

Emerging Technological Trends and Business Process Management:

Preparing the Philippines for the Future

Emerging
Trends *in*
APO Members

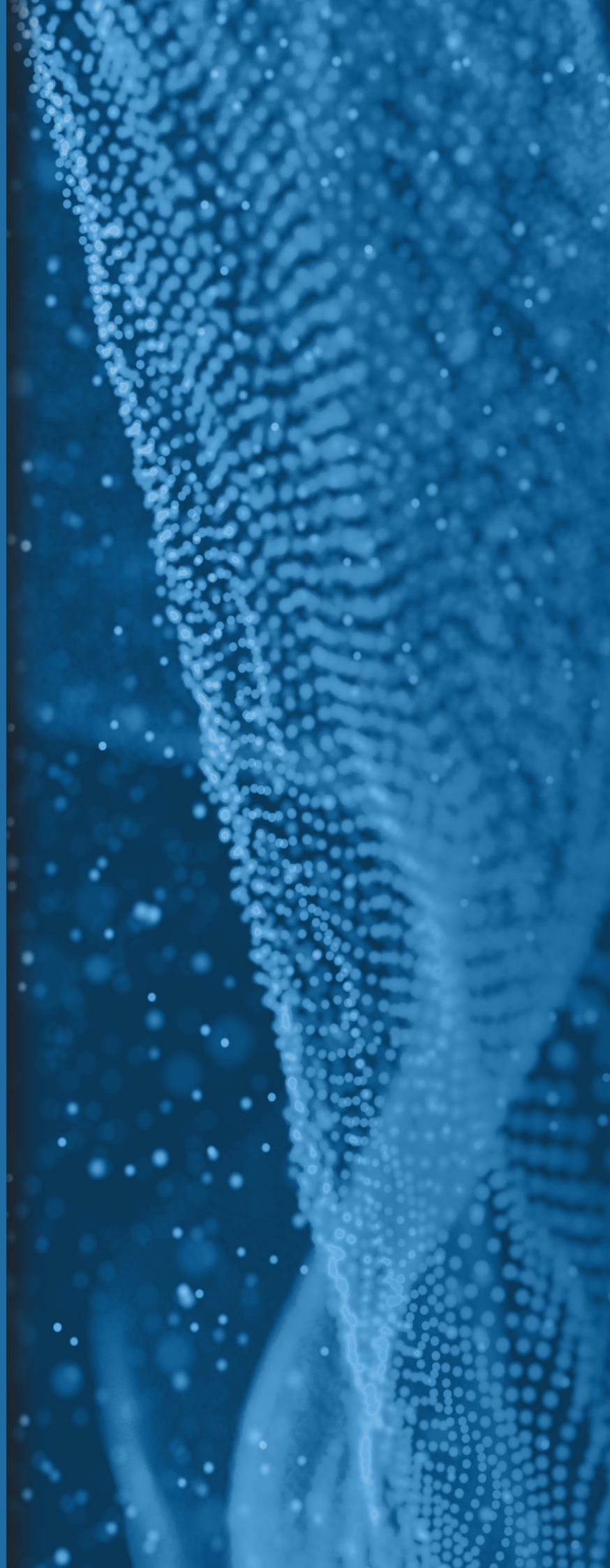
Asian Productivity Organization



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EMERGING TRENDS IN APO MEMBERS:

**EMERGING TECHNOLOGICAL
TRENDS AND BUSINESS
PROCESS MANAGEMENT -
PREPARING THE PHILIPPINES
FOR THE FUTURE**

EMERGING TRENDS IN APO MEMBERS:
EMERGING TECHNOLOGICAL TRENDS AND BUSINESS PROCESS
MANAGEMENT - PREPARING THE PHILIPPINES FOR THE FUTURE

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PREFACE

This publication on *Emerging Trends in APO Members* is aimed at enabling better navigation of the volatility, uncertainty, complexity, and ambiguity (VUCA) landscape. In today's turbulent, unpredictable world, the APO adopts a country-specific approach to understand and analyze emerging trends and driving forces that will have significant effects on member economies in terms of productivity and competitiveness. This series of reports introduces several emerging trends with the potential to disrupt and transform markets, governments, and society now and in the near future. It is hoped that through these publications analyzing those impactful trends, governments, policymakers, and ordinary citizens from all walks of life will be able to harness those driving forces while coping with critical uncertainties.

Recommended approaches and methods to address the challenges ahead include political, economic, social, technological, legal, and environmental perspectives. Being future-ready requires such a comprehensive approach to informed decision-making by governments, enterprises, and individuals in the fast-changing environment in the Asia-Pacific region. For the APO, it is all about early identification of issues and prospects, which requires strengthening its role as a think tank and regional adviser on productivity in the region.

The APO thanks all contributors to the report. We hope that it will benefit those seeking to improve productivity and quality of life brought about by emerging trends in a rapidly changing world.

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EMERGING TECHNOLOGICAL TRENDS AND BUSINESS PROCESS MANAGEMENT: PREPARING THE PHILIPPINES FOR THE FUTURE

Abstract

The Information Technology and Business Process Management (IT-BPM) sector in the Philippines has experienced significant growth, contributing substantially to employment, investment inflows, and foreign exchange earnings. As the sector evolves, service providers are transitioning from traditional IT outsourcing models to embracing cutting-edge technologies, such as cloud computing, big data analytics, and Internet of Things (IoT). These emerging technologies are reshaping business processes and driving innovation.

Grounded in endogenous growth theory [1], this study emphasizes the crucial role of technological innovation and knowledge in fostering economic growth. Technological progress, fueled by investments in human capital and innovation, is pivotal for enhancing long-term productivity and maintaining the competitiveness of the IT-BPM industry.

The study examines key technological trends in the Philippines and their potential to disrupt and transform markets, government operations, and society. It assesses how these advancements influence productivity and growth at national and regional levels. Additionally, it explores strategic policy recommendations aimed at strengthening the Philippines' position as a premier outsourcing hub and supporting the growth of the IT-BPM sector.

Introduction

The business process management sector in the Philippines has experienced rapid growth in recent years, significantly contributing to job creation, attracting investments, and increasing foreign exchange earnings. To sustain and further accelerate this growth, it is crucial to implement coordinated actions and promote collaboration among stakeholders, laying the foundation for a future-ready business process management industry.

Service providers are transforming their businesses to accommodate changing customer demand and their shareholders' expectations to stay profitable. The focus on traditional IT outsourcing services that followed the typical software development life cycle (SLDC) model is giving way to increasing innovation through the usage of big data analytics, IoT, and cloud computing.

Although traditional IT services are not expected to disappear anytime soon, there is a move by both small and large providers in the Philippines toward platform-based services. Large Information Technology Outsourcing (ITOs) are leading this transition, which depends on the alignment with their global strategies, as many of the changes in other delivery centers are likely to adopt the practice in the Philippines. Smaller providers are more likely to follow ad-hoc strategies and offer basic services with a plan to move toward platform-based services in the next five years.

From a global perspective, service providers are trying to move away from the cost-plus/labor arbitrage model, especially in the leading ITO destination: India. The subsector has witnessed a spate of mergers and acquisitions in the last few years. Some of these acquisitions are involved in building technical expertise in new technology areas while others have new customer acquisition and vertical specializations in mind. The sum of these acquisitions indicates the support toward proprietary tools and technologies in a bid to offer a complete IT-plus-BPM service portfolio. This will enable the large ITOs in the mid-tier market levels to compete effectively against the top three service providers.

As described by Howitt [1], endogenous growth theory suggests that technological advancements occur through innovations in products, processes, and markets, many of which are often driven by economic activities. This concept underpins the study, highlighting the importance of technological innovation and knowledge as primary drivers of economic growth. Technological progress is viewed as a result of investments in human capital, innovation, and knowledge, making it highly pertinent for examining the role of emerging technologies in fostering long-term productivity and growth.

This study aims to explore the emerging technological trends in the Philippines that are likely to disrupt and transform markets, government functions, and society in the near future. It assesses how these trends impact productivity and growth dynamics at both national and regional levels. Additionally, the study seeks to identify potential policy responses to these trends to enhance the Asian Productivity Organization's (APO) role as a regional advisor for its members.

This study specifically examines three key emerging technological trends: cloud platforms, big data analytics, and artificial intelligence (AI). Although augmented reality and blockchain are also notable emerging technologies, their detailed exploration is addressed in a separate study.

Literature Review

In 2015, over one-sixth of the global IT expenditure, which amounted to USD650 billion annually, was outsourced, totaling USD99 billion. The outsourcing industry is expected to expand rapidly in the coming years, with projections indicating that nearly one-fifth of the IT sector, or USD147 billion, will be outsourced by 2022. While the overall IT expenditure is forecasted to grow at a compound annual growth rate (CAGR) of 2.5% by 2022, the IT service outsourcing subsector is expected to grow at more than twice that rate, with a CAGR of 5.2%.

The primary factors driving the IT service outsourcing subsector are the improvements in service quality and productivity for clients as well as the use of outsourcing by clients to expand their core business operations across various locations and regions. Conversely, some constraints on the subsector's growth include ongoing global economic uncertainty and reductions in overall IT budgets, which inadvertently affect outsourcing prospects.

In terms of demand, the Americas region, led by the United States of America (USA), accounts for nearly half of the global IT service outsourcing market. Europe follows as the second-largest market, holding over one-third of the market share, with the Asia-Pacific region contributing one-fifth. The most significant services in this sector are support and training, system integration, and infrastructure service outsourcing.

Furthermore, the leading industries relying on IT service outsourcing are the business sector, financial services, government, and manufacturing industries, which collectively represent for more than 60% of the market. Looking ahead, the healthcare sector is anticipated to become a significant growth driver for the IT service outsourcing subsector.

Numerous countries are focusing on developing their domestic IT service outsourcing subsector. These outsourcing destinations compete in various ways, including by cultivating a well-trained IT workforce, enhancing IT infrastructure to support a world-class outsourcing industry, and providing incentives for investors to establish operations. The top destinations for outsourcing services are India,

Poland, PR China, and the Philippines, while emerging locations include Brazil, Malaysia, Mexico, and Vietnam.

Impact of Emerging Technologies on Productivity and Growth Dynamics

The Philippines is witnessing significant advancements in emerging technologies like big data analytics, the IoT, and cloud computing. Various industries are gradually integrating these technologies to enhance innovation, efficiency, and competitiveness. As stipulated in the E-Government Masterplan 2022 [2], the country's digital transformation ambitions as well as the increased demand for innovative technical solutions to handle present-day business difficulties, are driving growth.

Each of these markets offers considerable prospects for businesses and investors eager to capitalize from the national digital transformation wave. The Philippines' robust development prospects emphasize its potential to become a major player in the global technological landscape.

Big Data Analytics

Big data analytics involves the complex task of examining vast and varied data sets, referred to as big data, to uncover hidden patterns, correlations, market trends, and customer preferences. This analytical approach allows companies to make better-informed business decisions, enhance operational efficiency, and drive innovation. Big data analytics, which uses techniques, like machine learning, statistical analysis, and data mining, allows businesses to process and comprehend massive amounts of data that traditional approaches cannot handle. This technology is becoming increasingly important across industries as companies seek to use the value of their data to create a competitive edge.

The following summary provides an overview of the current situation and future prospects for big data analytics, covering major facts and trends in the field.

- **Market size and growth** - In 2023, the global big data analytics market was valued at approximately USD300 billion. Forecasts suggest that the market will expand to USD450 billion by 2026, with an estimated CAGR of around 13% [3]
- **Data generation** - As of 2024, the world generates around 400 exabytes of data every day. Projections indicate that daily data generation will surpass 463 exabytes by 2025 [4]
- **Industry adoption** - The leading sectors utilizing big data analytics include banking and financial services, which account for 34% of big data investments, of which the government contributes 20%, healthcare 15%, and more than 90% of large firms having implemented big data initiatives [5]
- **Data sources** - Organizational tools, like databases and spreadsheets, account for about 20% of big data. Approximately 80% of data is unstructured, such as emails, videos, and social media content
- **Technological trends** - Machine learning integration is prominent with over 75% of big data organizations using machine learning methods. Cloud computing accounts for 60% of big data workloads [6]
- **Key benefits** - Organizations report cost reduction of 60% as a major benefit. Meanwhile, 69% of organizations report improved decision-making using big data. In addition, 54% of organizations utilize big data to improve the customer experience [7].

Despite the potential benefits, significant challenges persist. Approximately 36% of organizations report difficulties with data quality while 43% express concerns regarding data privacy and regulatory compliance. Additionally, the global demand for skilled data scientists currently surpasses supply by around 50%, exacerbating the challenge of leveraging data effectively [8–10]

- **Future trends** - Real-time analytics is set to become a priority in data processing as the demand for instantaneous insights continues to rise. The increasing number of devices capable of collecting

and processing data at the edge is expected to drive the growth of edge computing at a CAGR of 30%. This expansion is anticipated due to the demand for lower latency and improved processing efficiency. Additionally, the integration of AI with big data analytics is projected to greatly enhance process efficiency and predictive capabilities, allowing organizations to make faster, more accurate decisions [4, 11–13]

Drivers Influencing the Integration of Big Data Analytics

Enterprises' growing need to harness the massive volumes of data they generate for better decision-making, operational efficiency, and competitive advantage is driving the adoption of big data analytics. Key considerations include technological breakthroughs, like cloud computing and AI integration, which have made data analytics more accessible and affordable. Furthermore, the growing relevance of customer-centric strategies, predictive analytics, and real-time insights is encouraging firms to engage in big data analytics to stay competitive. These tools enable businesses to personalize customer experiences, streamline operations, and innovate more quickly, making big data analytics a critical component in today's data-driven economy.

Factors Hindering the Integration of Big Data Analytics

Numerous obstacles frequently hinder the integration of big data analytics, including concerns about the quality of data, integration, and administration as well as concerns around data privacy and security. Many firms struggle to integrate big data technologies with existing IT infrastructure, which can be costly and complex, particularly for those using legacy systems. Furthermore, a dearth of qualified data analytics specialists as well as the high costs associated with adopting and maintaining big data solutions stifle uptake. Organizational resistance to change coupled with the difficulties of establishing a clear return on investment (ROI) further contribute to the reluctance to fully embrace big data analytics.

Market Potential

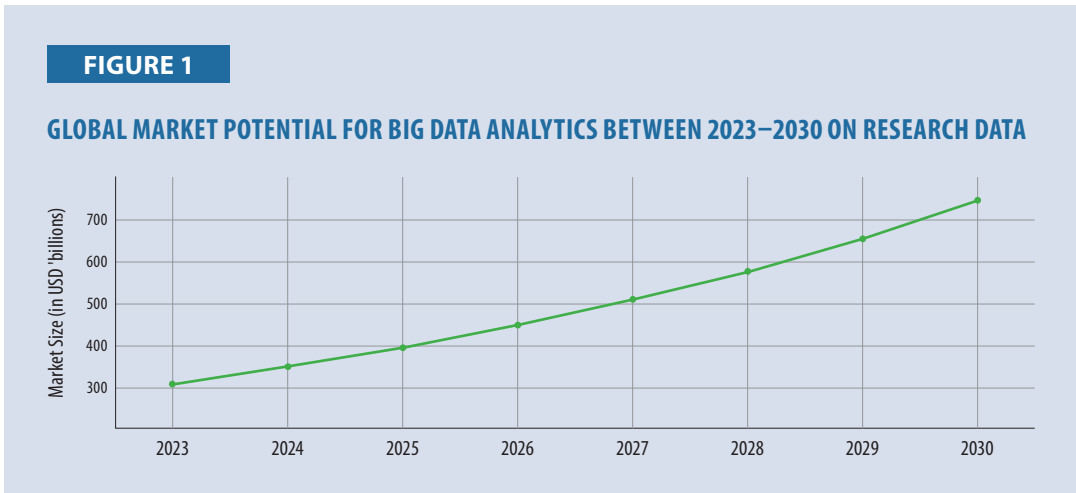
The global big data analytics market has witnessed substantial growth, reflecting its increasing importance across various industries. In 2023, the market was valued at an impressive USD307.52 billion, underscoring the widespread adoption of data-driven strategies by organizations worldwide [14]. This growth trend is anticipated to persist, with forecasts indicating that the market will hit USD349.56 billion by 2024, demonstrating a consistent year-on-year increase [15–16].

Looking further ahead, experts anticipate that the market will expand to USD396.4 billion by 2025, as businesses increasingly rely on analytics to gain competitive advantage [17]. The growth is not expected to taper off; by 2029, the market is forecasted to soar to USD655.53 billion, nearly doubling within four years [18]. This remarkable growth trajectory is set to culminate in a market value of USD745 billion by 2030 [19–24].

These projections highlight the robust market potential of big data analytics, driven by advanced technology, increased data generation, and the growing demand for real-time insights [14]. As more industries recognize the value of leveraging big data to enhance decision-making, optimize operations, and innovate, the market is poised for sustained expansion [17].

The figures reflect a notable CAGR of approximately 13% from 2023 to 2030, indicating continued growth fueled by the rising integration of big data analytics across diverse sectors, such as banking, healthcare, retail, and telecommunications.

Figure 1 illustrates the global market potential for big data analytics from 2023 to 2030, based on research data. The graph reveals a consistent upward trend with projections estimating the market will grow from USD307.52 billion in 2023 to USD745 billion by 2030. This significant growth highlights the increasing integration and reliance on big data analytics across various industries worldwide.



Adoption Trends for Big Data Analytics

The usage of big data analytics in the Philippines is rising, mainly due to the growing recognition of data as a strategic asset in both the corporate and public sectors. Many firms have begun to incorporate data analytics into their operations, with roughly three out of every five now having dedicated data analytics teams. However, financial constraints, managing unstructured data, and a scarcity of experienced data experts continue to stymie widespread use. The Philippine government is also pushing for digital transformation, including the use of big data analytics to improve public services and governance. The growing demand for data analysts reflects the country's transition to a more data-driven economy [25– 27].

IoT

The IoT refers to an extensive network of interconnected physical objects that are embedded with sensors, software, and other technologies, enabling them to collect, share, and process data through the internet. These devices range from everyday items, like smart thermostats and fitness trackers to advanced industrial machinery and smart city infrastructure. IoT facilitates automation, improves operational efficiency, and offers data-driven insights across various sectors, transforming both organizational operations and daily interactions with technology.

Expansion of IoT Devices

In 2023, around 15 billion IoT devices were connected worldwide, and forecasts indicate this figure will increase to 25 billion by 2025 and reach a remarkable 75 billion by 2030. The global IoT market, which was valued at USD384.70 billion in 2022, is projected to expand at a CAGR of 26.1% from 2023 to 2030, potentially surpassing USD1 trillion by the end of the decade [28].

In terms of data generation, IoT devices are expected to produce around 73.1 zettabytes of data by 2025. This vast amount of data is collected by a wide range of devices, including sensors, cameras, and smart appliances. To put this in perspective, one zettabyte equals 1,000 exabytes.

The smart home market is also on the rise, projected to reach USD313.95 billion by 2026, driven by products, such as smart speakers, thermostats, and security systems. The industrial IoT market is expected to grow from USD216.13 billion in 2021 to USD1.11 trillion by 2028, with manufacturing, logistics, and energy sectors leading this growth. However, security concerns persist, as more than 98% of IoT device traffic remains unencrypted, making it vulnerable to attacks. By 2025, experts predict that over 25% of cyberattacks will involve IoT devices.

IoT-enabled energy management systems have the potential to reduce building energy consumption by up to 25%, supporting sustainable practices. The healthcare sector is also leveraging IoT, with the market estimated at USD180 billion in 2022 [29-30]. Key applications include remote patient monitoring, smart wearables, and hospital asset tracking.

Factors Driving the Adoption of IoT

Developments in connectivity technologies, such as 5G, which offer faster and more reliable data transfer, and the reduced cost of sensors and devices, which make IoT solutions more affordable, are driving the adoption of IoT. Furthermore, the growing availability of cloud computing and big data analytics enables businesses to process and derive insights from the massive amounts of data created by IoT devices, resulting in better-informed decision-making. Consumer demand for smart devices and the push for digital transformation in industries are driving IoT adoption as businesses strive to improve efficiency, innovation, and sustainability.

Factors Hindering IoT Adoption

Several problems impede the adoption of IoT, including substantial security and privacy concerns caused by IoT devices' vulnerability to cyberattacks, which can result in unauthorized data access and system breaches. The high cost of establishing IoT infrastructure, particularly for small and medium-sized businesses (SMEs), is also an impediment, along with the complexity of integrating IoT with existing systems and managing the large amounts of generated data. Furthermore, interoperability concerns caused by a lack of standardized protocols across various devices and platforms hamper IoT deployment and adoption.

Market Growth Potential

The IoT market demonstrates remarkable growth potential, reflecting its increasing integration into various sectors. In 2023, the market was estimated to be worth USD595.73 billion, showcasing the pivotal role IoT technologies play in modernizing industries and enhancing connectivity. This growth is anticipated to persist with forecasts indicating that the market will achieve USD714.48 billion by 2024, indicating a strong upward trend [20–22].

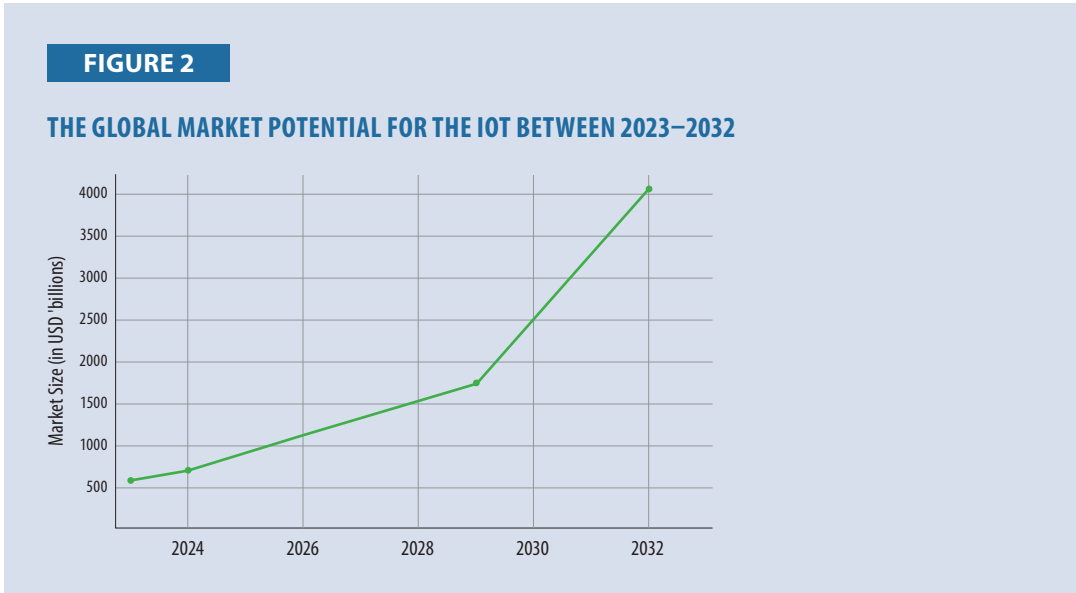
Looking ahead, the IoT market is poised for even more substantial expansion. By 2029, experts predict the market will nearly triple, reaching an impressive USD1,751.8 billion. This anticipated growth underscores the ongoing adoption of IoT solutions across industries, driven by advancements in technology and the increasing demand for smart devices and automated systems [31].

The long-term forecast for the IoT market is exceptionally promising. By 2032, the market is projected to reach USD4,062.34 billion, propelled by a CAGR of around 24.3%. This dramatic growth is expected to be driven by ongoing advancements in IoT applications, the proliferation of 5G networks, and a growing demand for real-time data analytics [32–34].

These projections highlight the immense potential of the IoT market as it becomes a cornerstone of digital transformation across industries, driving efficiency, connectivity, and innovation on a global scale.

This data shows a strong upward trend fueled by increased adoption across a variety of industries, including manufacturing, healthcare, smart cities, and automotive. Rapid technological breakthroughs, such as 5G, AI, and edge computing are also helping to drive the global expansion of IoT solutions.

Figure 2 reveals the global market potential for the IoT from 2023 to 2032, based on research data. The graph shows a considerable upward trend with the market predicted to increase from USD595.73 billion in 2023 to more than USD4,062.34 billion in 2032, indicating a strong CAGR driven by widespread use and technological developments.



Adoption Trends for the IoT

The Philippines is seeing an increase in IoT usage, supported by government initiatives and cooperation with industry leaders to support digital transformation. The Department of Information and Communications Technology (DICT) has been a key driver in advancing IoT, notably through initiatives, like the annual IoT Conference. This event highlights the potential of IoT in sectors, such as smart cities, agriculture, and utilities. However, barriers, such as infrastructural limits and concerns about data security and privacy, continue to impede wider implementation. Despite these challenges, the country's IoT ecosystem is progressively expanding with increased awareness and use in both urban and rural areas.

Cloud Computing

Cloud computing involves delivering computer services, such as storage, processing power, networking, and software, over the internet ("the cloud") instead of relying on local servers or personal devices. This technology provides on-demand access to shared resources, enabling businesses to scale operations more effectively, reduce costs, and enhance flexibility. Cloud computing is categorized into three service models: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), each offering different levels of control and management. Despite its benefits, challenges, like data security concerns, regulatory compliance, and the complexity of transitioning existing systems can affect the adoption of cloud computing.

The cloud computing market has experienced rapid growth in recent years, underscoring its essential role in modernizing IT infrastructure and facilitating digital transformation across various sectors. In 2022, the global cloud computing market was valued at approximately USD480 billion and is projected to grow at a CAGR exceeding 18%, potentially reaching USD1.2 trillion by 2027 [35]. This expansion reflects the increasing dependence on cloud services as organizations pursue scalable, cost-effective solutions to adapt to their evolving needs.

Adoption Rates

Cloud computing adoption has become nearly ubiquitous, with over 90% of organizations utilizing cloud services as of 2023. A notable trend in this adoption is the multicloud strategy, used by over 80% of organizations. This approach enables them to capitalize on the benefits of various cloud providers while reducing the risks linked to being dependent on a single vendor. SMEs are also rapidly embracing cloud technologies with 70% already using at least one cloud solution [36]. This widespread adoption underscores the cloud's versatility in meeting the diverse needs of businesses of all sizes.

Cost Efficiency

One of the key drivers of cloud adoption is its potential for cost savings. Businesses that migrate to the cloud can reduce IT expenses by 15%–20%, primarily by lowering the costs associated with hardware, software, and personnel [37]. These savings enable organizations to reallocate resources to other strategic areas, further enhancing their operational efficiency and competitiveness.

Data Growth

The cloud is poised to become the primary repository for global data storage with predictions indicating it will hold 100 zettabytes of data by 2025. This figure would account for 60% of all global data storage, underscoring the critical role of cloud infrastructure in managing the exponential growth of data generated by businesses, consumers, and IoT devices [38].

Security and Compliance

Security continues to be a primary concern for organizations contemplating cloud adoption. Despite initial fears, over 94% of companies report improved security after migrating to the cloud, citing enhanced data protection measures provided by cloud providers. However, concerns persist, with 93% of firms expressing worries about potential data breaches and loss of control over their data [39]. These concerns highlight the need for robust security practices and ongoing vigilance as organizations continue to expand their cloud footprints.

Factors Driving Cloud Computing Adoption

The demand for increased flexibility, scalability, and cost efficiency in IT operations drives the adoption of cloud computing. Businesses are increasingly turning to cloud services to avoid the high upfront costs involved with constructing and maintaining physical infrastructure while simultaneously benefiting from the capacity to rapidly scale resources up or down in response to demand. Moreover, cloud computing improves collaboration and mobility by allowing employees to access data and apps from anywhere, which has become critical in the context of remote working. Furthermore, cloud service providers' sophisticated security measures as well as the possibility of improved disaster recovery capabilities, contribute to cloud technology adoption.

Factors Hindering Cloud Computing

Concerns around data security, privacy, and legal compliance frequently impede cloud computing adoption, particularly in companies that handle sensitive information. Businesses have additional obstacles due to the complexity of transferring old systems to the cloud, which can be both time-consuming and costly. The risk of vendor lock-in, where an organization becomes overly dependent on a single cloud provider, raises concerns about flexibility and long-term costs. Furthermore, a shortage of experienced staff to handle cloud environments as well as the continuous expenditures involved with cloud maintenance, make cloud adoption difficult for many firms.

Market Potential of Cloud Computing

The global cloud computing market is set for significant expansion over the coming decade, fueled by the growing use of cloud services across different sectors and the ongoing advancement of cloud technologies. In 2023, the market was estimated to be worth USD626.4 billion, highlighting its crucial role in digital transformation and contemporary IT strategies. This upward trajectory is anticipated to persist, with projections indicating the market will hit USD735.45 billion by 2024, emphasizing the swift adoption of cloud solutions by businesses.

Looking further into the future, the cloud computing market is projected to experience even more significant growth. By 2028, the market is expected to almost double, reaching USD1.19 trillion. This increase is driven by the continued transition to cloud-based infrastructure and services as organizations look for scalable and adaptable solutions to address their evolving needs. Additionally, the incorporation of advanced technologies, such as AI, machine learning, and edge computing into cloud platforms is expected to accelerate this growth, providing improved capabilities and efficiencies.

The long-term outlook for the cloud computing market is particularly optimistic. By 2032, the market is projected to surge to an impressive USD2.297 trillion, driven by a CAGR of around 17% from 2023

to 2032. This significant growth reflects not only the increasing reliance on cloud technologies but also the expanding range of applications and services available through the cloud. As businesses continue to innovate and seek competitive advantages through digital transformation, the cloud computing market is likely to remain a key enabler of global economic growth and technological advancement [21–22, 28, 40–43].

These projections highlight the robust market potential of cloud computing, positioning it as a critical component of future business strategies and technological infrastructure. As the market continues to expand, it will create numerous opportunities for cloud service providers, technology developers, and organizations that leverage cloud technologies to drive innovation and efficiency.

Factors, such as increased acceptance of cloud-based solutions across industries, advancements in digital transformation projects, and the growing popularity of SaaS are driving this rise. Furthermore, hybrid and multicloud strategies are becoming increasingly common as firms strive to optimize their IT infrastructure.

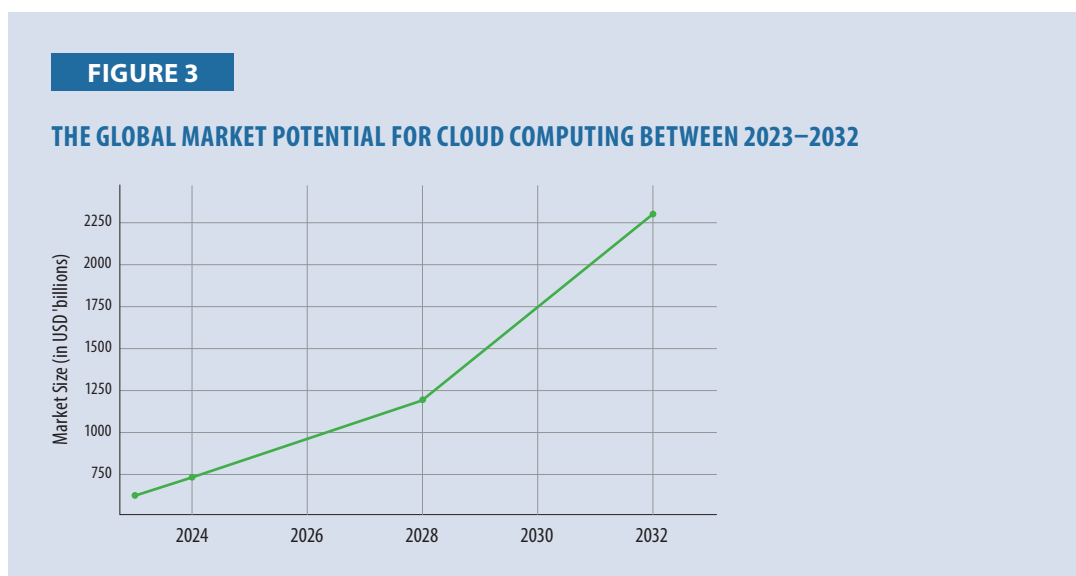


Figure 3 illustrates the global market potential for cloud computing from 2023 to 2032, based on research data. The graph shows tremendous development, with the market predicted to rise from USD626.4 billion in 2023 to USD2.297 trillion by 2032, driven by the widespread adoption of cloud technology across industries.

Adoption Trends for Cloud Computing

Cloud computing usage in the Philippines is rapidly increasing, driven by both government initiatives and private sector understanding of the benefits of digital transformation. The government's Cloud First Policy has promoted the adoption of cloud technology in a variety of industries, particularly public administration. As a result, 91% of firms in the Philippines want to invest in cloud services with 85% aiming to completely migrate their data to the cloud over the next two years. The rising local data center market as well as the activities of major cloud providers, such as Alibaba Cloud and AWS, are also driving the spike in usage. However, issues, such as data security and migration complexity remain important obstacles.

Connectivity and its Impact

Connectivity, particularly the broad use of high-speed internet and the introduction of 5G networks, has become a vital enabler for the development and deployment of innovative technologies. With quicker and more dependable connectivity, innovations like the IoT, self-driving cars, and smart cities have flourished. Enhanced connections enable these technologies to send enormous amounts of data

in real time. For example, IoT devices ranging from smart household appliances to industrial sensors rely on seamless connectivity to interact and function effectively. Improved connectivity also allows for the large data exchanges required for AI-driven applications, resulting in more sophisticated and responsive systems that can adjust to user needs in real time [28, 44].

Connectivity has a far-reaching impact on developing technologies, affecting entire ecosystems. For example, better connection in the healthcare industry enables the widespread use of telemedicine, remote monitoring, and digital health records, all of which improve patient care and access to medical services. In manufacturing, improved connections enable the incorporation of advanced robotics and AI into production processes, resulting in increased efficiencies and innovations in Industry 4.0 [45]. However, the proliferation of connected devices and networks also heightens cybersecurity concerns, as the growing interconnectedness of systems introduces more potential points of vulnerability. As a result, while connectivity promotes the development and acceptance of innovative technologies, it also needs improvements in security measures.

Conclusion and Policy Implications

This study provides a comprehensive analysis of the latest technological trends in the Philippines, offering valuable insights into how these trends can potentially disrupt and transform markets, governance, and society. By examining the effects of these technological advancements, the study sheds light on their implications for productivity and growth dynamics at both national and regional levels, helping stakeholders understand the broader economic impact.

In addition, by analyzing global competitiveness and the role of emerging technologies, such as big data analytics, IoT, and cloud computing, the study highlights strategies to bolster the Philippines' position as a leading outsourcing destination.

This study recommends policy responses to emerging technological trends, enhancing the advisory role of the APO as a regional advisor. These following recommendations are considered instrumental in guiding policymakers to support and facilitate industry growth through orchestrated actions and collaboration among stakeholders.

- **Invest in infrastructure development** - Investing in the improvement and expansion of the nation's digital infrastructure, such as high-speed internet access and a dependable power supply, particularly in rural regions, should be prioritized. This will ensure that the benefits of emerging technologies can be realized nationwide, reducing the digital divide
- **Strengthen data security and privacy regulations** - This involves developing and enforcing stringent standards specifically designed for the said emerging technologies. Key measures should include mandatory encryption protocols, robust data storage security, and clear guidelines on data ownership and usage. These regulations will be crucial in safeguarding citizens from potential cyber threats and ensuring the safe and responsible deployment of emerging technologies
- **Implement education and training programs for emerging technologies** - Implement educational initiatives to build a skilled workforce capable of developing, managing, and securing emerging technologies systems. This can include incorporating emerging technologies-focused courses in higher education curricula and offering specialized training programs for professionals

REFERENCES

- [1] Howitt P. Endogenous growth theory. In: Durlauf S.N., Blume L.E., eds. *Economic Growth*. The New Palgrave Economics Collection. London: Palgrave Macmillan; 2010, pp. 68–73. Available on https://doi.org/10.1057/9780230280823_10.
- [2] Department of Information and Communications Technology (DICT). *E-Government Masterplan 2022*. Quezon City: Department of Information and Communications Technology; 2019. <https://dict.gov.ph/ictstatistics/wp-content/uploads/2020/03/EGMP-2022.pdf>, accessed on 28 August 2024.
- [3] MarketsandMarkets. *Big data market by offering, deployment mode, organization size, end user, and region - global forecast to 2026 (2023)*. <https://www.marketsandmarkets.com>, accessed on 28 August 2024.
- [4] International Data Corporation (IDC Research). *IDC futurescape: worldwide IT industry 2023 predictions*. Available on <https://www.idc.com/research/futurescape-2023>.
- [5] Gartner. *Big data adoption in large enterprises*. Gartner Research 2022. <https://www.gartner.com>, accessed on 28 August 2024.
- [6] McKinsey & Company. *The state of AI in 2022 - and a half-decade in review*. McKinsey Global Institute 2022. <https://www.mckinsey.com>, accessed on 28 August 2024.
- [7] Deloitte. *Big data analytics: trends and challenges*. Deloitte Insights 2023. <https://www2.deloitte.com>, accessed on 28 August 2024.
- [8] Marr B. *Big Data in Practice: How 45 Successful Companies Used Big Data Analytics to Deliver Extraordinary Results*. West Sussex: Wiley; 2016.
- [9] Press G. *6 predictions about the future of data science and machine learning*. Forbes website. Available on <https://www.forbes.com/sites/gilpress/2017/11/21/6-predictions-about-the-future-of-data-science-and-machine-learning/?sh=244c7c8264f3>.
- [10] Davenport T.H., Patil D.J. *Data scientist: the sexiest job of the 21st century*. *Harvard Business Review* 2012; 90(10): 70–76.
- [11] Statista. *Edge computing market size worldwide from 2020 to 2026*. Statista Research Department 2023. <https://www.statista.com>, accessed on 28 August 2024.
- [12] Gartner. *Top strategic technology trends for 2023: real-time analytics, edge computing, and AI integration*. Gartner Research 2023. Available on <https://www.gartner.com/en/documents/strategy-2023>.
- [13] McKinsey & Company. *The future of data analytics: trends to watch in 2023 and beyond*. McKinsey Insights 2023. Available on <https://www.mckinsey.com/insights/2023-data-analytics-trends>.
- [14] Smith R. *The current state of big data analytics: market analysis for 2023*. *Technology Today*, January 2023. Available on <https://www.technologytoday.com/bigdata2023>.
- [15] Jones M., Brown S. *Year-on-year growth in big data analytics*. *Data Analytics Quarterly*, April 2023. Available on <https://www.dataanalyticsquarterly.com/growth2023>.

- [16] Fortune Business Insights. Big data analytics market. <https://www.fortunebusinessinsights.com/big-data-analytics-market-106179>, accessed on 28 August 2024.
- [17] Taylor A. Leveraging big data for competitive advantage: a market overview. *Business Intelligence Review*, June 2023. Available on <https://www.businessintelligencereview.com/market-overview2023>.
- [18] Johnson E. The future of big data: market trends and predictions. *Global Market Insights* September 2023. Available on <https://www.globalmarketinsights.com/bigdata2023>.
- [19] Doe J. Big data analytics market projections: 2023–2030. *International Journal of Data Science*, 15 August 2023. Available on <https://www.journalofdatascience.com/projections>.
- [20] Fortune Business Insights. Internet of things [IoT] market size, share & industry analysis, by component (platform and solution & services), by deployment (on-premise and cloud), by enterprise type (SMEs and large), by industry (BFSI, retail, government, healthcare, manufacturing, agriculture, sustainable energy, transportation, IT & telecom, and others), and regional forecast, 2024–2032. Updated 14 October 2024. <https://www.fortunebusinessinsights.com>, accessed on 28 August 2024.
- [21] Fortune Business Insights. Cloud computing market size, share & industry analysis, by type (public cloud, private cloud, and hybrid cloud), by service (infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), by enterprise type (SMEs and large enterprises), by industry (BFSI, IT, and telecommunications, government, consumer goods and retail, healthcare, manufacturing, and others), and regional forecast, 2024–2032. Updated 14 October 2024. <https://www.fortunebusinessinsights.com>, accessed on 28 August 2024.
- [22] Fortune Business Insights. Big data analytics market size, share & industry analysis, by component (software, hardware, and services), by enterprise type (large enterprises and small & medium enterprises (SMEs)), by application (data discovery and visualization, advanced analytics, and others), by vertical (BFSI, automotive, telecom/media, healthcare, life sciences, retail, energy & utility, government, and others), and regional forecast, 2024–2032. Updated 14 October 2024. <https://www.fortunebusinessinsights.com>, accessed on 28 August 2024.
- [23] Introspective Market Research. Big data analytics market global industry analysis and forecast (2024–2032) by component (software, hardware, services), deployment model (on-premise, cloud-based), analytics tool (dashboard & data visualization, data mining, self service tools, reporting, others), end-user (banking & finance, telecommunication, web, retail, others) and region. June 2024. <https://introspectivemarketresearch.com/reports/big-data-analytics-market/>, accessed on 28 August 2024.
- [24] Introspective Market Research. Big data analytics market - overview and outlook by potential growth (2024–2032). <https://www.introspectivemarketresearch.com>, accessed on 28 August 2024.
- [25] PwC Philippines. Making the big leap: are we ready for data analytics? (2020). <https://www.pwc.com/ph/en/publications/pwc-publications/making-the-big-leap.html>, accessed on 28 August 2024.
- [26] OpenGov Asia. The Philippines enhances digitalisation efforts in 2024. 8 January 2024. <https://www.opengovasia.com/the-philippines-enhances-digitalisation-efforts-in-2024>, accessed on 28 August 2024.
- [27] Medenilla S. Amid shift to digital, demand for data analysts seen to double in 2022. *Business Mirror*, 10 June 2021. <https://businessmirror.com.ph/2021/06/10/amid-shift-to-digital-demand-for-data-analysts-seen-to-double-in-2022/>, accessed on 28 August 2024.

- [28] Manyika J., Chui M., Bisson P., et al.. The internet of things: mapping the value beyond the hype. McKinsey Global Institute, 2015. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world>, accessed on 28 August 2024.
- [29] Deloitte. The IoT opportunity: accelerating energy efficiency and decarbonization (2021). Deloitte Insights. Available on <https://www2.deloitte.com/us/en/insights/focus/internet-of-things/overview.html>.
- [30] Porter M.E., Heppelmann J.E. How smart, connected products are transforming competition. Harvard Business Review, November 2014. <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition>, accessed on 28 August 2024.
- [31] Mordor Intelligence. IoT market - size, growth & trends - internet of things. <https://www.mordorintelligence.com>, accessed on 28 August 2024.
- [32] GlobalData. Internet of things (IoT) market trends, analysis and forecast to 2026. <https://www.globaldata.com>, accessed on 28 August 2024.
- [33] Market Research Future. Internet of things market size, trends, industry report till 2032. May 2024. <https://www.marketresearchfuture.com>, accessed on 28 August 2024.
- [34] Market Data Forecast. Internet of things (IoT) market size, share, growth report. <https://www.marketdataforecast.com>, accessed on 28 August 2024.
- [35] Gartner. Forecast: public cloud services, worldwide, 2020–2027. <https://www.gartner.com>, accessed on 28 August 2024.
- [36] Flexera. 2023 state of the cloud report. <https://www.flexera.com>, accessed on 28 August 2024.
- [37] RightScale. 2022 state of the cloud report by Flexera. <https://www.flexera.com>, accessed on 28 August 2024.
- [38] International Data Corporation (IDC Research). Data age 2025: the digitization of the world. <https://www.idc.com>, accessed on 28 August 2024.
- [39] McAfee. Cloud adoption & risk report 2023. <https://www.mcafee.com>, accessed on 28 August 2024.
- [40] Grand View Research. Cloud computing market size, share & growth report, 2030. <https://www.grandviewresearch.com>, accessed on 28 August 2024.
- [41] Mordor Intelligence. Cloud computing market size & share analysis - growth trends. <https://www.mordorintelligence.com>, accessed on 28 August 2024.
- [42] Beyond Market Insights. Cloud computing market size, share, growth and forecast to 2030. <https://www.beyondmarketinsights.com>, accessed on 28 August 2024.
- [43] Precedence Research. Cloud computing market size to surpass USD 2297.37 bn by 2032. <https://www.precedenceresearch.com>, accessed on 28 August 2024.
- [44] Cisco Systems. The role of connectivity in digital transformation. Cisco White Paper, 2020. <https://www.cisco.com>, accessed on 28 August 2024.
- [45] Schwab K. The Fourth Industrial Revolution. New York: Crown Business; 2016.

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ABBREVIATIONS AND ACRONYMS

AI Artificial intelligence

APO Asian Productivity Organization

CAGR Compound annual growth rate

IoT Internet of Things

IT-BPM Information Technology and Business Process Management

ITO Information Technology Outsourcing

SaaS Software as a service

SMEs Small and medium-sized businesses

