design and production of its products in-house. It produces 300,000 units of 400 different types of electronic devices annually, with 50% of its production sold abroad, exporting to more than 80 countries. The customer profile of the firm, which has over 3,000 clients, is very diverse, ranging from large generator companies to individual users. The firm employs 80 individuals, including 20 R&D engineers, 13 white-collar workers (4 of whom are in marketing), and 47 blue-collar and other personnel.

The firm has completed eight projects utilizing R&D support from TÜBİTAK, and two Green Transformation in Industry projects are currently under evaluation. Additionally, the firm has benefited from the support of the HAMLE Program administered by the Ministry of Industry and Technology, as well as the Foreign Fair Participation support provided by KOSGEB. The R&D department is located in a TDZ, allowing the firm to take advantage of the tax and social security incentives provided to TDZs.

The incentives and support encouraged the firm to expand its R&D department and increase its R&D expenditures, especially during the start-up phase. However, project-based personnel support was not sufficient or regular, which limited its direct impact on staffing. Nonetheless, TDZ support facilitated the employment of additional engineers. The firm continuously improves its management system in response to staff growth, an increase in the number of projects, and ongoing operations; however, the direct impact of the support and incentives in this regard has not been observed. Training support was limited, and external consultants were hired for some projects. Generally, the support and incentives encouraged the initiation of projects with lower chances of success by reducing product design costs and enabling new product designs.

Since TDZ support (tax and social security) is calculable and continuous, they were included in the planning and contributed to an increase in R&D capacity. The subsidies accessed through the HAMLE Program significantly enhanced the firm's production capacity by enabling improvements to the factory building and expansion of the machinery park. The Foreign Fair Participation support provided the firm with opportunities to establish new commercial relationships and acquire new customers.

The firm representative stated that the complexity of the project-based support processes and the lengthy approval periods sometimes hinder project execution reliant on these supports, potentially leading to project failure in the absence of sufficient equity. Additionally, it was emphasized that the approach of the members of the support evaluation committees who do not have private sector experience and who have an academic background does not make evaluations in line with the private sector working logic.

5.2 Firm B

Firm B was established in 1994 and specializes in the production of circular knitting machines and spare parts used in the raw fabric sector. The firm employs a total of 25 individuals, including 2 engineers, 3 undergraduate graduates, and 20 technical and production personnel. The firm sells to fabric-producing companies both domestically and internationally.

The firm has benefited from the support provided by the Technology-Oriented Industrial Move Programme and the entrepreneurial support offered by KOSGEB. However, the support process has not been completed because the project carried out within the scope of the Technology-Oriented Industrial Move Programme has not yet been approved.

By leveraging these supports, the firm made additional investments and began producing circular knitting machines. It is also making investments in software and equipment for R&D and innovation, aiming to enhance its technology capacity and improve the quality of its production machinery and equipment. Due to the limited project support period, it has been challenging to find suitably qualified personnel to work during this time, which has hindered staff development. Nonetheless, progress has been made in personnel training and competence during the project process.

The firm has improved its investment capacity by benefiting from tax and customs support in general, but the desired level of benefit could not be achieved from personnel support due to time limitations, and from interest and grant support due to changing economic conditions. While the firm has developed a new product, the project for this product has not yet been approved, as it does not meet sufficient criteria. The firm's project development activities within the scope of the program are ongoing.

5.3 Discussion

Through the case study of two firms benefiting from public incentives and support, we aim to determine which incentives and support are successful or unsuccessful and how they create effects and results in different firms. To ensure comparability, SMEs operating in the manufacturing sector within the same region were selected. Both firms export, and Firm A has a higher R&D personnel count and technological capacity compared to Firm B. Both firms utilize common and varying incentives and support. Both Firm A and Firm B applied for project support under the HAMLE Program; while Firm A's project was approved, Firm B's project has not yet been received sufficient for approval.

The evaluation of the case studies yielded the following results:

- The tax and customs support provided by the HAMLE Program contributed to the enhancement of production capacity for both firms.
- Project-based support did not offer significant benefits, particularly regarding personnel support, due to time constraints.
- TDZ support and incentives were particularly beneficial for Firm A due to their continuity.
- Project-based support negatively impacted projects by creating uncertainty and delays due to complex processes and lengthy approval periods, as these incentives (especially personnel support) are often viewed more as rewards than as support.
- Firm A utilized both its own resources and the support to develop its R&D capacity and implement its projects. Adequate own resources also played a critical role in making Firm A more successful.
- Economic developments, such as rising inflation, limited the impact of interest and grant support.
- Firm A was able to establish new commercial relationships and gain new customers by utilizing support for participation in foreign fairs.

6. CONCLUSION AND POLICY RECOMMENDATIONS

SMEs, as one of the key drivers of Turkiye's economic development, play a critical role in growth, employment, and innovation. To sustain this role, SMEs must remain competitive, increase their productivity, and strengthen their technological capacities. Process improvements, digital transformation, and the integration of innovative technologies into business operations are essential for this progress. However, Turkish SMEs face several major challenges, including limited access to finance, lack of infrastructure for digital transformation, and intense global competition.

Turkiye has developed a comprehensive support system for SMEs, including tax incentives, grants, loans, public procurements, alternative financing instruments (venture capital, etc.), and training programs. The second part of this study demonstrates that SMEs have increased R&D expenditures, human resources, innovation activities, and productivity levels over the years. As policies for SMEs continue to evolve, it is essential to further accelerate and sustain advancements in these areas while addressing persistent challenges related to financing, technology, and competitiveness problems.

Key recommendations for improving current policies and introducing new measures are outlined below:

Sequencing of Policy Support: The incentives and support to be implemented for SMEs should be determined based on the needs of the business and sectoral dynamics. Tax incentives and social security (personnel support) are generally long-term and regular, making them priority support as they enable businesses to reduce their financial burdens and engage in sustainable financial planning. Tax and social security incentives provide support for certain expenses of businesses, but financial support, such as loans and grants, is crucial, especially for financing R&D and innovation projects and increasing production capacities. In addition to tax incentives and grants/loans, support for the commercialization of R&D products and consultancy services related to entering new markets, as well as participation in trade fairs, are important for the growth and sustainability of SMEs. Policy instruments similar to public procurement generally require various technical and financial competencies and are more suitable for SMEs operating in certain sectors, making them quite beneficial for these businesses.

Project-Based Support: The lengthy duration of the approval and evaluation processes for support creates difficulties in the realization of projects. The fact that members of the evaluation commissions, especially academics, may lack sufficient knowledge about the working principles of the private sector can adversely affect the quality and objectivity of evaluations. Therefore, the approval and evaluation processes for support should be simplified and shortened, and commission members should be selected based on their competence in private sector experience and working principles.

TDZ and R&D Centre Support: As these supports are continuous and include significant elements, firms can incorporate them into their planning and strategies, thereby encouraging capacity building. Increasing and expanding the number of TDZs and R&D Centers will benefit SMEs and enhance the entrepreneurship ecosystem.

Grant and Credit Support: Economic challenges, such as rising inflation, limit the impact of grants and credit support. It is crucial to adjust support limits in accordance with changing economic conditions to ensure they adequately meet the needs of SMEs.

Impact Assessment System: The Directorate General for State Aids is responsible for inter-institutional coordination on impact assessment studies. Public institutions and organizations should prepare impact assessment reports on the incentives and support they provide and submit these to the Directorate. Given the specialized skills required, it is essential that public institutions and organizations develop the necessary expertise and increase their capacity to effectively conduct impact assessments. This includes increasing the number of staff with expertise in this area.

Evaluation of Support and Incentive Programs: Impact assessment analyses of support and incentive programs should be conducted using a "data-driven approach." Programs should be reviewed according to the results of the studies, inefficient support programs should be terminated, and new programs should be designed in response to the findings.

Simplification and Efficiency of Programs: Each public institution and organization should implement support and incentive programs for specific sectors and beneficiaries. This will enable institutions to build the expertise needed to better address the specific needs of various industries. For instance, in 2024, KOSGEB simplified its support programs related to facilitating access to finance under two main categories. Other institutions could similarly benefit from program simplification.

Development of Venture Capital Funds: To expand the investor base, public support models, including the inclusion of local governments and the private sector in the venture capital fund system, and alternative mechanisms, including crowdfunding, should be developed.

Information and Promotion: Information activities regarding the support programs and incentives offered by public institutions and organizations are considered adequate. However, firms' knowledge of risk capital funding options, including venture capital, is insufficient. There is a need for information/training activities, especially on innovative financing models.

REFERENCES

Arslan, E.T. (2018). *Fear Of Failure In Entrepreneurs*. Suleyman Demirel University *The Journal of Faculty of Economics and Administrative Sciences*, Vol. 23, 707-725.

Baysoy, E., Özkul, G. (2020). *Venture Capital Versus Bank Financing in Financing Entrepreneurship: The METU Technopolis Example*. Journal of Business Research, 12(1), 610–630.

Banking Regulation and Supervision of Agency (BRSA). (2024). *Key Indicators Report 2024*. Retrieved 11 August 2024. https://www.bddk.org.tr/Veri/Detay/162

Bilgin O., IŞIK H.B. (2022). *Türkiye'deki Teknoloji Geliştirme Bölgeleri Üzerine Tekno-Ekonomik Araştırmalar: Makale Ve Tezler Üzerine Bir İçerik Analizi*. Journal of the Institute of Social Sciences, Pamukkale University. 341-362.

KOSGEB. (2021). *SME Development Support Program (KOBIGEL)*. Retrieved 13 July 2024. https://webdosya.kosgeb.gov.tr/Content/Upload/Dosya/Kurumsal/Raporlar/KOB%C4%B0GEL_2017-1_Proje_Teklif_%C3%87a%C4%9Fr%C4%B1s%C4%B1_Nihai_De%C4%9Ferlendirme_Raporu_-_%C3%96zet.pdf

KOSGEB. (2022). *Evaluation Reports*. Retrieved 11 August 2024. https://webdosya.kosgeb.gov.tr/Content/Upload/Dosya/Kurumsal/Raporlar/KOSGEB_Destek_Programlar%C4%B1_Etki_De%C4%9Ferlendirme_Raporlar%C4%B1_Y%C3%B6netici_%C3%96zetleri....pdf

KOSGEB. (2023). *Strategic Plan (2024-2028)*. Retrieved 13 August 2024. https://webdosya.kosgeb.gov.tr/Content/Upload/Dosya/Tablo%20ve%20Raporlar/KOSGEBN%20Stratejik%20Plan/KOSGEB_Stratejik_Plan%C4%B1_(2024-2028).pdf

KOSGEB. (2024a). *Small And Medıum Sızed Enterprıses Regulatıon*. Retrieved 15 August 2024. https://webdosya.kosgeb.gov.tr/Content/Upload/Dosya/Mevzuat/2023/K%C3%BC%C3%A7%C3%BCk_ve_Orta_B%C3%BCy%C3%BCkl%C3%BCkteki_%C4%B0%C5%9Fletmeler_Y%C3%B6netmeli%C4%9Fi.pdf

KOSGEB. (2024b). *Support Services*. Retrieved 23 August 2024. https://www.kosgeb.gov.tr/site/tr/genel/destekler/3/destekler

Law On Support Of Research, Development And Design Activities. (10 July 2024). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=5746&MevzuatTur=1&MevzuatTertip=5

Mengü, H.,K. (2015). *Venture Capital and Firm Performance*. Doctoral Thesis. 2015.

MoIT. (2019). *2023 Industry and Technology Strategy*. Retrieved 13 July 2024. https://www.sanayi.gov.tr/assets/pdf/SanayiStratejiBelgesi2023.pdf

MoIT. (2021a). *Impact Assessment of KOSGEB and TÜBİTAK R&D Supports*. Retrieved 15 August 2024. https://verimlilikkutuphanesi.sanayi.gov.tr/Library/Detail/1544

MoIT. (2021b). *Evaluation of the Effectiveness of Technology Transfer Offices*. Retrieved 29 December 2024. https://verimlilikkutuphanesi.sanayi.gov.tr/Library/Detail/1546

MoIT. (2022a). *Impact Assessment of Design Supports, 2022*. Retrieved 13 July 2024. https://verimlilikkutuphanesi.sanayi.gov.tr/Library/Detail/1547

MoIT. (2022b). *The Impact of Model Factory Services: A Field Study on Firms, 2022*. Retrieved 15 July 2024. https://verimlilikkutuphanesi.sanayi.gov.tr/Library/Detail/1564

MoIT. (2022c). *Impact Assessment of KOSGEB Domestic Fair Support, 2022*. Retrieved 29 December 2024. https://verimlilikkutuphanesi.sanayi.gov.tr/Library/Detail/1559

MoIT. (2023). *Strategic Plan of the Ministry of Industry and Technology (2024-2028)*. Retrieved 25 December 2024. https://www.sanayi.gov.tr/plan-program-raporlar-ve-yayinlar/stratejik-planlar/mu0801012103

MoIT. (2024a). *Statistics*. Retrieved 13 July 2024. https://www.sanayi.gov.tr/istatistikler/istatistiki-bilgiler

MoIT. (2024b). *About Model Factory*. Retrieved 15 July 2024, https://www.sanayi.gov.tr/merkez-birimi/92d9c73bddbb/model-fabrika

MoIT. (2024c). *The Digital Transformation Support Program*. Retrieved 19 July 2024. https://dijitaldonusum.sanayi.gov.tr/

MoIT. (2024d). *Technology-Oriented Industrial Movement Program*. Retrieved 23 July 2024. https://www.hamle.gov.tr/

MoIT. (2024e). *Annual Report 2023*. Retrieved 25 July 2024. https://www.sanayi.gov.tr/plan-program-raporlar-ve-yayinlar/faaliyet-raporlari/mu2802011618

MoIT. (2024f). *Productivity Statistics*. Retrieved 25 July 2024. https://www.sanayi.gov.tr/istatistikler/verimlilik-istatistikleri/mi0503011615

MoIT. (2024g). *Entrepreneur Information System*. Retrieved 28 July 2024. https://gbs.sanayi.gov.tr/

MoIT. (2024h). *Technological Product Experience Certificate (TUR)*. Retrieved 20 December 2024. https://turbelgesi.sanayi.gov.tr/

MoIT. (2024i). *Industry Cooperation Projects (SIP)*. Retrieved 22 December 2024. https://www.sanayi.gov.tr/merkez-birimi/6f188a931f68/sanayi-isbirligi-projeleri

MoIT. (2023). *Strategic Plan of the Ministry of Industry and Technology (2024-2028)*. Retrieved 25 December 2024. https://www.sanayi.gov.tr/plan-program-raporlar-ve-yayinlar/stratejik-planlar/mu0801012103

OECD. (2024). *Venture Capital İnvestments (Market Statistics)*. Retrieved 13 July 2024. https://data-explorer.oecd.org/vis?df[ds]=DisseminateFinalDMZ&df[id]=DSD_VC%40DF_VC_INV&df[ag]=OECD.SDD.TPS&dq=...USD_EXC.A&pd=2007%2C&to[TIME_PERIOD]=false

OECD. (2023). *Financing SMEs and Entrepreneurs Scoreboard: 2023 Report*.

PRA. (2024). *Public Procurement Report 2023*. Retrieved 22 December 2024. https://dosyalar.kik.gov.tr/genel/Raporlar/2023_yil_sonu_kamu_alimlari_izleme_raporu.pdf

Presidency of Strategy and Budget (PSB), Republic of Turkiye. (1984). *Fifth Development Plan (1985–1989)*; p. 159. Retrieved 13 August 2024. https://www.sbb.gov.tr/wp-content/uploads/2022/08/Besinci-Bes-Yillik-Kalkinma-Plani-1985-1989.pdf

Presidency of Strategy and Budget (PSB), Republic of Turkiye. (2023). *Twelfth Development Plan (2024–2028)*; p. 122. Retrieved 15 August 2024. https://www.sbb.gov.tr/wp-content/uploads/2023/12/On-Ikinci-Kalkinma-Plani_2024-2028_11122023.pdf

KOBI Venture Capital Investment Trust Inc (KOBIVCIF). (2024). *Annual Report, 2023*. Retrieved 15 August 2024. https://kobias.com.tr/wp-content/uploads/2024/04/FAALIYET-RAPORU-31122023-SPK.pdf

Şahin, B. (2022). *The effect of incentives provided to research and development activities on firm performance in Turkiye and an application regarding companies in technology development zones*. Master Thesis.

Technology Development Zones Law. (10 July 2024). https://www.mevzuat.gov.tr/MevzuatMetin/1.5.4691.pdf

The Investment Office of the Presidency (IOoT), Republic of Turkiye. (2023). *The State Of Turkısh Startup Ecosystem*. Retrieved 15 August 2024. https://www.invest.gov.tr/en/library/publications/lists/investpublications/the-state-of-turkish-startup-ecosystem.pdf

The Union of Chambers and Commodity Exchanges of Turkiye (TOBB). (2024). News. https://tobb.org.tr/Sayfalar/Detay.php?rid=14292&lst=Haberler

TurkStat. (2024a). *Small and Medium-Sized Enterprises*. Retrieved 13 August 2024. https://data.tuik.gov.tr/Bulten/Index?p=Kucuk-ve-Orta-Buyuklukteki-Girisim-Istatistikleri-2022-49438.

TurkStat. (2024b). *TurkStat Innovation Survey 2022*. Retrieved 14 August 2024. https://data.tuik.gov.tr/Bulten/Index?p=Yenilik-Arastirmasi-2022-49743

TurkStat. (2024c). *Statistics On Research And Development Activities*. Retrieved 18 October 2024. https://data.tuik.gov.tr/Bulten/Index?p=Yenilik-Arastirmasi-2022-49743

TÜBİTAK. (2024). *Industrial Supports*. Retrieved 14 August 2024. https://tubitak.gov.tr/tr/destekler/sanayi/ulusal-destek-programlari

Ulutaş, F. (2020). *The effect of technology development zones on the country economy: An evaluation on the perceptions of the company managers in ADÜ Teknokent*. Master Thesis.

Yeditepe University (YU). (2019). *Entrepreneurship in Turkiye and International Comparison 2018*. Retrieved 25 September 2024.

VIETNAM

1. Introduction

Vietnam has achieved remarkable development milestones over the past 30 years. The sustained average GDP growth of 7% annually since 1988 has led to a nearly fivefold increase in the per capita income and elevated Vietnam to the status of a middle-income country. Through the liberalization of trade and investment, Vietnam has attracted a substantial amount of foreign direct investment (FDI) and created numerous jobs in export-oriented segments of global value chains (GVCs). Nowadays, Vietnam is the world's second-largest exporter of smartphones, producing over 40% of Samsung's global phone output, demonstrating the success of Vietnam's growth strategy. However, the involvement of Vietnamese manufacturing enterprises, 98% of which are small and medium-sized enterprises (SMEs), in these GVCs remains relatively low.[1]

As of 2023, Vietnam hosts nearly 20 local and central innovation support centers and over 1,400 organizations with the capacity to support startups, including more than 200 coworking spaces, 79 incubators, and hundreds of investment funds. Additionally, over 170 universities are engaged in entrepreneurial activities, with 43 incubators. According to the World Intellectual Property Organization (WIPO), Vietnam's Global Innovation Index (GII) ranking for 2023 was 46 out of 132, marking an improvement of 2 positions from 2022. Within the ASEAN region, the country ranks 4th in terms of innovation, following Singapore (5th), Malaysia (36th), and Thailand (43rd).[2] However, Vietnam's Research and Development (R&D) index is ranked 66th, showing no improvement from the previous year.

The innovation in the study is understood as the introduction and application of new products, technologies, business processes, and business models, as well as R&D. For Vietnamese manufacturing SMEs, conducting R&D presents significant challenges. This study focuses on how enterprises apply existing knowledge and technologies to implement improvements that enhance productivity and growth. The study utilized secondary data from the National Economics University Hanoi (NEU) in 2023 on 250 Vietnamese manufacturing companies regarding their innovation activities. Additionally, the author conducted interviews with nine companies in the mechanical and electronics sectors and selected four companies to include in a case study that illustrates companies that have received support from policies aimed at enhancing productivity and innovation. The findings indicate that while most of these companies have been successful in productivity and quality improvement activities, R&D has only been successfully carried out by a few large companies and is often a subsequent outcome of the productivity and quality improvement processes.

1 Ministry of Industry and Trade (MOIT), Vietnam's National Export Strategy; Electronics Industry Strategy, Chiến lược xuất khẩu quốc gia Việt Nam, chiến lược ngành điện tử. Available at https://trungtamwto.vn/file/23037/4-dien-tu-pdf.pdf (Accessed on 15 September 2024).
2 General Statistical Office (GSO), Socio-economic situation report in the fourth quarter and 2023, Báo cáo tình hình kinh tế xã hội quý IV và V 2023. Available at https://www.gso.gov.vn/bai-top/2023/12/bao-cao-tinh-hinh-kinh-te-xa-hoi-quy-iv-va-nam-2023/ (Accessed on 28 December 2024).

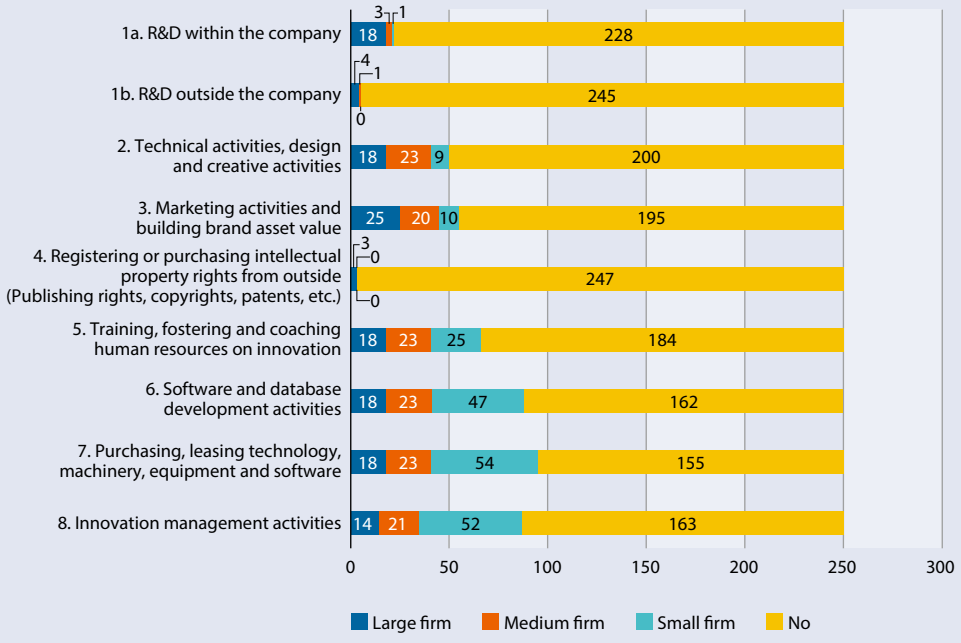
2. Overview of Innovation Activities of Manufacturing SMEs

In 2023, according to the General Statistics Office of Vietnam (GSO), the labor productivity of the entire economy reached US$8,380 per worker, an increase of $274 compared to 2022. Compared to $68.7 in 2013, this productivity has grown 120-fold.[3] Over the past decade, the concentrated efforts to improve national labor productivity have yielded encouraging results for Vietnam that include significantly enhancing productivity growth and rapidly narrowing the productivity gap with neighboring countries. However, despite this growth, Vietnam's labor productivity remains significantly lower compared to its peers. According to the Asian Productivity Organization (APO), in 2020, the value of production per hour worked in Vietnam was only $6.40, compared to $14.80 in Thailand and $68.50 in Singapore. The total factor productivity (TFP) of the country has improved in a sustained trend since the 2000s (Appendix 2). The TFP average annual growth rate was 1.4% in the period of 2010-2015, 2.2% for 2015-2019, and 5.4% for 2020-2021. According to the GSO Vietnam,[4] the share of TFP in GDP growth was 40.5% in the period 2016-2020.

The survey conducted in 2023 by the NEU on 250 manufacturing enterprises, in which there were 18 large, 23 medium, and 208 small companies[5] (Figure 1), reveals several key findings related to innovation activities. Large and medium-sized companies are more proactive in implementing innovation activities and enhancing labor productivity compared to small companies. Figure 1

FIGURE 1

INNOVATION ACTIVITIES OF MANUFACTURING FIRMS



Source: NEU, 2023

3 General Statistical Office (GSO), Socio-economic situation report in the fourth quarter and 2023, Báo cáo tình hình kinh tế xã hội quý IV và V 2023. Available at https://www.gso.gov.vn/bai-top/2023/12/bao-cao-tinh-hinh-kinh-te-xa-hoi-quy-iv-va-nam-2023/ (Accessed on 28 December 2024).

4 See above

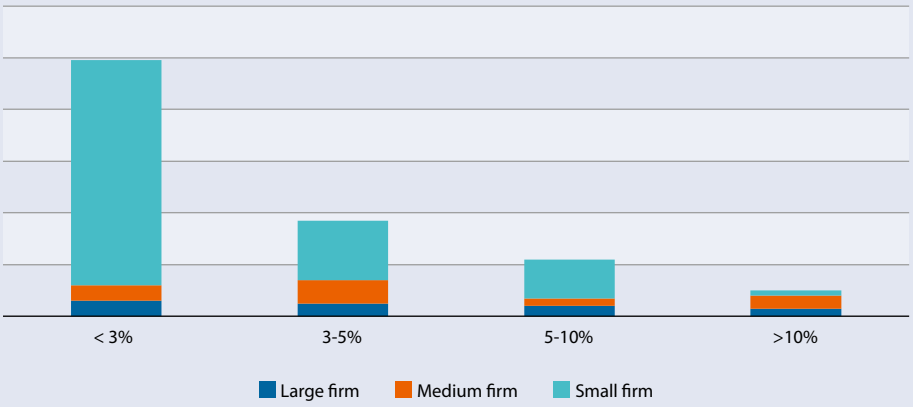
5 National Economics University Hanoi (NEU), 2023, Solutions to Promote Innovation in manufacturing enterprises by 2030, *Giải pháp thúc đẩy đổi mới sáng tạo trong doanh nghiệp sản xuất, đến năm 2030*.

illustrates the differences between large and small companies in innovation activities. Nearly all small companies lacked in-house R&D activities, whereas 100% of large companies and over 50% of medium-sized companies engage in R&D. Some large companies also conduct external R&D, such as collaborating with partners to develop products or technologies, or hiring experts from research institutes and universities.

The medium and large-sized companies engage in a broad range of innovation-related activities, including: 1. research and development (R&D), 2. technical activities, 3. marketing and branding, 4. human resources training, 5. software development, 6. machinery, and 7. innovation management. In contrast, only about 25% of small companies focus on upgrading machinery, technology, equipment, software, innovation management, and human resource training.

FIGURE 2

THE PERCENTAGE OF PRE-TAX PROFITS ALLOCATED TO ESTABLISH AN R&D FUND

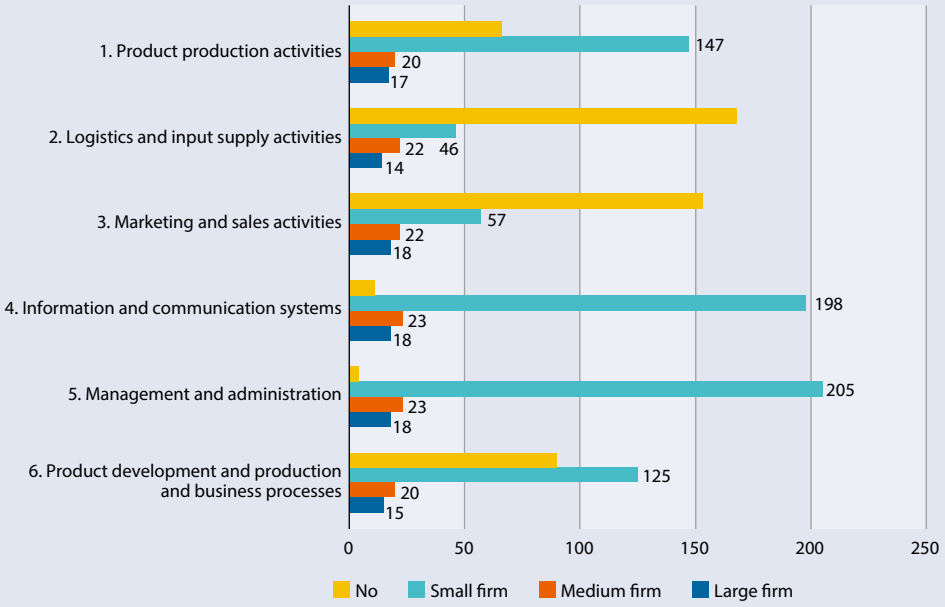


Source: NEU, 2023

Regarding the budget for innovation, large companies allocate profits to R&D funds, with more than half dedicating less than 5% of pre-tax profits (Figure 2). Four companies allocate less than 10%, while three companies allocate more than 10%. Conversely, only half of small companies allocate profits to an R&D fund, with most allocating less than 3% of pre-tax profits.

FIGURE 3

INNOVATION ACTIVITIES RELATED TO MANUFACTURING AND BUSINESS OPERATIONS

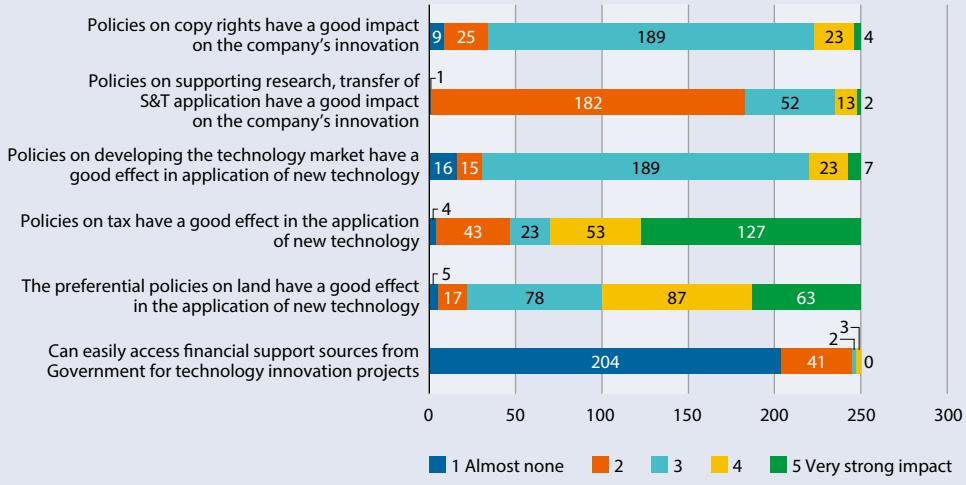


Source: NEU, 2023

Innovation activities in large and medium-sized manufacturing companies are present across all stages of their operations, whereas small companies show limited innovation, primarily in logistics, marketing, and sales. Figure 3 illustrates that most small companies focus their improvements on areas directly related to production and management.

FIGURE 4

IMPACT OF GOVERNMENT POLICIES ON INNOVATION ACTIVITIES WITHIN ENTERPRISES

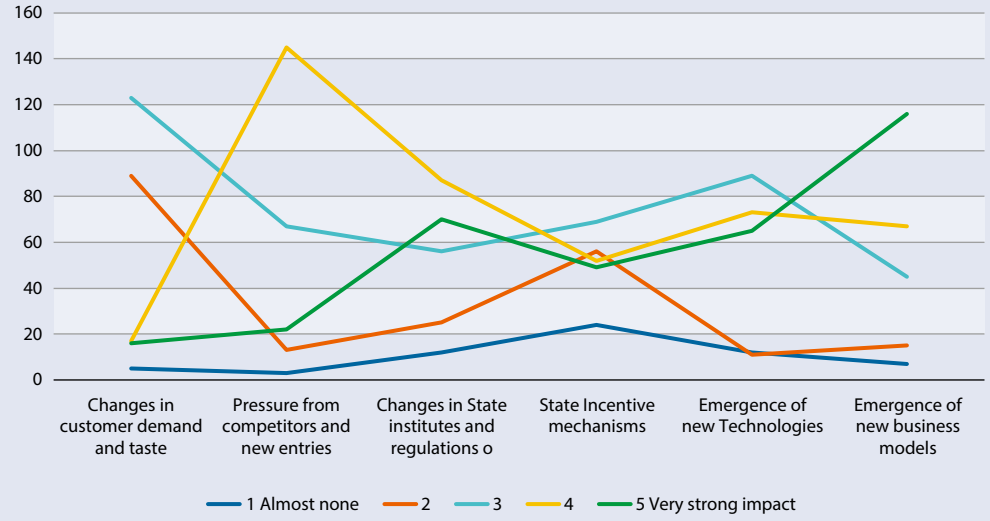


Source: NEU, 2023

When asked about the impact of government policies on the motivation and actions related to innovation within their companies, responses varied considerably. Nevertheless, most companies agree that it is quite challenging to access government support for financial or credit assistance related to innovation or technology upgrades (Figure 4).

FIGURE 5

FACTORS INFLUENCING THE PROMOTION OF INNOVATION ACTIVITIES WITHIN ENTERPRISES

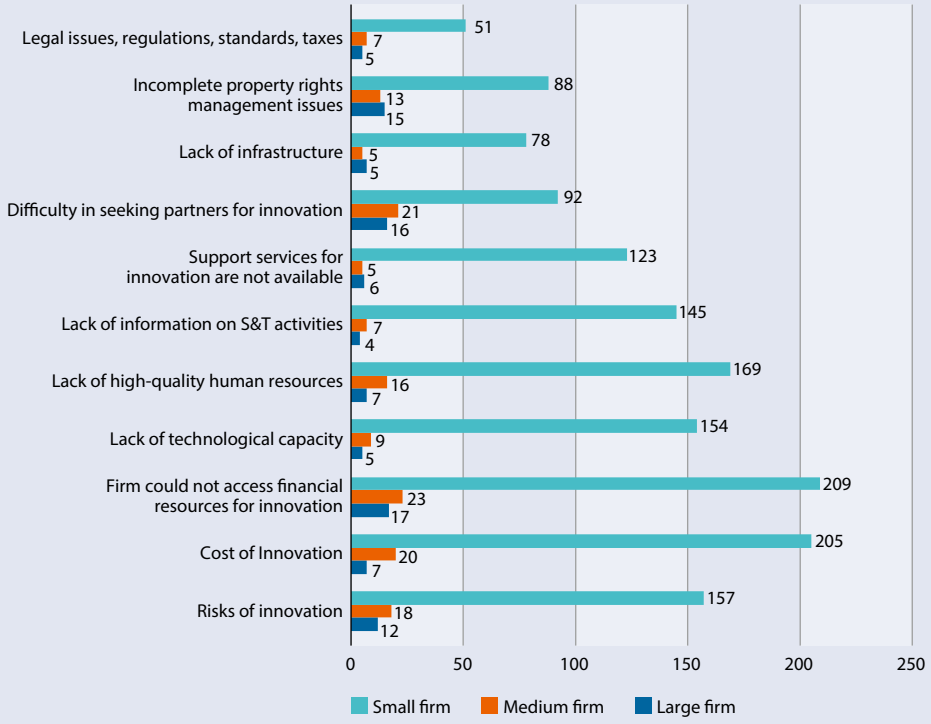


Source: NEU, 2023

Regarding the factors influencing and obstructing innovation activities within enterprises, Figure 5 shows that the most significant drivers are the pressure from competitors and new entrants, as well as the emergence of new business models. On the other hand, the most substantial barriers are issues related to funding and costs for innovation, with 100% of small firms affirming this challenge. Additionally, the lack of high-quality human resources is a major impediment for small businesses, followed by insufficient technological capacity and limited information on science and technology activities (Figure 6).

FIGURE 6

BARRIERS AFFECTING THE PROMOTION OF INNOVATION ACTIVITIES WITHIN ENTERPRISES



Source: NEU, 2023

3. Policy Instruments for Enhancing Technological Capabilities and Innovation of SMEs

Table 1 indicates that several government policies in Vietnam are directly aimed at fostering innovation within manufacturing enterprises. These include Program 712 on enhancing productivity and quality, Program 68 on supporting industries, and the National Technology Innovation Programme. Additionally, enterprises investing in manufacturing within industrial zones are entitled to corporate income tax incentives under tax legislation, which provides a two-year tax exemption and a 50% reduction in tax liabilities for the next five years of production and operations. This constitutes a standard incentive for manufacturing enterprises and is not specifically related to innovation activities, yet it is of considerable importance and is consistently highlighted by manufacturers.

TABLE 1

POLICY INSTRUMENTS FOR FOSTERING INNOVATION IN MANUFACTURING COMPANIES

Program	Ministry and Duration	Third Parties	Policy Type	Objectives and Main Contents
Program 712 on enhancing productivity and quality	MOST 2010-2020 2020-2030	MOIT BAs, BDSs	supply-side	To enhance the productivity and quality of Vietnamese companies - Support for adopting international quality management systems - Development of new national standards (TCVN) - Publish guidebooks on productivity and quality
Program 68 on supporting industries	MOIT 2018-2025	BAs, BDSs	supply-side and systemic	To enhance the competitiveness of Vietnamese companies and connect them to global value chains - B2B Vietnam suppliers to FDIs/ export - Support Vietnam enterprises to apply management systems to meet the requirements of GVCs - Improve human resources as a global manufacturing requirement - Support the application of technology transfer and innovation - Building a supporting industry database
National Technology Innovation Programme	MOST 2013-2020	—	supply-side	To enhance national scientific and technological capacity - Enhance the technological absorption capacity of Vietnam enterprises - Support Vietnam enterprises being innovative
Tax legislation	MOFA 1999-2014 2014-2030	—	systemic	To attract investment by corporate income tax incentives: a two-year exemption and a 50% reduction for the next 5 years

Source: Author

3.1 Program on enhancing productivity and quality (Program 712)

3.1.1 Overview about Program 712

In 2010, the Prime Minister approved Decision No. 712/QD-TTg regarding the national program "Enhancing the Productivity and Quality of Products and Goods of Vietnamese Enterprises by 2020" (Program 712). Over 10 years, Program 712 has created significant transformations in promoting productivity and quality in Vietnam, laying the foundation for thousands of enterprises to improve their competitiveness and reputation in both regional and international markets.[6]

After a decade of implementation, around 15,000 enterprises have been guided in applying new models to enhance productivity and quality (P&Q). Many enterprises have adopted international quality management systems (such as ISO 9000, ISO 14000, IATF 16949, etc.) and basic improvement tools (such as 5S, Lean, or Six Sigma, etc.). Following consultations and the implementation of these systems and tools, enterprise productivity has increased by 30-40% compared to prior levels.

Additionally, the program has contributed to the development of a Vietnamese Standard (TCVN) system with nearly 13,000 standards, 60% of which are harmonized with international standards, covering most sectors. This system serves as the foundation for quality management activities in production, business, and trade. In addition to focusing on developing standards for key product groups, the Ministry of Science and Technology (MOST) has proactively collaborated with various ministries and sectors to develop standards for strategic sectors such as smart cities, smart manufacturing, high-tech agriculture, organic agriculture, barcodes, traceability, renewable energy, information security, climate change, water resource management, waste treatment, food safety, supporting industries, and mechanical engineering.

The program has also produced and published 40 books with over 50,000 copies and more than 120 types of materials aimed at disseminating, guiding, and training different audiences on P&Q. The application of advanced productivity and quality management systems, improvement tools, and the criteria of the National Quality Award model has helped tens of thousands of businesses improve product and goods quality, reduce error costs, enhance labor productivity, and boost competitiveness. Moreover, the program has developed a nationwide team of P&Q experts and raised awareness and knowledge about P&Q, especially within enterprises.

3.1.2 Companies

Thanh Long company

Thanh Long Electronics Production Company (Thanh Long) JSC is located in Hap Linh Industrial Zone, Bac Ninh province. It was established in 2007 by two founders: a skilled technical worker, who had served in a Korean firm producing printed circuit boards (PCB) in Seoul for more than five years, and a graduate from NEU with no previous experience in the electronics industry. Table 2 shows the development of Thanh Long.

The company produces PCB, coil transformers, and PCB assembly (PCBA) for about 10 clients. The most important buyer is the tier 1 supplier of Samsung – RFTech Vietnam, who contributed 60% to its PCB and transformer output and 40% of its turnover. In 2023, total sales reached $17.8 million with 110 workers, a 4-fold increase from 2011, before the business began supplying RFTech. In 2021, the company started exporting PCB to Germany, which accounted

6 Ministry of Science and Technology (MOST), Program 712 – Establishing Credibility for Enterprises, *Chương trình 712 – Khởi tạo uy tín cho doanh nghiệp*. Available at https://www.most.gov.vn/vn/Pages/chitiettin.aspx?IDNews=19026 (Accessed on 30 August 2024).

for 6% of total sales, and became a tier 1 PCB supplier in Canon's Vietnam supply chain. The company has received ISO 9001 and ISO 14001 certifications and UL marks for different product items. Being a successful supplier to RFTech (and as such a tier 2 supplier to Samsung) helped Thanh Long to approach Samsung Vietnam in 2019 to become a tier 1 supplier for high-tech household appliances.

TABLE 2

DEVELOPMENT OF THANH LONG COMPANY

2007	Began producing PCB
2010-2011	TAC supported 5S system development
2012	Became supplier of RFTech – the tier 1 supplier of Samsung
2018	VASI supported the adoption of UL marks
2016-2020	Began matching with MNCs yearly through VASI
2019	Became a tier 1 supplier for high-tech Samsung household appliances
2021	Began exporting to Germany

Source: Author

The company has received support from Program 712, through the Northern Technical Assistance Center (TAC) of the Ministry of Planning and Investment and VASI, in various productivity and quality improvement activities, and B2B activities with MNCs. The company highly values TAC's expert advice during the implementation of 5S and VASI's consultancy for obtaining UL marks.

According to the Thanh Long's CEO, the most difficult aspect of implementing 5S came from the last two Ss, maintenance and management of the system. He realized that 5S had been well employed at Jaguar's Vietnam factory, where there was only one Japanese monitor, but the system had hardly been implemented successfully yet by any Vietnamese company. This meant to him that either the industrial awareness of the Vietnamese was lower than that of foreigners, or the management system at the foreign manufacturers was better. He believed in the second statement. Thus, with the sustainable support of TAC in the three years following Program 712, the company focused on managing the implementation of the 5S system, instead of merely building the system. It took a long time, but they achieved a more sustainable operation. Based on that experience, the Kaizen plan was then built annually with clear targets and plans for each production stage.

The most challenging aspect was achieving the UL mark, which is required by nearly all global electronics buyers, including RFTech and Samsung. Understanding the crucial role of the UL system, with VASI experts, the company spent nearly 15 months not only working to gain its first certification but also to set up the most efficient UL process. Based on general and specific UL requirements,[7] such as that the defect rate and product lead time needed to meet the safety of electronic equipment users, the UL team built the action plan with detailed requirements for each process stage. The team delivered weekly reports to the CEO about issues, solutions, and progress. Consequently, passing the UL mark requirement also helped the company in optimizing its production process, leading to reduced costs, ensuring product quality, and meeting safety requirements. Thanh Long was certified ISO 14001 in 2013 and UL in 2018. So far, the company

7 Thanh Long was required to comply with UL V-0, which requires correct material and standardized production process to manufacture products under the V-0 fire rating. It means, when burning the product on an alcohol light and then turning off the flame, the burning must be done in a maximum of 10 seconds.

has achieved 2 UL certifications for 10 product items, which is the same as many large FDI electronics firms in Vietnam.

The company has received strong support from TAC, VASI, and Bac Ninh Province since its establishment and during more than 15 years of development. However, the company has encountered difficulties with import and export tariffs, which are quite intricate and unsupportive to multi-level part manufacturing. For example, inductors for power supplies for automatic data processing machines have no import tariffs, but bobbin components to produce the inductors face a tariff of 12%. Also, while the import tariff for machinery is 0%, the import tariff for spare parts of the same machine is about 7-10%. The tariffs are inconsistent in calculating tier-component taxes (both inductors and bobbin are components), and obviously, discourage firms from producing components. Furthermore, the company has plans to invest in the production of multilayer circuit boards to supply Samsung's smartphones. In 2021, the company intended to submit an R&D project for government funding, but suspended the process due to the complexity of the procedures. As of now, the company remains unprepared to undertake this technological transition.

Export Mechanical Tools Joint Stock Company (EMTC)

Founded in 1960 as a state-owned enterprise, Export Mechanical Tools Joint Stock Company (EMTC) transitioned into a joint-stock company in 2001, with all shares owned by its employees (Table 3). Throughout its more than 60 years of development, the company has consistently prioritized technological advancements, product quality improvements, and system optimization, while maintaining steady growth. It employs thousands of workers and generates revenue of about 15% annually.

Currently, the company operates 10 production plants, covering an area of over 50,000 m^2 at Quang Minh Industrial Park, Me Linh, Hanoi. EMTC specializes in hot forging, precision machining (robot welding, milling, turning, bending, multi-step stamping, etc.), heat treatment, and surface treatment. The company is equipped with advanced machinery and technology lines, and all products undergo rigorous quality control processes, adhering to international standards. This includes strict management of raw materials and end products within a comprehensive and closed-loop process. Through these efforts, the company has obtained numerous international quality certifications, including IATF 16949, ISO 9001:2015, ISO 14001:2015, BSCI, and CE. The company has received support from Program 712, through VASI, in the application and certification of IATF 16949 and CE, which are the most important for the company to supply to automobile clients and export to Europe.

TABLE 3

DEVELOPMENT OF EMTC

1960	Became a mechanical SOE
2001	Acquired equities to become a Joint Stock Company
2002	Became a Honda motorcycle tier 1 supplier
2011	VASI supported the adoption of CE marks
2012	Began exporting to Germany (BBQ grilling tool set, OEM-Original Equipment Manufacturing production)
2015-2016	VASI supported the adoption of IATF 16949
2016-2020	Began matching with MNCs yearly through VASI
2017	Became a Toyota tier 1 supplier of mechanical pressing parts
2018	Adopted LEAN Manufacturing with support from P&Q Solution Company (Program 712)
2019	Began exporting to the U.S. (hand mechanical tools, OEM production)
2021	Conducted market research with VASI on elevators in Vietnam
2021	Signed a two-year contract with a marketing consultancy to develop a marketing strategy
2023	Launched the ITEK ELEVATOR brand for the domestic market

Source: Author

The products range includes precision machining components, machine parts, tool kits, automotive and motorcycle spare parts, molds and fixtures, medical equipment, specialized machinery, kitchen accessories, and cooking appliances such as grills and gas stoves. EMTC has maintained a high export turnover to Germany, the United States, France, and Japan. Notably, since 2023, the company has introduced its European-standard elevator brand, ITEK ELEVATOR.

The decision to engage in Original Brand Manufacturing (OBM) elevator production arose from the company's experience in producing replacement components for imported elevators in Vietnam. Following market research conducted by VASI, the company opted to manufacture OBM elevators. Imported elevators are costly with long lead times of three to six months, and are only available in standard sizes with limited customization options. These limitations do not align with the space constraints and diverse design needs of Hanoi and Ho Chi Minh City. Moreover, domestic elevators currently in production suffer from inconsistent quality, with many companies competing primarily on price, often using components of dubious origin. Customers frequently encounter difficulties with maintenance, after-sales service, and customer support, leading to diminished trust in "Made in Vietnam" products.

In response to these challenges, EMTC launched the ITEK ELEVATOR brand to address key market gaps. The company has developed a specialized quality management system for elevator production and forged partnerships with trusted suppliers for essential components, such as motors, electrical systems, and safety devices. Leveraging expertise in manufacturing for leading GVCs, EMTC ensures customers receive continuous maintenance and support throughout the elevator's lifecycle. The company has entered into a two-year contract with a marketing consultancy to develop this brand. The scope of the contract includes product segmentation, channel positioning, and the formulation of marketing and sales strategies. The design team collaborates closely with clients and architects to meet specific size requirements, with a production lead time of just 15 days, offering cost-effective solutions. As a result, despite being a recent entrant to the market, ITEK ELEVATOR is projected to contribute 15% of the company's revenue by 2024, within just two years of its launch.

3.2 Supporting Industry Development Program (Program 68)

3.2.1 Overview of Program 68

The Supporting Industry Development Program (Program 68) was implemented under Decree No. 111/2015/ND-CP dated November 3, 2015, on the development of supporting industries, and Decision No. 68/QD-TTg dated January 18, 2017, approving the Supporting Industry Development Program from 2016 to 2025. Accordingly, from 2018 to 2023, the Vietnam Industry Agency (VIA) under the Ministry of Industry and Trade (MOIT) has presided over the implementation of Program 68 with 306 projects and a budget of nearly 700 billion VND.[8] The projects are implemented with five main goals: (1) Connect and promote supporting industry enterprises to become suppliers and exporters of FDI in Vietnam (2) Support enterprises to apply management systems to meet the requirements of global supply chains (3) Improve human resources as a global manufacturing requirement (4) Support the application of technology transfer and innovation (5) Building supporting industry database. After six years, this program has the participation of most industrial business associations, related business support organizations, and manufacturing SMEs. The program actively contributes to improving the competitiveness of local supporting industry enterprises and successfully initiates connections with MNCs in Vietnam.

After participating in the program's activities, enterprises experienced positive transformations, with enhanced productivity and production efficiency. At the same time, cost reductions and resource savings helped boost the competitiveness of these enterprises while opening up opportunities to seek new potential customers and partners. The program facilitated connections between supporting industry enterprises and domestic and foreign manufacturers, as well as multinational corporations. Information on supporting industries was widely disseminated through media channels, which helped convey the message about the role and importance of supporting industries and manufacturing in the nation's industrialization and modernization process. This information portal has become a platform for businesses, organizations, industry associations, and experts in the field of industry to share their challenges, opportunities, and potential for growth within the sector.

3.2.2 Hung Dung

Hung Dung became a supplier for Jaguar Vietnam in 2013. The company received support from TAC (Program 712) in developing its 5S management system (Table 4). An expert was sent to Hung Dung one day a week for six months, for 5S training and set up, including guiding theory, onsite practice, and production line management. Jaguar Vietnam contacted Hung Dung by the time its 5S system was almost completed. The company purchased 30 new hand welding machines from Germany to fulfil its supply contract with Jaguar. Jaguar sent two experts to Hung Dung for a month-long training in the production process and quality control. Given its previous efforts with the 5S system, Hung Dung was ready in only three months to begin supplying wire harnesses to Jaguar. Jaguar required the company to obtain the UL mark for plastic-wrapped electric cables. With the support of VASI under Program 68, Hung Dung obtained the UL mark in 2018.[9]

8 Ministry of Industry and Trade (MOIT), Implementation of the 2024 Supporting Industry Development Program, Triển khai Chương trình phát triển Công nghiệp hỗ trợ năm 2024. Available at https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/trien-khai-chuong-trinh-phat-trien-cong-nghiep-ho-tro-nam-2024.html. (Accessed on 12 September 2024)

9 The UL mark for plastic wrapped electric cables requires Hung Dung to use input electric cables certified as UL in its production. The company has to undergo unprecedented scrutiny by UL engineers four times per year.

TABLE 4

DEVELOPMENT OF HUNG DUNG

2010	Began producing wire harnesses
2013	TAC supported 5S system development and became a supplier for Jaguar (Program 712)
2018	VASI supported the adoption of UL marks (Program 68)
2018-2020	Began matching with MNCs yearly through VASI (Program 68)
2019	Began producing LEDs for domestic markets
2019-2023	Began technical training courses by VASI (Program 68)

Source: Author

For the last six years, Hung Dung has been the only wire harness supplier for the Jaguar factory in Vietnam, with production volume increasing consistently by about 20% annually. They believe that the key factors to maintain its stable supplier status with Jaguar still lie in an enthusiastic attitude towards cooperation and good production management ability. These products are comparatively labor-intensive, and the company has increased its labor productivity by about 50% over this period. However, after years of supplying to Jaguar, the company has not been able to develop linkages to any new FDI customer. Under VASI's recommendation as a part of Program 68, Samsung Vietnam has audited the company twice in its efforts to develop a local wire harness supplier. Hung Dung received a "C" from Samsung, indicating a large gap with respect to Samsung's standards, including machinery, technology, and production management.

Besides Samsung, under Program 68, the company is familiar with the demands and requirements of other FDI firms such as Canon and Panasonic Vietnam. Supplying those more sophisticated customers requires a very large production scale, the quality of the electric cables for wire harnesses needs to be upgraded, and the management of costs needs to be more efficient. The latter implies a huge investment that Hung Dung has estimated might reach US$2 to 4 million. The large scale of the investment, in addition to the estimated risk and return, has kept Hung Dung from more aggressively pursuing linkages with the MNCs alluded to above. It is extremely hard for domestic enterprises to access loans. While the Government has a loan rate support program for companies through some commercial banks, Hung Dung has not been able to access it due to the lack of reciprocal capital and mortgage assets. Hung Dung has been borrowing mainly from Vietinbank at a rate of about 8% per year, and can possibly borrow the necessary funds at that rate to finance this investment. They estimate, though, that the profit for the first three years could be low for the level of risk being undertaken. A subsidy from MOST could fund up to 30% of the investment, and thus reduce Hung Dung's risks. However, the procedure for securing the funds is a long (it could take about a year) and complicated one, so they are not actively pursuing this opportunity yet.

Meanwhile, the company is also looking at opportunities to massively increase the scale of its LED production for the domestic market, despite tremendous challenges involving higher productivity requirements associated with this. Another challenge for Hung Dung is maintaining a stable input supply for LED light production. It currently imports all of its inputs for LED light production, including LED chips from Singapore, and plastic and aluminum parts from China. Its domestic supply currently involves plastic and aluminum molds, of which the higher quality products are mostly supplied by Japanese firms in Vietnam, while the lower quality ones are expensive and cannot meet the production requirements. According to the CEO, there is limited information about and linkages with domestic suppliers. The company does not know of any official information

source for potential Vietnamese suppliers, and relies mostly on the Internet or introductions through acquaintances. In order to compete, Hung-Dung needs to invest itself in developing its own inputs, in new machines for plastic compression, electric cables, and SMT (Surface Mount Technology) machines.

3.3 National Technology Innovation Programme

3.3.1 Overview of the National Technology Innovation Programme

The National Technology Innovation Programme, approved by the Prime Minister under Decision No. 677/QD-TTg on May 10, 2011, and assigned to MOST as the coordinating agency, aims to enhance national scientific and technological capacity and the technological absorption capacity of enterprises. The program also seeks to create key and strategic products in line with state policies and orientations, as well as to develop new Vietnamese-branded products and goods that are competitive in terms of quality and cost.

The program was implemented nationwide with the participation of ministries, sectors, local authorities, research institutes, universities, associations, and businesses. Over the course of seven years (from 2013 to 2020), the program received over 500 proposals and selected 58 qualified units to participate in the assigned tasks. Of these participants, 65% were enterprises, and they mobilized VND 1,320 billion in counterpart funding, accounting for 70% of the total implementation budget, with only 30% (VND 560 billion) coming from state budget support.[10] The tasks were carried out across more than 20 provinces and cities, including several economically disadvantaged areas, and across various technological fields, significantly contributing to the socio-economic development of these regions. The inputs for some of these tasks were the results of applied research from other basic research programs. The program focused on research and implementation within production chains and value chains, creating linkages between tasks along the value chain. It also encouraged businesses to invest in scientific research, application, and the transfer of new and advanced technologies, especially those relevant to the Fourth Industrial Revolution.

Through the program, enterprises have achieved impressive results. Hundreds of technologies and technological processes have been absorbed and mastered, with dozens of patents and utility solutions registered for protection. Labor productivity increased significantly, with some businesses experiencing a 5.4-fold increase in productivity after technology innovation. Products now meet domestic market demands and stringent international standards, and enterprise revenues have more than doubled. The total revenue of the projects before technological innovation was approximately VND 6,477 billion, and after 1 to 3 years of technological innovation, this figure rose to around VND 14 trillion. Profits increased by approximately 2.4 times compared to pre-innovation levels.

3.3.2 Hanel PT

Established in 2000, Hanel PT is one of the first pioneering enterprises in manufacturing, processing, and importing and exporting high-tech electronic components. Working closely with Japanese partners, Hanel PT understands and has mastered piezoelectric ceramic technology and electronic circuit boards - one of the leading manufacturing technologies in the electronics industry today. In particular, Hanel PT has successfully researched, developed, and produced a series of freezing dryers and smart processors under the Sasaki brand, helping to enhance the position and value of Vietnamese agricultural products, medicinal herbs, and seafood. The products have been

10 Ministry of Science and Technology (MOST), National Technology Innovation Programme until 2030 - New Phase, New Goals, Chương trình đổi mới công nghệ quốc gia đến năm 2030 - Giai đoạn mới mục tiêu mới. Available at https://www.most.gov.vn/vn/Pages/chitiettin.aspx?IDNews=20489 (Accessed on 12 September 2024).

successfully exported to Japan. In 2016, the company began researching and producing freeze dryers, and its sales increased sevenfold, from US$5 million in 2017 to nearly US$35 million in 2023 (Table 5).

TABLE 5

DEVELOPMENT OF HANEL PT

2001	Began manufacturing piezoelectric ceramic for high-tech electronic components
2002	Began 100% export to Japan
2014	Began manufacturing electronic circuit boards (PCBA)
2015-2016	VASI supported the adoption of IATF 16949
2016-2020	Began matching with MNCs yearly through VASI
2017	Became Brother's tier 1 supplier of PCBA
2016	Started research on producing freeze dryers
2017-2018	Received a grant from the National Technology Innovation Programme for R&D for producing freeze dryers
2019	Launched the Sasaki brand for the domestic market
2020	Adopted LEAN Manufacturing by P&Q Solution Company (Program 712)
From 2020	Continued to invest 20%-25% of its post-tax profits into R&D activities to upgrade its freeze dryer technology
2022	Began exporting Sasaki to Japan
2023	Began the initiative "Green Vietnam Project" in collaboration with the Center for Organic Agriculture Promotion and Studies to support agricultural products of about 10,000 farms

Source: Author

The company secured granting from the National Technology Innovation Programme for the years 2017 and 2018, amounting to approximately US$120,000 to support the R&D of manufacturing freeze dryers. This financial allocation was primarily designated for research personnel and related materials and inputs, excluding machinery and technology. This approach represents the most straightforward method of obtaining government program support. However, the relatively modest sum served as supplementary support rather than the principal funding source. The core R&D budget remains derived from the company's annual profits. Although the external funding was limited, it provided a significant incentive for the company to excel and facilitated access to information on innovative projects conducted by Vietnamese research institutions. Leveraging this support, the company successfully developed the "Made in Vietnam" Sasaki dryer line, achieved technological mastery, and is positioned to lead the dryer industry. The company continues to invest 20%-25% of its post-tax profits into R&D activities. Additionally, it consistently engages in activities aimed at reducing costs, enhancing productivity, and optimizing production processes. In 2023, the company implemented hundreds of improvement proposals, with each employee contributing at least one improvement topic per month.

In an effort to support agricultural products, the Green Vietnam Project, initiated by Hanel PT in collaboration with the Vietnam Organic Agriculture Center, aims to assist 30,000 farms across the nation by 2025. The project focuses on reducing the use of chemical fertilizers, improving soil quality, and decreasing carbon emissions in agriculture, livestock, and cultivation practices. To date, nearly 10,000 farming households have participated in the initiative.

3.4 Policy Effectiveness in enhancing companies' technological capabilities

The selected case studies all participated in the Program 712, aimed at enhancing productivity and quality. Additionally, EMTC and Hung Dung participated in Program 68, while Hanel PT participated in the National Technology Innovation Programme. These companies were chosen due to both their similarities and differences in the support programs they engaged with. All four companies exhibit a relatively positive impact of government policies on the enhancement of their innovation capabilities. However, the extent of these impacts varies across the companies. The below table presents the impacts of enhancing the technology capabilities and innovation-related activities undertaken by the companies. There are three levels representing the impact, with the lowest level indicating minimal or no impact.

TABLE 6

POLICY IMPACT IN ENHANCING THE TECHNOLOGICAL CAPABILITIES OF THE COMPANIES

Impact	Thanh Long	EMTC	Hung Dung	Hanel PT
Programs	712	712, 68	712, 68	NTI Programme, 712
Increase investment in R&D	●	●●	—	●●●
Product innovation	●●	●●●	●	●●●
Business process innovation	●●●	●●	●●	●●●
Upgraded R&D/innovation management system	●●	●●	—	●●
New recruitment of innovative resources	●	●●	—	●●
Export existing products to more demanding/profitable markets	●●	●●●	—	●●●
Diversification into new products	—	●●●	—	●●
New market segments	●●●	●●●	●	●●●
Upgrade position in value chains	●	●●●	—	●●●
Produce more technologically sophisticated/higher value-added components locally	●●	●●●	—	●●●

Source: Author

Table 6 shows that EMTC and Hanel PT are the two companies that have innovated the most and effectively leveraged the policy support. Specifically, both companies have undergone comprehensive innovation, transitioning from ODM to OBM for the domestic market and, in the case of Hanel PT, for exports as well. In contrast, Hung Dung exhibited the least change, remaining focused on manufacturing wire harnesses for its long-standing customers for nearly 20 years, despite increased production volume. As for Thanh Long, although it initially experienced rapid growth within Samsung's supply chain, it later stagnated at the first tier of suppliers for Samsung TVs, failing to innovate or invest further to upgrade its production to include PCBs for Samsung's mobile phones. Both of these companies maintained their existing products and technologies, focusing primarily on increasing output and market. Thus, the policies have different impacts on those companies, considering the following aspects:

Management capabilities: Table 6 illustrates the impact of policies on innovation activities, where EMTC and Hanel PT demonstrate better outcomes compared to the other two. The two companies have better management systems, with ISO 9001, 14001, and IATF 16949 certifications. Meanwhile, the other two companies only have ISO 9001. This suggests that the company with a better management system tends to absorb policies more effectively.

Innovation learning capabilities: EMTC is a company with limited internal innovation capabilities, so it outsourced to consulting firms to support activities such as market research, branding, and other areas outside the expertise of a manufacturing company. After establishing dominance in the domestic elevator market, the company's staff took over the management of innovation and further developed the strategies and initiatives initially designed and implemented by the consulting firms. Meanwhile, Hanel PT invested in building an in-house R&D team. This indicates that the capabilities in innovation and learning of these two companies are significantly higher than those of Hung Dung and Thanh Long. The latter two companies, after receiving government program support, only maintained their innovation activities without developing new ones or investing in learning capabilities. This demonstrates that the level of innovation in companies heavily depends on their learning capacity, and the initial phase can have a substantial impact on subsequent innovation activities. Thus, policies should be designed with longer durations, for example, two years instead of one, to create sustained motivation for innovation rather than merely stopping at implementation activities.

Substantial support from policies appears to motivate further innovation: EMTC and Hanel PT received greater and longer-term support from policies, which enabled them to innovate more and achieve OBM production. Companies that receive more support tend to increase investment in R&D, product innovation, and upgrading their positions in value chains, these being the most critical pillars for corporate innovation. The remaining companies typically receive support from policies for only one year, making it challenging to sustain the momentum of innovation within the organization.

Policy barrier: The complexity of application procedures and the requirement for the success of innovation projects under the National Technology Innovation Programme were overcome by Hanel PT, while the other three companies did not participate. This was also identified as the main reason when four other companies interviewed by the research team were asked why they did not participate in the National Technology Innovation Programme. Thus, the primary barrier of this policy is quite evident.

Institutions affecting the effectiveness of policies

Currently, Vietnam's policies related to supporting SMEs in improving productivity, quality, and innovation are relatively comprehensive. Among these, the three key programs—Program 712, Program 68, and the National Technology Innovation Programme—primarily focus on enhancing the capacity of enterprises. These supply-side policies are designed to boost incentives for investing in innovation by reducing costs. However, demand-side technology policies, such as government procurement, have not yet been formally established or implemented at the national level. Certain activities under Program 68, which involve fostering innovation and connecting with customers, can be viewed as systemic technology policies. Nevertheless, the technological aspect remains relatively vague, with a primary emphasis on business networking rather than direct technological advancement.

The support activities aimed at enhancing productivity and quality involve technical assistance, such as that provided by Program 712 and Program 68, which are led by MOST and MOIT. These programs are implemented primarily by third parties such as business support organizations, including associations, technical support centers, productivity institutes, and private consulting firms. This approach is highly valued by businesses for its effectiveness, as intermediary organizations have a deep understanding of the SMEs they serve and actively engage with them. In contrast, the National Technology Innovation Programme managed by MOST provides direct support for R&D and investment in new technologies. This support requires enterprises to submit proposals, manage implementation, and handle disbursements themselves, making the process quite complex. This complexity and bureaucracy represent a significant barrier for SMEs in accessing these funds and leveraging them as a catalyst for innovation. As a result, companies such as Thanh Long and Hung Dung, as well as others interviewed, have refrained from pursuing innovation or investing in new technologies.

On the other hand, these programs are implemented within the scope of individual ministries, with limited collaboration between different ministries. The cooperation between businesses and universities/research institutes has not been reported in the companies interviewed, indicating that such linkages have not been effective. Although the policies are clear, businesses' engagement with the programs remains passive, with few companies taking an active approach. In particular, the requirements of the National Technology Innovation Programme are more challenging, which is why very few companies have accessed and benefited from it. Furthermore, the National Technology Innovation Programme also requires activities to be effective, meaning that failures are not accepted, which discourages small and medium-sized private companies from participating in the program.

Although annual evaluation reports are available for each program, a comprehensive overview of the support activities aimed at improving productivity, quality, and innovation within enterprises is still lacking from a policy perspective. There is a need for third-party evaluations of the support programs and monitoring and evaluation activities to gather insights, collect feedback, and make supplementary adjustments based on the ongoing needs of enterprises.

Despite rapid credit growth in Vietnam, manufacturers continue to face challenges in accessing financing for innovation. Enterprises require diverse funding methods as they progress through various stages of their lifecycle. While investment funds have emerged at most stages of the startup lifecycle, they remain relatively small. This situation arises from issues on both the supply and demand sides. On the demand side, many companies cannot develop business plans to seek funding and do not possess investment projects with high growth potential. On the supply side, many incentives remain "on paper" due to cumbersome and administratively heavy procedures that diminish accessibility for businesses. Management mechanisms have not kept pace with the development of innovative startups, thereby becoming a barrier rather than facilitating access to funding.

4. Conclusion and Policy Recommendations

4.1 For existing policies

Capacity building as a priority for innovation: SMEs' capabilities play a crucial role in improving productivity and innovation of the manufacturing sector in Vietnam. The case study shows that two companies, EMTC and Hanel PT, have better management systems, enabling them to innovate faster, achieve more success, and be more sustainable. Supporting manufacturing SMEs should begin with fundamental reforms in organizational and management practices, enabling companies to implement and adjust new processes, and eventually adopt more complex technological knowledge associated with Industry 4.0. Alternatively, it is necessary to select companies that already have an internationally recognized management system to implement innovation at a higher level. Bridging the capacity gap is crucial for both the absorption of new technologies in production processes and the development of digital services. The companies must be at the center of national innovation policies as the primary entities utilizing knowledge, rather than focusing solely on the academic sector for R&D activities.

Financial support is a key driver for innovation: The successful adoption of new technologies involves not only the acquisition of machinery and equipment but also the full integration of these assets into the company's production and business processes. Two companies in the study, Hung Dung and Thanh Long, have experienced slow development and poor innovation because they did not invest financially at the right time. This was due to the high bank loan interest rates, which were too high compared to the profit margins of the new production technologies they intended to invest in or expand. Currently, the government has implemented policies to support loan interest rates for businesses, but these are not considered relevant to innovation. As a result, manufacturing enterprises are not prioritized, and most of the support goes to businesses with a strong post-portfolio, mainly in the service and trade sectors. It is necessary to revise these funds to prioritize manufacturing companies, allowing them to access low-interest loans, similar to how technology enterprises are supported.

Accepting failure when implementing innovation projects is important: The National Technology Innovation Programme is an effective support program, as seen in the case of Hanel PT. However, because the program stipulated that only successful innovation projects are eligible, companies are hesitant to apply. Additionally, the paperwork and procedures are still too complicated and bureaucratic, with a high rejection rate, which makes SMEs less enthusiastic about participating. This program needs to be revamped to better align with the needs of businesses. Most importantly, it should accept a certain percentage of failure to encourage SMEs to take risks and innovate.

Annual monitoring and evaluation: These programs have had a positive impact on the innovation activities of businesses, particularly Programs 712 and 68. However, they need to be evaluated by a third party and adjusted annually to better meet the innovation needs of businesses. In this context, regarding the innovation capacity of businesses after benefiting from the policy, criteria such as those in Table 6 can be considered as the KPI for evaluation, such as: Increase investment in R&D, Product innovation, Business process innovation, Upgraded R&D/innovation management system, New recruitment of innovative resources, Export existing products to more demanding/profitable markets, Diversification to new products, New market segments, Upgrade position in value chains, Produce more technologically sophisticated/higher value-added components locally. In particular, all the policies should be made more accessible, with simplified procedures and longer project durations.

4.2 New policy measures initiating

4.2.1 Comprehensive program for productivity, quality, and R&D

The case study demonstrates that the manufacturing sector primarily benefits from government policies aimed at enhancing productivity (Programs 68 and 712), yet it has limited access to subsidies for R&D activities. Of the eight companies interviewed, only Hanel PT received subsidies from the National Technology Innovation Programme. As these enterprises improve productivity and quality, strengthen their integration into global value chains (GVCs), and expand their operations, it is anticipated that they will increase investments in technology and R&D. This investment is crucial for enabling them to move towards higher value-added products or transition to Original Brand Manufacturing (OBM).

We propose a more comprehensive support program, which was frequently mentioned by the companies during the interviews with the research team. They require more extensive support to envision and pursue a long-term innovation strategy with distinct stages. The comprehensive program is expected to vary significantly across different stages of the process: the initial phase typically involves technical assistance, such as guidance on standards and connections with multinational corporations, while subsequent stages demand financial and technological support for R&D and brand development. The well-integrated program that combines these activities and incorporates third-party guarantees or joint implementation could provide businesses with a clear, proactive strategy from the outset. This would facilitate improved resource planning and more efficient execution, potentially reducing the R&D timeline. Conversely, the effectiveness of policy implementation, when evaluated against the criteria outlined in Table 6, would become more evident, occur more promptly, and yield higher quality outcomes.

4.2.2 Program for Supporting the Transition from OEM to OBM

The case studies reveal that while most manufacturing SMEs involved in GVCs with lead firms demonstrate strong production capabilities, they predominantly produce low-value-added products and remain heavily dependent on foreign inputs. For companies transitioning from OEM to OBM, such as Hanel PT and EMTC, the critical innovation lies in developing proprietary products that capitalize on their unique competitive advantages.

Therefore, rather than offering generic R&D support, it is crucial for the government to establish a targeted program aimed at assisting OEMs in their transition to OBMs. Such a program could encompass activities including market research for end products, competitor analysis, assessment of technology levels and investment requirements, facilitation of credit access, support for brand development and distribution channels, and assistance with export activities. As demonstrated in this study, Hanel PT developed a dedicated workforce, while EMTC engaged external consultants in this domain, both of which contributed to their success. Currently, these components are often dispersed across various support programs managed by different ministries. Consequently, integrating them into a cohesive, comprehensive program specifically designed for OEMs transitioning to OBMs would be more effective and better aligned with the needs of these manufacturing enterprises.

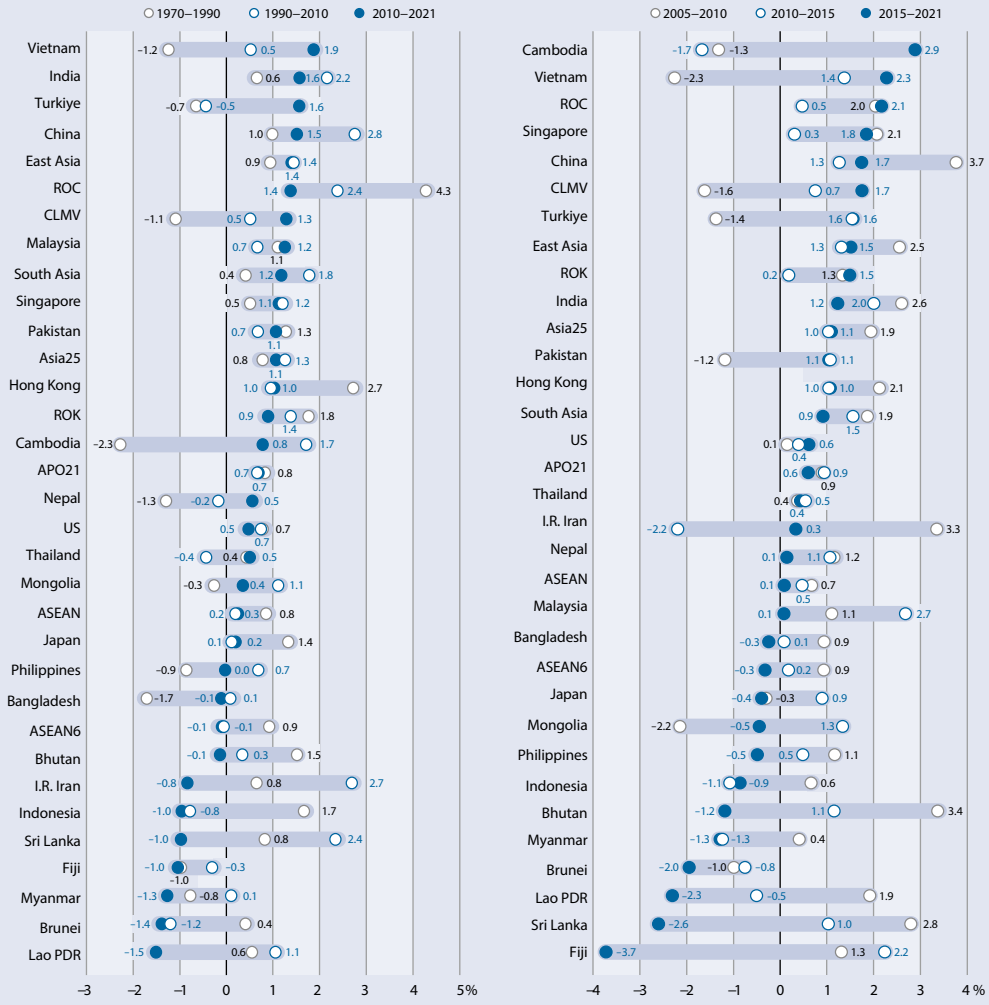
APPENDIX 1

LIST OF INTERVIEWEE COMPANIES

Company and main products	Interviewee and Date	Workforce size	Support from the government relating to productivity, quality, and innovation
Accuracy *Mechanical parts for motorbikes*	Le Tran Hoang Director of Sales 23 Jul 2024	120	- 5S and LEAN consultancy by TAC and VNPI (Program 712) - B2B matching by VASI with MNCs (Program 68)
ANCL Techco *Mechanical components for automobiles*	Nguyen Thi Hanh Deputy Managing Director 16 Aug 2024	150	- Linkage to Samsung, Panasonic, IIT by VASI (Program 68) - Training course on IATF 16949 by VASI (Program 68)
EMTC *Mechanical components OEM and OBM products*	Le Xuan Hiep Vice President 02 Aug 2024	1200	- LEAN consultancy by P&Q Solution Company (Program 712) - CE and IATF16949 consultancy by VASI (Program 712) - B2B matching by VASI with MNCs (Program 68)
Hanel PT *PCBA, Sasaki dryer*	Tran Thu Trang Founder, CEO 23 Jul 2024	280	- Grant from the National Technology Innovation Programme - LEAN consultancy by P&Q Solutions company (Program 712)
Hung Dung *Wire harness*	Nguyen Tien Dung Founder, CEO 02 Aug 2024	85	- 5S consultancy by TAC (Program 712) - UL consultancy by VASI (Program 712) - Some technical training courses by VASI (Program 68)
Kim Sen *Aluminum components*	Hoang Lan Director of Sales 15 Aug 2024	250	- Some technical training courses by VASI (Program 68) - LEAN consultancy by P&Q Solutions company (Program 712)
Mekamic *Mechanical parts for motorbikes*	Mai Manh Hien Founder, CEO 15 Aug 2024	140	- Some technical training courses by VASI (Program 68) - B2B matching by VASI with MNCs (Program 68)
TCI pre *Mechanical components for automobiles*	Le Thanh Binh Deputy Managing Director 15 Aug 2024	130	- LEAN consultancy by P&Q Solutions company (Program 712) - Some technical training courses by VASI (Program 68)
Thanh Long *PCB, PCBA*	Mr. Duc Founder, CEO 18 Jul 2024	110	- 5S consultancy by TAC (Program 712) - UL consultancy by VASI (Program 712) - B2B matching by VASI with MNCs (Program 68)

APPENDIX 2

TFP OF VIETNAM AMONG OTHER COUNTRIES



Source: The 2023 APO Productivity Databook

References

APO (2024). *The 2023 APO Productivity Databook*. Available at: https://www.apo-tokyo.org/publications/apo-productivity-databook-2023/

General Statistical Office (GSO). Năng suất lao động của Việt Nam giai đoạn 2011-2020: Thực trạng và giải pháp. *Vietnam's labor productivity in the period 2011-2020: Current situation and solutions*. Available at: https://www.gso.gov.vn/tin-tuc-thong-ke/2023/02/nang-suat-lao-dong-cua-viet-nam-giai-doan-2011-2020-thuc-trang-va-giai-phap/

General Statistical Office (GSO). *Socio-economic situation report in the fourth quarter and 2023*. Báo cáo tình hình kinh tế xã hội quý IV và V 2023. Available at https://www.gso.gov.vn/bai-top/2023/12/bao-cao-tinh-hinh-kinh-te-xa-hoi-quy-iv-va-nam-2023/ (Accessed on 28 December 2024).

Ministry of Industry and Trade (MOIT). *Implementation of the 2024 Supporting Industry Development Program*, Triển khai Chương trình phát triển Công nghiệp hỗ trợ năm 2024. Available at https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/trien-khai-chuong-trinh-phat-trien-cong-nghiep-ho-tro-nam-2024.html. (Accessed on 12 September 2024).

Ministry of Industry and Trade (MOIT). *Vietnam's National Export Strategy; Electronics Industry Strategy*, Chiến lược xuất khẩu quốc gia Việt Nam, chiến lược ngành điện tử. Available at https://trungtamwto.vn/file/23037/4-dien-tu-pdf.pdf (Accessed on 15 September 2024).

Ministry of Science and Technology (MOST). *National Technology Innovation Programme until 2030 - New Phase, New Goals*, Chương trình đổi mới công nghệ quốc gia đến năm 2030 - Giai đoạn mới mục tiêu mới. Available at https://www.most.gov.vn/vn/Pages/chitiettin.aspx?IDNews=20489 (Accessed on 12 September 2024).

Ministry of Science and Technology (MOST). *Program 712 – Establishing Credibility for Enterprises, Chương trình 712 – Khởi tạo uy tín cho doanh nghiệp*. Available at https://www.most.gov.vn/vn/Pages/chitiettin.aspx?IDNews=19026 (Accessed on 30 August 2024).

National Economics University Hanoi (NEU), 2023. *Solutions to Promote Innovation in Manufacturing Enterprises by 2030, Giải pháp thúc đẩy đổi mới sáng tạo trong doanh nghiệp sản xuất, đến năm 2030*.

Nguyễn Quốc Duy. *Absorptive Capacity and Innovation – A study on Vietnamese Firms, Năng lực hấp thụ và đổi mới sáng tạo – Nghiên cứu các doanh nghiệp Việt Nam*. Available at: https://ktpt.neu.edu.vn/Uploads/Bai%20bao/2020/So%20271(II)/379256.pdf

Patarapong Intarakumnerd and Jarunee Wonglimpiyarat. *Towards Effective Policies for Innovation Financing in Asia: A Comparative Study of Singapore, Taiwan, Malaysia and Thailand*.

Truong Thi Chi Binh, Chuỗi cung ứng toàn cầu một số ngành công nghiệp chế tạo ở Việt Nam. *Global supply chains for some manufacturing industries in Vietnam*. Tạp chí nghiên cứu công nghiệp và thương mại (Industry and Trade Research Review), Volume 65, November 2021, Page 42-52.

UNIDO (2021), *Competitive Industrial Performance Report 2021 CIP Index, edition 2021: Country and Economy Profiles*.

Vietnam Chamber of Commerce and Industry (VCCI). Báo cáo tóm tắt năng lực động của doanh nghiệp Việt Nam: Hiện trạng, vị trí trong chuỗi giá trị và hàm ý cho hợp tác đa phương, *Dynamic Capacity of Vietnamese Enterprises, current status, position in the value chain and implications for multilateral cooperation*. Available at: https://vienptdn-vcci.vn/wp-content/uploads/2023/04/Bao-cao-tom-tat-Nang-luc-dong-2022.pdf

Vietnam General Statistical Office (GSO). 2021. *Manufacturing and Processing Industry – Dynamics of Vietnam Economic Growth 2011-2020*.

Vietnam National Innovation Center (NIC). *Vietnam Innovation & Tech Report 2024*. Available at: https://doventures.vc/assets/uploads/reports/download/vietnam-innovation-and-tech-investment-report-2024-1714215107.pdf

Vietnam National Productivity Institute (VNPI), *Handbook for SME Productivity Measurement and Analysis for NPOs*. Available at: https://vnpi.vn/vn/thu-vien-tai-lieu/bao-cao-quoc-te/handbook-for-sme-productivity-measurement-and-analysis-for-npos-1419.aspx

Vietnam National Productivity Institute (VNPI), *Vietnam Productivity Report 2021*, Báo cáo năng suất Việt Nam 2021. Available at: https://vnpi.vn/vn/thu-vien-tai-lieu/bao-cao-trong-nuoc/bao-cao-nang-suat-viet-nam-2021-12687.aspx

Vietnam National Productivity Institute (VNPI), Vietnam productivity report 2017, Báo cáo năng suất Việt Nam 2017. Available at: https://vnpi.vn/vn/thu-vien-tai-lieu/bao-cao-trong-nuoc/bao-cao-nang-suat-viet-nam-2017-1446.aspx

World Bank Group (2016) *Vietnam at a Crossroads: Engaging in the Next Generation of Global Value Chains*. Washington DC: The World Bank Group.

World Bank Group (2017) *Vietnam: Enhancing Enterprise Competitiveness and SME Linkages*. Lessons from international and national experience.

World bank group (2021), *Vietnam: Science, Technology and Innovation Report 2020*. Available at: https://documents1.worldbank.org/curated/en/929681629871018154/pdf/Vietnam-Science-Technology-and-Innovation-Report.pdf

CONCLUSION

APO Research on Technological Capability Enhancement Support for SMEs and Productivity Improvement

After the COVID-19 pandemic, SMEs are facing productivity and innovation challenges. Formulating and implementing effective policies to promote the productivity improvement, innovation, and technological capabilities of SMEs is critical to their recovery and sustainable growth. This study aims to assess the current state of SMEs' technological capabilities and support their innovation system; evaluate the content, implementing mechanisms, and effectiveness of the existing financial and non-financial government supporting measures for enhancing SME technological and innovation capabilities; and propose policy recommendations to a) improve the existing policy measures, b) initiate new ones, and c) upgrade innovation systems enabling effective implementation of these policies.

This is a study funded by the Asian Productivity Organization (APO). The study comprises 12 member economies: Japan, the Republic of China, and Singapore are high-income economies; Thailand, Turkiye, and Mongolia are upper-middle-income economies; and the rest are lower-middle-income economies.

1. Status of Productivity and Innovation of the Studied Asian Economies

SMEs in the studied economies had different productivity and innovation performances.

1.1 Productivity

The study investigated both labor and total factor productivity (TFP).

Most studied economies experienced an increase in labor productivity. However, during the COVID-19 pandemic (2020-2021), the labor productivity growth was negative. After the pandemic, all studied economies demonstrated a strong rebound in their labor productivity growth. Among the high-income economies, the Republic of China and Singapore outperformed Japan, whose economy has experienced very slow economic growth since the early 1990s. Middle-income economies in the study had moderate labor productivity growth. Some economies, like Pakistan, had relatively downward and fluctuating growth. It is worth mentioning that Vietnam's labor productivity increased 120-fold in the one decade from 2013 to 2023, illustrating that Vietnam's economy, with one of the fastest GDP growth rates, is supported by remarkable labor productivity growth. In general, the labor productivity growth of SMEs was lower than that of large firms. The exception was Turkiye, whose medium-sized firms with 50-249 employees had the highest labor productivity growth.

The situation on TFP growth, a proxy to measure the contribution of innovation to a country's growth, varies considerably. Japan had considerably low TFP growth in the past few decades, where the TFP growth of SMEs was significantly lower than that of large firms. The TFP growth of Singapore and the Republic of China was not impressive either, though there was an increase after the COVID-19 pandemic. Among upper-middle-income economies, Turkiye performed better than Thailand and Mongolia. The studied lower-middle-income economies had relatively low or

even negative TFP growth during the decade before the COVID-19 pandemic, with the exception, once again, of Vietnam, whose TFP growth during 2020-21 was as high as 5.4%, and the share of TFP in GDP growth during 2016-2020 was 40%. This is in contrast to its neighbor, Thailand, whose TFP contributed to only 3% of the country's GDP growth during 1970-2021. After the pandemic, there was a rebound of TFP growth in all countries, but the TFP growth of SMEs in all economies was lower than that of large firms. Interestingly, while SMEs in more advanced economies had higher TFP growth in high-tech sectors like electronics, India's SMEs had the highest productivity gains after the pandemic in resource-based industries, namely, furniture, wood products, and paper products.

1.2 Innovation

In all studied economies, SMEs performed much less research and development (R&D) compared to large firms. Nonetheless, SMEs in the Republic of China and Turkiye, in particular, had a steady upward trend in R&D, while other countries experienced fluctuation in their SMEs' R&D spending. This reflects that SMEs in these two economies are quite technologically capable compared to other economies. SMEs in Turkiye occupied quite a large share in gross domestic R&D expenditure (28.8% in 2022) and total business R&D personnel (45.5%). In Japan and Singapore, there was quite a large gap in R&D expenditure between large firms and SMEs. Foreign firms in Singapore, in particular, contributed a very large proportion of total business R&D. On the contrary, foreign firms in Thailand engaged in proportionally less R&D than local firms. This signifies that while foreign firms carry out higher value-added activities like R&D in Singapore, they simply use Thailand for the assembly of their products. In other economies of this study, SMEs are quite weak in R&D.

In all countries, large firms engaged in both product and business process innovation more than SMEs. Among high-income economies, the percentage of firms conducting innovation in Japan was higher than that of the Republic of China and Singapore. Surprisingly, for small enterprises (up to 20 employees) in Japan, the ratio of enterprises conducting innovation was higher in the service sector than in the manufacturing sector. This is in contrast to the Republic of China, where SMEs in manufacturing had more innovation than in the service sector. In the Republic of China, firms with new-to-market innovations were less than those with firm-level innovation by only 3%. This signifies that the degree of novelty of innovations in the Republic of China was quite high. For economies that were popular destinations for foreign direct investment of multinational corporations like Thailand, Vietnam, Turkiye, India, and the Philippines, there was more process innovation than product innovation. This is not surprising, as firms in these countries focused on improving their production processes to meet the demands of multinational corporations for a few decades. Interestingly, in the cases of Pakistan, Mongolia, and Nepal, SMEs also had more product innovation than process innovation. Digitalization of production processes, marketing activities, and back-office activities of firms played very important roles in process innovation. Similarly, there were more process innovations aiming to reduce defects in production processes and improve production efficiency, in the case of Laos.

While competitors were the driving force for innovation in Vietnam, SMEs in Turkiye cited improving their reputation and high energy and material costs as the most important factors driving them to innovate. Lack of funds both internally and externally, lack of human resources, and lack of demand for innovation were the most critical barriers for SMEs to innovate. Customers, suppliers, and competitors were major sources of innovation in all studied economies. However, universities and public research institutes were important collaborators only in high-income

economies like the Republic of China. Collaborations with universities and public research institutes were especially strong in the electronics industry, where the Republic of China is a world leader. As for the rest, collaborations between universities and firms in general and SMEs in particular were quite weak. While SMEs in the Philippines and Pakistan had serious problems in accessing government support, local firms in Thailand cited some government financial and consulting support programs as important for their innovation efforts.

2. Analysis of Contents, Implementation Mechanisms, and Effectiveness of Policy Instruments for Enhancing Technological Capabilities and Innovation of SMEs

Country reports investigate three types of policies for promoting innovation and technological capabilities of SMEs in their countries: supply-side policies, demand-side policies, and systemic policies.

2.1 Supply-side Policies

Supply–side policies have been the most widely implemented policies in all studied economies. High-income economies (Japan, Singapore, and the Republic of China) have more diversified, complete, and generous support than middle-income economies, except Turkiye. While middle-income economies rely more on loans and tax incentives, high-income economies have more instrumental and generous grants and government equity investment, either directly or indirectly through government-supported venture capital companies. It is observed that grants and, to some extent, government equity investment became more prominent in other middle-income economies to support SMEs in general and startups (new and young firms with relatively high technological capability and innovation) in particular since 2010. However, government support has been quite small in volume and fragmented. There were too many small supporting schemes with an insufficient amount of funds, and they were not well coordinated.

Implementation of policies was also a major problem in Nepal, Pakistan, Mongolia, Thailand, the Philippines, India, and Laos. Organizational competencies of government agencies in providing key support to SMEs were quite limited.

Japan, the Republic of China, and Singapore were quite exceptional in providing grants. Following the USA, both Japan and the Republic of China have had SBIR programs since the late 1990s. The programs provided substantial grants to SMEs from the feasibility study and R&D stages to the commercialization stages. The support included not only individual firms but also R&D alliances with other firms and/or universities and public research institutes. Over time, the targets expanded from the development of cutting-edge technologies and products to business models, service platforms, and knowledge-driven business services to integrate advanced technologies with practical applications. In the Republic of China, SBIR has been provided by both national and local governments. The ones provided by local governments supplemented the national ones and targeted regional/local specialization and development of relatively backward regions. Singapore's government agencies provided grants for various activities, from R&D to skill training, and business and market development.

Singapore is very remarkable in providing government equity investment, especially to early-stage startups. By adopting the fund-of-fund strategy, the Singaporean government agency co-invested with selected promising private venture capital firms in early-stage startups to nurture these

companies and help them scale. These startups covered diverse sectors from deep tech to health care, food and agritech, and urban solutions.

Over time, supporting policies became more sector-specific, technology-specific, and region/industrial cluster-specific, and the degree of specificities increased. Several economies now provide specific and better incentives to their strategic industries as compared to generic incentives. These are, for instance, the cases of the deep tech industry in Singapore, the cashmere industry in Mongolia, the handicraft industry in Laos, and the semiconductor industry in the Republic of China. Most studied countries provided specific support for the development and application of Industry 4.0-related technologies (AI, cloud computing, Internet of Things, 3D printing, big data) and digital technologies. Governments initiated various policies to support regions/industrial clusters with special characteristics or those lagging behind others with specific incentives.

Policies targeting the penetration of international markets became very popular. Policies encouraging external collaboration with other domestic and/or foreign firms to form R&D consortia, collaboration with universities and public research institutes, and 'open innovation' became significant. There were special and more generous incentives for these objectives, both in the form of R&D tax reduction (Japan) and grants (the Republic of China, Singapore, Turkiye).

Mission-oriented policies to address societal and environmental challenges have gained importance across countries. Sustainable transformation, inequality reduction (regions, race, gender), and an aging society are examples of the key societal challenges.

To address inter-ministerial coordination problems and enhance the effectiveness of policies, some countries had different ministries jointly plan and execute certain policy measures. In Japan, the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Economy, Trade and Industry (METI) joined hands to develop the Agriculture, Commerce and Cooperation Program, which provided subsidies and credit guarantees to farmers, local firms, and universities to develop new products and launch them to market. In Turkiye, three government agencies worked together to provide support through a single window system.

2.2 Demand-side Policies

In general, demand-side policies, albeit important, have been given much less attention by governments. Difficulty in accessing the 'first' market, either public or private, for their innovative products, is one of the most important barriers to innovation, identified by several economies in this study.

SMEs are disadvantaged in accessing government procurement projects. However, some economies like Singapore, Japan, Nepal, the Republic of China, and Turkiye designed specific programs and relaxed conditions to allow SMEs to participate in government procurement.

In Singapore, the government established a new category by simplifying the traditional public procurement process to make it easier for SMEs and startups to engage in public tenders, especially those focused on innovations. As a result, over 70% of government contracts up to 1 million Singapore Dollars went to SMEs. In Japan, outputs of SMEs from the results of SBIR programs were allowed to join the bidding for government procurement without illustrating previous satisfactory records of accomplishment and management performance. These conditions were normally required for firms to bid on government procurement projects. In 2023, the Japanese

government took another step by starting SBIR Phase 3 (similar to that of the USA). If the R&D topic of granted SMEs was in line with the needs of government procurement, commitment to procure outputs of R&D was guaranteed. In the Republic of China, the combination of demand-side policies and supply-side policies was even more evident. SMEs received grants from the government to conduct R&D aiming to develop innovative solutions to address specific local needs. On the other side, municipal and county governments received subsidies (70%-90%) to procure those innovative solutions. These initiatives in Japan and the Republic of China demonstrate the linkages between supply-side and demand-side policy, which make government policy more effective, as they incentivize firms to innovate and subsequently provide them with a 'first' market.

The linkages between demand-side and supply-side policies are quite lacking in other studied economies, even if they have policies to support the access to public procurement by SMEs. For example, in Nepal, the government had a policy of prioritizing the procurement of locally produced goods and services by government organizations even when they were priced up to 15% higher than imported alternatives. To participate in such public procurements, certification from reputable organizations was required. Similarly, in Turkiye, companies holding a 'domestic good certificate' can join public procurement tenders with a price advantage of up to 15%. In some economies like Laos, governments have simplified procurement procedures and reduced barriers for SMEs, introducing capacity-building initiatives to help them meet public procurement requirements. However, the implementation of such policies is still problematic, especially issues concerning the transparency of the procurement processes.

Another vital demand-side policy is to stimulate private demand from individual consumers and businesses. For example, in Japan, regional collective trademarks were used to promote regional branding of goods and services from a particular region collectively. METI set up the Good Design Award in 1957, and more than 70% of awardees reported increases in popularity in their markets. Singapore strengthened demand for locally made IT tools and solutions by providing grants to Singaporean companies to buy them. It also provided grants for Singaporean companies to pay for skill training and development services from local firms in the training and education industry.

2.3 Systemic Policies

Japan and the Republic of China stand out in having policies promoting better coordination of actors in innovation systems.

SME Support Japan was set up to be a semi-public implementing organization of major policies of the SME Agency. At the regional level, a regional platform was organized to build a coalition of local SME supporting organizations and regional government agencies to support local SMEs. A type of intermediary that largely succeeded in providing technological support to local SMEs is local public research institutes/public technology centers (Kosetsushi). Kosetsushi are technology transfer organizations established and administrated by prefectural or municipal governments in Japan since the late 19th century for agriculture, textiles, and breweries (e.g. sake and soy sauce), and have since then gradually developed for manufacturing in general. Currently, there is at least one manufacturing Kosetsushi in each prefecture.

The Republic of China has 16 government-sponsored research institutes (GSRIs) under the Ministry of Economic Affairs (MOEA) to organize industrial cluster R&D alliances in less-developed regions. The goal is to develop a strategic industry based on the specializations of a region, enhance the technological capabilities of local firms, and scale up these alliances by linking the local SMEs

to other partners, particularly from the service sector. Through the outcomes of the R&D alliance, GSRIs help participating firms apply for more R&D grants from the central government.

Singapore has outperformed other economies in the aspect of linking local SMEs and startups with global innovation networks. The Advisory Services for Singapore SMEs (IPI) was set up in 2011 to provide local enterprises with access to innovation ideas and technologies through its global innovation networks. It facilitates firms' innovation processes to the stage of commercialization and market development.

It should be noted that intermediaries do not have to be public organizations. Industrial associations and even private consulting firms can act as intermediaries, as illustrated in the cases of Japan, the Republic of China, India, and Vietnam.

Other studied economies also had systemic policies like establishing technology transfer offices, incubators, and accelerators in universities to promote university-industry collaborations and startups. Compared to Japan, Singapore, and the Republic of China, these policy initiatives were quite small in scale. Their implementation was rather bureaucratic. Local governments and private-sector organizations had limited participation. Consequently, most of the programs had limited successes. Nevertheless, public and university incubators for promoting startups became much more prominent even in lower-middle-income economies, namely India, Pakistan, and Nepal, since the 2010s.

3. Institutions Affecting the Effectiveness of Policies

Several institutional factors affect the content and implementation of policies. Therefore, they influence policy effectiveness.

The capacity of government agencies and their inter-agency coordination and coordination with other actors in national innovation systems (SMEs, large local firms, and multinational corporations, universities, public research institutes, financial institutes, industrial associations, etc.) are very critical for policy effectiveness. Bureaucrats in Japan, Singapore, and the Republic of China are quite well paid. They can recruit highly talented bureaucrats, and have enough budget for professional training and organizational capacity building. Therefore, they can plan and execute policies rather effectively. That is not the case in other economies.

In Japan, coordination between government agencies across ministries, between national and regional/local government agencies, and with other actors (local SMEs, large firms, industrial associations, universities, public research institutes, etc.) in the aspect of improving innovation and productivity of SMEs has been carried out quite well. The SME Agency has SME Support Japan as its policy implementation organization. These two agencies had their regional offices working closely with SME divisions of local governments. There were other supporting regional intermediaries, namely the Chambers of Commerce and Industry, the Regional Small Business Association, regional public universities, and regional public research institutes under regional/local governments to act as brokers, mediators, consultants and resource providers. There were also informal networks of SME owners under the name "Regional SME Study Groups" to facilitate cooperation among themselves and engage with other regional/local actors. As mentioned earlier, public research institutes acted as region-specific and sector-specific intermediaries in the Republic of China. In the Philippines, Regional Inclusive Innovation Centers (RIICS) were set up in different

regions in the country to enhance collaboration between the government, academics, and the private sector. Nonetheless, successes varied across these regions. In some regions, SMEs were hesitant to participate due to financial constraints.

To solve coordination problems, Japan, the Republic of China, and Singapore have policy measures jointly planned and executed by more than one ministry and/or agency. These include agencies in charge of SMEs' promotion, ministries in charge of international trade and industry, ministries in charge of agriculture, ministries in charge of education and training, ministries/agencies in charge of culture, ministries/agencies in charge of digitalization, and others. A less effective alternative deployed by several economies, such as Thailand and Pakistan, is to set up committees comprising representatives from concerned ministries and agencies to supervise certain key policy measures.

Coordination between SMEs and other actors in national innovation systems depends very much on the level of trust between them. Societal trust varies by country, but policies aiming to build collaboration between SMEs and different actors can help to mitigate a lack of trust. Most studied economies have such policies in place. In Japan and the Republic of China, R&D alliances between several SMEs or large firms, universities, and/or public research institutes had been formed before they applied for some government grant schemes. As mentioned above, intermediaries can mitigate the level of distrust between SMEs and other actors by brokering different actors to participate in government policy measures.

In lower-middle-income economies like India, Laos, and Mongolia, foreign technical assistance to local SMEs is important to supplement the lack of local technical capacity. Therefore, coordination with foreign technical providers/consulting companies, and foreign aid agencies, both at the policy and implementation levels, is quite important.

The number of opportunity-based entrepreneurs leveraging other people's talent and resources, and later taking risks to create innovative products, varies from one economy to another, and is quite critical for the success of governments' supporting policies. Societal attitude towards innovation and failure acceptance influence the number of opportunity-based entrepreneurs in an economy. If society's attitude is positive, the number of such entrepreneurs can be relatively high. This is not the case for most economies in this study. Nonetheless, if policies are implemented long enough, they can increase the number of opportunity-based entrepreneurs. Singapore, for example, has had generous grant and investment participation schemes to encourage startups since the early 2000s. They helped to change the attitude of young graduates to start their own businesses rather than working for the government and multinational corporations as before.

4. Policy Recommendations

The level of economic development and SMEs' productivity, innovation, and technological capability vary considerably across the studied economies. However, common policy recommendations that may benefit them and other developing economies can be observed.

First, to carry out policies to enhance SMEs' productivity and innovation, supply-side policies, demand-side policies, and systemic policies are needed. Supply-side policies incentivize firms to invest in innovation and productivity improvement activities by reducing costs and uncertainty. Demand-side policies help to create and/or strengthen public and private markets for innovative products and services of SMEs. Systemic policies facilitate collaboration between SMEs and other

actors in national innovation systems and/or industrial clusters, which is necessary for effective policy implementation. Most studied economies lack adequate demand-side and systemic policy measures. Japan, the Republic of China, and to a certain extent, Turkiye are exceptions and can be viewed as examples to the rest.

Second, to have effective demand-side policies, policy measures to create both new public and private markets are essential. Public procurement by government agencies, both at the national and regional/local levels, can act as a 'first' market for innovative products and services of SMEs. To be effective, government agencies with public procurement programs need to be convinced and build up their execution capacity through SME development agencies. In the case of Nepal and Turkiye, government agencies, universities, or industrial associations certify the qualities of SMEs. These SMEs are given priority to sell their innovative products or services to government agencies in comparison to large domestic firms and multinational corporations. These kinds of practices should be encouraged in other economies. In addition, a special rule allowing SMEs already receiving supply-side policy support to participate in government procurement programs without having past records and management capability, as in the case of Japan, is needed. In a nutshell, coordination between demand-side and supply-side policies is essential.

Third, having effective systemic policies allows economies to promote collaboration between SMEs and other actors in national innovation systems. The roles of public and private-sector intermediaries in brokering, mediating, and providing resources and consultancies to participating actors are significant. It should be noted that the bureaucratic capabilities of these intermediaries have to be enhanced over time. Governments should allocate separate budgets and arrange specific capacity-building programs for this purpose on top of normal project-based budgeting.

Fourth, effective design and implementation of policies for promoting productivity and innovation of SMEs require coordination across agencies or ministries in charge of SMEs' promotion, industry and enterprise development, education and training, trade, foreign investment, foreign technical assistance, and so on. Therefore, jointly developed and executed programs by different concerned agencies/ministries should be encouraged. Simply establishing inactive or ad-hoc committees comprising representatives from the concerned agencies/ministries may not really solve coordination problems.

Fifth, as policies become more sector-specific, technology-specific, region-specific, and mission-oriented, targeted agencies planning and implementing these specific policies are necessary, and their capacities should be enhanced over time. These include agencies under the jurisdiction of regional/local governments, which are significant for policy deployment at the regional/local level. Normally, agencies under regional/local governments are either totally absent or weak in terms of bureaucratic capacities. Experiences of countries like the Philippines show us that the implementation of the same policy measures directed by the central government can have different results in different regions due to the different capacities of regional implementing agencies. Time and budget should be allocated to local/regional governments to create and strengthen these agencies.

Sixth, continuity of monitoring and evaluation of supporting policies is very important to mitigate negative institutional problems, namely lack of collaboration across responsible agencies and between these agencies, SMEs, and other actors, low trust, an inadequate number of opportunity-based entrepreneurs, and unfavorable societal attitudes to innovation and failure. Political consensus on important policies needs to be established so that there is no major change in these

policies when governments change. It is necessary for SME development agencies to actively engage in building such political consensus with political parties, government agencies, and the industry.

Lastly, SME's own domestic efforts are also important, such as their voluntary collaboration among SMEs. Policies are effective if an SME has the will and some capability to enhance its productivity. Some SMEs prosper in extremely adverse environments. Some SMEs fail even in extremely favorable environments.

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