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Readiness for AI Adoption of Philippine Business and Industry: The Government's Role in Fostering Innovation- and AI-Driven Industrial Development

Francis Mark A. Quimba, Neil Irwin S. Moreno, and Alliah Mae C. Salazar

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Abstract

This paper examines the current state of AI adoption in Philippine businesses and industries, analyzing the barriers to adoption and evaluating the government's role in fostering AI-driven industrial development. Through analysis of various AI readiness indices and case studies, the research finds that while basic digital infrastructure is widespread, with 90.8 percent of establishments having computers and 81 percent having internet access, advanced technology adoption remains limited. Only 14.9 percent of firms use AI technologies, with adoption concentrated in urban areas and larger firms, particularly in the ICT and BPO sectors. The study identifies key barriers including limited digital infrastructure, low awareness of AI technologies, significant skills gaps, and insufficient funding opportunities. Drawing from economic theory and international case studies, the paper outlines three critical domains for government intervention: market facilitation, capability building, and ecosystem coordination. The research proposes policy recommendations focusing on infrastructure development, human capital development, regulatory frameworks, public-private partnerships, and ethical guidelines. These recommendations emphasize the need for coordinated action across government agencies, substantial investment in digital infrastructure and education, and the establishment of clear governance frameworks to ensure responsible AI adoption while fostering innovation and competitiveness in the Philippine business sector.

Keywords: artificial intelligence, AI policy, industrial policy, AI adoption

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Readiness for AI Adoption of Philippine Business and Industry: The Government's Role in Fostering Innovation- and AI-Driven Industrial Development

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1. Introduction

1.1. Background

Artificial Intelligence (AI) has emerged as a transformative force across various industries worldwide, with the potential to significantly enhance productivity, efficiency, and innovation. Globally, AI is expected to contribute approximately USD 15.7 trillion to the economy by 2030, highlighting its substantial economic impact (Rao and Verweij 2017). The Asia-Pacific region, in particular, is projected to see its AI market grow to USD 136 billion by 2025, driven by the widespread adoption of AI technologies across multiple sectors, including healthcare, financial services, education, and telecommunications.

The global artificial intelligence (AI) market is experiencing rapid growth and transformation, with significant implications for economies worldwide. According to Statista, the global AI market size was estimated at around 200 billion USD in 2023, with projections suggesting it could surpass 1.8 trillion USD by 2030. This dramatic expansion is further supported by data from International Data Corporation (IDC), which forecasts worldwide spending on AI-centric systems to reach USD154 billion in 2023, marking a 26.9 percent increase over the previous year. The same report projects that AI spending will exceed USD300 billion by 2026, growing at a compound annual growth rate (CAGR) of 27 percent from 2022-2026.

This growth is being driven by advancements in various AI technologies, including machine learning (ML), natural language processing, computer vision, and robotics. Notably, the Generative AI (GenAI), market, which stood at USD44 billion in 2023, is expected to see particularly rapid expansion in the coming years (Statista). Goldman Sachs reports that AI investment is ramping up quickly across industries, with the potential to significantly impact gross domestic product (GDP).

On the global stage, the United States continues to lead in AI development and investment, followed closely by China. However, the landscape is evolving, with countries like Singapore making significant strides. According to the Global AI Index rankings, Singapore has emerged as a strong player, jumping to third place, while the UK and Canada round out the top 5 countries in AI readiness. This shift highlights the growing global competition in AI development and adoption.

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Countries globally are actively leveraging AI to enhance their industries' competitiveness in export markets and develop new areas of comparative advantage (Mishra et. al. 2024). In recent times, many countries have formulated their respective national AI strategies, which serve as a blueprint for the advancement and integration of this technology. Industries at the forefront of AI adoption include banking, retail, professional services, and manufacturing. Goldman Sachs projects that by 2025, AI investment could approach USD100 billion in the US and USD200 billion globally. CEO surveys indicate that widespread AI adoption is expected in the second half of this decade, suggesting that the economic impact of AI will become increasingly pronounced in the coming years.

Box 1. What is Artificial Intelligence?

Artificial intelligence (AI) encompasses computer systems and models capable of performing tasks that usually require human intelligence. These functions mainly involve sensing, thinking, learning, and taking action in response to what the system is sensing and its objectives (Rao and Verweij 2017; Wirjo et al. 2022). It has emerged at the forefront of automation and digitalization, thanks to the development of large amounts of data, improved algorithms, and more powerful computer hardware (Liu et al. 2024). AI has been extensively applied in many emerging technologies and products utilized by society, such as chatbots, image and speech recognition, search algorithms, and autonomous vehicles.

IBM (2023) presented the various types of AI technologies, which fall under two general categories: capabilities and functionalities. AI systems, based on capabilities, can be classified as Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Super AI. The ANI, also known as Weak AI, is the only type that currently exists. ANI systems can be developed to perform specific activities and can often outperform humans in routine tasks. Their performance is only limited to a specific subset of cognitive abilities, and they can only advance in that area. Technologies under ANI can be further classified by functionality:

- *Reactive Machine AI*. These are AI systems designed to perform a very specific task and only rely on presently available data. Reactive AI utilizes statistical mathematics and can analyze large amounts of data to produce a seemingly intelligent output. Examples of this are chess-playing computers and recommendation engines.
- *Limited Memory AI*. This type of AI can use past- and present-moment data and monitor specific objects or situations over time. However, it usually cannot retain data for long time periods. GenAI, virtual assistances and chatbots, and self-driving cars are examples of Limited Memory AI.

Meanwhile, AGI and Super AI are still theoretical concepts. AGI systems are perceived to utilize previous learnings and skills to perform new tasks without the need to train the underlying models. An example of AGI would be Theory of Mind AI, which would understand the thoughts and emotions of other entities, allowing it to simulate human-like relationships. Unlike GenAI, the Theory of Mind AI would be capable of understanding the contextualize artwork and essays.

Super AI would include systems that possess cognitive abilities surpassing those of human beings. An example of an AI system with super AI capabilities would be Self-Aware AI, which could understand its own internal conditions and traits, along with human emotions and thoughts. A Self-Aware AI system is also expected to possess its own set of emotions, needs and beliefs.

The potential economic impact of AI is substantial. Goldman Sachs economists suggest that AI has the potential to boost global labor productivity by more than 1 percentage point annually in the decade following widespread adoption. Furthermore, AI-related investment could peak at 2.5-4 percent of GDP in the US and 1.5-2.5 percent in other major AI leaders, underscoring the significant role AI is expected to play in future economic growth.

Key trends shaping the AI landscape include an increasing focus on GenAI capabilities across various domains, growing investment in AI hardware and infrastructure to support model development and deployment, and rising interest in AI applications across diverse industries and use cases. These trends point to a future where AI becomes increasingly integrated into various aspects of business and society.

Utilizing AI provides opportunities to both developed and developing countries for innovation, productivity growth, jobs generation, consumer welfare, and government efficiency (Makridakis 2017; Babina et al. 2024; Autor et al. 2024; Mondal et al. 2023; Van Noordt and Misuraca 2022). However, the approaches taken by countries reveal notable differences in their priorities, as well as their level of development. Developed countries mostly possess the resources and infrastructure required to facilitate the development and adoption of sophisticated AI technologies (Mhlanga 2021). Conversely, developing economies tend to adopt simpler technologies, in an attempt to catch up with developed countries in terms of technological and economic development (Goralski and Tan 2020; Pinheiro et al. 2022). Thus, widespread use of AI entails the risk of widening income gap and aggravating inequality. Moreover, AI utilization could lead to issues in cybersecurity and privacy, intellectual property, job automation, and competition (Liu et al. 2024).

In the Philippines, the integration of AI into business and industry is still in its nascent stages, with the country ranking below average in AI readiness compared to other Asia-Pacific nations. However, there is growing recognition of AI's potential to revolutionize various sectors, from manufacturing and logistics to customer service and finance. The government has also started to take steps towards enhancing AI adoption, as seen in the development of the National AI Roadmap, which aims to establish the country as a hub for AI research and development in Southeast Asia.

Despite these initiatives, there remains a significant gap in understanding the actual readiness of Philippine businesses and industries to adopt AI. This gap underscores the need for comprehensive research that assesses the current state of AI adoption, identifies the barriers to implementation, and provides actionable insights to accelerate AI integration across the country's business landscape.

Given this context of rapid growth and widespread impact of AI across industries and economies, the role of government in shaping AI industry development becomes crucial. For a developing country like the Philippines, understanding these global trends can inform policies to foster AI innovation, attract investment, develop talent, and ensure responsible AI adoption to boost economic competitiveness. As the AI landscape continues to evolve, governments will play a key role in creating an environment that supports AI development while addressing potential challenges and ensuring equitable access to the benefits of this transformative technology.

1.2. Importance of the Research

Understanding the readiness for AI adoption among Philippine businesses and industries is crucial for several reasons. Firstly, AI has the potential to drive significant economic growth by enhancing productivity, reducing operational costs, and enabling the development of new products and services. For Philippine businesses to remain competitive in a rapidly evolving global market, it is essential that they leverage AI technologies effectively.

Secondly, assessing AI readiness can help identify specific areas where businesses may be struggling, such as a lack of technical expertise, inadequate infrastructure, or insufficient regulatory support. Addressing these challenges will be key to ensuring that businesses can successfully integrate AI into their operations and reap its full benefits.

Moreover, this research is timely given the accelerated digital transformation brought about by the COVID-19 pandemic. As businesses increasingly turn to digital solutions to stay afloat, understanding their readiness for AI adoption will be critical in guiding government policies, industry initiatives, and educational programs that aim to build the necessary capabilities for AI integration.

Finally, the findings from this research could inform the development of targeted strategies to support small and medium-sized enterprises (SMEs), which make up a significant portion of the Philippine economy. By identifying the unique challenges faced by SMEs in adopting AI, stakeholders can develop tailored solutions that ensure these businesses are not left behind in the AI revolution.

1.3. Key Research Questions

As the global economy increasingly embraces AI, it is imperative for Philippine businesses and industries to assess their readiness for AI adoption. This research will provide valuable insights into the current state of AI integration in the Philippines, identify the barriers that need to be overcome, and offer strategic recommendations for enhancing AI readiness. By doing so, it will contribute to ensuring that the Philippines remains competitive in the AI-driven global economy.

More specifically, this study will have the following major research questions:

1. What is the current state of the AI environment for businesses and industries in the Philippines?

This question aims to establish a baseline understanding of how the ecosystem to support AI adoption and use in Philippine business. It explores the extent to which businesses are already using AI technologies, the types of AI applications being implemented, and the key drivers behind these adoption decisions.

2. How does AI adoption vary across different sectors and types of businesses?

AI readiness may not be uniform across all sectors or business sizes. This question seeks to understand the disparities in AI adoption readiness, examining how factors such as industry type, business size, and regional location impact a company's ability to integrate AI into its operations.

3. What are the primary barriers to AI adoption faced by Philippine businesses?

Identifying the challenges that hinder AI adoption is critical for developing effective interventions. This question will explore issues such as the availability of technical skills, access to necessary infrastructure, regulatory constraints, and financial barriers that businesses encounter when trying to implement AI.

4. What role do government policies and industry initiatives play in supporting AI adoption in the Philippines?

Government policies and industry initiatives are crucial in creating a conducive environment for AI adoption. This question will assess the effectiveness of existing policies and initiatives, identify gaps, and provide recommendations for how the government and industry stakeholders can better support businesses in their AI adoption journeys.

2. Current State of AI and ICT in the Philippines

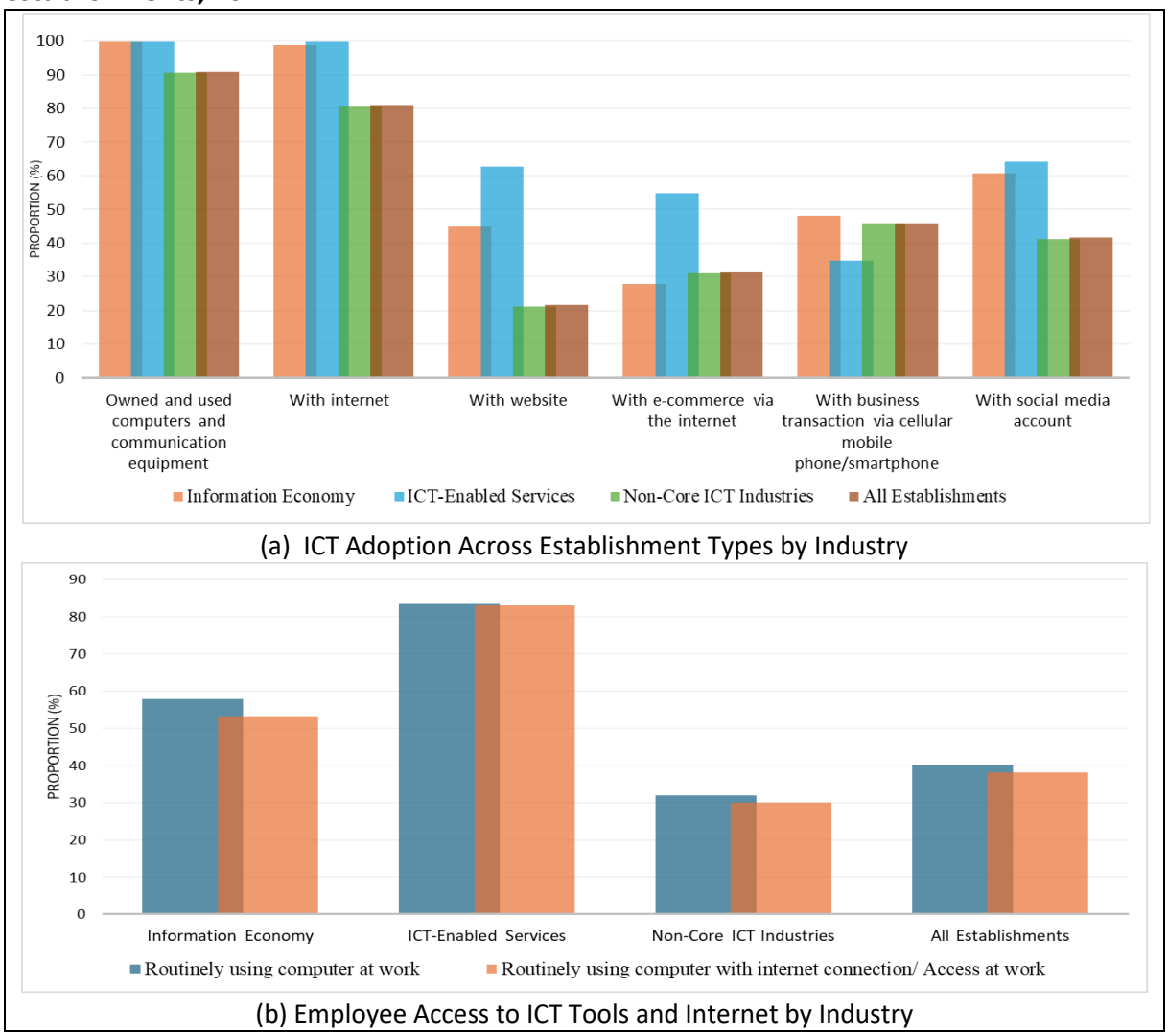
2.1. Digital transformation and ICT adoption

Foundational for the adoption of AI and Machine learning is the adoption of information and communications technology (ICT) across businesses operations of establishments in various sectors. Findings from the Survey on Information and Communications Technology (SICT),

conducted by the Philippine Statistics Authority (PSA), provide valuable insights into the status of digital technology adoption among establishments in the Philippines.

On the aggregate level, data shown (in brown) in Panel (a) of Figure 1 portray a significant portion (90.8%) of all establishments own and use computers and communication equipment, and 81 percent have internet access, suggesting most businesses in the Philippines are equipped with basic digital tools. One key observation across industries is that their rate of internet access is consistently lower than their ownership and use of computers and communication equipment. This suggests that although many businesses have access to the necessary digital equipment, not all are fully connected to the internet.

Figure 1. ICT usage and digital adoption by industry classification in Philippine establishments, 2021



Note: Core ICT Industries consist of two key areas: (1) the Information Economy (IE), focusing on activities that rely on fast, global information exchange to create economic and social value, and (2) ICT-Enabled Services, delivered remotely through ICT networks like the internet. IE includes the ICT sector and the Content and Media sector. Non-core ICT industries include arts, entertainment and recreation; agriculture, forestry and fishing; transportation and storage; real estate activities; and accommodation and food services activities.

Source: 2021 SICT (PSA, 2024a, 2024b, 2024c)

Only a moderate proportion of establishments reported having adopted more advanced digital practices such as having a website (21.7%) and engaging in e-commerce (31.2%). Despite a sizable portion using social media (41.7%) and conducting mobile business transactions (45.9%), there is still potential for intensifying digital engagement through websites and online services. In terms of employees, Panel (b) of Figure 1 shows that the majority do not routinely utilize a computer at work, as only 40 percent do, and just 38.1 percent have access to the internet.

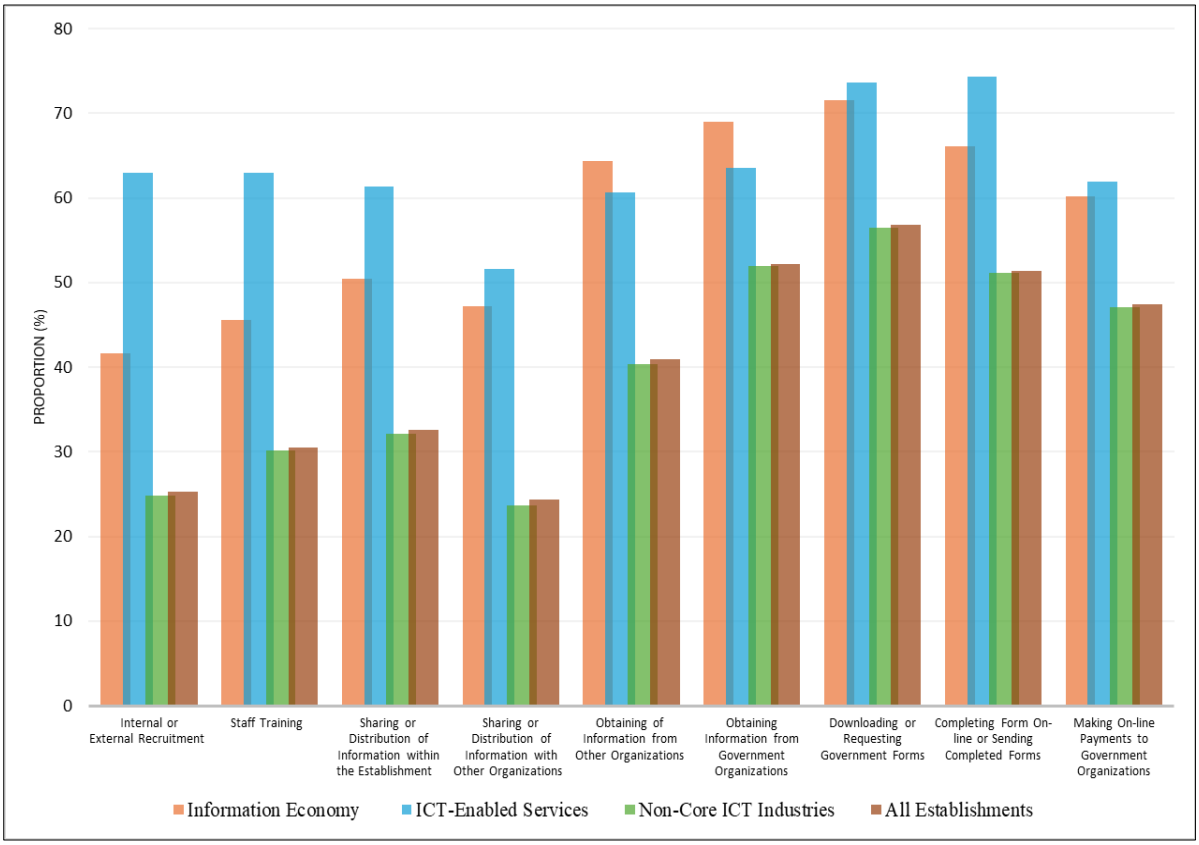
In terms of core ICT industries, Panel (a) of Figure 1 further highlights that almost all establishments under IE (99.7%) and ICT-Enabled Services (99.9%) use computers and communication equipment. Internet access was similarly high, with over 98 percent in both. However, there are notable differences in advanced digital adoption. For instance, only 44.8 percent in IE have websites compared to 62.6 percent of establishments under ICT-Enabled Services. Engagement on e-commerce via the Internet is also higher in ICT-Enabled Services (54.8%) compared to IE (27.9%)— almost twice as high. Similarly, the adoption of social media accounts is slightly more prevalent in ICT-Enabled Services (64.3%) than in IE (60.7%). In contrast, when it comes to business transactions conducted via mobile phones, IE leads with a higher proportion of establishments (48.2%) compared to ICT-Enabled Services (34.8%). With 83.5 percent of employees reported to routinely use computers and 83.1 percent reported to have internet access at work, employee-level data (Figure 1, Panel b) further emphasizes that ICT-Enabled Services are more digitally integrated. These figures likely reflect the nature of these industries and their reliance on ICT for delivering their services. On the other hand, only 57.9 percent of employees in IE use computers, and 53.3 percent have internet access at work.

Notably lower integration rates across all ICT indicators are observed in non-core ICT industries compared to core ICT industries, except in e-commerce usage via mobile (31.1%) and conducting business transactions via cellular phone (45.9%). These figures suggest that non-core ICT industries use accessible technology for operational purposes. Social media usage is present in 41.3 percent of establishments, which reflects some degree of digital engagement, but it plays less importance than in core ICT industries. Employee-level data (Figure 1, Panel b) further supports the observed varied levels of technology adoption. With only 31.9 percent of employees routinely using computers and only 30 percent having access to internet-connected computers at work, ICT plays a more supplementary role in enhancing essential business functions within non-core ICT industries.

Examining further the differences between core and non-core ICT industries, Figure 2 presents how internet usage differs between these sectors, specifically in terms of operational and administrative activities. Data reveals that the three most prominent activities among core ICT industries are downloading or requesting government forms (71.5% of IE and 73.6% of ICT enabled services), obtaining of information from government organizations (69% of IE and 63.5% of ICT-enabled services), and completing forms online (66.1% of IE and 74.3% of ICT-enabled services). These figures reflect the reliance of core-ICT industries on digital tools for managing administrative tasks efficiently and accessing government services. In line with this, these industries also utilize the internet for internal communication, e.g., sharing information

within the organization (50.5% of IE and 61.4% of IE-established services), and external correspondences, e.g., obtaining information from other organizations (64.4% of IE and 60.6% of IE-established services).

Figure 2. Internet usage in core vs non-core ICT industries, 2021

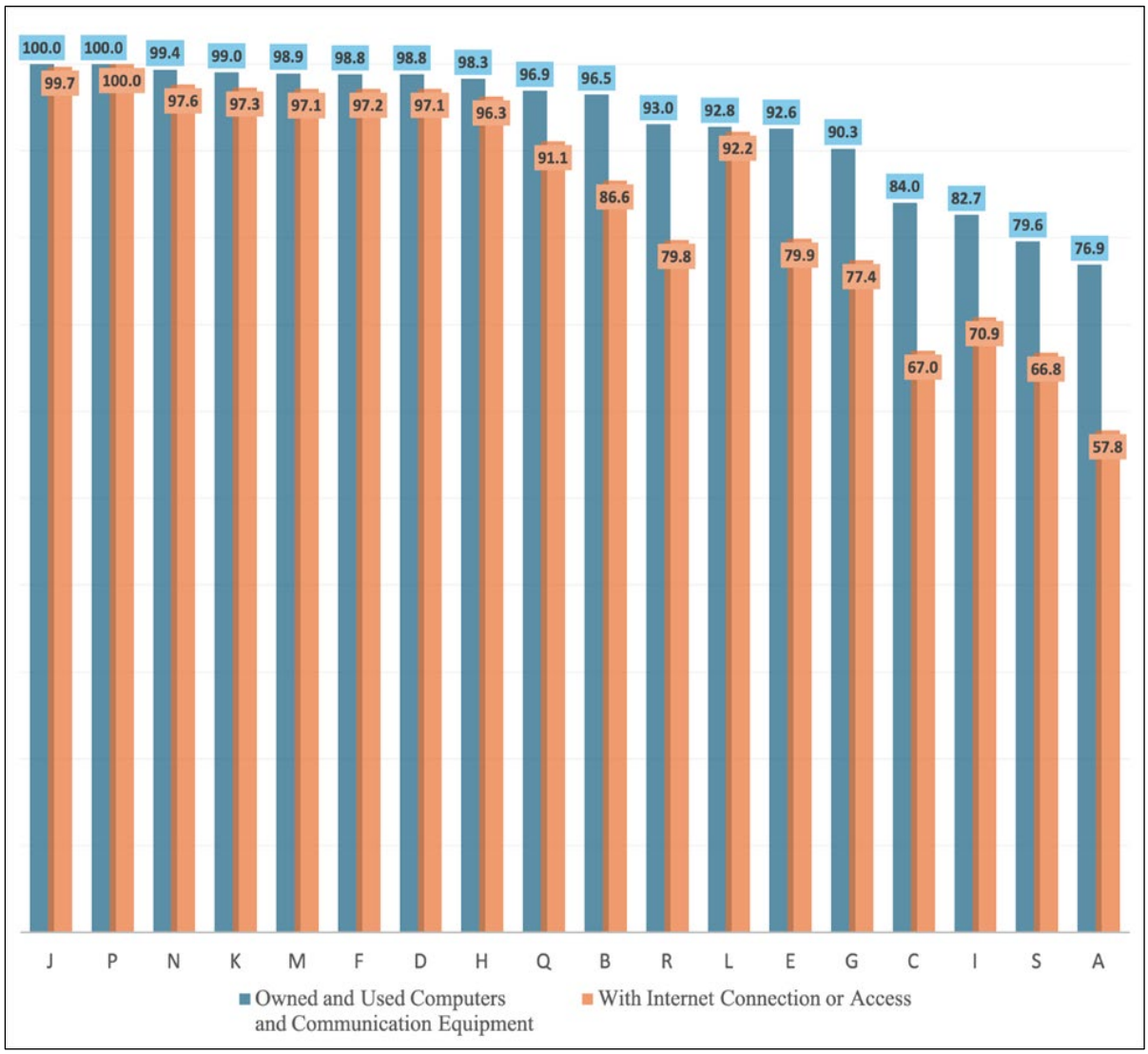


Source: 2021 SICT (PSA, 2024a, 2024b, 2024c)

Similarly, non-core ICT industries also utilize the internet for managing government-related tasks, such as obtaining information from government organizations (51.9%), downloading or requesting government forms (56.5%), and making online payments to government organizations (47.1%). The practice of using the internet for sending completed forms (51.1%) and obtaining information from other organizations (40.4%) also reflects its role in enhancing administrative efficiency and external communication, respectively, among non-core ICT industries.

In identifying gaps and opportunities across industries, exploring sectoral differences in ICT usage can facilitate the strategy development for improving digital technology adoption. By illustrating the proportion of establishments that owned and used computers and communication equipment (blue bars) and those with internet connection or access (orange bars), Figure 3 presents the sectoral breakdown that highlights variations in ICT usage across the industries.

Figure 3. Proportion of establishments with computers and communication equipment and internet connection or access by sector, 2021



Note: The section codes and description are based on 2009 Philippine Standard Industry Classification (PSIC). The sectors included are: **A**- agriculture, forestry and fishing; **B**- mining and quarrying; **C**- Manufacturing; **D**- electricity, gas, steam and air conditioning supply; **E**- water supply; sewerage, waste management and remediation activities; **F**- construction; **G**- wholesale and retail trade; repair of motor vehicles and motorcycles; **H**- transportation and storage; I- accommodation and food service activities; **J** - information and communication; **K**- financial and insurance activities; **L**- real estate activities; **M**- professional, scientific and technical activities; **N**- administrative and support service activities; **P**- education; **Q**- human health and social work activities; **R**- arts, entertainment and recreation; and **S**- other service activities

Source: 2021 SICT (PSA,2024)

Findings indicate that the information and communication (J) and education (P) sectors have the two highest ICT adoption rates, with 100 percent of establishments using computers and communication equipment and nearly 100 percent having internet access. Sectors such as the administrative and support service activities (N); financial and insurance activities (K); professional, scientific, and technical activities (M); construction (F); electricity, gas, steam,

and air conditioning supply (D); transportation and storage (H); human health and social work activities (Q); and mining and quarrying (B) also show high levels of ICT adoption. In each of these sectors, 90 percent of establishments own and use computers and communication equipment, with more than 85 percent having access to the internet, reflecting the sectors' reliance on digital tools for operations.

Although more than 77 percent of establishments in each sector have the required digital tools, Figure 3 reveals that not all are fully connected to the internet. Notable differences in adoption rates (more than 10%) between the two ICT indicators are observed in sectors such as manufacturing (C); arts, entertainment and recreation (R), wholesale and retail trade; repair of motor vehicles and motorcycles (G), other service activities (S); water supply; sewerage, waste management and remediation activities (E); and accommodation and food service activities (I). Meanwhile, the agriculture, forestry and fishing (A) sector has the lowest adoption rates for both indicators and the largest gap, at 19 percent.

2.2. Distribution of AI Adopters

While digital tools, such as computers and the internet, are becoming integrated across industries, significant gaps remain in how businesses in the Philippines utilize advanced technologies. The Fourth Industrial Revolution (FIRe) technologies, including AI, have become increasingly important as part of digital transformation as they play a critical role in enhancing productivity and competitiveness across sectors. However, according to Albert et al. (2021), overall awareness of FIRe technologies, including AI, is relatively low among Philippine firms, with only about 1 in 5 firms are aware of these technologies. Awareness levels vary significantly by firm size and sector, with larger firms and those in the ICT and BPO sectors showing higher awareness.

When it comes to specific AI adoption, the paper reports that 14.9 percent of firms use AI and ML technologies. This places AI as the fourth most adopted FIRe technology, behind Internet of Things (IoT), 5G networks, and automation.

The adoption of AI in the Philippines shows a diverse landscape, characterized by variations in adoption across regions, industries, and organizational sizes. The regional distribution of AI adopters (Figure 4) reveals disparities, with National Capital Region, Region VI (Western Visayas) and Region IVA (CALABARZON) leading with 25.4, 14.3 and 11.8 percent respectively. These urbanized regions benefit from relatively better infrastructure and concentrated business activity. In contrast, less urbanized areas like the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Region IVB (MIMAROPA) and Region XI (Davao Region) lag, indicating possible a widening of digital divide in the future.

Figure 5 illustrates that the majority of AI adopters are micro and small enterprises, contributing 67 percent and 29 percent, respectively, to the total. Meanwhile, Figure 6 highlights the distribution of AI adopters across industries, with a notable concentration in the Other Services sector, which accounts for 87.6 percent of the total.

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Figure 4. Distribution of AI adopters by region, 2021

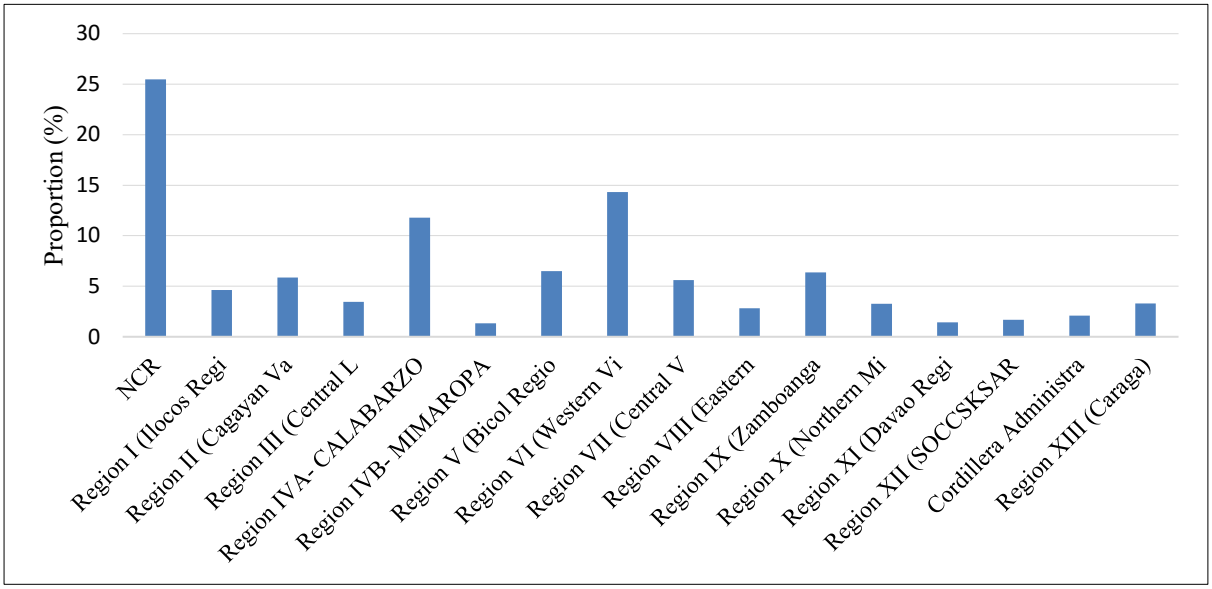


Figure 5. Distribution of AI adopters by size, 2021

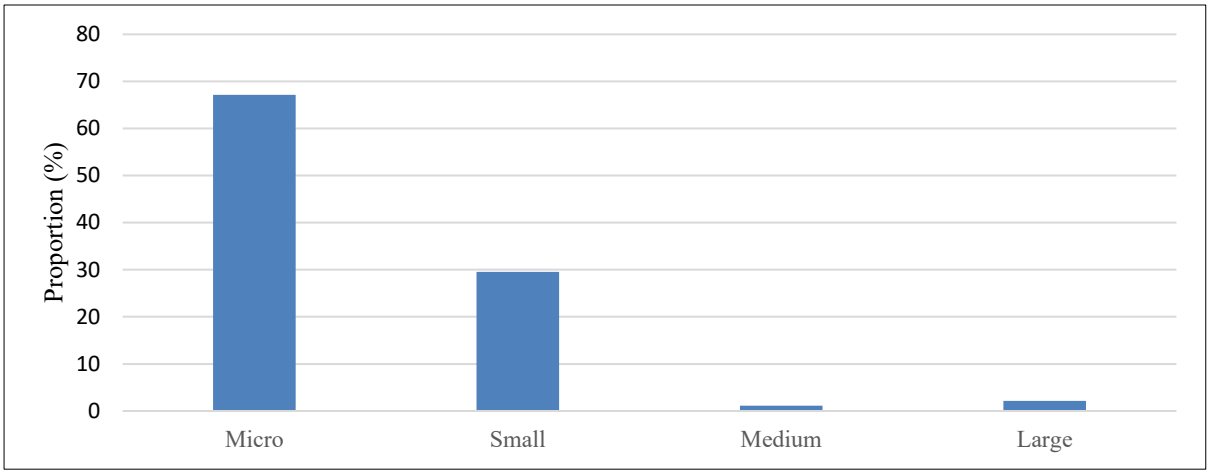
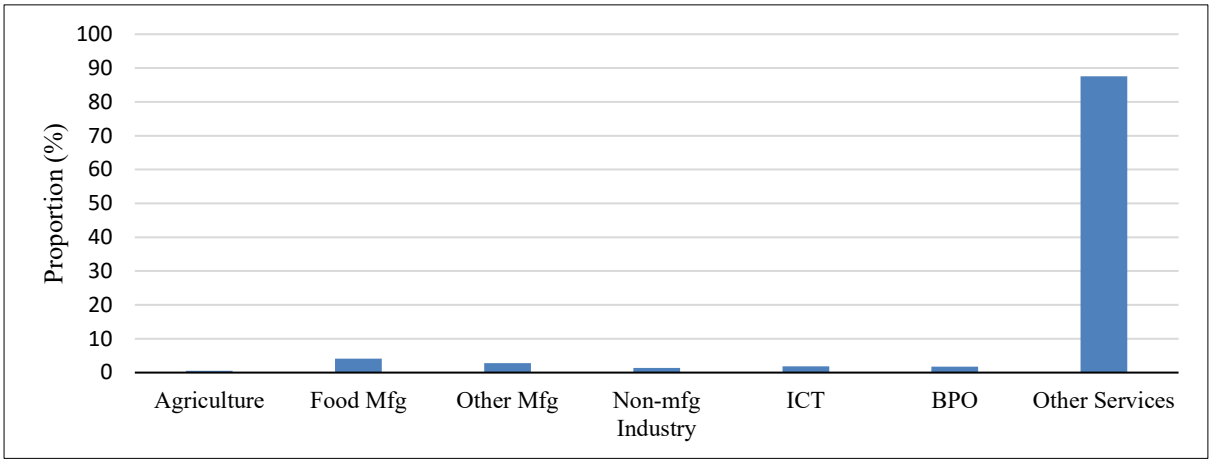


Figure 6. Distribution of AI adopters by industry, 2021



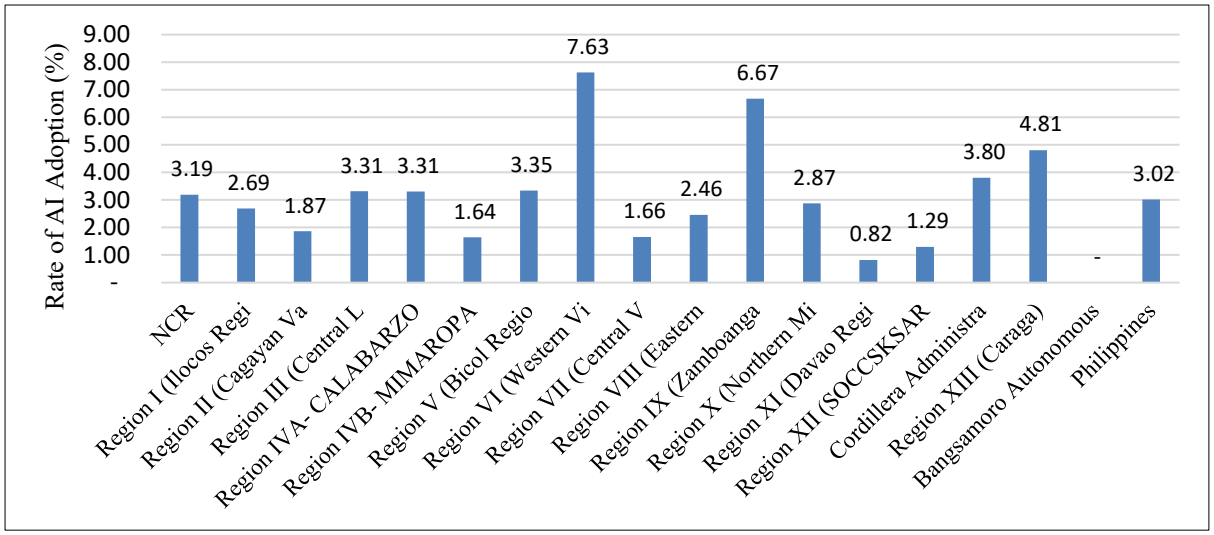
Source: 2021 PIDS Survey of Innovation Activities (SIA) of Establishments

2.3. *Rate of AI Adoption*

In addition to examining the distribution of AI adopters, it is essential to analyze the rate of AI adoption within each category. The rate of adoption is calculated as the ratio of total AI adopters for a certain category divided by the total number of firms in that category.

Figure 7 indicates an overall adoption rate for the country of 3.02 percent. Regions known for an active industry and business sector report higher than the national average, led by Region VI (Western Visayas), Region IX (Zamboanga Peninsula) and Region XIII-CARAGA. Meanwhile, certain regions like BARMM, Region XI-Davao Region, Region XII-SOCCSKSARGEN have significantly below the national average. This imbalance emphasizes the need for specific strategies targeting these regions to promote AI adoption and ensure equitable growth.

Figure 7. Rate of AI adoption by region, 2021



Source: 2021 PIDS SIA of Establishments

The rate of adoption by employment size (Figure 8) confirms that large enterprises, with a rate of 5.29 percent, surpass micro-, small and medium-sized enterprises (MSMEs). However, small enterprises demonstrate an emerging trend, with their rate reaching 3.59 percent, suggesting increasing accessibility of AI solutions for smaller businesses.

Finally, the rate of AI adoption, as depicted in Figure 9, provides insights into sectors that are actively adopting AI. The BPO and ICT industry leads with a rate of 7.19 percent and 5.94 percent, respectively, significantly higher than agriculture at 1.55 percent. Interestingly, among the Industry subsectors covered in the survey, only Non-manufacturing industry (this includes construction, electricity, gas and water and others), only non-manufacturing industry has an adoption rate above the national average. This disparity underscores a widening gap in technological advancement across industries, which may be driven by differences in resources, digital infrastructure, and perceived return on investment.

Figure 8. Rate of AI adoption by size, 2021

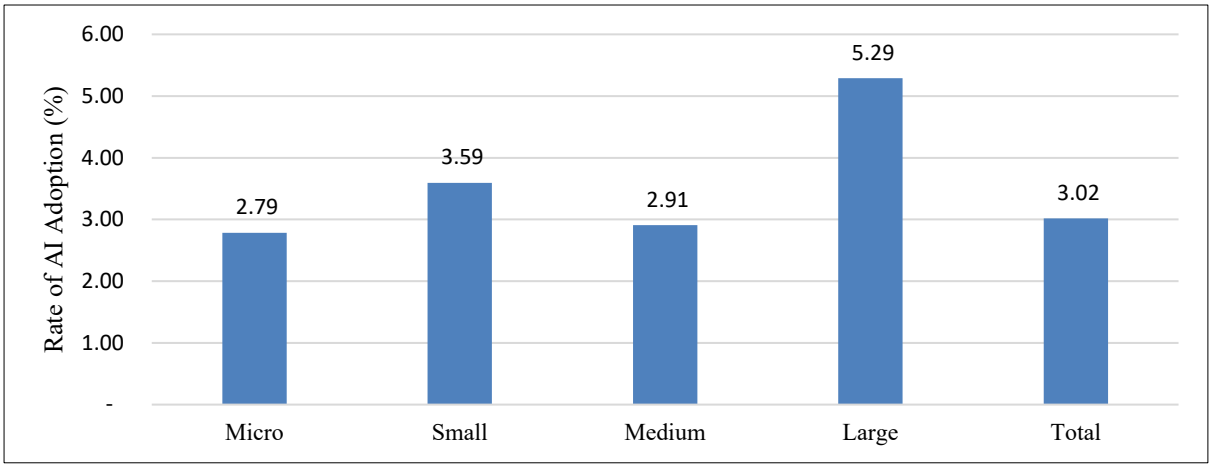
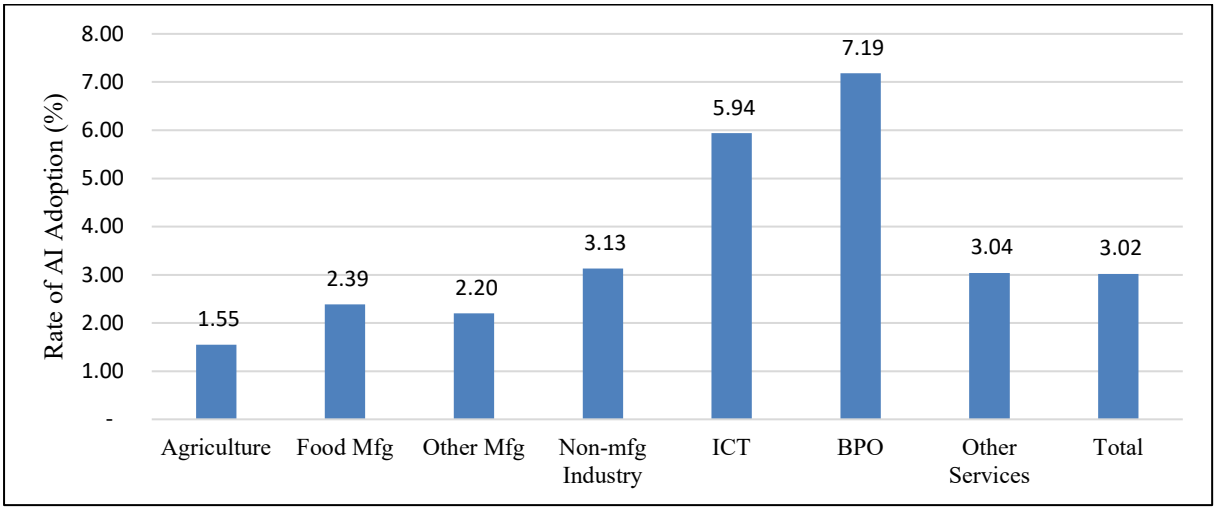


Figure 9. Rate of AI adoption by industry, 2021



Source: 2021 PIDS SIA of Establishments

2.4. AI Policy environment in the Philippines

The Philippine government has taken significant steps to promote and develop artificial intelligence (AI) in the country's business and industry sectors, as evidenced by various policy documents and roadmaps.

The Department of Science and Technology (DOST) has crafted an Artificial Intelligence Roadmap for 2022-2028 that outlines key strategies and mission-driven programs to advance AI research and development in the Philippines. This roadmap focuses on developing AI applications for various sectors including industries, health and education, mobility, environment, and disaster risk reduction. It also emphasizes the importance of establishing AI data centers, cloud platforms, and building human resource capabilities through conferences, workshops, and partnerships with tech companies (DOST 2023).

In parallel, the DTI launched the National AI Strategy Roadmap in 2021, aiming to position the Philippines as an AI Center for Excellence in the region. This roadmap is built on two main pillars - implementation and innovation - and focuses on four strategic dimensions: digitalization & infrastructure, workforce development, regulation, and research & development. The DTI estimates that AI could boost the Philippine GDP by 12 percent or about USD 92 billion by 2030 (DTI 2021).

Building on this foundation, the DTI is set to launch an updated National AI Strategy Roadmap 2.0 in July 2024, which incorporates recent technological advancements, including GenAI. Alongside this, the DTI will establish the Center for AI Research (CAIR), positioning the Philippines as a Center of Excellence in AI R&D. CAIR aims to address societal and industrial challenges, stimulate economic growth, and promote inclusive development through AI-driven innovation (DTI 2024).

The Philippine Development Plan (PDP) 2023-2028 further reinforces the government's commitment to advancing AI and other emerging technologies. Chapter 8 of the PDP emphasizes the need to "Advance Research and Development, Technology, and Innovation" (National Economic and Development Authority [NEDA] 2023). It outlines strategies to strengthen basic R&D, promote market-driven research, and accelerate technology adoption and commercialization. The plan specifically mentions AI as a key area for development, with the goal of establishing a Center for AI Research and Development.

Chapter 6 of the PDP, focusing on revitalizing industry, highlights the importance of embracing Industry 4.0 technologies, including AI. It proposes strategies such as implementing Industry 4.0 roadmaps, building Industry 4.0 facilities, and assisting firms in digital readiness assessment. The plan also emphasizes the need to upskill and reskill workers to adapt to new technologies like AI (NEDA 2023).

Chapter 7, which addresses the services sector, recognizes the potential of AI in enhancing various service industries, particularly in IT-BPM, creative industries, and digital services. It proposes strategies to foster AI-driven innovation in these sectors and to develop high-value services leveraging AI and other digital technologies (NEDA 2023).

These initiatives demonstrate a concerted effort by the Philippine government to harness AI's potential for economic growth and societal improvement. The roadmaps and research centers aim to foster collaboration between government, academia, and industry, ensuring that the benefits of AI advancements reach Filipino businesses and citizens alike.

However, challenges remain in terms of AI adoption, particularly among MSMEs. The PDP acknowledges that many Philippine companies, especially smaller ones, are still in the early stages of digital transformation. To address this, the government plans to provide support for MSMEs in adopting digital technologies, including AI, through various programs and incentives.

The current policy environment in the Philippines strongly supports the promotion of AI use across various sectors. The government has laid out comprehensive plans and strategies to drive AI development and adoption, recognizing its potential to boost economic growth, improve competitiveness, and address societal challenges. As these plans are implemented in the coming years, the Philippines aims to position itself as a key player in AI innovation in the Association of Southeast Asian Nations (ASEAN) region.

3. Assessment of Philippine Readiness for AI Adoption

3.1. Assessment metrics for AI readiness

A number of indicators or indices have been developed to look at the performance of economies and countries in terms of artificial intelligence. These indicators provide a measure of the country's capability and readiness to adopt and utilize artificial intelligence. Examples include Oxford's AI Readiness Index, AI watch index, AI Preparedness Index, Asia-Pacific AI Readiness Index (Salesforce). These will be presented in the next sections to understand how the Philippines performs in terms of various aspects of AI readiness.

3.1.1. Oxford's AI Readiness Index

Oxford's AI Readiness Index, developed by Oxford Insights in collaboration with the International Development Research Centre (IDRC), is a comprehensive tool designed to assess countries' preparedness for implementing artificial intelligence (AI) in public services. The index evaluates nations across multiple dimensions to provide a holistic view of their AI readiness.

The methodology of the Oxford AI Readiness Index is based on a multi-faceted approach that considers various aspects of a country's AI ecosystem. The index is composed of three main pillars: Government, Technology Sector, and Data and Infrastructure. Each of these pillars is further divided into several sub-indices, which are calculated using a range of indicators.

The Government pillar assesses the country's vision, governance, and adaptability in relation to AI. It looks at factors such as the existence of national AI strategies, ethical frameworks, and the government's digital capacity. The Technology Sector pillar evaluates the strength of a country's technology industry, including the availability of AI expertise, research output, and commercial ventures. The Data and Infrastructure pillar examines the quality and availability of data, as well as the robustness of digital infrastructure that can support AI development and deployment.

Data for these indicators are collected from various reputable sources, including international organizations, academic institutions, and industry reports. The indicators are normalized and weighted to produce scores for each sub-index, which are then aggregated to create the overall country score and ranking.

Examining the Philippines' performance in the Oxford AI Readiness Index from 2020 to 2023, one can see that in 2020, the Philippines ranked 74th out of 172 countries in the AI Readiness Index, with an overall score of 42.94 out of 100 (Table 1). This placed the country in the middle tier of nations, indicating a moderate level of AI readiness. The country showed strengths in data availability, human capital and innovation capacity but lagged in government AI vision and infrastructure (Figure 10).

Table 1 presents the AI Readiness index scores of Regional Comprehensive Economic Partnership (RCEP) countries relative to the Philippines from 2020 to 2023. Analyzing the Philippines' performance across these four years reveals several key insights. First, there has been a general upward trend in the country's AI readiness, as evidenced by the overall improvement in both ranking and score from 2020 to 2023. This indicates that the Philippines is making concerted efforts to prepare for the AI revolution and is gradually building its capabilities in this domain.

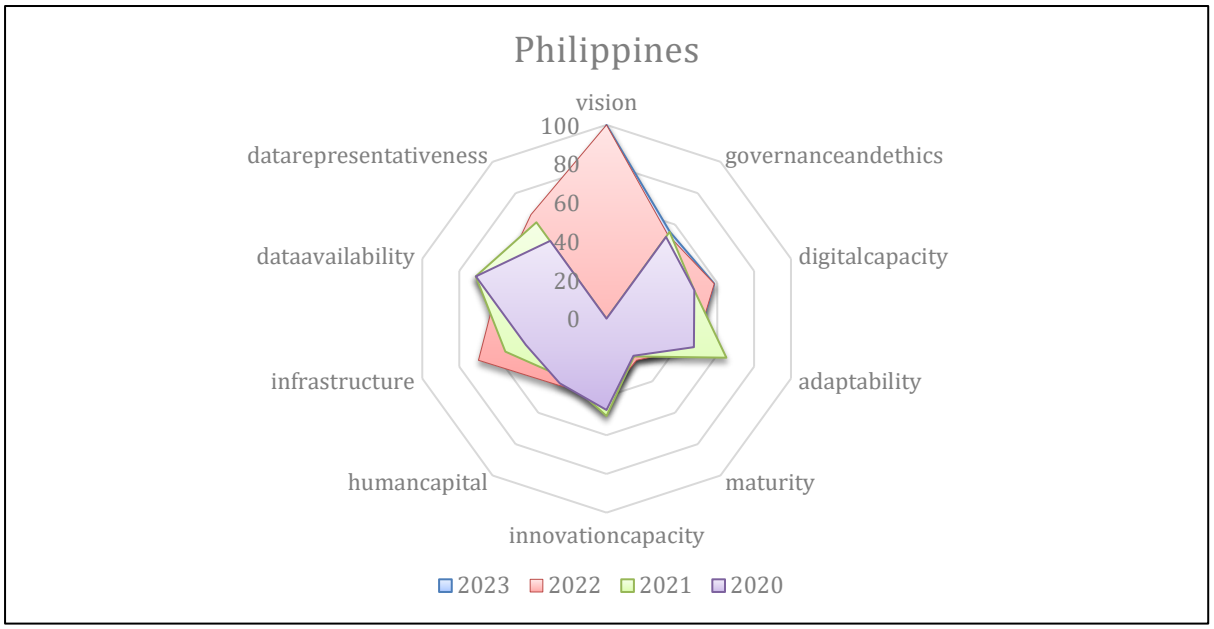
Table 1. AI Readiness index score of RCEP countries, 2020-2023

Country	2020	2021	2022	2023
Australia	73.6	75.4	75.3	73.9
Brunei Darussalam	51.5	52.9	48.1	48.1
Cambodia	32.1	33.4	31.2	31.9
China	69.1	74.4	70.8	70.9
Indonesia	47.5	58.1	60.9	61.0
Japan	73.3	76.2	75.3	75.1
Lao People's Democratic	32.2	34.9	31.7	33.1
Malaysia	63.7	62.5	67.4	68.7
Myanmar	31.2	31.6	32.4	30.9
New Zealand	68.1	68.1	67.8	60.2
Philippines	42.9	47.2	55.4	52.0
Republic of Korea	77.7	76.5	76.8	75.6
Singapore	78.7	82.5	84.1	82.0
Thailand	48.2	52.6	64.6	63.0
Vietnam	42.8	51.8	54.0	54.5

Source: Oxford's AI Readiness Index, 2020-2023

The most dramatic improvement came between 2021 and 2022, with the country jumping 13 places in the rankings and increasing its score by over 6 points. This leap could be attributed to several factors, such as increased government focus on AI development, improvements in digital infrastructure, or advancements in the local technology sector.

Figure 10. Philippine performance by AI domains, 2020-2023



Source: Oxford's AI Readiness Index, various years

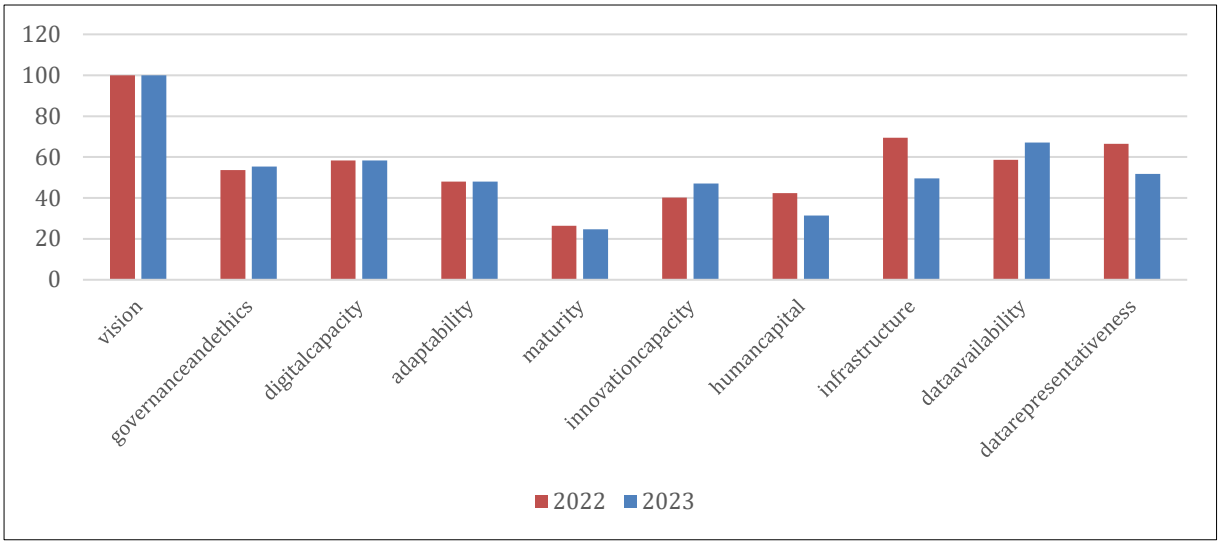
In 2021, the Philippines saw a slight improvement in its ranking, moving up to 71st place out of 160 countries, with a score of 47.20. This upward movement indicated that the country was making progress in its AI preparedness, possibly through initiatives in education, infrastructure development, or policy formulation.

Meanwhile, the 2022 index saw the Philippines maintain improve significantly in terms of its ranking at 54th out of 181 countries with a score of 55.42. The significant improvement in ranking may be due to the improvements in the following components: having an AI vision, digital infrastructure and digital capacity.

In the most recent 2023 index, the Philippines experienced a noticeable decline in its ranking, descending to 65th place out of 193 countries, with a score of 51.98. The component scores that declined significantly from the 2022 figures include significant reduction in infrastructure score, data representativeness and human capital. The improvements in data availability innovation capacity and governance and ethics do not make up for the declines in these components (Figure 11).

Unlike previous publications, the 2023 Oxford Readiness Index provided detailed data on 39 indicators across 10 dimensions (Table 2). This comprehensive data set was consulted to investigate the indicators in each dimension. Among the highest scores, Vision (100.00) demonstrates the government's strong strategic direction for AI, while Data Protection and Privacy Laws (100.00) reflect a solid framework for safeguarding personal data, which is an essential component for building public trust in AI systems. Crucial for supporting AI applications, a score of 100.00 in 5G Infrastructure reflects high-speed connectivity in the country. The Philippines also scored high in Gender Gap in Internet Access (96.00), indicating

Figure 11. Component scores of AI readiness index of the Philippines, 2022 and 2023



Source: Oxford's AI Readiness Index, 2022 and 2023

inclusivity in digital access across genders. Additionally, the Time Spent Dealing with Government Regulations (94.60) shows efficiency in regulatory processes, which suggests that companies are able to innovate with minimal bureaucratic delays.

Table 2. The Philippine score in 39 indicators across 10 dimensions in the Oxford Government AI Readiness Index, 2023

Pillars	Dimensions	Description	Indicators	
Government *65.43*	Vision *100.00*	Does the government have a vision for implementing AI?	AI Strategy	100.00
	Governance and Ethics *55.40*	Are there the right regulations and ethical frameworks in place to implement AI in a way that builds trust and legitimacy?	• Data Protection and privacy laws • Cybersecurity • Regulatory quality • Ethical principles • Accountability	100.00 77.00 51.20 0.00 48.80
	Digital Capacity *58.38*	What is the existing digital capacity within government?	• Online services • Foundational IT infrastructure • Government Promotion of Investment in Emerging Technologies	63.03 72.90 39.22
	Adaptability *47.95*	Can the government change and innovate effectively?	• Government Effectiveness • Government responsiveness to change • Procurement Data	51.20 43.64 49.00

Table 2 (continued)

Pillars	Dimensions	Description	Indicators	
Technology Sector *34.38*	Maturity *24.72*	Does the country have a technology sector capable of supplying governments with AI technologies?	• Number of AI Unicorns log transformation	0.00
			• Number of non-AI Unicorns log transformation	0.00
			• Value of trade in ICT services (per capita) log transformation	40.61
			• Value of trade in ICT goods (per capita) log transformation	59.89
			• Computer software spending	23.08
	Innovation Capacity *46.99*	Does the technology sector have the right conditions to support innovation?	• Time spent dealing with government regulations	94.60
			• VC availability	6.00
			• R&D Spending log transformation	15.10
			• Company investment in emerging technology	61.00
			• AI research papers log transformation	58.25
	Human capital *31.42*	Are there the right skills in the population to support the technology sector?	• Graduates in STEM or computer science	34.31
			• Github Activity log transformation	45.21
			• Female STEM Graduates	72.51
			• Quality of Engineering and Technology Higher Ed	0.00
			• ICT skills	5.08
Data and Infrastructure *56.13*	Infrastructure *49.52*	Does the country have a good technological infrastructure to support AI technologies?	• Telecommunications Infrastructure	56.38
			• Supercomputers log transformation	0.00
			• Broadband Quality	39.40
			• 5G Infrastructure	100.00
			• Adoption of Emerging Technologies	51.83
	Data Availability *67.14*	Is there good availability of data that could be used to train AI models?	• Open Data	50.00
			• Data governance	50.00
			• Mobile-cellular telephone subscriptions	100.00
			• Households with internet access	59.99
			• Statistical Capacity	75.72

Table 2 (continued)

Pillars	Dimensions	Description	Indicators	
	Data Representa-tiveness *51.71*	Is the data available likely to be representative of the population as a whole?	• Cost of cheapest internet-enabled device (% of monthly GDP per capita) • Gender gap in internet access	7.42 96.00

Source: Oxford's AI Readiness Index, 2023

On the other hand, the lowest scoring indicators reveal critical areas for improvement. Supercomputers (0.00) are entirely lacking, which limits the country's capacity to process large AI datasets and conduct complex AI research. The absence of Ethical Principles (0.00) for AI indicates a gap in guidelines necessary for responsible AI development. Similarly, a score of 6.00 in Venture Capital (VC) Availability is extremely low, signaling a lack of funding opportunities for AI startups and innovation. The Quality of Engineering and Technology Higher Education score of 0.00 indicates weaknesses in the education system for developing a skilled AI workforce. Finally, a score of 7.42 on Affordability of Entry-level Internet-enabled Device suggests that lower-income individuals are facing limited digital access and exclusion from the benefits of AI advancements.

The reduction of Human Capital dimension score from 42.34 in 2022 to 31.42 in 2023 suggests that there was a decline in the country's workforce readiness for AI. Although there is a strong Representation of Female STEM graduates (72.51), low ICT skills (5.08) and Quality of Engineering and Technology Higher Education (0.00) suggest gaps in foundational skills and training. In line with this, a large decline was also observed in the Infrastructure Dimension from 69.52 in 2022 to 49.52 in 2023. Although the Philippines demonstrates a strong foundation for high-speed connectivity with a score of 100.00 in 5G infrastructure, the absence of Supercomputers (0.00) remains a significant limitation. Scores in Broadband Quality (39.40), Adoption of Emerging Technologies (51.83), and Telecommunications Infrastructure (56.38) suggest that while there is some support for technological advancement, improvements in broadband speed and wider technology adoption are needed to fully enable an AI-driven environment.

The Innovation Capacity, Data Availability, and Governance and Ethics are the only three dimensions that showed improvement. With a score of 46.99, the Philippines reflects mixed conditions for supporting innovation. High efficiency in Time Spent Dealing with Government Regulations (94.60) indicates a supportive regulatory environment. However, low VC Availability (6.00) and R&D Spending (15.10) suggest limited funding and investment in research, which are essential for driving innovation. Scores in company investment in emerging technology (61.00) and AI Research Output (58.25) show some engagement in new tech and research but highlight room for growth.

The Data Availability score of 67.14 indicates a generally supportive environment for AI model training. High mobile-cellular subscriptions (100.00) and strong Statistical Capacity (75.72) provide a strong data foundation. However, scores in Open Data (50.00), Data Governance (50.00), and Household Internet Access (59.99) suggest there is still room to improve data accessibility and quality for comprehensive AI readiness. The Governance and Ethics score of 55.40 reflects a mixed approach to AI regulation and ethical frameworks. High scores in Data Protection and Privacy Laws (100.00) and Cybersecurity (77.00) indicate a secure environment for AI implementation. Scores in Regulatory Quality (51.20) and Accountability (48.80) are moderate, suggesting potential for improvement in oversight and responsibility to enhance governance.

It is worth noting that the Philippines' improvement in AI readiness aligns with broader trends in Southeast Asia, where many countries are increasingly prioritizing AI development as part of their digital transformation strategies. The country's progress could be partly attributed to regional initiatives and knowledge sharing among ASEAN nations.

The Philippines' performance in the Oxford AI Readiness Index from 2020 to 2023 shows a promising trajectory. While starting from a moderate position, the country has demonstrated improvements in some key domains, but the challenge is to maintain a consistently increasing trend. The progress in key domains reflects the Philippines' growing recognition of AI's importance and its efforts to prepare for an AI-driven future. However, the journey is far from over, and continued focus and investment will be necessary for the Philippines to fully realize its AI potential and compete on the global stage.

3.1.2. AI Preparedness Index

The AI Preparedness Index (AIPI), developed by the International Monetary Fund (IMF), is a comprehensive tool designed to assess countries' readiness to adopt and benefit from artificial intelligence technologies. This index aims to evaluate preparedness across multiple strategic areas crucial for AI adoption and integration, providing a comparative framework across economies at different development levels. The AIPI's primary objective is to help policymakers identify areas needing improvement to enhance AI readiness, while also offering insights into the potential impacts of AI on labor markets and economic structures.

The AIPI's methodology is grounded in the literature on historical episodes of technology adoption, which has identified key determinants likely relevant for AI: digital infrastructure, human capital, technological innovation, and legal frameworks. The index is composed of four main dimensions: digital infrastructure, innovation and economic integration, human capital and labor market policies, and regulation and ethics. Each dimension incorporates multiple indicators drawn from various international data sources, covering aspects such as internet accessibility, STEM education, R&D investment, and adaptability of legal frameworks to new digital business models.

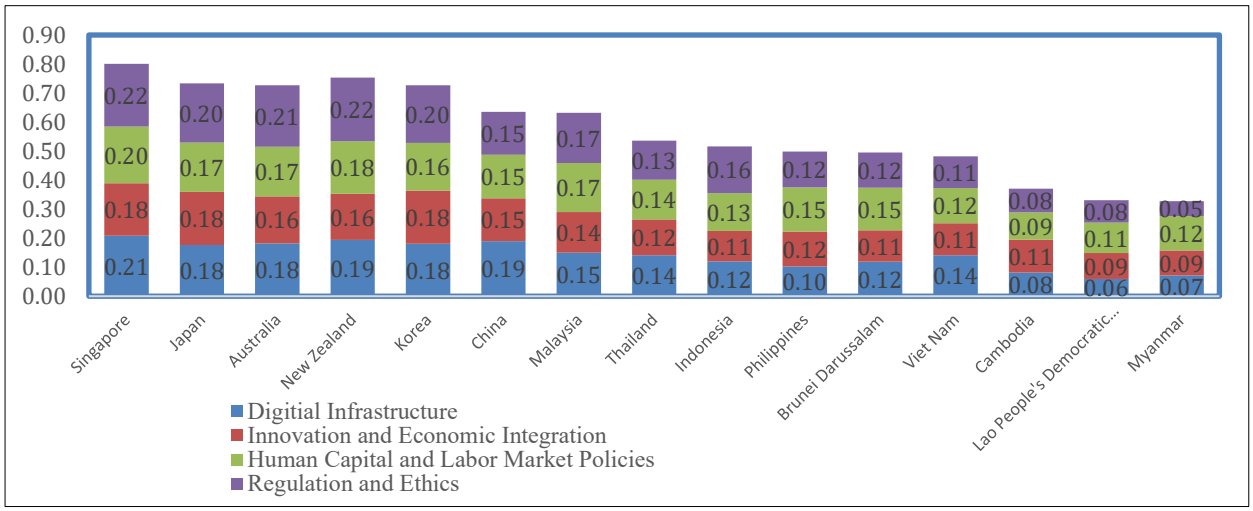
To construct the index, indicators within each dimension are first normalized on a 0-1 scale. The score for each of the four dimensions is then calculated as a simple average of its normalized subcomponents. Finally, the overall AIPI score is derived as the simple average of the four dimension scores. This methodology allows for a balanced assessment of a country's AI preparedness across different critical areas. The index covers a wide range of 125 countries, including 32 advanced economies, 56 emerging markets, and 37 low-income countries, enabling meaningful comparisons across different levels of economic development.

One of the key strengths of the AIPI is its focus on AI adoption preparedness rather than invention leadership. This approach allows for a more relevant comparison across all economies, including low-income countries where the focus is primarily on adopting rather than inventing new technologies. Additionally, the index incorporates labor market transition indicators relevant for the AI era, including active labor market policies and social protection measures, which are crucial for managing the potential disruptions caused by AI adoption.

The AIPI analysis reveals that advanced economies and some emerging markets tend to be better prepared for AI adoption, although there is considerable variation in preparedness even among countries at similar income levels. The index identifies digital infrastructure and human capital as "foundational" elements of AI preparedness, while innovation, economic integration, and regulatory frameworks are seen as "second-generation" elements that can maximize AI's economic impact. These insights can guide policymakers in prioritizing investments and reforms to enhance their countries' AI readiness.

Based on the data of the IMF on the AIPI (Figure 12), the Philippines scored relatively low (0.10) in digital infrastructure dimension compared to other countries, indicating potential weaknesses in the critical infrastructure necessary to support AI development and integration. The leading countries in this dimension, such as Singapore (0.20) and New Zealand (0.19), scored almost double.

Figure 12. Artificial Intelligence Preparedness Index, 2023



Source: AIPI of IMF, 2023

In terms of Innovation and Economic Integration, the Philippines' score (0.12) suggests moderate efforts in fostering innovation and integrating economically with AI advancements, but it still lags top performers like Singapore (0.18) and Japan (0.18).

One bright spot for the Philippines would be Human Capital and Labor Market Policies, as the country's score here is slightly higher (0.15) than in the other categories. The country has also been at the upper half of the rankings since 2020. Its notable performance was driven by the skillset of graduates, the extensive coverage of mobile networks, and the widespread use of mobile phones and internet. However, the country's performance is still below leading nations in the region suggesting that while there is some strength in human capital development and labor market policies related to AI, there is still room for significant improvement when compared to countries like Singapore (0.19) and Japan (0.17).

Finally, the Philippines scored relatively low (0.12) in Regulation and Ethics dimension, reflecting the need for better regulatory frameworks and ethical guidelines in AI deployment. Top countries like Singapore and Japan both scored 0.21, indicating well-developed frameworks.

The Philippines shows considerable gaps in AI readiness, especially in digital infrastructure and regulation. This highlights the need for substantial improvements across these dimensions to better compete in the regional AI landscape. The country's relatively stronger performance in human capital suggests a foundation that could be leveraged with the right policies and investments.

3.1.3. Asia Pacific AI Readiness Index

The Asia Pacific AI Readiness Index, commissioned by Salesforce and prepared by Access Partnership, assesses the readiness of 12 Asia Pacific economies to adopt, deploy, and integrate artificial intelligence. The index uses 15 proxy indicators clustered into two key dimensions: Business Readiness and Government Readiness. Table 3 provides a summary of these indicators. All indicators are normalized to a score out of 10, and the overall total is normalized to 100 for comparison. The index uses the most recent publicly available data for each indicator.

Based on the 2023 Asia Pacific AI Readiness Index, The Philippines ranks 12th out of the 12 countries included in the index, with an overall AI Readiness score of 35.7 out of 100. This places it below the APAC average and at the bottom of the list. Singapore leads with a score of 70.1 followed by Japan (59.8) and China (59.7). ASEAN Countries: Malaysia (47.3), Thailand (43.6), Indonesia (39.3) and Viet Nam (36.5) are at the lowest ranks (Table 4).

Table 3. Indicators of the Asia Pacific AI Readiness Index

Dimension/Indicator	Definition
1. Business Readiness	
Companies' Adoption of Emerging Technologies	Measures the extent to which companies are adopting five emerging technologies (AI, robotics, app- and web-enabled markets, big data analytics, and cloud computing).
Business Sophistication	Evaluates how conducive firms are to innovation activity.
Knowledge and Technology Outputs	Assesses firms' and countries' ability to create, impact, and diffuse knowledge.
Creative Outputs	Measures firms' and countries' ability to create and market innovative physical and digital products.
Labor-Market Reconfiguration Due to Digital Transformation	Estimates the digitally driven disruptions the labor market is expected to undergo in the next five years, including worker and job reallocation.
Number of AI Start-Ups	Counts the number of active companies headquartered in a country and categorized as "artificial intelligence."
Venture Capital Availability & Valuation	Measures the size, value, and dynamics of venture capital, including market capitalization of listed domestic companies and venture capital deals.
2. Government Readiness	
Digital Evolution Index	Assesses governments' digital readiness by evaluating their competitiveness and trust in the global digital arena.
Digital Government Score Scored out of 10.	Evaluates national digital government readiness and development across ten indicators and 35 sub-indicators.
E-Participation Index (EPI)	Measures ICT-supported participation in government processes including administration, service delivery, decision-making, and policymaking.
Open Government Data Index (OGDI)	Assesses the free and open publication of government data.
Human Capital and Research	Measures the level of government spending and support on skills, training, science, and research.
H-index for AI Publications	Evaluates the productivity and citation impact of scientific publications related to AI.
ICT Regulation	Measures the extent to which a government promotes participation in the network economy through regulation, policy, and planning.
Government Promotion of Investment in Emerging Technologies	Assesses the extent to which a government fosters investment in five emerging technology sectors.

Source: Asia Pacific AI Readiness Index 2023

Table 4. AI Readiness (overall, business and government), 2023

Ranking	Overall AI Readiness		Business AI Readiness		Government AI Readiness	
1	Singapore	70.1	Singapore	53.6	Singapore	86.5
2	Japan	59.8	China	43.1	Australia	77.7
3	China	59.7	South Korea	42.7	Japan	77.5
4	South Korea	59.2	India	42.2	China	76.3
5	Australia	58.2	Japan	42.1	South Korea	75.7
6	New Zealand	54.6	Australia	38.7	New Zealand	72.9
7	India	49.8	New Zealand	36.2	Malaysia	64.4
8	Malaysia	47.3	Malaysia	30.3	Thailand	59.9
9	Thailand	43.6	Thailand	27.3	India	57.4
10	Indonesia	39.3	Philippines	25.4	Indonesia	55
11	Vietnam	36.5	Vietnam	25	Vietnam	48.1
12	Philippines	35.7	Indonesia	23.5	Philippines	46

Source: Salesforce AI Readiness Index 2023

In terms of business readiness, Table 5 shows that the Philippines (25.4) ranks 10th out of 12 countries with a score of 25.4 out of 100, slightly edging out Vietnam (25.0) and Indonesia (23.5). Compared to advanced economies in the Region, the country is significantly scored below the leaders: Singapore (53.6), China (43.1), and South Korea (42.7). Its score is less than half of the top performer's, suggesting a substantial gap in business preparedness for AI adoption.

Table 5. Business AI Readiness scores, 2023

Country	Companies' Adoption of Emerging Technologies	Business Sophisti-cation	Knowledge and Technology Outputs	Creative Outputs	Labour-Market Reconfiguration ("Churn") Due to Digital Transfor-mation	No. of AI Start-Ups	Venture Capital Availability Valuation
Australia	8.2	4.9	3.2	3.8	2.1	2.1	2.8
China		5.6	5.7	4.9	2.3	4.5	2.9
India	5.2	3.1	3.4	2.4	2.2	9.4	3.9
Indonesia	5.9	2.2	1.9	1.9	2.8	0.4	1.4
Japan	8.5	5.8	5.3	3.9	2.4	1.2	2.4
Malaysia	7.2	3.6	3.2	2.7	2.5	0.4	1.6
New Zealand	7.8	4.4	3.6	3.8		0.3	1.8
Philippines	5.2	3.7	3.1	2.1	2.6	0.1	1.1
Singapore	8.9	6.6	4.9	3.9	2.1	2.0	9.3
South Korea	7.5	5.8	5.5	5.5	2.3	1.6	1.7
Thailand	6.1	3.6	3.0	2.5	2.4	0.3	1.3
Vietnam	5.0	3.2	2.6	3.1	2.1	0.4	1.1

Source: Salesforce AI Readiness Index 2023

Contributing to the Philippines scoring among the lowest in Business readiness for AI adoption is the country's 5.2 (out of 10) score on Companies' Adoption of Emerging Technologies. This moderate score suggests that while some companies are adopting AI and other emerging technologies, there remains significant room for improvement compared to leading countries. The country also ranked relatively low in Business Sophistication (3.7 out of 10) which is indicative of a relatively low level of business sophistication, that is, many firms may lack the advanced business practices and innovation capabilities necessary for effective AI adoption. Other areas where the country scored low are in Knowledge and Technology Outputs (3.1), Creative outputs (2.1), Labor-market reconfiguration due to digital transformation (2.6) and Number of AI start-ups (0.1). The low scores in knowledge outputs and labor market reconfiguration hint at a possible skills gap in the workforce. Funding AI ventures in the country may also be difficult as indicated by a score of 1.1 out of 10 in Venture Capital Availability & Valuation.

As for Government AI Readiness, the Philippines ranks last (12th) with a score of 46.0 out of 100 (Table 6). The country's score is significantly behind the leader, Singapore, which scored 86.5. Even compared to its closest peers, the Philippines trails Vietnam (48.1) and Indonesia (55.0). Only the Philippines and Vietnam scored blow 50 among the 12 countries.

Table 6. Government AI Readiness scores, 2023

Country	Digital Evolution Index	Digital Governance Score	E-Participa-tion Index	Open Government Data Index	Human Capital and Research	H-Index for AI publications	ICT Regulation	Government promotion of Investment in Emerging technologies
Australia	8	8.2	9.9	10	6.2	6.1	8.8	5.1
China	6.2	6.6	8.6	8.9	5.3	9.4	6	10
India	4.7	7.2	5.9	9.9	3.8	4.9	6.1	3.5
Indonesia	4.8	7.6	7.2	9	2.2	1.2	6.1	6
Japan	7.8	8.5	10	9.9	5.3	5.3	8.1	7.2
Malaysia	6.9	7.4	6.8	8.6	4.1	3.2	6.9	7.6
New Zealand	8	9.3	9.5	10	5.5	2.5	8.4	5.2
Philippines	4.4	7	4.9	7.3	2.5	0.8	6	3.9
Singapore	9.9	9.2	9.8	10	6.2	5.5	8.8	10
South Korea	8.3	8.7	9.4	9.7	4.8	4.4	7.4	7.7
Thailand	5.3	7.8	7.8	9.3	3	1.6	6.6	6.4
Vietnam	4.7	6.5	5.3	6.4	2.7	1.8	5.6	5.4

Source: Salesforce AI Readiness Index 2023

To explain the country's dismal performance, one could look at the specific indicators that make up the specific indices. The Philippines scores 4.9 out of 10, which is lower than most other countries in terms of the E-Participation Index. The Open Government Data Index which measures availability and access of government data, puts the Philippines among the lowest of the Asia Pacific countries in the study at 7.3. The low scores for H-Index for AI publication (0.8), ICT regulation (6.0) and Government promotion of investment in emerging technologies

(3.9) are other contributors to this dismal performance as the country is among the lowest in all these indicators.

The Philippines' performance in the 2023 Asia Pacific AI Readiness Index indicates that it faces significant challenges in both business and government readiness for AI adoption compared to its regional peers. To improve its ranking, the Philippines would need to focus on fostering a stronger AI startup ecosystem, attracting more venture capital, encouraging businesses to adopt AI and other emerging technologies, and developing the necessary skills in the workforce. Additionally, policies to stimulate innovation and creativity in the business sector could help boost the country's AI readiness.

3.2. Examples of AI adoption in different sectors

AI adoption in the Philippines is gradually increasing, with certain sectors leading the way (IDC 2023). The BPO industry, a significant contributor to the Philippine economy, has been at the forefront of AI adoption, implementing chatbots, natural language processing, and automated customer service solutions (IT and Business Process Association of the Philippines [IBPAP] 2023). The financial sector has also shown progress, with banks and fintech companies leveraging AI for fraud detection, credit scoring, and personalized banking services (Bangko Sentral ng Pilipinas [BSP] 2023). However, adoption rates vary significantly across industries, with many SMEs lagging behind due to resource constraints and lack of technical expertise (Department of Trade and Industry [DTI] 2023). A survey by IDC (2023) suggests that while AI adoption in the Philippines is growing, it still trails behind some of its Southeast Asian neighbors, indicating significant room for growth and improvement.

This section presents specific use cases by the private sector or specific industries that illustrate how AI is being used as a tool for development of businesses processes and improving operations efficiency. These cases can also be seen as building blocks for the development of a robust AI ecosystem in the country.

3.2.1. Banking and Finance: UnionBank

UnionBank of the Philippines is one of the country's leading banks, known for its innovative approach to banking services. Established in 1968, UnionBank has consistently been at the forefront of digital transformation in the Philippine banking sector earning the recognition as one of Southeast Asia’s true digital-banking gems (Manning 2023). The bank serves a wide range of customers, from individual account holders to large corporations, and has been recognized for its efforts in leveraging technology to improve banking services.

UnionBank employs AI in various aspects of its operations, with the following notable applications:

a) AI-powered Chatbots: UnionBank has implemented an AI-driven chatbot named "Rafa".

Rafa is a Google AI-powered chatbot using NLP to serve customers via Facebook Messenger. It's a 24/7 digital assistant representing UnionBank, accessible on the web and mobile. Rafa handles sensitive data securely, using OTP for features like card activation and balance inquiries. The chatbot is also able to handle a wide range of tasks, from basic account inquiries to more complex financial advice (Stevie Awards n.d.-b).

b) Fraud Detection: UnionBank utilizes fraud indicators to analyze the volume of connections associated with a user's account, identify intermediary entities, and assess their closeness to other accounts to measure the speed of fund transfers. In identifying the most effective indicators linked to fraudulent activity, UnionBank also examined metrics across different connection levels (Back End News 2024). Yu (2023) also reported innovations being done by UnionBank using AI to strengthen fraud detection such as utilizing AI models fraud detection for network analysis and outlier detection.

c) AI-powered Credit Scoring system: UnionBank has developed an innovative AI-driven credit scoring system, showcasing its commitment to data science and artificial intelligence. This advanced solution aims to broaden financial inclusion across the Philippines by offering a more nuanced approach to assessing creditworthiness. Dr. Hardoon, a key figure in this initiative, explained that UnionBank and its fintech subsidiary, UBX, can now extend loans to a wider array of individuals and small enterprises who might have been overlooked by conventional credit evaluation methods. The impact has been significant, with the bank reporting a twofold increase in loan approvals. This technology-driven approach is playing a crucial role in UnionBank's mission to provide financial services to previously underserved or unbanked populations (Manning 2023).

According to reports, the primary motivations for UnionBank's adoption of AI technologies include: (1) enhancing customer experience by providing quick, efficient, and personalized services; (2) improving operational efficiency and reducing costs associated with manual processes; (3) strengthening security measures to protect customers from financial fraud; and (4) maintaining a competitive edge in the rapidly evolving digital banking landscape.

The implementation of AI technologies at UnionBank has had several significant impacts on their business operations. For instance, the use of Rafa has improved the bank's customer service by significantly reducing response times. According to UnionBank's reports, Rafa handles over 80 percent of customer queries without human intervention, leading to faster resolution times and increased customer satisfaction (Yellow.ai n.d.). It has also led to increased work efficiency for customer support teams as they are now freed to concentrate on more complex issues while significantly reducing operational costs (Yellow.ai n.d.). Meanwhile, the AI-powered innovations that the bank uses to enhance its fraud detection capabilities, enabled UnionBank to detect 19 percent more fraudulent transactions and achieve an 80 percent reduction in the turnaround time for identifying these transactions (Bankero 2024).

Finally, by automating routine tasks and inquiries, UnionBank has been able to reallocate human resources to more complex and value-added activities, improving overall operational efficiency. In addition, the implementation of AI-powered credit-scoring solution developed resulted in the doubling of the bank's loan approval rate making financial services more accessible especially for the unbanked and underbanked (Manning 2023).

3.2.2. Healthcare: Lifetrack Medical Systems

Lifetrack Medical Systems, a Philippines and Singapore-based health-tech company founded by Dr. Eric Schulze, specializes in radiology and medical imaging. It aims to address the lack of quality radiological services in developing countries with limited radiologists and healthcare resources. Their main product, Lifesys, is a cloud-based platform enabling remote reading and reporting of radiological images (Lifetrack Medical Systems n.d.-a).

Radiology is crucial for modern healthcare, but access to quality services is often limited in low-resource settings due to radiologist shortages, outdated technology, and inefficient workflows. Lifetrack's mission is to develop straightforward, efficient, and user-friendly software platforms for the healthcare sector, which focus on medical imaging in underserved emerging markets (Lifetrack Medical Systems n.d.-a).

Lifetrack Medical Systems Singapore planned to use cloud technology and AI to automate medical tasks and improve healthcare management (Lifetrack Medical System Singapore - A change in the course of radiology 2019). In 2020, Lifetrack provided its LifeSys platform free of charge to the provincial government of Antique to aid in triaging potential COVID-19 cases. By using AI-assisted analysis of chest computed tomography (CT) scans, the platform enabled remote identification of COVID-19 patterns and helped prioritize limited Real Time - Polymerase Chain Reaction (RT-PCR) tests. This initiative improved early detection and isolation efforts while ensuring access to radiology services despite travel restrictions (Lifetrack Medical Systems n.d.-b).

3.2.3. E-commerce and Retail: Lazada Philippines

Lazada Philippines is a leading e-commerce platform in the Philippines, part of the larger Lazada Group, which operates across Southeast Asia. Established in 2012, Lazada was one of the pioneers in the region's online retail space, aiming to provide a wide range of products, from electronics to fashion, household goods, and groceries, all accessible with just a few clicks. Lazada has rapidly grown to become one of the dominant players in the Philippine e-commerce market, thanks in part to its robust logistical network, vast product offerings, and strategic backing from Alibaba Group, which acquired a controlling stake in the company in 2016 (Lazada n.d.).

Lazada has established itself as a leader in AI-driven innovation within Southeast Asia's competitive eCommerce landscape. Utilizing AI-powered search recommendations and image-based search, the platform makes product discovery intuitive, while AI translation capabilities

support its diverse audience (Vichit-Vadakan 2020). Additional tools, like AI Key Attribute Autofill and the Skin Test function (LazBeat n.d.), assist sellers with data entry and offer personalized product suggestions to users.

In a recent update, Lazada introduced AI Lazzie, a 24/7 personal shopping assistant with four key capabilities: Message+ for contextual responses and shopping recommendations; Try-On Models for virtual fitting and sizing suggestions; AI-Powered Product Descriptions tailored to user preferences; and AI-Powered Smart Reviews for summarizing customer feedback (Manila Standard 2024). Together, these tools empower consumers by simplifying product discovery and enriching the shopping experience while supporting sellers in optimizing engagement.

The motivation behind Lazada's AI adoption is to enhance customer engagement, improve operational efficiency, and strengthen its competitive edge. As Lazada Thailand CEO Varitha Kiatpinyochai highlighted, AI has become a "game-changer," enhancing every step of the customer journey through best-in-class technology from the Alibaba Group (Haldane 2024).

The impact of AI on Lazada's operations and customer satisfaction is notable. Findings from a recent Lazada's whitepaper, which surveyed over 6,000 shoppers across six Southeast Asian countries, show that 88 percent of consumers use AI recommendations to make purchasing choices, and 83 percent are open to paying for experiences enhanced by AI. Consumer trust in AI-driven platforms is strong, with 92 percent of respondents valuing personalized suggestions and 90 percent appreciating AI-generated product summaries. The whitepaper also found that 52 percent of consumers in Southeast Asia enjoy the convenience that AI brings to shopping, while 51 percent prioritize detailed product and seller reviews, pointing to future opportunities for AI to add even greater depth and relevance to these features (Manila Standard 2024).

3.2.4. Transportation: Grab Philippines

Grab, founded in 2012, is a leading technology company in Southeast Asia, offering essential services across transportation, food delivery, and digital financial solutions. Originally launched as a ride-hailing app, Grab has evolved into a comprehensive platform that fulfills a variety of daily needs, including GrabPay for cashless transactions, GrabMart for online shopping, and GrabAds for advertising solutions. With 1 in 20 people in Southeast Asia using Grab daily—whether to eat, commute, or pay—the platform has become a central part of everyday life for millions in the region (Grab n.d.-a).

Grab is motivated by a commitment to empower local economies and improve lives through technology. To make its platform smoother, safer, and more efficient for both customers and drivers, Grab integrates a variety of AI tools. In fact, the company's website features a dedicated AI section (Grab n.d.-b) that highlights these advancements. For instance, Grab's AI-enabled synonym module helps its search engine understand and rephrase user queries, accurately matching destinations to user intent and making it easier to find locations.

Another motivation behind Grab's AI innovations is to optimize convenience and efficiency across services. KartaCam 2, an AI-driven tool, improves map accuracy with advanced camera technology. To assist merchant partners, Grab introduced the Merchant Menu Assistant, which automatically generates digital menus from photos, reducing manual work and time. This tool has already facilitated the upload of over 10,000 menus. For drivers, Last Mile Navigation provides precise pickup and drop-off directions, while another AI tool interprets customer delivery notes, extracting specific details like building names and landmark colors to improve delivery accuracy.

Grab's goal to improve accessibility is further achieved through its AI-based machine translation model, which translates Help Center articles into Chinese and other languages. An in-house translation model also ensures food items and menus are available in multiple languages, serving users across different linguistic backgrounds. GrabRideGuide supports drivers by offering real-time data on ride demand, allowing them to position themselves where rides are needed most.

The company's dedication to enhancing user engagement is evident in Mystique, an AI tool that generates concise, appealing menu descriptions for food items by focusing on key details like dish names and ingredients, keeping listings clear and engaging. For added safety, Grab implemented Audio Protect, which records audio during rides to help resolve disputes or safety concerns when necessary (Grab n.d.-c). Grab envisions this feature evolving to use AI for real-time audio analysis, potentially detecting safety risks as they occur.

3.2.5. Education: AMA Education System

The AMA Education System (AMAES), founded by Dr. Amable R. Aguiluz V in 1980, leads the way in IT-focused education in the Philippines. Renowned for its pioneering innovations, AMAES was the first in the country to adopt a one-to-one student-computer ratio. In 2014, AMAES launched the Philippines' first fully online education program, making learning flexible and accessible. With institutions such as its flagship AMA University and Colleges, AMA Computer Learning Center (ACLC), ABE International, and Delta Air Academy, AMAES offers a wide range of programs from Senior High to Graduate Studies, which include specializations in Data Science, Cybersecurity, and Blockchain. Through partnerships with global tech leaders like Cisco, Microsoft, and CompTIA, AMAES empowers students to earn internationally recognized certifications, enhancing their industry readiness (AMA Education System n.d.).

Starting with the 2023-2024 academic year, AMAES has launched an AI specialization within its Computer Science and Information Technology programs. This new curriculum addition aligns with AMAES's goal to equip students with essential, industry-relevant skills as they prepare for AI-driven workplaces. Dr. Amable R. Aguiluz V, the chairman of AMAES, emphasized the importance of adapting educational programs to meet AI's growing influence across various fields, ensuring graduates are prepared to excel in a tech-focused world. The specialization offers comprehensive coverage of AI, from foundational topics like ML and Neural Networks to advanced areas such as GenAI, Natural Language Processing, and Vision

AI, providing students with both theoretical and hands-on experience. Additionally, AMAES offers flexible learning options, allowing students to either specialize fully in AI or take individual AI courses as electives. This initiative bridges the gap between classroom learning and practical application, aiming to produce graduates who are skilled in applying AI to real-world scenarios (Chards 2023).

3.2.6. Manufacturing: Mitsubishi Motors Philippines Corporation

Mitsubishi Motors Philippine Corporation (MMPC), originally established as Chrysler Philippines Corporation on February 20, 1963, holds the title of the longest-standing automotive company in the Philippines, celebrated for its high-quality vehicles and services. MMPC has long played a role in introducing advanced automotive technology to the country. Today, the company offers over 16 vehicle models in the Philippines, ranging from well-known passenger cars like the Lancer EX, ASX, Mirage hatchback, and Mirage G4 to a variety of light commercial vehicles, including the Pajero, Strada, Montero Sport, and Fuzion. The lineup also features models like the Adventure, L300 chassis cab, L200, the Canter light truck, and the Rosa mini-bus (Chamber of Automotive Manufacturers of the Philippines, Inc. n.d.).

Mitsubishi Motors (n.d.) noted that MMPC is one of the Philippines' longest-running automotive manufacturers and the second-largest vehicle brand. It achieved a sales milestone in 2017 with 71,001 units sold and a 14.98 percent market share. MMPC, led by President and CEO Mr. Hikosaburo Shibata, operates over 50 dealerships and has its headquarters and assembly plant in Santa Rosa City, Laguna. Popular models like the Montero Sport and Xpander continue to earn praise and approval among Filipino consumers.

Based on the report from the International Business Machines Corporation (IBM), MMPC's Executive Vice President and CFO, Masaki Watanabe, stated that the company is redesigning its employee portal with IBM's watsonx.ai, utilizing GenAI to enhance the employee experience and provide faster responses to inquiries by analyzing internal documentation. This initiative seeks to transform a basic portal into a comprehensive support tool.

3.2.7. Manufacturing: Integrated Micro-Electronics, Inc.

Integrated Micro-Electronics, Inc. (IMI), founded in 1980 in the Philippines, is a global technology company specializing in the design, development, and manufacturing of electronics. IMI provides advanced solutions that power products worldwide. Operating across 21 sites with a team of 15,000, IMI serves a diverse range of customers in various markets and regions. IMI is known for its ability to tailor solutions to meet specific customer needs by leveraging its expertise, scale, and efficiency. Committed to sustainable technology, the company focuses on building lasting partnerships and delivering value to its stakeholders (Integrated Micro-Electronics, Inc. 2021, p.9).

Based on IMI 2023 Annual Report (Integrated Micro-Electronics, Inc. 2024, p.60), the company is actively pursuing a digital transformation strategy, with a focus on sustainability

and alignment with its Environmental, Social, and Governance (ESG) goals. By leveraging advanced technologies such as Robotics Process Automation (RPA), Artificial Intelligence (AI), and ML. IMI aims to enhance efficiency and promote innovation across its operations. This transformation has been rolled out in phases, with key components like RPA (70%) and AI/ML (30%) reaching full integration in 2021, 2022, and 2023, respectively, reflecting the allocation of effort and resources dedicated to each technology.

3.2.8. Energy Solutions: Mitsubishi Power (Philippines) Inc.

Mitsubishi Power (Philippines) Inc., a subsidiary of the Mitsubishi Heavy Industries (MHI) Group, has been a leader in the Philippine power industry for over 30 years. As the sole manufacturer of power and industrial boilers in the country, Mitsubishi Power specializes in the design, manufacturing, and maintenance of these systems and pioneered boiler risk diagnosis services, including Risk-Based Maintenance (RBM). To meet rising demand for after-sales services, Mitsubishi Power established MHI Power (Philippines) Plant Services Corporation in 2019 as a dedicated service arm, focusing on supporting clients both locally and regionally. Backed by a team of over 1,600 engineers, Mitsubishi Power (Philippines) Inc. delivers end-to-end solutions from design to maintenance, partnering with local stakeholders to promote a sustainable and energy-efficient future (Mitsubishi Power Asia Pacific Pte. Ltd. n.d.).

As reported by Walton (2021), Mitsubishi Power announced the global expansion of its AI capabilities in 2021 through the launch of five TOMONI HUB Analytics and Performance Centers, strategically placed in Takasago and Nagasaki, Japan; Orlando, United States; Alabang, Philippines; and Duisburg, Germany. These AI-powered hubs are designed to enhance remote operations and advanced maintenance analytics, offering actionable insights to optimize power plant performance.

This AI initiative aimed to strengthen Mitsubishi Power's dedication to resilience, adaptability, and operational flexibility in the face of challenges like extreme weather. With the TOMONI Hubs, Mitsubishi Power envisioned bringing the Intermountain Power Project—an advanced 840 MW power plant utilizing both natural gas and hydrogen—to life, aiming to make it one of the most resilient and technologically advanced facilities in the Americas. Leveraging over 20 years of expertise from Mitsubishi Power's Remote Monitoring Centers, the hubs provide cyber-secure, cloud-based analytics supporting a variety of power generation methods, including steam, gas-turbine combined cycles, renewables, distributed generation, smart energy systems, and all-duration energy storage (Walton 2021).

3.2.9. Energy: Manila Electric Company

Founded in 1903 as the *Manila Electric Railroad and Light Company*, now known as the *Manila Electric Company (Meralco)*, this organization is the largest private-sector electric distribution utility in the Philippines. Meralco serves 39 cities and 72 municipalities, covering over 9,685 km²—just 3 percent of the country's land area, yet responsible for 55 percent of its

electricity consumption. Celebrating 121 years of service in 2024, Meralco remains committed to delivering reliable and affordable energy to millions of Filipinos (Meralco n.d.).

Aligned with its *Customer-Centric and Digital Transformation* strategy, launched in 2020, Meralco has embraced AI to enhance customer experience and operational efficiency. One example is Meralco's *Talent Resourcing Automated Communication and Information (TRACI)*, a tool powered by AI and Robotic Process Automation (RPA) that streamlines the job application process by allowing applicants to engage via chat, submit details, and upload their resumes securely into Meralco's SharePoint system (Stevie Awards n.d.-a).

Additionally, Meralco's *Operations Platform and Telecommunications Integrated Command Center (OPTIC)* centralizes system monitoring to reduce unplanned downtime, increase employee productivity, and improve service delivery. AI-driven, OPTIC analyzes system logs, provides actionable insights, and enables predictive maintenance, reinforcing Meralco's focus on efficiency and operational resilience (Daily Tribune 2022).

The *Meralco Data Platform (MDP)*, launched in 2021, drives predictive maintenance and operational efficiency by processing extensive data and applying ML to identify secondary lines needing rehabilitation and overloaded transformers. MDP also supports the *M-Wing* dashboard, a mobile-accessible tool that provides managers with real-time operational metrics (Daily Tribune 2024). Meralco's *Powertech Innovation and Experience Lab (PIXL)* is another AI initiative, serving as a VR and metaverse-based training hub. Equipped with a Digital Twin system powered by VR and AI, PIXL offers immersive training and remote support to enhance employees' skills and deepen their understanding of critical systems (Manila Bulletin TechNews 2023).

With MDP's proactive prevention of outages, nearly 200,000 customers were shielded from disruptions in 2021, and resources were conserved for around 500,000 households. This achievement earned MDP the *Cloudera 2024 Data Impact Award*, recognizing Meralco's excellence in service reliability and efficiency (Daily Tribune 2024).

3.2.10. Training Services: Komatsu Philippines Corporation

In 2021, Komatsu was recognized as the world's second-largest supplier of construction and mining machinery (Top-10 Leading Global Construction Equipment Manufacturers n.d.). Established in 1921 as a small ironworks in Komatsu City, Japan, the company has grown to operate in over 140 countries, marking a century of progress in 2021 (Komatsu Corporation Philippines n.d.-b).

Komatsu entered the Philippines in 2008 by opening the Komatsu Human Resources & Development Center (KHRDC) in Metro Manila. By 2019, KHRDC had evolved into Komatsu Philippines Corporation (KPC) (Komatsu Corporation Philippines n.d.-b), Komatsu's training-focused subsidiary in the Philippines (Komatsu Corporation Philippines n.d.-a). As Komatsu's training-focused subsidiary in the Philippines, KPC has accepted 170 trainees since 2008, with

108 of them now working worldwide as “Global Engineers” (Komatsu Corporation Philippines n.d.-b). On April 24, KPC welcomed its 16th trainee batch, consisting of 12 engineers from various Philippine universities and three international trainees from Komatsu Germany and Komatsu Marketing and Support Indonesia (Komatsu Corporation Philippines n.d.-a).

In October 2024, Komatsu launched an updated version of its Smart Construction Edge tool, now using AI to improve drone surveys on construction sites. Developed with partners Sony, NTT Communications, and Nomura Research Institute under the EarthBrain project, this tool helps both experienced and new users conduct accurate drone surveys by automatically removing obstacles, like buildings and machinery, from the data, so fewer manual adjustments are needed. The goal of adding AI is to make construction work faster, safer, and more environmentally friendly. By quickly processing survey data into detailed 3D maps, construction teams can easily track progress and save time (Komatsu 2024).

3.2.11. Water Utility: Maynilad Water Services, Inc.

Maynilad Water Services, Inc. (Maynilad) is the water and wastewater provider for the 17 cities and municipalities of the West Zone in Greater Metro Manila. As a private concessionaire of the Metropolitan Waterworks and Sewerage System (MWSS), Maynilad is operated by a joint venture among Metro Pacific Investments Corporation (MPIC), DMCI Holdings, Inc. (DMCI), and Marubeni Corporation, taking control in 2007. Initially awarded a 25-year concession in 1997, Maynilad’s agreement was extended to 2037. The company was also granted a 25-year franchise under Republic Act No. 11600 in 2021 to operate waterworks and sewerage services across Metro Manila’s West Zone and Cavite Province. Maynilad provides customers with safe, piped-in drinking water, sewerage services in designated areas, and sanitation options, including septic tank cleaning for residents outside its sewerage network (Maynilad n.d.).

AI is a critical component of Maynilad’s Non-Revenue Water (NRW) Management Program, which aims to reduce water losses and improve supply reliability across the West Zone. The company utilizes two advanced AI technologies to achieve this goal: *Infrawise*, developed by Administração e Gestão de Sistemas de Salubridade (AGS), and a satellite-based AI system from Asterra. Infrawise enables Maynilad to analyze high-risk areas in its pipeline network, pinpointing vulnerable spots for targeted leak detection and pipe replacement. During pilot testing, Infrawise analyzed data across 1,700 kilometers of pipelines, identifying vulnerabilities in 750 kilometers and detecting 1,525 leaks (Maynilad 2024b).

The satellite-based AI technology from Asterra, on the other hand, uses patented algorithms to track the spectral “signature” of potable water underground, covering approximately 3,000 square kilometers. This information is captured in a Geographic Information System (GIS) report, allowing Maynilad to locate specific street-level leaks quickly and accelerate repairs (Maynilad 2024a).

Maynilad’s motivation for integrating these AI technologies is driven by the need to reduce water losses rapidly and enhance operational efficiency. Faced with one of Asia’s oldest pipeline networks, Maynilad set an ambitious 2024 target of 50,000 leak repairs, backed by an

investment of PHP 791 million for active leakage control. Expanding Infrawise's coverage by an additional 1,500 kilometers, Maynilad combines cutting-edge technology and increased manpower to streamline its leak detection and repair processes (Maynilad 2024c).

3.2.12. Telecommunications: PLDT

PLDT Inc., originally founded as the Philippine Long Distance Telephone Company, was established on November 28, 1928, following the merger of four US-owned telephone companies (Philippine Stock Exchange [PSE] Edge n.d.). Its inception occurred in a period marked by heightened communication needs due to a recent typhoon that underscored the importance of connected systems. At the time, local networks were fragmented, limiting communication within small cities. PLDT's creation aimed to unify these isolated networks into a cohesive, nationwide telephone system, thus enhancing connectivity, improving service accessibility, and supporting economic development across the country. Early leadership from Theodore Vail Halsey and Major J.E. Hamilton Stevenot facilitated PLDT's expansion by acquiring smaller regional phone companies, thereby establishing connections both within the Philippines and internationally (PLDT n.d.).

As a leading telecom provider today, PLDT Inc. operates through three main divisions: wireless, fixed line, and other services, boasting the country's most extensive fiber optic, fixed line, and cellular network. The company's wireless services are offered under the brands 'Smart,' 'TNT,' and 'Sun Cellular,' while its fixed line services are marketed as 'PLDT Home' and 'PLDT Enterprise' (PSE Edge n.d.-a).

In recent years, PLDT has integrated AI to improve customer communication and service delivery. Its Conversational AI system, powered by a natural language processor (NLP), enables automated customer interactions, such as bill payment reminders and account verification. By automating routine tasks, this AI solution enhances efficiency and reduces dependence on human agents, while also prioritizing customer privacy with restricted data access and secure data retention practices (PLDT Home n.d.).

PLDT also utilizes Wiz AI's Talkbot Pro, an AI-powered voice assistant that personalizes customer service through natural, human-like interactions. Deployed on ePLDT's Azure Stack Hub, the Talkbot supports the collections team by increasing efficiency and revenue, automating routine reminders, and reducing manual tasks. In its first year, the Talkbot conducted 3.7 million outbound communications and cut average call handling time from six to three minutes. The localized Talkbot, which communicates in Taglish, adds cultural relevance and enhances customer satisfaction, contributing to a 33 percent productivity boost and a 15 percent decrease in manual callouts (Wiz AI n.d.).

Furthering its sustainability efforts, PLDT's subsidiary Smart Communications has implemented AI-powered green radio network solutions to optimize power usage at its cell sites. This technology adjusts power dynamically based on traffic, conserving energy during low-demand periods and aligning with PLDT's goal of reducing carbon emissions by 40 percent by the end of the decade. Since deploying this AI solution, Smart has saved

approximately 10,900 megawatt-hours of energy, equivalent to the annual carbon emissions of 920 households (Jose 2024).

PLDT has also partnered with Ericsson to drive digital transformation across Philippine industries. Leveraging PLDT's Innovation Laboratory (Innolab) and Ericsson's AI Exchange Platform, this collaboration facilitates applications in machine vision, traffic analysis, and AI-driven insights to support sectors such as safety, security, food production, and environmental conservation. This partnership is part of PLDT's commitment to sustainable development goals and its support for local innovation (Syed 2023).

PLDT and Smart have partnered with Amdocs for a multi-year cloud modernization project on Amazon Web Services (AWS). Amdocs will migrate key systems to AWS and provide an AI-powered cloud management platform that optimizes infrastructure and enhances resilience. This initiative aligns with PLDT's vision to support digital connectivity across the Philippines, improve service continuity, and allow resources to be redirected toward innovation. The AI-driven approach is expected to streamline operations and enhance customer experiences (PLDT-Smart taps Amdocs 2023).

3.2.13. Telecommunication: Globe Telecom

Globe Telecom, Inc., originally founded on January 16, 1935, as Globe Wireless Limited, began with a franchise to deliver wireless long-distance messaging services across the Philippines. The company adopted its current name in 1992 and welcomed Singapore Telecom, Inc. as a foreign partner the following year. Today, Globe is a leading telecommunications provider, offering digital wireless services under the "Globe Postpaid," "Globe Prepaid," and "TM" brands via its fully digital network and providing both domestic and international communication services (PSE Edge n.d.-b).

For over seven years, Globe has led the Philippine mobile sector by revenue market share and was recently recognized on the Fortune Southeast Asia 500 list, which ranks companies by total revenues as of December 31, 2023. As of Q1 2024, Globe serves 61.3 million customers, including 58.8 million mobile subscribers, 1.7 million broadband users, and 797,000 landline customers (Globe 2024c).

In line with its commitment to innovation, Globe launched the AI Development and Enablement Group (AIDE) on June 1, 2024, to lead its AI strategy across planning, integration, and governance, ensuring a competitive edge. CEO Ernest Cu emphasized the need for a unified approach to maximize AI's potential across Globe, appointing Anton Bonifacio as Chief AI Officer to oversee responsible AI use for growth and service improvement (Cordero 2024).

To further its digital transformation, Globe partnered with Amdocs to deploy an AI-powered Data Platform on Google Cloud, centralizing its information hub for better data-driven decision-making. This platform will integrate real-time business data, enabling more

personalized digital services while streamlining operations and reducing costs through a unified data model (Staff Writer 2024).

In sustainability efforts, Globe implemented an AI and ML-driven energy management system across its wireless networks to optimize power usage at base stations, saving 3 to 8 percent in energy costs. In 2023, this initiative saved approximately 187,774 kWh, reducing CO_2 emissions by 139 metric tons, aligning with Globe's Net Zero target by 2050 (Globe 2024b).

Expanding its AI applications, Globe uses AI tools to enhance customer care, improve network performance, and advance fintech services. This includes conversational AI for customer interactions in Tagalog and AI-based credit scoring within GCash for quick loan assessments. Globe's innovation arm, 917Ventures, is also exploring AI applications in tech projects that address Filipinos' needs (Globe 2024a).

To further enhance customer experience, Miles (2024) reported that Globe partnered with GMS to bring GenAI, Conversational AI, and Communications Platform as a Service (CPaaS) solutions to its enterprise clients, aiming to boost customer engagement, operational efficiency, and data-driven decision-making. By deploying tools like chatbots and leveraging GenAI for content creation, this partnership is expected to increase customer satisfaction and drive sustainable growth for Globe’s business clients. GMS’s expertise in Mobile Network Operator (MNO) services and AI-driven communication is anticipated to support Globe's expansion of digital solutions.

4. Economic Theory of Industrial Policy and AI

4.1. Evolution of economic theory on government’s role in industrial policy and technology development

To gain a comprehensive understanding of current policy approaches to AI adoption, it is beneficial to revisit the evolution of economic thought on government intervention in innovation. This review begins with classical and neoclassical economic perspectives, followed by an exploration of Schumpeter’s ideas on creative destruction. It then examines post-WWII developments in government-funded R&D, the emergence of new growth theory, and innovation systems approach. Finally, it addresses modern perspectives on industrial policy and current trends.

4.1.1. Classical Perspectives

The First Industrial Revolution (around 1760-1840), characterized by colonial trade, the rise of merchant capitalism, as well as the emergence of factory-based division of labor, gave rise to industrial wealth and industrial capitalism. At this time, growth or the expansion of the production function, which had been limited to land and labor, is driven by introducing capital as a key factor of production. Moreover, classical economists at this time challenged the protectionist policies of mercantilism, advocating instead for the removal of trade barriers. According to Adam Smith, free trade induces competition, lowers prices for consumers, and increases profits for businesses. Smith also revisited the concept of an invisible market force

referred to as "invisible hand," which suggests that individuals pursuing their own self-interest could unintentionally promote the welfare of society as a whole. This idea became the foundation of *laissez-faire* policies which signifies a limited role for government in industrial policy (van der Kooji 2017).

Wang and Zhang (2023) outlined how Marx's *Das Kapital* observed that capitalists turned to science and technology as a response to worker resistance against extending working hours. To address this, capitalists invested in machinery and advanced production techniques to improve efficiency. By increasing efficiency with machinery, workers need less time to complete necessary labor. As a result, the remaining time in a worker's day is spent on surplus labor, which generates profit for the capitalist. Capitalists who adopt new technology earlier than competitors can produce goods more efficiently and at a lower cost. This gives early adopters a temporary advantage by allowing them to claim a larger share of surplus labor and profit than other capitalists in the same industry. However, as more capitalists start using the same advanced technology, the entire capitalist system benefits, as all capitalists collectively extract more surplus value from workers.

4.1.2. Neoclassical Perspectives

One of the principles advocated by Marshall related to R&D and innovation is related to the role of government in education. There was a consensus among economists of his time in favor of state-funded education for the masses as it gives people the chance to realize their potential. Marshall highlighted that the rare emergence of a single "great industrial genius" could produce contributions significant enough to outweigh the costs of educating an entire community.

In the early 20th century, Clark recognized that trusts—large, unified corporations or cartels—could be efficient but only if they avoided monopolistic behavior (Leonard 2003). Noting that not all monopolies lead to market failure, Clark emphasized that the "natural way"—the best way—to regulate monopolies is through the threat of potential competition, making the outright elimination of large firms unnecessary (Clark 1900, as cited in Leonard 2003).

Clark also cautioned that breaking up monopolies not only could lead to collusion, as smaller firms may work together to fix prices or limit competition instead of competing, but could also reduce scale economies (Clark 1900, as cited in Leonard 2003). Government intervention should be limited to cases where monopolies engage in anticompetitive practices and instead advocated for a targeted approach such as banning predatory pricing and exclusionary contracts (Clark 1900, as cited in Leonard 2003). Clark also argued that monopolies, by restricting output and reducing competition, ultimately harm wages across the economy (Clark 1903, as cited in Leonard 2003). Furthermore, Clark believed that monopolies, whether private or public, are less innovative due to the lack of competitive pressure. He saw competition as the key driver of innovation and dynamic efficiency, which is why he opposed widespread state ownership of firms (Clark 1914, as cited in Leonard 2003). Clark also rejected price regulation, believing it could lead to corruption in government and that determining fair prices in monopoly markets was too difficult due to the lack of competition (Clark 1900, as cited in Leonard 2003).

4.1.3. Schumpeterian View

Schumpeter's influential concept of “creative destruction” describes how capitalism creatively destroys old economic structures—such as skills, equipment, ideas, and technology—leaving some individuals worse off while fostering progress by replacing the old with the new. In line with this, Schumpeter is also well known for his view that monopolies induce innovation and that they might be more effective at driving innovation than companies operating in competitive markets (Baker 2007).

Compared to smaller firms, large firms and monopolists are better positioned to innovate because they have the resources, stability, market power, and first-mover incentive to take risks and pursue large-scale research and development efforts (Baker 2007). Thus, Schumpeter’s view may provide for a special role of government to support the micro, small and medium firms in pursuing R&D and innovation activities.

4.1.4. Post-World War II Developments

After World War II, the primacy of technological progress to drive economic growth became one of the leading theories of development. The Solow-Swan growth model demonstrates that as more capital is accumulated, each additional unit generates progressively smaller increases in output, which limits its impact on sustaining long-term growth. In the long run, once an economy reaches its steady-state, per capita income growth depends entirely on technological advancements (Koutun and Karabona 2013).

By incorporating human capital as an input into the original Solow model, Mankiw, Romer, and Weil (1992) showed that investments in physical and human capital, along with savings and education, determine long-term growth in output per capita. Findings also suggest that without technological progress, continued growth requires continuous improvements in education (Conrad 2017).

Arrow's (1962b) macroeconomic model based on "learning by doing" showed that economic growth depends on behavior, rather than being determined solely by external factors (Dasgupta 2017). As firms produce more, they gain experience and improve efficiency, which boosts productivity. However, if the benefits of this learning—such as knowledge or skills—spill over to other firms without proper incentives or compensation, the firm will underproduce relative to the optimal.

Bebczuk (2002) notes that Arrow (1962a) is the earliest account to discuss the responsibility of governments in R&D. Arrow (1962a) explains that while allowing everyone to freely use a discovery maximizes societal benefits, it can discourage innovation since private enterprise may not receive sufficient rewards for their efforts, which may result to under-allocation of investment in innovation. Arrow (1962a) recommends that non-profit organizations or governments finance research and invention. He also highlighted the importance of non-financial incentives, such as curiosity and societal benefit, in conducting research. Likewise, Arrow (1962a) acknowledged that the government's involvement in research has been crucial

for driving progress. He noted the potential impact of research institutes funded by industries, the government, or private donations on innovation and research.

In determining the amount to allocate on investment in inventions, Arrow (1962a) suggests that governments use historical data in the prediction of future rates of return. With these predictions, governments could adjust their investment in innovation, i.e., an increase if past returns exceeded the average rate of return in the economy, or a cut if past returns were lower. Arrow (1962a) recognized that individual talent is the key source of ideas, and, if necessary equipment are provided or can be rented, a greater range of research contracts can be established with individuals and organizations.

In terms of efficiency, Arrow (1962a) argued that payment for the contracts should be based on costs with a fixed fee remaining the same regardless of the outcome. To justify this type of arrangement, Arrow (1962a) provided three points. First, new contracts would be partly awarded based on past performance, and therefore, incentivize efficiency. Second, rather than a precise result, the purchased service would be the provider's expertise, judgment, and ability to manage uncertainty. Third, since the provider cannot fully control all the risks associated with the invention, it would place significant risk on the provider if the payment were solely based on the outcome.

Arrow (1962a) noted that alternative compensation methods for contractual arrangements should be studied. He mentioned three issues governments need to address regardless of the alternative methods. First is the challenge of evaluating the right invention to fund. The second and third issues, which he drew from Hitch's *The Character of Research and Development in a Competitive Economy* (as cited in Arrow 1962a), are biases in decision-making, such as funding less risky projects, and the possibility of excessive centralization in how government contracts are awarded.

Using UNESCO R&D data from the 1980s to the 1990s across 88 countries, Bebczuk (2002) observed a negative correlation between R&D expenditures and GDP per capita, and a positive association between the share of government funding in total R&D and GDP per capita. The study reveals an estimated compensation coefficient of 0.31, suggesting that for every 1 dollar decrease in private R&D, public R&D drops by an additional 0.31 dollars. These findings provide two key insights: (1) despite supporting Arrow's (1962a) and Romer's (1990) notion that market failures create opportunities for governments to actively engage in the R&D sector, public R&D fails to compensate for the shortage of private R&D and might even reduce private sector incentives to invest, and (2) poorer countries have less private R&D due to deep market failures and, therefore, less total R&D investment.

4.1.5. New Growth Theory

Romer's (1990) endogenous growth model based on monopolistic competition explains how economic growth is driven by the creation of new ideas (innovation), which are actively pursued by entrepreneurs and researchers who aim to maximize their profits. For Romer (1990), the nonrival nature of ideas is critical for economic growth as it enables the realization

of increasing returns to scale. Since firms do not need to recreate the same idea every time they expand production or establish additional facilities, combining these non-rival inputs with rivalrous inputs—which exhibit constant returns to scale—leads to increasing returns to scale, which result to growth (Romer 1990, as cited in Jones 2019).

Having more researchers leads to the generation of more ideas. Since ideas are non-rival, they can be shared and used without being depleted, which benefits everyone. Over time, both the total stock of ideas and the number of innovators would increase, driving exponential growth in the long-run (Romer 1990, as cited in Jones 2019).

Romer's endogenous technological change model emphasizes the importance of producing knowledge and patents as key drivers of economic growth. As highlighted by Zhao et al. (2020), Romer suggests that to strengthen the knowledge economy, society must invest in knowledge, share ideas, and foster global creativity, while also formulating effective policies that support innovation by entrepreneurs, scientists, and researchers.

4.1.6. Innovation Systems approach

One of the most widely used conceptual frameworks in innovation studies is the Triple Helix model. Introduced by Etzkowitz and Leydesdorff (1995), it describes the dynamic collaboration among university, industry, and government as a driver of innovation, entrepreneurship, and economic growth in a knowledge-driven economy. In this model, universities and industry, which were previously separate entities, are now taking on roles traditionally held by each other. Governments, on the other hand, not only regulate industries and academic institutions but also actively fund innovation and support startups. By providing financial resources, incentives, and policies, governments create an environment where innovation can thrive, and new ideas can be developed and commercialized.

The National Systems of Innovation (NSI) framework highlights the government's role as a coordinating agent in strengthening innovation. Developed in the 1980s, NSI emphasizes the importance of how systemic interactions among institutions and policies, specific to a country's national context, work together as a whole to shape innovation outcomes (Weel et. al 2010).

4.1.7. Modern perspectives on industrial policy

Policymakers around the world have acknowledged the need to modify competition laws to address the unique challenges digital markets present. Known as *digital competition regulations* or "DCRs", these rules aim to tackle the growing concern about the increasing control and market dominance held by a few major digital platforms. According to the International Center for Law & Economics (2024), DCRs share two common features. First, they focus specifically on dominant platforms or "gatekeepers", which have enough economic power to affect the market. Second, they place similar, if not the same, rules and restrictions on gatekeepers to prevent anti-competitive behavior and ensure fair competition in digital markets. Regulated platforms are identified using either specific quantitative measures, such as annual turnover and user count, or qualitative criteria, like market entry barriers and dominance, to evaluate their influence in the market (Deutscher 2022). Passed in 2022, the

European Union (EU) Digital Markets Act (DMA) serves as the foundational framework for all subsequent regulations related to digital competition.

As stressed by Webber et al. (2022), investment in digital infrastructure must be accompanied by digital skills training to maximize benefits. However, unequal access to broadband within and between countries creates significant digital divides. In addition to improving communication and service delivery to citizens, governments worldwide prioritize universal broadband infrastructure as it not only increases the competitiveness of various economic sectors but also attracts international businesses, thereby enhancing global competitiveness (Falch and Henten 2010). In the Philippines, DICT's National Broadband Plan (NBP) serves as a roadmap to enhance the country's internet connectivity, which aims to provide affordable and fast internet connection. As part of this effort, the NBP mandates a minimum speed of 2.0 Mbps for entry-level broadband to ensure basic internet access nationwide. Aside from this, DICT also implements digitaljobsPH program, which offers ICT training to individuals in rural areas by enhancing their skills and employability in the growing digital economy (Banogon 2021).

A substantial body of literature on public private partnerships (PPPs) has focused on broadband infrastructure (Steelyana 2022). PPPs are often more cost-effective in delivering services compared to traditional methods, and they also align the public sector's social and economic goals with the private sector's business objectives. This model secures funding for ICT projects and ensures the development of digital infrastructure, which makes services more accessible to both rural and urban areas (Witters, Marom, and Steinert 2012). In the case of underserved areas, close PPPs are especially valuable (Nucciarelli et al. 2010). Through providing incentives, such as public spending, Steelyana et. al (2024) encourage policymakers to promote private sector involvement in broadband infrastructure projects.

4.1.8. Current trends

First introduced by Rhodes and Wield in 1994, green technology aims to reduce the ecological impact of technology (Wu et al. 2022). It is a type of emerging technology which can improve energy efficiency, encourage clean production, decrease pollution levels, and promote sustainable development. The mediator role of the government in green technology innovation (GTI) is reflected in Porter's hypothesis (Porter 1991; Porter and van der Linde 1995), which states that well-designed environmental regulations can encourage firms to innovate further and increase their competitiveness, instead of hindering their progress and sustainable growth. Porter and van der Linde (1995) argued that firms can partially or even completely offset the expenses associated with complying with environmental regulations.

Aside from GTIs, governments also provide environmental subsidies to encourage businesses to invest in environmental protection initiatives. In the case of China, results from the study of Bai et al. (2019) reveals that environmental subsidies significantly boost the green innovation efforts and performance of energy-intensive firms. Notably, the impact is found stronger in state-owned enterprises and SMEs. In reference to the principal-agent framework of Waterman and Meier (1998), Chen and Chan (2024), pointed out that principal-agent problems may arise

as subsidy allocations increase. Specifically, managers may direct funds towards lower-risk areas less related to green innovation, which could reduce the effectiveness of the subsidies. To address this problem and guide investments toward green innovation, Chen and Chan (2024) advise governments to strengthen supervision, incentivize business executives, promote environmental information disclosure, and enforce environmental regulations.

International research collaborations (IRCs) have been recognized for their significant impact on advancing national scientific systems, inspiring researchers and scientists globally, and influencing government research policies. Based on Moradi et al. (2020), both domestic and foreign policies play a critical role in shaping IRCs. At the domestic level, governments can strengthen IRCs by establishing international universities, increasing the enrollment of international students, adopting best practices from leading nations, revising regulatory frameworks, and appointing skilled, experienced managers. Foreign policies, on the other hand, should prioritize reducing sanctions and establishing diplomatic relations, such as easing visa processes for international conferences and facilitating fund transfers for international researchers.

Forero-Pineda (2006) notes that the increase in scientific and technological capacity within developing countries is often seen as a justification for raising intellectual property rights (IPR) protection levels. In the same study, he discussed how stronger protection of IPRs may pose challenges to international technology transfer, particularly in the case of developing countries. This aligns with Maskus (2004), who observes that stronger IPR protections may lead foreign firms to (1) focus on exports instead of establishing physical presence in the local markets, and (2) increase the market power of foreign investors, which enables them to impose stricter licensing terms.

In contrast, Edler, Cameron, and Hajhashem (2015) highlighted the importance of strong IPR policy, especially for developing nations, as it helps attract foreign expertise and investments and enable countries to transition from merely copying existing technologies to creating unique innovations. Aside from this, they advise governments to align IPR policies with innovation policies to ensure that both work together to drive growth and development.

4.2. Economic Principles Shaping AI Development

Understanding the economic principles underpinning AI development helps explain its adoption and integration into industries.

Goldfarb and Trefler (2018) discussed four economic principles that they considered as necessary to understand the economics of AI. First, they discuss economies of scale in AI, where the accuracy of predictions improves as the quantity and quality of data increases. As basic statistics suggest, predictions become more reliable with larger datasets, though at a decreasing rate due to diminishing returns to scale. Companies with more observations generally have an advantage in prediction accuracy. This concept demonstrates *direct network externalities*, where an increase in the number of users generates more data. This, in turn, leads to improved prediction accuracy, which attracts even more users.

Second, Goldfarb and Trefler (2018) emphasize that economies of scale in AI also arise from significant investments in skilled personnel. Firms that can attract top researchers are generally able to develop more advanced AI systems. Third, economies of scope arise when firms use their AI capabilities across multiple applications, which offer more incentives for investment in AI development. Lastly, AI knowledge externalities present a paradox. While scientific advancements are widely accessible through publications and academic exchanges, AI expertise tends to concentrate in specific regions like Silicon Valley, London, and Toronto. This concentration arises mainly from the challenges in transferring tacit knowledge remotely, which highlight the critical role of proximity in AI innovation.

Varian (2018) pointed out that the externalities gained from direct network effects are not the same as Arrow's (1962b) "learning by doing", which suggests the generation of productive efficiency from experience. While network effects rely on the passive accumulation of users or data to enhance value, learning by doing requires deliberate effort and investment. For instance, in ML, simply collecting vast amounts of data does not create value unless the data is analyzed and utilized effectively, which depends on having skilled personnel. Many firms struggle to leverage their data due to a lack of internal expertise, which makes it difficult to identify needed skills or recruit qualified professionals.

Varian (2018) also discussed the "make vs. buy" decision firms face when choosing between developing their own ML capabilities or purchasing solutions from vendors. Firms must evaluate the costs and benefits of in-house development versus relying on external providers. Some may prefer to build ML capabilities for control and customization, while others may buy solutions to access specialized expertise. This decision impacts the structure and competitive dynamics of AI-driven industries.

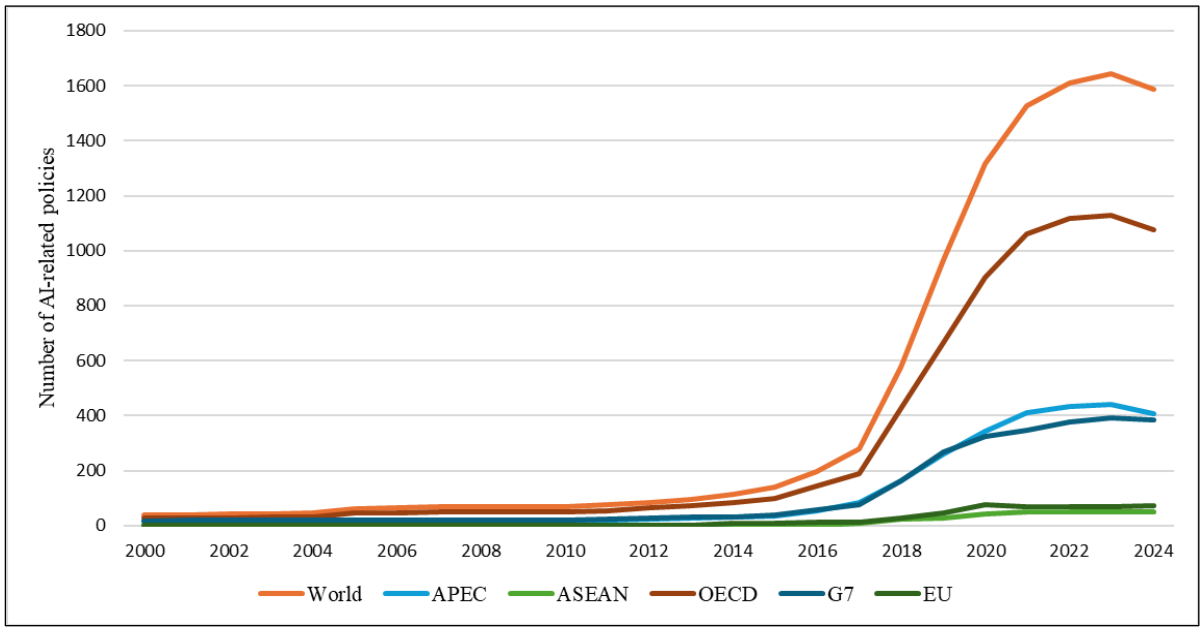
5. Global Trends and Country Case Studies in AI Policy Development

5.1. Trends in AI policies and strategic approaches

5.1.1. Economic Group Initiatives to AI Policy Development

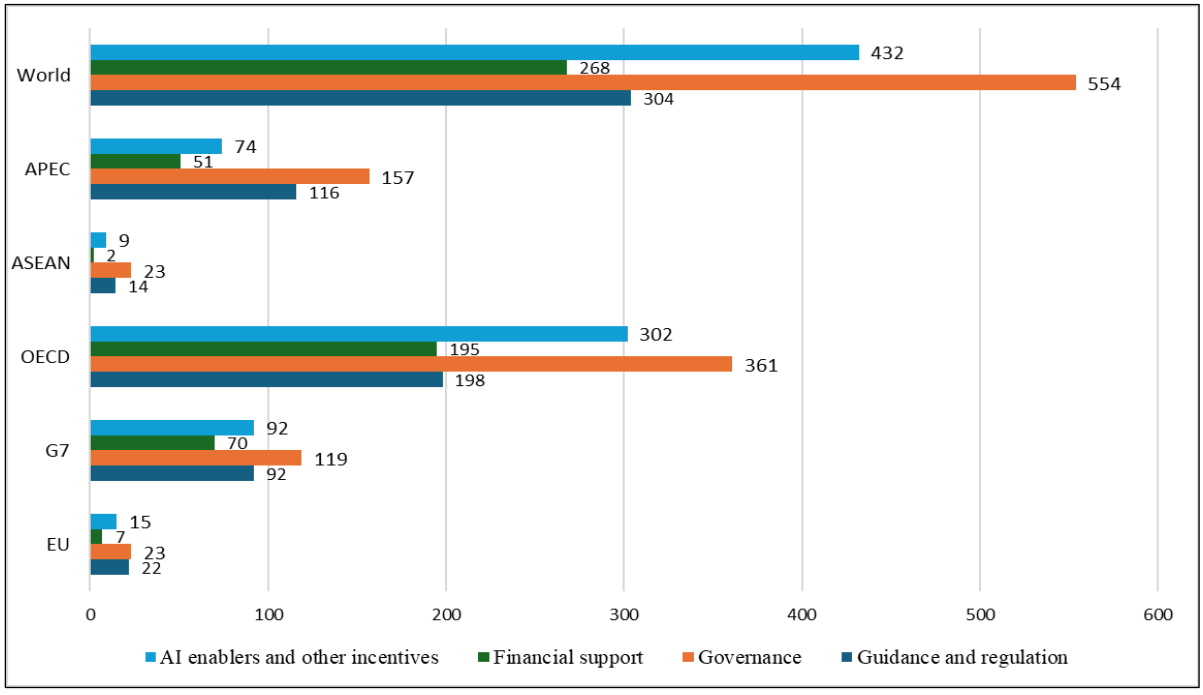
As AI integrates into economies and sectors, governments and AI actors worldwide are developing policies to manage its impact on the economy, society, and ethical standards. Figure 13 illustrates the rise in AI-related policies among major economic groups, namely, Asia-Pacific Economic Cooperation (APEC), ASEAN, Organization for Economic Cooperation and Development (OECD), Group of Seven (G7), and the EU from 2000 to 2024. Policy growth was generally slow across all groups in the early years, but there is a notable global spike around 2016. Among these groups, ASEAN experienced the slowest growth.

Figure 13. Global trends in AI-related policies, 2000-2024



Note: Author's calculations based on data from the OECD.AI (2024). The world aggregate includes data from 71 territories, APEC comprises 15 economies, ASEAN represents 4 economies, OECD includes 38 economies, and the EU as an aggregate.

Figure 14. Distribution of AI-related policies by policy instrument type and economic group, cumulative 2000-2024



Note: Author's calculations based on data from the OECD.AI (2024). The world aggregate includes data from 71 territories, APEC comprises 15 economies, ASEAN represents 4 economies, OECD includes 38 economies, and the EU as an aggregate. In this breakdown, the total number of AI-related policies for each group may not precisely match the sum discussed in Figure 13 due to missing data.

Based on data from the OECD AI Policy Observatory (n.d.), there is a cumulative total of 1,587 AI-related policies implemented from 2000 to 2024 that remain in effect today. This total includes 408 policies for APEC, 48 for ASEAN, 1,077 for OECD, 385 for G7, and 72 for the EU.

OECD.AI (2024) segmented AI-related initiatives into four main categories: AI Enablers and Other Incentives, Financial Support, Governance, and Guidance and Regulation. Figure 14 presents a breakdown of AI policy instruments across various international groups, specifically APEC, ASEAN, OECD, G7, and EU. At the global level (world), *governance* (554 initiatives) is the most prominent policy instrument type followed by *AI enablers and other incentives* (432 initiatives). Across all groups, *financial support* is consistently the least prioritized category, underscoring a relatively low level of direct funding or subsidies for AI initiatives. Overall, the OECD demonstrated the most comprehensive policy coverage, reflecting approaches to managing AI risks and advancing responsible AI development.

5.1.2. AI strategies in developed and emerging economies

Regulators are quickly implementing reforms for AI governance as AI-driven products become more widespread and global regulations adjust. The regulatory environment in this sector is evolving rapidly, as diverse enforcement approaches are being implemented worldwide. Europe has emerged as the initial major global player to implement comprehensive AI regulations, addressing aspects such as transparency, the utilization of AI in public domains, and high-risk systems (Chee et al. 2023).

In April 2021, the European Commission introduced the inaugural EU regulatory framework for AI. This framework involves the analysis and classification of AI systems capable of being utilized across various applications, categorizing them based on the risks they present to users. The new regulations impose responsibilities on both providers and users, varying according to the level of risk associated with artificial intelligence (European Parliament 2023).

The G7, in collaboration with the EU, has instituted the G7 AI Principles and Code of Conduct (AIP&CoC) for companies engaged in advanced AI systems. The voluntary code seeks to govern how leading countries manage AI technology and tackle issues regarding privacy, security risks, and potential misuse. An important aspect underscored in the code is the commitment of companies in implementing necessary measures to recognize, analyze and mitigate risks across the entirety of the AI lifecycle (Digital Watch 2023).

The G7 "Hiroshima Process," which resulted in the AIP&CoC, is part of an expanding array of international endeavors aimed at establishing frameworks for AI governance. They expand upon the 2019 OECD AI Principles, and serve as a shared framework for recent initiatives such as the US Executive Order on Safe, Secure, and Trustworthy AI, Canada's Bill C-27 AI & Data Act, and contribute to broader global initiatives such as the UK-hosted AI Safety Summit, the Council of Europe Convention on AI, Human Rights, Democracy, and the Rule of Law, and the UN Global Digital Compact (Ernst and Young Global 2023).

Advanced nations have also enacted various policies addressing artificial intelligence. The United States, via its National Institute of Standards and Technology, has formulated the NIST AI Risk Management Framework to enhance the management of risks linked to artificial intelligence. It is designed for voluntary adoption, seeking to enhance the integration of trustworthiness aspects into the design and development of AI goods and services. China also launched the Global AI Governance Initiative (GAIGI) for nations involved in the Belt and Road Initiative, highlighting the importance of ensuring that all countries derive equal benefits from AI, irrespective of their political structures (Gonzales 2023).

In contrast, Singapore has introduced its Model AI Governance Framework. This framework offers guidance on implementing responsible AI usage within organizations, focusing on key areas such as internal governance structures and measures, determining the extent of human involvement in AI-enhanced decision-making, operations management, and stakeholder interaction and communication (Personal Data Protection Commission Singapore 2020).

ASEAN boasts the fastest-growing internet market globally, with a digital economy expected to experience significant growth. Consequently, member states are striving to establish mechanisms for overseeing these influential technologies while maintaining competitiveness in this swiftly evolving market. Adopting a non-binding approach to AI promotion, ASEAN introduced the ASEAN Guide on Governance and Ethics. presents a set of guidelines for governments and businesses in the region to adhere to as they develop and deploy AI systems (Asia Pacific Foundation of Canada 2024).

5.2. Country Case Studies

5.2.1. South Korea

The "National Strategy for Artificial Intelligence" outlines South Korea’s ambitious AI goal and strategy. South Korea's need for a national AI strategy is driven by several factors. Global competition for AI leadership is intensifying, with major countries implementing comprehensive national strategies. The National Strategy for Artificial Intelligence notes that competition from developed countries is increasing as leading developed countries are focusing their national capacity on AI strategies (Ministry of Science at ICT 2019). In addition to this, South Korea faces global uncertainties stemming from the US-China trade conflict and Brexit, while its traditional industries like shipbuilding and automobiles are experiencing difficulties.

However, South Korea possesses significant advantages it can leverage. The country has "the world's best ICT infrastructure and semiconductor and manufacturing technology" (Ministry of Science at ICT 2019, p. 14) as demonstrated by an impressive 58 percent market share in memory semiconductors in 2018. South Korea also boasts of a 70 percent higher education completion rate of young people; the highest among OECD countries in 2018. Finally, South Korea also demonstrates high acceptance of new technology as evidenced by having a 95 percent smartphone penetration rate (Ministry of Science at ICT 2019).

Given these factors, the document establishes Korea's Vision for AI to be world leader in AI beyond IT by 2030 with a slogan "AI for Everyone, AI of Everything." This vision has three main pillars for its strategies covering establishing an AI ecosystem, promoting AI Utilization and ensuring a people-centered AI:

- AI Ecosystem: Establish a world-leading AI infrastructure, expand computing resources, and create regional AI innovation clusters.
- AI Utilization: Promote comprehensive AI adoption across industries, from manufacturing to healthcare.
- People-Centered AI: Emphasize ethics, social responsibility, and inclusive AI usage to address societal needs like aging and job automation.

South Korea's strategy for establishing a global-leading AI ecosystem emerges from its recognition of current limitations in data availability and computing infrastructure. The document notes that "there is a lack of data available to individuals and companies, and the distribution structure is closed" (MSIT 2019, p.17). This is particularly challenging for small and medium-sized companies that struggle to secure high-performance computing resources due to high costs.

The foundation of South Korea's AI ecosystem strategy begins with AI Infrastructure Enhancement, which focuses heavily on data accessibility and computing power (Table 7). The ambitious plan to open 45,000 sorts of big data represents a dramatic increase from the current 1,500, demonstrating South Korea's commitment to data democratization. A cornerstone of this infrastructure development is the Gwangju AI Cluster initiative (2020-2024), with a total project cost of 393.9 billion Won (280 million USD), which aims promote convergence between AI and regional flagship industries such as automobiles, energy, and healthcare.

Building on this infrastructure, the strategy leverages South Korea's world-class memory semiconductor competitiveness to secure AI technology advancement. A significant initiative in this area is the development of new-concept artificial intelligence chips (PIM - Processing-In-Memory) that integrate memory and calculation. The document outlines a massive investment plan of 1,009.6 billion won, split between the Ministry of Science and ICT (488 billion won) and the Ministry of Trade, Industry and Energy (521.6 billion won).

The regulatory framework supporting this ecosystem undergoes fundamental transformation through the regulatory innovation strategy, which shifts from a positive list regulation system to a negative list system, embodying the principle of "approve first, regulate later." This includes establishing a comprehensive negative regulation roadmap specifically for the AI field and creating framework legislation that presents national strategic direction, including basic values and principles for the AI era.

Supporting the growth of new AI businesses, the startup strategy focuses on providing comprehensive support throughout the entire lifecycle of AI startups. The creation of an AI investment fund and the hosting of the 'AI Olympics' as part of the Global Startup Festival 'ComeUp2020' demonstrate South Korea's commitment to becoming a global AI startup hub.

The strategy includes practical support measures such as AI vouchers for companies and the establishment of a Future Technology Development Fund.

Table 7. Pillar 1: Establishment of global-leading AI ecosystem

Strategy	Specific Tasks	Specific Targets/Goals
AI Infrastructure Enhancement	• Full opening of public data • Expanding construction of AI learning data • Securing high-performance computing resources Building AI innovation clusters	• Open 45,000 sorts of big data (from 1,500) • Establish Gwangju AI Cluster (2020-2024) • Expand AI Hub support from 200 to 800 organizations
Securing Competitiveness in AI Technology	• Developing next-generation intelligent semiconductor • Expanding support for basic AI research • Improving SW system • Innovating R&D in AI areas	• Achieve 95 percent of AI technology competitiveness (from 82%) • Secure more than five core technologies by 2030
Drastic Regulatory Innovation	• Establishing comprehensive negative regulation roadmap • Establishing framework legislation • Preparing regulatory sandbox	• Create one of top 5 regulatory environments (from 26th) • Transition to "approve first, regulate later" system
Nurturing Global AI Startups	• Creating AI investment fund • Establishing future technology development fund • Hosting AI Olympics • Operating AI Meetup	• Expand investment in venture companies • Create 300 billion won AI funding • Support AI startups through K-Startup competition

Source: MSIT, 2019

South Korea's AI strategy also recognized that advanced ICTs, including AI, have become fundamental elements of market competition and industrial production, however, the country faces significant challenges in maintaining global competitiveness, especially in its traditional industries. Thus, the second pillar (Table 8) focuses on making the best use of AI.

One of the major strategies under the second pillar is the nurturing of AI talent and education. South Korea's AI strategy document acknowledges significant gaps in the current educational system, noting that SW and AI education remains in its early stages, with missed opportunities both in schools and post-graduation (MSIT 2019). To address this, the strategy implements comprehensive educational reforms. Universities are being granted permission to expand AI-related departments, accommodating between 100 to 300 new students annually. The strategy extends beyond traditional education, mandating AI training for military personnel and public officials, ensuring broad exposure to AI literacy across public service sectors (MSIT 2019).

Furthermore, school curriculum reforms aim to equip all students with fundamental SW and AI skills deemed essential for future society (MSIT 2019).

Table 8. Pillar 2: The country that makes best use of AI

Strategy	Specific Tasks	Specific Targets/Goals
Nurturing World's Best AI Talent and Educating People	• Allowing creation/expansion of AI departments • Expanding AI graduate programs • Implementing AI education for military/public officials • Revising SW/AI curriculum in schools	• Train 2,000 AI professionals and 300 top talents annually by 2022 • Increase to 8,000 professionals and 1,000 top talents by 2030
Diffusing AI Technology Across All Industry Areas	• Implementing AI+X projects • Building smart factories • Establishing industry-specific AI platforms • Supporting SMEs and merchants	• Achieve 30 percent manufacturing value-added rate • Build 2,000 AI-based Smart Factories by 2030 • Implement industry-specific AI solutions
Building Best-performing Digital Government	• Establishing digital transformation roadmap • Building smart work environment • Promoting cloud services • Implementing AI-based public services	• Complete next-generation intellectual government • Achieve world's 3rd largest digital competitiveness

Source: MSIT, 2019

The diffusion of AI technology across industries represents another crucial component of the strategy. The document emphasizes the importance of achieving tangible results through AI convergence, particularly in sectors with substantial market size and potential impact (MSIT 2019, p.35). This includes the implementation of AI+X projects designed to deliver visible public benefits (p.36). The strategy also focuses on manufacturing advancement through the establishment of data centers and platforms for smart factory development (p.36). Small and medium enterprises receive particular attention, with support for smart services enhancement through AI and big data-based pre-diagnosis systems (p.37).

The digital government transformation addresses the aging technology infrastructure, which has suffered from delayed adoption of advanced digital technologies (MSIT 2019, p.41). The strategy outlines comprehensive plans for establishing a digital transformation roadmap, enhancing public participation through integrated call centers, and promoting cloud services throughout the public sector (p.42).

The third pillar (Table 9) addresses crucial concerns about AI accessibility and its societal impact. While AI promises improved convenience, there are significant concerns about potential exclusion of underprivileged groups and those lacking basic AI literacy skills (MSIT 2019, p.44).

Table 9. Pillar 3: Realization of people-centered AI

Strategy	Specific Tasks	Specific Targets/Goals
Establishing Inclusive Job Safety Network	• Expanding insurance coverage • Introducing National Employment System • Upgrading job information platform • Expanding vocational training	• Implement comprehensive employment safety net • Increase new technology training from 4 percent to 15 percent • Support transition to AI-focused workforce
Preventing Dysfunction and Establishing AI Ethics	• Establishing cyber infringement detection system • Developing AI-based information protection • Creating AI ethics standards Building quality management system	• Establish global-level AI ethics • Achieve top 3 position in cyber safety index • Reach top 10 in quality of life

Source: MIST, 2019

The establishment of an inclusive job safety network responds to the anticipated disruption in employment patterns, particularly the potential loss of jobs centered on simple, repetitive tasks (MSIT 2019, p.44). The strategy proposes expanding social insurance coverage to protect various types of workers and introducing a comprehensive National Employment System to address safety net gaps (p.45). A significant aspect of this strategy involves increasing the proportion of new technologies vocational training from 4 percent in 2019 to 15 percent by 2022 (p.46).

The prevention of dysfunction and establishment of AI ethics represents a critical response to increased security threats arising from AI technology proliferation (MSIT 2019, p.47). The strategy outlines the development of comprehensive cybersecurity measures, including an intelligent detection and response system for cyber threats (p.48). Additionally, the creation of an Information Protection AI Learning Support Center will provide essential security infrastructure (p.48). The strategy emphasizes the importance of establishing AI ethical standards aligned with global norms (p.49), demonstrating South Korea's commitment to responsible AI development.

5.2.2. Australia

The Australia AI Action Plan 2021 is Australia’s strategic roadmap aimed at establishing the country as a global leader in AI (Australian Government 2021). Recognizing AI’s transformative potential in sectors such as healthcare, manufacturing, and defense, the strategy highlights the necessity of leveraging AI to secure economic growth, create jobs, and maintain Australia’s competitiveness in an increasingly digital global market (Australian Government 2021). AI applications are already visible across Australian industries, contributing to safety, diagnostics, and productivity gains; however, further efforts are needed to maximize the advantages of AI and address adoption challenges (Australian Government 2021).

Australia's vision for AI, as articulated in the Action Plan, is to become a global leader in trusted, secure, and responsible AI by 2030 (Australian Government 2021). The strategy aligns with the country's broader Digital Economy Strategy, which seeks to position Australia among the world's top digital economies by the same year. By focusing on trusted AI development, the strategy sets forth actions intended to foster job creation, enhance business productivity, and solve pressing national challenges through AI-enabled solutions (Australian Government 2021). The Action Plan is structured into four focus areas, each aimed at facilitating specific objectives in AI adoption, talent development, national problem-solving, and ethical governance (Australian Government 2021):

Focus Area 1: Developing and Adopting AI to Transform Australian Businesses

Focus area 1 (Table 10) represents Australia's primary thrust to integrate AI into its business ecosystem, with particular emphasis on SMEs. The cornerstone initiative is the National AI

Table 10. Initiatives, details and implementation status of focus area 1: Business AI transformation

Key Initiatives (Budget)	Details & Targets	Implementation Status (2024)
National AI Centre & 4 AI Capability Centres (USD53.8M)	• Central coordination hub for AI expertise • Front door access for SMEs • Cutting-edge AI technology access • Expert consultation services	• AI Expert Group established • Development of coordination frameworks • Setting up of physical and virtual hubs
Regional AI Program (USD12M)	• Three annual rounds of grants • 12 co-funded projects per round • Grants ranging USD250K-USD1M • Focus on regional business adoption	• First round of grants initiated • Regional partnerships being formed • Project evaluations ongoing
Cooperative Research Projects (USD43.7M)	• 21 industry-led AI projects since 2018 • Focus on practical applications • Industry-research partnerships	• Successful projects like Seeing Machines • Ongoing project monitoring • New partnerships being formed
Modern Manufacturing Strategy (USD1.5B)	• AI integration in manufacturing • Digital transformation support • Industry modernization	• Integration with AI initiatives • Focus on six national priority areas
Digital Solutions Program (USD12.7M)	• Support for 17,000 small businesses • Digital technology adoption • AI integration guidance	• Program rollout in progress • SME engagement increasing

Source: Australia's AI Action Plan, 2021

Centre within CSIRO's Data61, supported by a substantial investment of AUSUSD53.8 million. The Centre serves as the coordinating hub for Australia's AI expertise and capabilities, specifically addressing the barriers that SMEs face in adopting and developing AI technologies. Working alongside the main center are four AI and Digital Capability Centres that provide SMEs with direct access to cutting-edge AI technology, experts, and training resources. These centers function as accessible entry points for businesses seeking AI transformation support, creating a comprehensive support network for Australian enterprises.

To ensure equitable distribution of AI benefits across the country, the government has established the Catalysing the AI Opportunity in Regions program with a AUSUSD12 million investment. This program operates through a sophisticated grant system offering funding between USD250,000 and USD1 million per project, specifically targeting regional businesses, including those in key manufacturing industries. The initiative's structure includes three annual rounds, each supporting up to 12 co-funded competitive grants, fostering collaboration between regional businesses and research institutions.

The Cooperative Research Centres Projects, which has invested USD43.7 million since 2018, plays a crucial role in facilitating industry-research collaboration. A prime example of its success is the development of computer vision technology by Seeing Machines in partnership with Monash University, demonstrating practical applications in transport safety. These research collaborations are complemented by broader technology adoption programs such as the Modern Manufacturing Strategy (USD1.5B) and the Digital Solutions program (USD12.7M).

Focus Area 2: Creating an Environment to Grow and Attract World's Best AI Talent

Australia's capability in AI research and development is already notable, with the country ranking third globally in terms of peer-reviewed AI publications when citation impact is field-weighted (Australia's AI Action Plan, 2021, p.17). To build on this strength, the government has committed substantial investments totaling over USD255.4 million across various initiatives. The centerpiece is the Next Generation AI Graduates program with a USD24.7 million investment to develop home-grown AI specialists through competitive national scholarships. This program aims to train at least 234 AI specialists through competitive national scholarships, addressing CSIRO Data61's estimate that industry will need up to 161,000 additional AI specialist workers by 2030 (Australia's AI Action Plan 2021, p.14).

The Australian Research Council has demonstrated significant commitment to AI development with over USD200 million awarded since 2018 for projects, linkages, and fellowships involving AI. Additionally, the establishment of the Centre for Augmented Reasoning at the University of Adelaide with a USD20 million investment aims to support Advanced Reasoning research through PhD scholarships and increase AI literacy. The Digital Skills Cadetship Trial, supported by a USD10.7 million investment, provides innovative approaches to digital career paths through 4–6-month cadetships combining formal training with on-the-job learning (Australia's AI Action Plan 2021, p.15).

Table 11. Initiatives, details and implementation status of Focus Area 2: AI talent development

Key Initiatives & Budget	Details & Targets	Implementation Status (2024)
Next Generation AI Graduates Program (USD24.7M)	• At least 234 competitive national scholarships Industry co-funded model Focus on AQF Levels 8-10 qualifications • Professional development programs • Industry placement components	• Program implementation in progress First cohorts under selection • Industry partnerships being established • Curriculum development ongoing
ARC AI Research Projects (USD200M+)	• Research projects across multiple disciplines • Linkage program for industry partnerships • Fellowship opportunities • Knowledge transfer initiatives • International research collaboration	• Ongoing project funding • Research outcomes being monitored • New project applications under review • International partnerships expanding
Centre for Augmented Reasoning (USD20M)	• Advanced Reasoning research hub • PhD scholarship programs • AI literacy initiatives • Industry engagement programs • Research commercialization support	• Centre established at University of Adelaide • Research programs initiated • Student recruitment ongoing • Industry partnerships developing
Digital Skills Cadetship (USD10.7M)	• 4-6 month structured programs • Combined formal training and work placement • Focus on practical digital skills • Industry partnership model • Career pathway development	• Pilot programs launched • Industry partners engaged • Training frameworks established • Career pathway mapping ongoing

Source: Australia's AI Action Plan, 2021

Focus Area 3: Using Cutting Edge AI Technologies to Solve National Challenges

This focus area (Table 12) demonstrates Australia's commitment to applying AI solutions to critical national issues through a combined investment of approximately USD62.7 million. The flagship initiative is the AI Solutions to Build a Stronger Australia program (USD33.7 million), which facilitates partnerships between businesses and government to develop AI-based solutions for national challenges. The program specifically targets areas identified in the Artificial Intelligence Roadmap, National Science and Research Priorities, CSIRO Missions,

and areas supporting the Modern Manufacturing Strategy (Australia's AI Action Plan 2021 p.26).

Table 12. Focus Area 3: National challenges

Key Initiatives & Budget	Details & Targets	Implementation Status (2024)
AI Solutions Program (USD33.7M)	• Government-business partnerships • Focus on national priority areas • Pilot project development • Solution commercialization pathways • Intellectual property retention by businesses	• Challenge-based grants initiated • First round of projects selected • Implementation frameworks established • Evaluation metrics developed
Medical Research Fund (USD19M)	• Mental health treatment improvements • Anxiety and depression research • Treatment optimization studies • Patient outcome analysis • Healthcare system integration	• Research projects ongoing • Clinical trials in progress • Data collection and analysis active • Healthcare provider engagement
Defense AI Development (USD10M)	• Intelligence mission data applications • Virtual reality integration • Graphics applications development • Security protocol implementation • Cross-domain coordination	• Project implementation active • Security frameworks established • Technology testing ongoing • Integration with existing systems
CSIRO ML Platform	• Future Science Platform development • Environmental protection applications • Cross-sector collaboration • Innovation ecosystem support • Research commercialization	• Platform operational • Research projects active • Industry partnerships growing • Applications being developed

Source: Australia's AI Action Plan, 2021

The Medical Research Future Fund has allocated USD19 million for transformative medical research projects using AI, including projects focused on improving mental health treatments and understanding stress, anxiety, and depression interventions. The Defense sector has received a USD10 million allocation to develop AI applications for intelligence mission data and virtual reality applications. These initiatives are supported by CSIRO's ML and AI Future Science Platform, which explores critical questions such as providing explainable AI for decision-making to protect national assets like the Great Barrier Reef (Australia's AI Action Plan 2021 p.18).

Focus Area 4: Making Australia a Global Leader in Responsible and Inclusive AI

Recognition that public trust is crucial for AI adoption has led Australia to focus on responsible and inclusive AI development. The government acknowledges that while public acceptance of AI is trending positively, there remains significant hesitation about these new

Table 13. Focus Area 4: Responsible AI

Key Initiatives & Budget	Details & Targets	Implementation Status (2024)
Women in STEM Program (USD42.4M)	• 500 industry co-funded scholarships • Cross-disciplinary skill development • Mentorship programs • Re-entry workforce support • Industry placement opportunities	• Scholarship programs active • Mentorship networks established • Industry partnerships growing • Support frameworks implemented
AI Ethics Framework	• 8 AI Ethics Principles implementation • Industry pilot programs • Case study development • Best practice guidelines • Monitoring and evaluation systems	• Voluntary principles in place • Pilot program completed • Case studies published • Ongoing framework refinement
Global Partnership on AI	• International collaboration • Standards development • Policy alignment • Knowledge sharing • Best practice exchange	• Active international participation • Standard setting contributions • Policy harmonization ongoing • Regular engagement in forums
Privacy Act Review	• Digital era adaptations • Privacy protection strengthening • International compliance alignment • Business guidance development • Implementation frameworks	• Review completed • Recommendations under consideration • Stakeholder consultation ongoing • Reform planning in progress
International Engagement	• Multilateral forum participation • Bilateral partnerships • Standards development contribution • Technology cooperation • Knowledge exchange programs	• Active participation in key forums • Partnership development ongoing • Standards influence growing • International visibility increasing

Source: Australia's AI Action Plan, 2021

technologies among Australians (Australia's AI Action Plan 2021 p.19). Recent updates from AI Watch (2024) confirm that Australia continues to rely on its voluntary AI Ethics Principles published in 2019 to guide responsible AI development, with these principles being consistent with the OECD's Principles on AI.

The government has committed USD42.4 million to the Women in STEM program to address gender disparity in the field, noting that women made up just 19 percent of domestic ICT enrolments in 2019. The strategy emphasizes international cooperation through Australia's membership in the Global Partnership on AI and participation in international standard-setting forums. Recent developments include the commencement of a consultation into "Safe and Responsible AI in Australia" in June 2023, followed by an interim response in January 2024 that identified the need for appropriate mandatory safeguards in high-risk contexts (AI Watch 2024).

5.2.3. Germany

Germany launched its National AI Strategy in 2018 with the goals of enhancing the country's competitiveness, ensuring responsible AI development and deployment for societal benefit, and integrating AI ethically into societal frameworks. This initial strategy earmarked €3 billion for AI development, later increased to €5 billion by 2025 through the Future Package. Progress by 2020 included the establishment of AI research hubs, adoption of ethical guidelines, and regulatory reforms (Federal Ministry of Education and Research 2020).

An interim review highlighted challenges such as talent shortages, limited SME integration, and the need for stronger interdisciplinary collaboration. The updated strategy, Fortschreibung_KI, responded to these by emphasizing sustainability, pandemic resilience, and enhanced European cooperation. The strategy update aligns AI development with global challenges while promoting "AI Made in Europe" (Federal Ministry of Education and Research 2020).

Minds: Building AI Talent and Expertise

Germany recognizes the competitive nature of the global AI labor market and has adopted a multifaceted approach to securing talent. The government plans to establish 100 AI professorships at universities and applied sciences to foster interdisciplinary research and innovation, particularly in sectors such as healthcare, mobility, and climate science. These professorships are complemented by the Alexander von Humboldt Professorship for AI, which attracts globally renowned researchers through significant funding. Salary reforms and improved working conditions aim to retain domestic talent and draw international experts (Federal Ministry of Education and Research 2020).

STEM education is being prioritized through initiatives like *mintmagie*, which encourage young people, particularly women, to pursue AI-related careers. The government is also integrating AI-specific modules into academic curricula and vocational training programs. The National Skills Strategy focuses on lifelong learning and workforce upskilling to address skill shortages. Partnerships with platforms such as *Plattform Lernende Systeme* highlight

successful use cases, providing practical guidance for AI adoption in businesses (Federal Ministry for Economic Affairs and Energy 2020).

Table 14. Key pillars and strategies of Germany's National AI Strategy

Sector	Strategy	Details
Minds: Building AI Talent and Expertise	AI Professorships	Establishment of 100 positions at universities; focus on interdisciplinary research and SME innovation.
	STEM Campaigns	Initiatives like mintmagie aim to increase female participation in AI-related fields.
	Vocational Training	Integration of AI-specific skills into national training frameworks.
	Global Collaboration	Partnerships with the Global South to enhance global AI skill development.
	Talent Attraction	Enhanced working conditions and salary reforms to draw international researchers.
Research: Strengthening National and International Research Ecosystems	Research Hubs	Expansion of AI centers into a 12-hub network fostering innovation and economic integration.
	Infrastructure	Development of HPC systems for large-scale AI applications and data analysis.
	Interdisciplinary Research	Focus on applications in health, climate, and mobility sectors.
	European Collaboration	Partnerships with France and Canada to strengthen European AI leadership.
	Sustainability	Emphasis on energy-efficient AI systems and open-source research outputs.
Transfer and Application: Bridging Research and Industry	SME Support	Mittelstand 4.0 centers and advisory programs to aid small businesses in adopting AI.
	Pilot Projects	Initiatives in healthcare and mobility showcasing AI's impact.
	Test Environments	Regulatory sandboxes for experimentation and innovation.
Regulatory Framework: Building Trust in AI	Data Protection	Updates to the Federal Data Protection Act to align with EU regulations.
	Ethical Standards	Frameworks for transparency, fairness, and accountability in AI.
	Global Alignment	Cooperation with European bodies on ethical AI development.
Society: Promoting Awareness and Ethical Use of AI	Public Education	Campaigns to increase awareness and understanding of AI.
	Civil Society Initiatives	Platforms promoting ethical AI applications for societal benefit.
	Impact Monitoring	Tools like AI Observatory to assess societal implications of AI.

Research: Strengthening National and International Research Ecosystems

Germany’s long-standing commitment to AI research is evident in its development of interconnected research hubs. These centers, part of a planned 12-hub national network, integrate research with local industries to facilitate knowledge transfer and practical

applications. The government is also upgrading its high-performance computing (HPC) infrastructure to meet the demands of large-scale AI applications, with a focus on energy efficiency and data security (Federal Ministry of Education and Research 2020).

Interdisciplinary research is a central focus, addressing areas such as healthcare, mobility, and environmental sciences. Collaboration with European partners, particularly under the "AI Made in Europe" framework, ensures that ethical standards and shared values guide AI development. Partnerships with countries like France and Canada further strengthen this international approach (Federal Ministry for Economic Affairs and Energy 2020).

Transfer and Application: Bridging Research and Industry

The updated strategy emphasizes the translation of research into practical applications. This includes robust support for SMEs through Mittelstand 4.0 centers and dedicated advisory programs. Pilot projects in key sectors such as healthcare and mobility demonstrate AI's potential, while regulatory sandboxes and test environments allow businesses to experiment under controlled conditions. These initiatives aim to reduce barriers to entry and foster widespread AI adoption (Federal Ministry of Education and Research 2020).

Regulatory Framework: Building Trust in AI

The regulatory framework strategy under the updated AI strategy is designed to ensure transparency, accountability, and fairness in AI applications. Updates to the Federal Data Protection Act ensure Germany's alignment with EU standards, while ethical guidelines developed by the Data Ethics Commission promote "ethics by design." These measures aim to foster public trust and support innovation by providing clear rules and standards for AI development (Federal Ministry for Economic Affairs and Energy 2020).

Society: Promoting Awareness and Ethical Use of AI

Germany's strategy incorporates societal considerations by promoting digital literacy and fostering public trust. Platforms like the AI Observatory monitor AI's societal impacts, providing insights into ethical and social dimensions. Civic initiatives such as the Civic Innovation Platform encourage the development of AI for public good. These efforts aim to align AI development with societal values and priorities (Federal Ministry of Education and Research 2020).

5.2.4. United States

The United States' policy on artificial intelligence (AI) reflects a commitment to leading in the safe, secure, and innovative development of AI technologies. This is underscored by two critical documents: the "Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence" (2023) and the "Memorandum on Advancing the United States' Leadership in Artificial Intelligence" (2024). Together, these policy frameworks outline a comprehensive vision for harnessing AI while addressing associated risks.

The overarching goal of the United States' AI policy is to ensure the country maintains global leadership in AI innovation while safeguarding national security, civil liberties, and human rights. President Biden emphasized the dual potential of AI as a transformative technology for

societal progress and a source of risks if misused (The White House 2023). The vision includes promoting responsible innovation, ensuring AI systems are safe and ethical, and fostering international cooperation to create a stable governance framework for AI technologies (The White House 2024).

Strategies to achieve the vision include ensuring AI safety and security, promoting responsible innovation, upholding ethical AI use, advancing National security objectives and fostering global cooperation. In terms of ensuring AI Safety and Security, the U.S. aims to establish rigorous frameworks to ensure AI systems are robust, reliable, and resilient against misuse. This includes standardized evaluations, post-deployment monitoring, and labeling mechanisms to inform the public about AI-generated content (The White House 2023). The National Institute of Standards and Technology (NIST) is tasked with creating guidelines for safe AI development, focusing on GenAI and dual-use technologies (The White House 2023).

In addition, the US government also prioritizes cybersecurity and critical infrastructure protection. Initiatives like red-teaming tests, testbed environments, and collaboration with private AI laboratories are designed to identify vulnerabilities and mitigate risks before AI technologies are deployed (The White House 2024).

Recognizing the critical role of AI in economic competitiveness, the U.S. strategy promoting responsible innovation entails investing in research, education, and workforce development. The government seeks to attract and retain global AI talent through streamlined immigration policies and scholarships. Additionally, significant investments are being made in computational infrastructure, such as AI-specific semiconductors and high-performance computing facilities, to maintain technological leadership (The White House 2024).

To encourage competition and prevent monopolistic practices, The US is implementing policies aimed at ensuring the free access to AI resources like data and computational tools for SMEs and academic institutions. Programs like the National AI Research Resource (NAIRR) are pivotal in democratizing access to cutting-edge AI capabilities (The White House 2024).

The U.S. emphasizes the ethical use of AI, with a focus on eliminating bias, discrimination, and other societal harms. The administration has introduced the Blueprint for an AI Bill of Rights, which includes principles to protect civil liberties, promote transparency, and ensure fairness in AI applications (The White House 2023). These measures are particularly critical in sectors like healthcare, education, and criminal justice, where AI can have profound societal impacts.

Because AI is viewed as a transformative technology for national defense and intelligence, the US Department of Defense and related agencies are integrating AI into operations to enhance situational awareness, cybersecurity, and autonomous systems. Simultaneously, safeguards are in place to prevent misuse of AI for malicious purposes, including biosecurity and cyber threats (The White House 2024).

Finally, the U.S. recognizes the importance of international collaboration in managing AI risks and establishing global norms. Efforts include engaging with allies to develop governance frameworks that promote the responsible use of AI and counter digital authoritarianism. This

leadership is positioned as critical to maintaining democratic values and ensuring AI benefits are shared globally (The White House 2024).

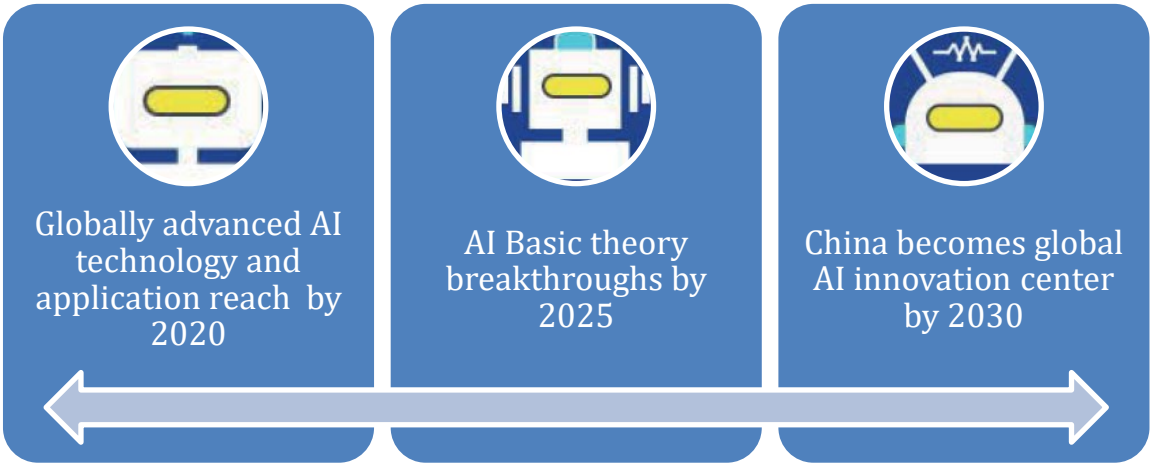
5.2.5. China

Background and Need for AI Policy

China's Next Generation Artificial Intelligence Development Plan is a strategic response to AI's emergence as "a core driving force for next round of industrial transformation" (State Council of China 2017). The plan recognizes AI as a technology that would fundamentally alter production, distribution, and consumption patterns while creating new technological paradigms and industrial models. Building on China's achievements such as ranking second globally in AI technology papers and patents, notable advances in voice and visual recognition technologies, achieving rapid development in adaptive self-learning, intuitive awareness, comprehensive reasoning, hybrid intelligence, and group intelligence, the plan aims to utilize AI to address societal challenges like aging population and resource constraints. However, the plan also recognizes that AI has potential risks related to employment disruption, ethical concerns, and national security implications. The policy framework aims to capitalize on China's unique advantages, including massive data resources, substantial application demand, and an open market environment.

Figure 15 visually represents the three-step strategic vision of China as described by the plan. By 2020, China envisions to have its technology and applications aligned with global advanced levels (Step 1). Step 1 establishes AI as a new economic growth point and supporting tool for improving people's livelihood to build a moderately prosperous society in all respects. Building on this success, China aims to achieve fundamental breakthroughs in AI basic theory by 2025, bringing applications to a globally advanced level. By then, AI has evolved to become a major driving force for industrial upgrade and economic restructuring. By 2030, the goal is to position China as the world's primary AI innovation center, with AI theory, technology, and applications reaching world-leading levels, establishing an intelligent economy and society.

Figure 15. Three-step strategic vision of China



Source: Author's representation based on State Council of China, 2017

The plan emphasizes efficient resource distribution through existing capital and infrastructure while leveraging both domestic and international innovation resources. Implementation is coordinated by the Steering Group for National Science and Technology System Reform and Innovation System Building, with the Ministry of Science and Technology playing a central role in program coordination. Fiscal revenue and policy incentives have a guiding role while the dominant role is played by the market to distribute resources.

The strategy also establishes an AI Plan Promotion Office and an AI Strategy Consultancy Committee to study forward-looking issues and assess major AI policies. This structure ensures comprehensive oversight while maintaining flexibility to adjust to rapid technological changes and emerging challenges.

To achieve these targets the following strategic directions have been outlined in the document:

1. "Formulate laws and regulations and ethical norms related to promoting AI development"

This direction focuses on establishing comprehensive legal frameworks for AI applications, addressing critical issues such as civil and criminal liability, privacy protection, and intellectual property rights. The strategy emphasizes developing ethical frameworks for human-machine coordination and active participation in global AI governance. It includes creating traceability and accountability systems while establishing moral standards for AI product research and design. The plan also promotes international cooperation in developing AI laws and regulations to address global challenges collectively.

2. "Improve major policies for AI development"

The strategy positions financial and tax incentives specifically designed for AI enterprises, with particular emphasis on supporting SMEs and startups. Key elements include tax breaks for high-tech businesses and weighted deductions for R&D activities. The plan also addresses data sharing and protection policies, promoting public statistics sharing and enabling commercial utilization of public data. Additionally, it calls for developing policies adapted to AI-related education, medical care, insurance, and social assistance to effectively manage social transitions.

3. "Set up AI technology standard and intellectual property system"

This direction emphasizes developing comprehensive standards focusing on safety, usability, interoperability, and traceability. The plan promotes Chinese businesses' participation in international standard-setting, aiming to influence global AI product and service applications through technological standards. It includes establishing AI public patent pools and implementing measures to promote AI technology dissemination while protecting intellectual property rights.

4. "Set up AI safety regulation and assessment system"

The strategy addresses national security implications through a multi-layered approach incorporating human, technological, product, and management aspects. It establishes warning mechanisms for AI safety monitoring and implements a two-level monitoring structure with clear accountability. The plan emphasizes forward-thinking prevention and guidance,

including risk assessment and prevention protocols, while promoting industrial and business discipline in AI development.

5. "Enhance AI labor force training"

This direction focuses on preparing for AI-driven changes in employment structure and work modes. It establishes a lifelong learning and employment training system adapted to the intelligence economy and society. The strategy supports higher education institutions, vocational schools, and social training institutions in providing AI skills training, aiming to dramatically improve workforce capabilities to meet the demands of highly skilled work in the AI era.

6. "Carry out extensive activities to popularize AI"

The strategy promotes public awareness and understanding of AI through comprehensive education programs. It includes incorporating AI courses in elementary and middle schools, promoting programming education, and encouraging social participation in developing educational programming software. The plan also supports AI competitions and various forms of public engagement to enhance general understanding and application of AI technologies.

5.2.6. Indonesia

Indonesia has laid out an ambitious roadmap for artificial intelligence development through its National AI Strategy 2020-2045. With projections indicating that AI could contribute USUSD366 billion to Indonesia's GDP by 2030 (Desouza and Picavet 2024), the nation is taking steps to harness AI's transformative potential but at the same time ensure that the deployment of the technology remains inclusive and is aligned with national values.

Background and Context

Indonesia's push for AI development comes amid broader digital transformation efforts, including the Digital Indonesia Vision 2045, which envisions the country as a digital leader in the region. The nation's young, tech-savvy population and growing startup ecosystem provide fertile ground for AI innovation. Currently, Indonesia ranks second only to Singapore in Southeast Asia's technology startup landscape (East Ventures 2023), demonstrating its potential for digital leadership.

The National AI Strategy centers on four fundamental objectives designed to shape the country's technological future. The strategy emphasizes digital sovereignty by prioritizing Indonesia's interests and reducing dependence on foreign solutions. It also focuses on technological advancement through fostering homegrown AI innovation, while ensuring ethical implementation through responsible and equitable use of AI. Finally, it aims to drive economic prosperity through AI-powered innovations (Digital Watch Observatory 2020).

The strategy aligns with Indonesia's broader national vision of becoming "Sovereign, Advanced, Just, and Prosperous" by 2045, marking the country's centenary of independence (Desouza and Picavet 2024).

Strategic Priority Areas and Implementation

The government has established a comprehensive framework focusing on five key sectors for AI implementation. These include healthcare for improved medical delivery and disease detection, bureaucratic reform to enhance government efficiency, education and research advancement, food security through smart farming, and smart cities development for improved urban planning and mobility (Digital Watch Observatory 2020).

The implementation framework rests on four foundational pillars (Digital Watch Observatory 2020). The first pillar addresses ethics and policy development, which includes establishing robust ethical frameworks aligned with Pancasila values and creating comprehensive legal policies. The second pillar focuses on talent development through integrated AI education across all educational levels. Infrastructure and data development forms the third pillar, emphasizing the modernization of digital infrastructure and implementation of the One Data Indonesia initiative. The fourth pillar concentrates on research and industrial innovation, fostering collaboration between academia and industry through initiatives like Inovasi Kecerdasan Artifisial (an Innovation center), and the "Collaboration to accelerate Indonesian Artificial Intelligence innovation" (KORIKA) (Desouza and Picavet 2024).

Current Progress and Challenges

Indonesia has made significant strides in implementing AI across various sectors. Companies like Waresix, Mekari, and Ruangguru are pioneering AI applications in logistics optimization, HR management systems, educational platforms, cybersecurity solutions, and customer service technology (East Ventures 2023).

However, the nation faces several significant challenges in its AI implementation journey. These include inadequate digital infrastructure, particularly in remote areas, alongside a persistent shortage of skilled AI workforce. The country also grapples with cybersecurity vulnerabilities and regulatory gaps in AI governance. Additionally, low adoption rates of AI technologies and digital disparity across regions continue to pose significant obstacles to progress (Desouza and Picavet 2024).

Moving Forward

Indonesia's approach to addressing these challenges involves several strategic initiatives. The government is implementing substantial investment in digital infrastructure modernization and forming international partnerships to accelerate capacity building. They are also creating AI experimentation and innovation platforms while developing public value metrics to measure AI's societal impact. A general framework promoting responsible innovation has been established to guide these developments (Desouza and Picavet 2024).

The success of Indonesia's AI strategy will largely depend on its ability to execute these plans while maintaining a balance between rapid technological advancement and inclusive development that upholds national values and promotes public good.

5.2.7. Japan

Japan's AI Strategy 2022 represents a continuation and enhancement of its efforts to integrate AI into societal, economic, and environmental frameworks. In 2018, Japan's initial strategy laid the groundwork by focusing on human-centered AI principles, such as promoting dignity, diversity, and sustainability. Subsequent updates in 2019 and 2021 incorporated more robust measures addressing education reform, data infrastructure, and ethical AI, as well as emerging challenges like the COVID-19 pandemic and natural disasters (AI Strategy 2022, p. 1).

The 2022 update incorporates lessons learned, focusing on imminent crises like pandemics and natural disasters, while aligning with Japan's broader goal of creating Society 5.0—a human-centered, technology-driven society. The strategy addresses gaps in infrastructure, talent development, and ethical considerations, setting a comprehensive framework to enhance resilience, industrial strength, and global AI leadership (AI Strategy 2022, p. 3).

Strategic Objectives

Japan's AI Strategy 2022 outlines five core objectives (Strategic Objectives 0–4), each targeting specific areas of societal and industrial enhancement.

Strategic Objective 0 "Addressing Imminent Crises" aims to develop resilient systems and technologies to respond to national and planetary crises such as pandemics and natural disasters. It emphasizes the use of AI to create robust infrastructures like digital twins, which simulate real-world scenarios for disaster prediction, prevention, and recovery. By integrating AI with real-time data, robotics, and sensors, the strategy aims to enhance Japan's disaster resilience. Moreover, AI platforms are being designed to tackle planetary crises like climate change and biodiversity loss, ensuring sustainability through advanced technologies and innovative applications. Investments in cybersecurity and privacy-preserving AI systems, such as Explainable AI (XAI) and Federated Learning, further bolster resilience against vulnerabilities (AI Strategy 2022, p. 9).

Table 15. Strategies on addressing imminent crises

Area	Goal	Action Plan
National Resilience	Maximize disaster prediction and response capabilities.	Build digital twins for disaster management; digitize infrastructure including the construction of data economic zone.
Planetary Resilience	Address global environmental and sustainability challenges.	Develop AI for energy efficiency, telemedicine, and recycling systems.
Responsible AI	Ensure safe and ethical AI deployment globally.	Strengthen cybersecurity; promote R&D in Federated Learning and XAI.

Source: AI Strategy 2022

Meanwhile, Positioning Japan as the global leader in AI talent by fostering education, attracting international experts, and retaining domestic talent is the goal of Strategic Objective 1: Developing AI Talent (Table 16). Strategic Objective 1 highlights a multifaceted approach to talent development. The government is introducing AI and data science programs at all

educational levels, complemented by scholarships and international partnerships. Reskilling and upskilling initiatives are also being expanded for the existing workforce. Additionally, Japan seeks to attract top-tier global researchers through competitive funding and working conditions. AI literacy campaigns aim to prepare citizens to engage with AI technologies effectively (AI Strategy 2022, p. 20).

Table 16. Strategies for developing AI talent

Area	Goal	Action Plan
Education Reform	Improve AI literacy among citizens.	Introduce AI curricula in schools and universities; focus on creativity and problem-solving skills.
Global Talent	Attract and retain global AI researchers.	Offer incentives and establish collaborative research programs.
Lifelong Learning	Equip workforce with AI skills.	Conduct large-scale training and professional development programs.

Source: AI Strategy 2022

Strategic Objective 2 "Enhancing Industrial Competitiveness" (Table 17) aims to position Japan as a top innovator in applying AI into real world industries. This strategic objective focuses on integrating AI into manufacturing, logistics, and other key sectors to boost productivity and innovation. The strategy promotes public-private partnerships to accelerate research commercialization and incentivizes SMEs to adopt AI technologies. Furthermore, it aligns industrial AI applications with the United Nations' Sustainable Development Goals (SDGs), such as clean energy and sustainable agriculture (AI Strategy 2022, p. 22).

Table 17. Strategies for enhancing industrial competitiveness

Area	Goal	Action Plan
Real-World Applications	Enhance industrial productivity and innovation.	Develop AI systems for manufacturing, logistics, and agriculture.
SME Support	Empower small businesses with AI capabilities.	Establish advisory services and provide funding for digitalization.
Sustainability	Contribute to global SDGs through AI.	Focus on AI for environmental conservation and efficient resource utilization.

Source: AI Strategy 2022

With an overall goal of building an inclusive society where AI enhances accessibility and equity, Japan envisions using AI to address demographic challenges, improve healthcare access, and promote regional development under strategic objective 3: Realizing a Diverse and Inclusive society (Table 18). For example, telemedicine and AI-powered education platforms are being developed to bridge urban-rural divides. AI applications are also tailored to support marginalized groups, such as the elderly and people with disabilities, aligning technological advancements with ethical and inclusive practices (AI Strategy 2022, p. 24).

Table 18. Strategies for realizing a diverse and inclusive society

Area	Goal	Action Plan
Accessibility	Enable inclusive access to services.	Develop AI tools for healthcare, education, and transportation for diverse demographics.
Demographic Challenges	Address aging and rural decline.	Leverage AI for telemedicine, remote education, and smart community planning.
Equitable Benefits	Ensure fair distribution of AI advantages.	Deploy AI for public services and urban-rural integration.

Source: AI Strategy 2022

To Position Japan as a global leader in AI research, education, and ethical development, Strategic objective 4 Strengthening Global Leadership promotes international collaboration through partnerships with regions like ASEAN, Africa, and Europe. Japan seeks to establish itself as a hub for AI innovation by hosting global conferences and contributing to international standards. The strategy also includes developing AI systems that address global challenges, such as climate change and healthcare accessibility, showcasing Japan's technological prowess (AI Strategy 2022, p. 26).

Table 19. Strategies for strengthening global leadership

Area	Goal	Action Plan
International Collaboration	Expand Japan's AI influence globally.	Partner with ASEAN, Africa, and European nations on AI initiatives.
Research Leadership	Create globally competitive AI research centers.	Develop hubs with world-class facilities and interdisciplinary expertise.
Ethical AI Advocacy	Lead global discussions on ethical AI development.	Promote standards through GPAI, OECD, and G20 platforms.

Source: AI Strategy 2022

Japan's AI Strategy 2022 represents a comprehensive and forward-looking framework, addressing both immediate crises and long-term societal transformation. By aligning technological innovation with human-centered principles, Japan seeks to enhance its resilience, industrial competitiveness, and global influence. The strategy underscores the importance of ethical AI deployment and international collaboration in realizing these goals.

5.2.8. Singapore

Background and Rationale for the Strategy

Singapore's National AI Strategy represents a critical step in the country's journey toward establishing itself as a global leader in artificial intelligence (AI). As a small nation with limited natural resources, Singapore has historically relied on technological innovation to sustain economic growth and societal advancement. The emergence of AI offers transformative potential to redefine industries, enhance government efficiency, and improve citizens' quality of life. However, harnessing this potential requires deliberate action to address challenges such

as talent shortages, limited datasets, and the need for robust governance frameworks (Singapore National AI Strategy 2019, p. 12).

The National AI Strategy builds on the foundation laid by Singapore's Smart Nation initiative, emphasizing the integration of AI into key sectors to achieve scalable, impactful outcomes. The strategy prioritizes areas where Singapore has a competitive advantage, aiming to leverage AI to address national challenges, enhance economic competitiveness, and maintain societal trust in the face of rapid technological changes (Singapore National AI Strategy 2019, p. 14).

The overarching vision of Singapore's AI strategy is to position the country as a global hub for developing, deploying, and scaling impactful AI solutions by 2030. This includes ensuring that AI technologies benefit citizens and businesses while fostering public trust in AI's ethical and responsible use. Singapore aims to become a leading nation in AI governance and innovation, underpinned by a highly skilled workforce capable of driving AI advancements (Singapore National AI Strategy 2019, p. 16).

Singapore's National AI Strategy identifies five key projects, each addressing significant national challenges and opportunities. These projects serve as focal points for collaboration among government, industry, and academia, driving innovation and showcasing the transformative potential of AI.

1. Intelligent Freight Planning

This project focuses on optimizing freight movement to improve productivity and reduce traffic congestion. By using AI to pool and dynamically assign trucking jobs, Singapore aims to create an integrated freight ecosystem. This initiative will strengthen supply chain efficiency, enhance asset utilization, and support the development of higher-value jobs in the logistics industry (Singapore National AI Strategy 2019, p. 26).

2. Seamless and Efficient Municipal Services

The goal is to enhance municipal service delivery through AI-powered solutions. Key initiatives include deploying chatbots to streamline issue reporting, using sensors for predictive maintenance, and employing AI analytics for better urban planning. These efforts will reduce response times, improve infrastructure reliability, and foster community engagement (Singapore National AI Strategy 2019 p. 28).

3. Chronic Disease Prediction and Management

AI applications in healthcare will focus on predicting and managing chronic diseases like diabetes and hypertension. Projects include using AI for personalized risk assessment, clinical decision support, and self-management tools for patients. These initiatives aim to improve health outcomes, reduce complications, and alleviate the burden on healthcare systems (Singapore National AI Strategy 2019, p. 30).

4. Personalized Education through Adaptive Learning and Assessment

This project leverages AI to tailor learning experiences for individual students. Using adaptive learning platforms, automated marking systems, and AI-driven learning companions,

Singapore aims to improve educational outcomes and address diverse learning needs. Teachers will benefit from data-driven insights to better support their students (Singapore National AI Strategy 2019, p. 32).

5. Border Clearance Operations

The objective is to enhance border security while providing a seamless immigration experience. AI will enable 100 percent automated immigration clearance, supported by predictive analytics for risk profiling and data-sharing platforms for traveler information. This project will strengthen national security and improve efficiency at border checkpoints (Singapore National AI Strategy, 2019, p. 34).

6. Investments and Budgetary Commitments

Singapore has allocated significant resources to support the implementation of these projects. Under the Research, Innovation, and Enterprise 2020 (RIE2020) Plan, over SGD 500 million has been committed to AI-related research, innovation, and enterprise activities. Additionally, SGD 200 million is being invested to enhance supercomputing infrastructure, enabling the development of AI algorithms and models with higher computational demands (Singapore National AI Strategy 2019, p. 44).

7. Ecosystem Enablers

To support the successful implementation of National AI Projects and sustain long-term AI adoption, Singapore has identified five critical ecosystem enablers.

1. Triple Helix Partnership

This enabler focuses on fostering collaboration among government, industry, and research institutions. Initiatives such as the Singtel-NTU AI Lab and Smart Estates research partnerships exemplify the integration of academic research with industrial applications. The goal is to accelerate the commercialization of AI innovations and strengthen Singapore's position as a leader in applied AI research (Singapore National AI Strategy 2019, p. 42).

2. AI Talent and Education

Recognizing talent as a foundational element, Singapore emphasizes developing a multidisciplinary AI workforce. Programs such as the AI Apprenticeship Program (AIAP), postgraduate scholarships, and TechSkills Accelerator (TeSA) initiatives aim to train professionals in AI-related roles. By 2025, Singapore plans to train 25,000 professionals in AI and introduce AI literacy to 100,000 students and adults (Singapore National AI Strategy 2019, p. 56).

3. Data Architecture

Data is critical for AI development and deployment. Singapore has implemented frameworks for public-private data sharing, such as the Trusted Data Sharing Framework and Government Data Architecture (GDA). These initiatives ensure secure, high-quality datasets are available for AI applications, fostering innovation while safeguarding privacy (Singapore National AI Strategy 2019, p. 60).

4. Progressive and Trusted Environment

Singapore's governance framework aims to balance innovation with ethical considerations. The Model AI Governance Framework and sector-specific codes of conduct provide practical guidelines for deploying AI responsibly. Training and certification programs for AI ethics professionals further reinforce trust in AI technologies (Singapore National AI Strategy 2019, p. 64).

5. International Collaboration

As a global hub, Singapore actively contributes to international AI standards and collaborates on multinational projects. Partnerships with organizations like the OECD and the World Economic Forum ensure that Singapore remains at the forefront of global AI discourse, shaping the development of responsible AI practices (Singapore National AI Strategy 2019, p. 70).

5.2.9. Thailand

Thailand's National AI Strategy and Action Plan (NAIS) was initiated to address the country's lagging adoption and development of AI technologies. By 2021, Thailand ranked 59th globally on the Government AI Readiness Index, reflecting weaknesses in AI infrastructure, manpower, and societal awareness (Ministry of Higher Education, Science, Research and Innovation (MHESI) and Ministry of Digital Economy and Society (MDES), p. 4). Key challenges included a lack of skilled AI professionals, insufficient academic programs, limited business adoption of AI, and an absence of laws and ethical frameworks. Recognizing the transformative potential of AI for its economy and quality of life, Thailand adopted the NAIS, spanning from 2022 to 2027, to overcome these barriers (Thailand National AI Strategy and Action Plan, p. 2).

Thailand's NAIS envisions establishing "an effective ecosystem to promote AI development and application to enhance the economy and quality of life by 2027" (MHESI and MDES, p. 8). This includes boosting human capacity, leveraging AI for economic growth, and addressing social and environmental challenges. The strategy emphasizes the ethical and sustainable deployment of AI to ensure inclusivity and long-term societal benefits.

Five major strategies (Table 20) have been outlined in the NAIS to achieve its vision, focusing on foundational readiness, infrastructure development, human capacity building, innovation, and widespread AI adoption.

The second strategy aims to integrate ethical principles into AI deployment and establish public trust in AI technologies through education and transparent governance (Thailand National AI Strategy and Action Plan, p. 9). By investing in critical digital infrastructure, the strategy supports advanced analytics, real-time data processing, and broader AI application across industries (MHESI and MDES, p. 11). Strategy 3 focuses on reskilling and upskilling initiatives to address the current shortage of AI professionals and empower workers with future-ready skills (Thailand National AI Strategy and Action Plan, p. 12). Strategy 4 emphasizes the importance of translating research outputs into practical, high-impact applications (MHESI and MDES, p. 13) while Strategy 5 is about promoting the use of AI in public and private sectors with the overall goal of boosting productivity and competitiveness.

Table 20. Five major strategies of Thailand

Strategy (Goal)	Key Indicators	Action Plans
Strategy 1: Preparing Thailand's Readiness in Social, Ethics, Law, and Regulation Goal: Foster a supportive environment for AI through legal, ethical, and social frameworks.	Awareness among 600,000 Thais on AI law and ethics by 2027 Implementation of an AI law and regulatory framework	Develop AI ethics policies and standards; promote public awareness campaigns on AI-related social implications. Create legislation for AI governance, including guidelines for ethical usage and AI accountability systems.
Strategy 2: Developing National Infrastructure for Sustainable AI Development Goal: Strengthen Thailand's digital infrastructure to support scalable AI development.	Rank among the top 50 globally on AI readiness Increase digital infrastructure investment by 10 percent annually	Establish AI expert networks, develop national platforms for data analytics and AI services, and expand HPC capabilities. Build platforms such as the GDCC AI Marketplace and High-Performance Computing services.
Strategy 3: Increasing Human Capability and Improving AI Education Goal: Develop a workforce proficient in AI technologies and applications.	Train 30,000 AI professionals by 2027 Incorporate AI literacy into all educational levels	Launch AI-focused educational programs, scholarship initiatives, and global collaboration for knowledge sharing. Create AI-specific curricula from primary schools to universities; engage international experts in training.
Strategy 4: Driving AI Technology and Innovation Development Goal: Strengthen R&D efforts to position Thailand as a regional hub for AI innovation.	Develop 100 R&D prototypes and generate 48 billion THB in economic impact Wide adoption of AI innovations in critical sectors	Apply AI to strategic sectors like healthcare, agriculture, and transportation; develop core AI platforms. Facilitate partnerships between academia and industries to accelerate research commercialization.
Strategy 5: Promoting the Use of AI in Public and Private Sectors Goal: Integrate AI into government and business operations to boost productivity and competitiveness.	Adoption of AI by 600 government and private agencies Increase AI market value by 60 billion THB	Encourage AI startups and develop business sandboxes for experimentation and innovation. Promote AI applications in tourism, finance, and public surveillance sectors.

Source: Thailand National AI Strategy and Action Plan

Strategy 5 facilitates AI penetration across industries while fostering an ecosystem of innovation and entrepreneurship (MHESI and MDES, p. 14).

Since the formulation of Thailand's NAIS, significant progress has been achieved. In terms of Ethics and governance, the AI Ethics Guidelines has been released ensuring responsible AI use in various sectors. (Thailand National AI Strategy and Action Plan, p. 33). Meanwhile, High-performance computing facilities and data-sharing platforms for AI development have been put in place. For example, the GDCC AI Marketplace is now operational, facilitating advanced analytics and research (Thailand National AI Strategy and Action Plan, p. 34). Educational initiatives have also been launched since 2022, including AI-focused scholarships and partnerships with international researchers (MHESI and MDES ng, p. 15). Medical AI and digital farming prototypes have demonstrated significant progress in strategic sectors (Thailand National AI Strategy and Action Plan, p. 35). AI Adoption has also seen remarkable progress as more than 100 government and private agencies have integrated AI solutions, with flagship projects targeting tourism, finance, and public safety (Thailand National AI Strategy and Action Plan, p. 34).

5.2.10. Vietnam

Recognizing AI as a fundamental technology of the Fourth Industrial Revolution that can create breakthroughs in production capacity and enhance national competitiveness (Prime Minister of Vietnam 2021), Vietnam aims to establish itself as a significant AI player by positioning "among the top 5 countries in the ASEAN and top 60 leading countries in research, development and application of AI" (Prime Minister of Vietnam 2021). The strategy sets specific institutional goals including establishing five renowned regional brands, developing one national center for big data storage and high-performance computing, and creating two national innovation centers for AI. A key focus is upgrading and forming 10 new key research and training institutions on AI. The strategy also emphasizes improving public administration efficiency, particularly in major cities like Hanoi, Ho Chi Minh City, and Da Nang.

For 2030, Vietnam's goals reflect more ambitious aspirations, aiming to position Vietnam among the world's top 50 in AI development (Prime Minister of Vietnam 2021). The strategy envisions the establishment of 10 renowned AI centers in the regions of Vietnam and developing three national centers for big data storage and high-performance computing. Another goal is the development of 50 open and linked data sets across various economic sectors. The strategy aims to establish three national innovation centers for AI and have at least one institution ranked among ASEAN's top 20 AI research and training institutions. These goals are coupled with plans to universalize basic AI application skills among workers to boost labor productivity and improve living standards.

To achieve these goals, Vietnam's AI strategy document identified 5 main strategic directions:

1. Building a system of legal documents and regulations related to AI

Because of the need for a comprehensive legal framework to support AI development, Vietnams' first strategic direction focuses on "formulating and completing policies and laws to create an open legal corridor" (Prime Minister of Vietnam 2021). The strategy prioritizes

developing regulations that balance innovation with protection against potential risks. Key programs include developing intellectual property rights frameworks related to AI, establishing privacy protection guidelines, and creating regulations on legal responsibilities for AI-related activities. The Ministry of Justice and Ministry of Science and Technology are tasked with developing these frameworks, with specific attention to avoiding interference with organizations and individuals while promoting innovation.

2. Building data and computing infrastructure for the research, development and application of AI

Vietnam's second strategic direction emphasizes "promoting data sharing for AI research, development and application, establishing shared, open databases" (Prime Minister of Vietnam 2021). Major projects include establishing three national centers for data storage and high-performance computing by 2030, developing cloud computing capabilities, and creating a national data-sharing framework. The infrastructure development involves multiple agencies, with the Ministry of Defense, Ministry of Public Security, and Vietnam Academy of Science and Technology each tasked with establishing national-level centers. The strategy emphasizes developing "a data-sharing mechanism on the principle of mutual benefits" while ensuring protection against data leakage and breaches.

3. Developing the AI ecosystem

The AI ecosystem development strategy encompasses human resource development, organizational construction, research and development deployment, and promotion of incubation centers. Key projects under this main strategic direction include developing high-quality AI human resources until 2030, establishing innovation centers, and creating research institutions. As the strategy aims to "deploy basic skills in AI application and data science (DS) to promote innovation for young people" (Prime Minister of Vietnam 2021), specific programs include establishing training centers which will implement short-term and medium-term training courses for AI and developing research capabilities at leading universities. The Ministry of Education and Training leads these efforts, with support from various agencies to create a comprehensive AI talent pipeline.

4. Promoting the application of AI

Promoting the application of AI focuses on the practical implementation and widespread adoption of AI technologies across various sectors. The strategy emphasizes "increasing the number of businesses implementing, developing and applying AI to meet domestic demands" (Prime Minister of Vietnam 2021). Key programs include supporting AI enterprises through the National Digitalization Program, promoting AI applications in national defense and security, and implementing AI solutions in public administration. Each ministry is assigned specific AI application projects within their sectors, such as agriculture, manufacturing, healthcare, transportation and banking. The strategy also emphasizes raising awareness about AI among officials, civil servants, businesses, and the public through targeted training and education programs which is related to strategic direction 3.

5. Promote international cooperation in AI

The international cooperation strategy focuses on connecting Vietnam's AI ecosystem with global networks by "organizing and implementing bilateral and multilateral scientific research cooperation programs and projects on AI" (Prime Minister of Vietnam 2021). Key initiatives under this strategic direction include establishment of international research partnerships, promoting technology transfer, and attracting foreign direct investment in AI development. The strategy emphasizes exchanging experts and researchers with foreign organizations, joining international AI associations, and encouraging multinational corporations to establish AI research centers in Vietnam. Special attention is given to attracting overseas Vietnamese experts to participate in domestic AI development efforts.

Based on the AI strategy of Vietnam, government agencies are required to implement specific programs identified in the strategy within their assigned functions (Table 21). The key implementer of the AI strategy is the Ministry of Science and Technology, to which all agencies are required to report annually. The strategy also recognizes most of the programs would involve multiple agencies, so it encourages the coordination among agencies on overlapping responsibilities. Finally, existing programs are expected to incorporate AI initiatives as part of the implementation of this strategy.

Table 21. Role of Vietnam's government agencies on AI development

Government Agency	Key Roles and Responsibilities
Ministry of Science and Technology	• Lead agency for strategy implementation • Develop legal documents on AI-related intellectual property rights • Expand community data projects • Implement public-private cooperation for AI training centers • Coordinate basic AI research and national key research programs • Organize AI events and international cooperation • Report to Prime Minister on strategy implementation
Ministry of Information and Communications	• Develop legal documents on electronic transactions and data sharing • Establish standards and technical regulations for AI • Set up data and computing infrastructure • Implement National Data Strategy • Establish short-term training organizations
Ministry of Defense	• Construct national-level center for big data storage • Develop AI applications in military and defense • Focus on "intelligentization" and modernization of equipment and weapons
Ministry of Public Security	• Develop legal documents on privacy protection and security • Establish national-level data center • Deploy AI in national security systems

Table 21 (continued)

Government Agency	Key Roles and Responsibilities
Ministry of Education and Training	• Deploy STEAM and AI training programs • Implement formal AI education programs • Promote AI applications in education sector
Ministry of Planning and Investment	• Develop mechanisms for innovation centers • Improve policies to attract FDI in AI • Support AI startups
Ministry of Finance	• Balance and allocate funds for strategy implementation • Promote AI in financial sector
Ministry of Industry and Trade	• Standardize and share industrial sector data • Promote AI in industrial production • Develop AI in e-commerce
Ministry of Agriculture and Rural Development	• Share agricultural data sets • Promote AI in agricultural production
Ministry of Transport	• Promote AI in transportation and logistics • Develop smart traffic management systems
Ministry of Culture, Sports and Tourism	• Promote AI in culture and tourism • Develop digital culture industry
Ministry of Labor - Invalids and Social Affairs	• Deploy AI training consultation for career changes
State Bank of Vietnam	• Promote AI applications in banking sector
Ministry of Natural Resources and Environment	• Apply AI in environmental monitoring
Ministry of Health	• Develop climate change response systems • Share health data sets • Promote AI in healthcare and medical care
Ministry of Justice	• Develop regulations on AI-related legal responsibilities
Vietnam Academy of Science and Technology	• Establish national center for big data storage • Support high-performance computing

Source: Prime Minister of Vietnam (2021)

6. Conclusion and Policy Recommendations

Regarding the current state of ICT and AI environment for businesses and industries, this study finds that while many businesses have embraced digital transformation, with a significant proportion (90.8%) of establishments owning computers and communication equipment, and 81 percent having internet access, the adoption of advanced digital activities remains limited. For instance, only 31.2 percent of businesses engage in e-commerce, and just 21.7 percent maintain websites. In addition, ICT adoption is notably higher in core ICT industries such as

ICT-enabled services but non-core industries, including agriculture and food manufacturing services, show lower utilization of digital tools. As ICT adoption plays a foundational role in enabling AI integration across sectors, the uneven adoption across industries of ICT would imply a similar pattern would be the case for AI.

AI-specific adoption in the Philippines is still in its early stages. Awareness of Fourth Industrial Revolution (FIRe) technologies, including AI, is low, with only one in five firms demonstrating familiarity. As of 2021, 14.9 percent of businesses reported using AI technologies, making AI the fourth most adopted FIRe technology after the Internet of Things (IoT), 5G, and automation. AI adoption is concentrated in urban areas such as the National Capital Region and CALABARZON, where infrastructure and business activity are more advanced. Larger firms and industries like ICT and BPO show the highest adoption rates, whereas smaller firms and less urbanized regions lag. The overall adoption rate of AI across industries was 3.02 percent in 2021, with sectors like ICT and BPO leading at rates of 5.94 and 7.19 percent, respectively, while agriculture trailed significantly at 1.55 percent.

The Philippine government has implemented various strategies to foster AI adoption and innovation. The Department of Trade and Industry (DTI) launched the National AI Strategy Roadmap in 2021, focusing on digitalization, workforce development, regulation, and research. An updated version of the roadmap was introduced in 2024, along with the establishment of the Center for AI Research (CAIR) to support research and innovation. The Department of Science and Technology (DOST) has also outlined plans to advance AI applications in sectors like health, education, and disaster management. Additionally, the Philippine Development Plan (PDP) 2023-2028 integrates AI development into its strategies, emphasizing the importance of Industry 4.0 technologies in boosting economic growth and competitiveness.
Despite these policy efforts, significant barriers remain, particularly for micro, small, and medium enterprises (MSMEs). Many businesses, especially in rural and less developed regions, lack the infrastructure and resources to adopt AI technologies effectively. The government has recognized this gap and introduced programs to support MSMEs, such as providing digital tools, training, and incentives to reduce the digital divide.

Overall, while the Philippines has made strides in promoting AI integration, adoption rates vary widely across industries, regions, and firm sizes. Core ICT industries and urbanized areas lead in digital and AI adoption, while non-core sectors and smaller enterprises face challenges. Strategic government initiatives aim to close these gaps, fostering a more inclusive and competitive AI environment for businesses nationwide.

Several significant barriers impede AI adoption among Philippine businesses. A basic yet critical challenge is the limited digital infrastructure and technology adoption across the country. The small percentage of businesses engaged in advanced digital practices like e-commerce or maintaining websites is an indication of infrastructure access and know-how barriers existing within the firm. In addition, the presence of this digital divide is particularly pronounced in non-core ICT industries and less urbanized regions, creating an uneven foundation for AI adoption.

The overall awareness of AI and other Fourth Industrial Revolution technologies remains notably low among Philippine firms, with only about one in five firms being cognizant of these technologies, and merely 14.9 percent actually utilizing AI and machine learning. This limited awareness and adoption are particularly evident in regions outside major business centers, with areas like BARMM, Region IVB (MIMAROPA), and Region XI (Davao Region) showing significantly lower AI adoption rates compared to urban areas like the National Capital Region.

The country faces substantial challenges in human capital development, as evidenced by its low score of 31.42 in the Human Capital dimension of the Oxford AI Readiness Index. Particularly concerning are the low scores in ICT skills (5.08) and quality of engineering and technology higher education (0.00), suggesting a significant skills gap in the workforce needed to implement and manage AI technologies. This human capital challenge is further reflected in the basic digital literacy of workers, with only 40 percent of employees routinely using computers at work and just 38.1 percent having internet access.

Limited funding opportunities present another significant barrier to AI adoption, with the country scoring only 6.00 in Venture Capital Availability according to the Asia Pacific AI Readiness Index. This lack of access to financial resources makes it difficult for businesses to secure the necessary capital for AI investments and related digital transformation initiatives. MSMEs, in particular, face this challenge more as they lag behind larger enterprises in AI adoption rates. While large enterprises show an adoption rate of 5.29 percent, smaller businesses struggle to implement AI solutions despite showing interest, as evidenced by the lower adoption rates among micro and small enterprises. The discussion has also shown that large businesses across various industries have already began implementing and adopting AI solutions in their business operations. The businesses in general have reported benefitting from the AI and machine learning applications through reductions in cost and increased efficiency in business operations.

These barriers are further compounded by regional disparities in digital infrastructure and business activity, creating a cycle where less developed regions fall further behind in technological adoption, potentially widening the existing digital divide across the country.

Regarding the role of government, this paper looks at the role of government from the theoretical perspective (based on literature review) and practical (based on review of policy documents). Based on the literature review, government intervention in AI development and utilization may be through three interconnected domains each supported by distinct theoretical perspectives. The first domain is related to Market Facilitation. This is based on both classical and neoclassical perspectives, particularly Clark's targeted approach to monopoly regulation. Clark's emphasis on addressing specific anticompetitive practices rather than broad market intervention providing theoretical support for modern digital competition regulations. Schumpeter's recognition of the innovation benefits of large firms while suggesting the need to maintain competitive pressure, creating a balanced approach to market oversight in the AI

sector also supports the need for government to ensure an open market for AI development and utilization.

The second domain, Capability Building, is theoretically anchored in several traditions. Marshall's emphasis on public education's role in fostering "industrial genius" provides historical support for government investment in human capital. This is reinforced by Arrow's "learning by doing" concept and the augmented Solow model of Mankiw, Romer, and Weil, which highlight how human capital development drives long-term growth. The infrastructure aspect of capability building finds theoretical support in Romer's endogenous growth theory, which emphasizes how non-rival inputs like digital infrastructure can generate increasing returns to scale. The use of public-private partnerships for infrastructure development, as discussed in modern perspectives, offers a practical mechanism for implementing these theoretical insights.

The third domain, Ecosystem Coordination, is primarily grounded in the Innovation Systems approach, particularly the Triple Helix model of Etzkowitz and Leydesdorff. This theoretical framework justifies the government's role as an active coordinator of academe-industry-government collaboration. This coordinating role is further supported by Romer's emphasis on knowledge sharing and idea generation as drivers of growth. The international dimension of coordination finds support in modern IRC literature, while the balance between knowledge sharing and protection is informed by the ongoing theoretical debate around IPR protection in developing countries, as discussed by Forero-Pineda and Maskus.

These three domains interact in ways predicted by Goldfarb and Trefler's economic principles of AI development. Their emphasis on scale economies, scope economies, and knowledge externalities in AI suggests that government intervention across all three domains must be coordinated to address the unique challenges of AI development. For instance, the concentration of AI expertise in specific regions, as noted by Goldfarb and Trefler, requires coordinated action across capability building (developing local talent), market facilitation (ensuring competitive access to AI resources), and system coordination (fostering knowledge transfer through international collaboration).

Drawing from the diverse country experiences presented, several key roles emerge for governments in promoting AI development and industry adoption. First, governments must act as strategic architects, establishing comprehensive national frameworks that align AI development with broader economic and social goals. South Korea's approach exemplifies this through its vision of "AI for Everyone, AI of Everything," supported by concrete targets like achieving 95 percent AI technology competitiveness and building 2,000 AI-based Smart Factories by 2030. Similarly, Singapore's focused approach on five National AI Projects demonstrates how governments can strategically channel resources into high-impact areas that address specific national challenges.

A second crucial role is infrastructure development and data democratization. South Korea's commitment to open 45,000 sorts of big data from just 1,500 currently shows how governments

can actively expand data accessibility. Japan's emphasis on building digital twins and data economic zones for disaster management illustrates how infrastructure development can be aligned with specific national priorities. Even developing countries can build essential AI infrastructure systematically as exemplified by Thailand's establishment of the GDCC AI Marketplace and High-Performance Computing services.

Human capital development emerges as a third critical role for government. Australia's comprehensive approach through its Next Generation AI Graduates program (USD24.7M) and Digital Skills Cadetship Trial (USD10.7M) shows how governments can develop AI talent through multiple pathways. The case of Singapore also supports this as Singapore's goal to train 25,000 professionals in AI and introduce AI literacy to 100,000 students and adults by 2025 demonstrates the importance of setting specific, measurable targets for workforce development.

Governments must also serve as ecosystem facilitators, fostering collaboration between academia, industry, and research institutions. Germany's establishment of 100 AI professorships with a focus on interdisciplinary research and SME innovation showcases how academic initiatives can be linked to industrial needs. Meanwhile, Indonesia's implementation of initiatives like KORIKA (Collaboration to accelerate Indonesian Artificial Intelligence innovation) demonstrates how developing countries can foster ecosystem development through targeted collaborations (Desouza and Picavet 2024).

The role of ethical guardian and regulatory architect is increasingly important. Japan's emphasis on human-centered AI principles and establishment of comprehensive ethical frameworks shows how governments can balance innovation (AI adoption) with responsible development. Vietnam's systematic approach to developing legal frameworks for AI, involving multiple ministries in creating comprehensive regulations, demonstrates how developing countries can build robust governance structures.

Finally, governments must act as international collaborators and standard-setters. South Korea's participation in international frameworks and co-hosting of global summits shows how countries can actively shape global AI governance. Thailand's focus on international partnerships for knowledge sharing and Singapore's active contribution to international AI standards demonstrate how countries can leverage global collaboration for domestic development.

These roles should be implemented through coordinated action across government agencies, as demonstrated by Vietnam's comprehensive assignment of responsibilities across ministries. The experiences of these countries suggest that success requires not only substantial financial commitments but also clear institutional frameworks for implementation, regular strategy updates, and mechanisms for measuring and evaluating progress against specific targets.

Based on these findings, the following policy recommendations are put forward:

Research and Infrastructure Development

Arrow's seminal work on the government's role in funding basic research and invention provides a foundational framework for the Philippines' approach to research and infrastructure development, particularly where private incentives may be insufficient. The strategy could be enhanced by incorporating Romer's insights on the non-rival nature of ideas and knowledge spillovers, particularly in expanding digital infrastructure. While the Philippines plans to build AI data centers with High Performance Computing in selected HEIs, the strategy could be expanded to include specific targets for opening public datasets, similar to South Korea's goal of making 45,000 datasets available. The government must prioritize the expansion of broadband connectivity across the country, particularly in underserved areas (ITU 2022), while investing in data centers and cloud computing facilities to support growing data needs. Furthermore, following Singapore's approach, an independent data governance body should be established to oversee data sharing policies and privacy protection, with enhanced cybersecurity infrastructure to protect sensitive data and AI systems (DICT 2023).

Human Capital Development

The human capital strategy reflects Marshall's views on the importance of public education in fostering "industrial genius" and could be strengthened by incorporating modern innovation systems thinking. Following Australia's comprehensive approach, the current target of supporting 100 students for advanced AI studies could be expanded through their Next Generation AI Graduates program model. The Department of Education and Commission on Higher Education should collaborate with industry partners to ensure educational programs align with AI-driven job market demands (UNESCO 2021). Additionally, taking inspiration from Japan's AI Strategy 2022, the Philippines should establish clearer metrics for measuring AI talent development outcomes and create structured pathways for industry-academia collaboration. This should include continuous professional development programs and reskilling initiatives to help the existing workforce adapt to technological changes (ILO 2022).

Regulatory Framework and Governance

Clark's principles on targeted intervention in cases of market failure while avoiding excessive regulation provide a guiding framework for the Philippines' AI governance structure. Drawing from Germany's approach (i.e. the implementation of an AI observatory that monitors developments and provide policy recommendations), the Philippines should establish clear separation between regulatory and implementation functions. This connects with Schumpeter's insights on maintaining competitive pressure while allowing for sufficient scale in innovation. The government needs to establish clear guidelines on AI ethics, data privacy, and algorithmic transparency (UNESCO 2022), with regulations flexible enough to accommodate rapid technological changes while ensuring public safety and trust.

Public-Private Partnership and Industry Development

The strategy could be strengthened by incorporating elements of Singapore's successful public-private partnership approach, aligning with the Triple Helix model of government-industry-

academia collaboration. Rather than direct government provision of AI services, focus should be on creating frameworks that enable private sector innovation while ensuring public benefit. This includes establishing sector-specific AI adoption targets similar to Thailand's approach. Supporting industry clusters and innovation hubs can create synergies and knowledge spillovers, while encouraging large corporations to mentor AI startups can drive innovation (DTI 2023). The government should also facilitate international collaborations to tap into global AI expertise and markets (ASEAN 2023).

Ethical Framework and Implementation

The ethical framework should address Arrow's identified information asymmetries and externalities in technological development. Taking inspiration from Vietnam's comprehensive approach, the Philippines should develop detailed frameworks for responsible AI development (Prime Minister of Vietnam, 2021), overseen by an independent ethics council. Implementation mechanisms should incorporate insights from the National Systems of Innovation framework, emphasizing institutional interactions in shaping innovation outcomes. The strategy should establish transparent mechanisms for resource allocation, clear success metrics, and independent evaluation frameworks, supported by strong feedback mechanisms from industry and civil society. International cooperation in AI governance remains crucial to ensure interoperability and address cross-border issues (UN 2023).

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