ABAC
APEC Business Advisory Council

ARTIFICIAL INTELLIGENCE IN APEC:

Progress, Preparedness, and Priorities

Contents

Click on header to go to section

Foreword

Artificial Intelligence (AI) promises to revolutionize the global economy through exponential productivity gains; improved decision-making; unlocked insights and innovation; as well as newly expanded markets and revenue streams. Building on the 2020 *AI in APEC* report, *Artificial Intelligence In APEC: Progress, Preparedness and Priorities* is a critical contextual analysis of the APEC region's readiness to capitalize on AI. Through an analytical framework that examines policy and regulatory frameworks, private sector endeavours, ethical considerations, and cross-border linkages this report provides a roadmap to move the region to AI prowess.

Recognizing the importance of AI to businesses and to continued economic growth and integration across the region, the APEC Business Advisory Council (ABAC) sought to identify the critical features of an enabling environment that would facilitate the development, deployment, and adoption of AI. To achieve this, ABAC engaged AI business leaders and

experts from each economy in addition to conducting comparative research to better understand the current state of play and preconditions to success.

Artificial Intelligence In APEC: Progress, Preparedness and Priorities employs a regional lens and identifies a readiness gap that must be closed if the region is to take advantage of AI innovations. This report also identifies current strengths which must be catalyzed across the region's "capacity clusters" through a coordinated approach of best practice exchange. In addition, it also reveals competitive advantages within the region that, if combined with the emergence of leading AI ecosystems, would bolster APEC as an economic powerhouse.

To move the region to AI prowess, this report highlights key opportunities and policy actions for APEC Economic Leaders that would enable APEC to capitalize on the forthcoming AI revolution. These include creating enabling regional AI ecosystems, leveraging the role of diverse APEC AI leaders, and building trust by ensuring data privacy and security.

Our COVID-19 recovery and resilience toolkit must include the establishment of enabling environments for AI. APEC must be prepared to capitalize on the AI revolution. This report provides a roadmap to get us there.

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ABAC Chair, 2021

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ABAC
APEC Business Advisory Council

About ABAC

The APEC Business Advisory Council (ABAC) was created by the APEC Economic Leaders in November 1995 to provide advice on the implementation of the Osaka Action Agenda and on other specific business sector priorities, and to respond when the various APEC fora request information about business-related issues or to provide the business perspective on specific areas of cooperation.

ABAC comprises of up to three members of the private sector from each economy. ABAC members are appointed by their respective Leaders, and represent a range of business sectors, including small and medium enterprises. The economy determines the term of membership of each appointee as well as its own administrative arrangements and staff support.

The ABAC International Secretariat based in Manila, the Philippines, serves all members and all economies and maintains a website. Funding is provided through a system of annual dues, which are structured to reflect the size of each economy, following the APEC formula.

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Click to go to section

Introduction

There is a lot of excitement surrounding artificial intelligence (AI). The advances in computing power and capacity, combined with an abundance of data, have resulted in the emergence of machines that can perform "human-like" cognitive processes through algorithms, production processes, and end-user products and services.[1] This has accelerated the adoption of AI in different fields, business functions, and products. AI offers vastly improved efficiency and decision-making, enabling businesses to be agile and scale rapidly. Moreover, it can provide a business (and economy) with a competitive advantage as it unveils new insights that lead to the creation of new products, services, markets, or even industries, unlocking new revenue streams through increased consumer demand. Indeed, AI holds significant promise globally, potentially delivering additional economic output of US$16T by 2030 and boosting global GDP by 14%.[2] The resulting economic impacts will manifest themselves in three main ways: improved labour productivity through innovation and efficiency gains, intelligent automation resulting in a virtual workforce, and increased diffusion of technology across sectors. This could profoundly affect how markets are structured and regulated, laws are adjudicated, and capital allocated.

With the potential to transform entire industries, supply chains, and markets, AI presents a paradigm-shifting opportunity for APEC as a regional economic forum. Such a transformation, if cultivated well, could increase jobs, trade, economic development, and participation in the economy. At the same time, the risks associated with AI could be just as significant, ranging from ethical considerations (trust, privacy, discrimination, etc.) to a lack of preparation required to take advantage of the coming revolution. Recognizing the paradigm-shifting phenomenon that AI signifies for all economies, governments around the world have begun introducing national strategies, and businesses are seeking adoption opportunities to become more competitive in AI.

The APEC Business Advisory Council (ABAC) continues to raise the profile of AI on APEC's agenda, supporting APEC's responsiveness to new developments and challenges that will impact the region's economic and trade environments. ABAC's 2020 Artificial Intelligence in APEC report highlighted the diverse ways AI technologies were implemented across member economies and their potential to spur economic growth. That report demonstrated examples of near-term policy measures APEC economies could implement to harness the benefits of AI. The report also raised awareness about existing AI-driven solutions to some of the region's more complex long-term challenges, which APEC members could consider for expansion and replication at national and regional levels. In addition, and more importantly, it emphasized

the need for APEC economies to have a common appreciation and shared knowledge of the added value and systemic transformation AI adoption could have for the region.

In its recommendations, the ABAC report proposed that APEC economies accelerate development in two fundamental areas to support widespread AI adoption. First, it recommended strengthening business environments that would encourage and distribute the costs of investment in AI technologies across government and private sector. Second, it suggested preparing and equipping the workforce with skills and knowledge necessary to capitalize on wider adoption of AI across the economy. The report proposed that such transformation should be driven by the public sector, guided by expertise from academia and industry, and sustained by the private sector.

The Readiness Gap

Building on the ABAC 2020 study, this report evaluates each APEC economy on its strengths, weaknesses, and opportunities as they relate to AI. In particular, it focuses on readiness to deploy AI across the region, assessing the policy, regulatory, and investment landscapes for their ability to encourage the development and deployment of AI.

In 2021, the European Union (EU) proposed the world's first comprehensive draft regulation for AI, which defined AI and AI readiness.[3] This report relies on the EU's definition of AI and builds on its definition of AI readiness.

What is AI?

The EU's draft regulation defines an AI system as "software that is developed with machine learning, logic-and-knowledge-based models, and/or statistical models that can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with."[4]

Through these approaches, AI systems decrease the costs of operation and maximize efficiency. However, all AI systems are currently "narrow." That is, their capability is limited to specific and predetermined tasks, as opposed to being "general," which would entail functioning like a human being. Put differently, a human will not beat AlphaGo in the game of Go, for which it was designed, but AlphaGo will not be able to do other things (e.g., play checkers or chess).

What is AI Readiness?

AI readiness refers to the economic, policy, and social environments that support the adoption and deployment of AI applications throughout multiple sectors and industries in an economy. In this context, becoming AI ready or AI competitive does not merely mean having AI technologies adopted and deployed within the economy or possessing *the best* AI technologies. Rather, it is the planning for, investment in, and co-ordination of the *enabling environment* for AI adoption.

Critically, the process by which an economy becomes ready for the deployment of AI must also address potential risks, thereby safeguarding the benefits of AI. These risks can include ethical considerations related to trust, data privacy, and the potential for discrimination as

well as any potential short-term adverse impacts of AI. The process should be collaborative and inclusive, bringing together government, industry, academia, and civil society.

HOW READY IS APEC TO CAPITALIZE ON AI?

In short, APEC is not optimally prepared to take advantage of AI. Member economies possess varying levels of familiarity, governance, and adoption of AI. While there are leaders and followers when it comes to AI capacity and readiness, our research reveals a spectrum where economies tend to cluster based on their shared challenges and capacities. Indeed, most APEC member economies are not fully prepared to develop and deploy AI, and every economy can improve its ability to capitalize on AI-related opportunities. At the same time, it is important to note that no two economies will have the same challenges or solutions when it comes to AI readiness and adoption. However, given the range of capabilities within APEC, there are great opportunities for sharing best practices among economies to accelerate readiness.

The global race for AI is on and competition is strong. Considering the opportunities that AI presents for each economy and for regional trade and development, if the status quo continues and member economies remain unprepared to take advantage of AI, these opportunities will be lost, and APEC will be left behind. This presents a grave situation that could lead to increased inequality within and between economies, reinforcing the digital divide for countries, businesses, and workers.[5] Moreover, fractured AI capabilities could mean decreased trade, economic integration, and immeasurable costs to catch up. This would undoubtedly put APEC on a back foot and at a global competitive disadvantage.

Purpose of This Report

While this study does not assign a "rank" or "score" of AI readiness or competitiveness to individual economies, it aims to complement those types of efforts by providing more qualitative, in-depth analyses that build AI profiles for each economy. The comparative analysis not only provides an environmental scan, but it also highlights opportunities for action in specific areas that would increase readiness for AI adoption.

As such, this report goes beyond considering more traditional indicators of AI readiness, such as government investment in R&D or the number of STEM students in an economy. Our research and analysis also examine the economic, policy, and social environments that may support or deter the widespread adoption of AI among APEC members. It strives to identify *niche* areas where AI adoption has the potential to make the most impact as a competitive advantage.

Roadmap to Readiness: From Preparation to Prowess

There are four critical areas for the establishment and development of ecosystems conducive to AI's innovation, adoption, and commercialization. AI development and adoption require the mobilization of resources across multiple stakeholders including government, industry, civil society, and academia. Therefore, the analytical framework underpinning the assessment of AI readiness across the region examines **government policies, private sector activities, society**, and **international linkages**, which are described below in more detail. Achieving a high degree of advancement in each of these areas contributes to each economy's readiness, whereas a high degree of advancement in all demonstrates AI leadership.

- **Government policies:** This section investigates the different policy and regulatory environments/structures within APEC economies that support their AI ecosystems. This could be existing AI national strategies, data regulation, digital government initiatives, AI talent development schemes, research and development subsidies, or other incentives. It could also include startup incubation and acceleration programs;

- **Private sector activities:** This factor examines the AI business landscape in APEC economies, highlighting key companies making important progress in AI across multiple industries. For each profile, this section also highlights sectors or industries with mature adoption or that show promise for AI application;

- **Society:** This delves into educational efforts supporting talent development for AI within business and industry-specific civil society organizations. It also looks at AI technologies already in widespread use in society. This section also covers ethical issues that have arisen in a particular economy and their impact on regulation, businesses, and consumers; and

- **International linkages:** This section investigates existing co-operation and investment ties in education, research, infrastructural development, and business opportunities that foster and advance AI adoption across APEC members.

APEC member economy profiles comparing achievements and opportunities in each of the areas above can be found in the Appendix.[1]

[1] Due to constraints in stakeholder interview access and availability of information, the Russian Federation could not be analyzed in this study.

From the analytical framework above, the research unveiled five distinct capacity clusters. Each cluster shares many characteristics while at the same time possessing the potential, through knowledge exchange, to impact other clusters and increase readiness across the region. These clusters are as follows:

- **AI Global Leaders** are economies that have developed strengths in government policy, private sector investment and activities, talent development, and international linkages. These economies also have significant influence over AI governance globally due to their market size, leadership in AI research and development, and geopolitical power;

- **AI Middle Powers** are economies that have strengths in government policy, private sector investment and activities, and talent development. AI Middle Powers possess capacities on AI that could allow them to play significant roles in AI governance internationally, but they lack the clout of global leaders in terms of academic and business strengths for AI and geopolitical influence;

- **AI Regional Hubs** are economies that have or are developing a combination of strengths in comparison to their neighbours, allowing them to serve as hubs. While they may lag behind AI Middle Powers, relative to their neighbours they are ahead on different aspects pertinent to AI, such as research, governance, or education. Due to their relative strengths, they attract talent (in industry or for education), businesses, jobs, and investment in AI from different economies. Often sharing language or cultural ties with geographic neighbours, they also host key academic or industry networks that exchange AI research, best practices, and products with the potential to impact AI ecosystems in peer economies;

- **Emerging AI Economies** are in the process of building readiness and advancing capabilities in private sector activities and investment, talent development, and international linkages. They have great potential to accelerate AI adoption because they have certain strengths in AI (e.g., large population, strong AI national strategy, high AI adoption in key sectors); and

- **Nascent AI Economies** refer to the economies that are at the early stages of building up their AI ecosystems and thus require significant action and investment in advancing government policy, private sector activities, talent development and education, and international linkages.

Plotting Preparedness: APEC AI Capacity Clusters

As alluded to above, each economy falls on a readiness spectrum from AI Global Leader to Nascent AI Economy. However, no economy is alone, which is encouraging for the region from a capacity building and knowledge transfer perspective. Each capacity cluster has its own strengths and opportunities, and recommendations for improved preparedness can be operationalized according to existing capacities.

AI Global Leaders	AI Middle Powers	AI Regional Hubs	Emerging AI Economies	Nascent AI Economies
• People's Republic of China • United States	• Australia • Canada • Chile • Chinese Taipei • Hong Kong, China • Japan • New Zealand • Republic of Korea	• Malaysia • Mexico • Singapore	• Indonesia • Peru • Philippines • Thailand • Vietnam	• Brunei • Papua New Guinea

Examples of Actions Supporting Preparedness

Several APEC economies have issued various policy programs to further develop their domestic AI ecosystem. Such policies can include a national AI strategy and updates to AI-relevant policies, like changes to data governance regulations or digital government roadmaps that support the foundational infrastructure for AI. Governments have also made or plan on making significant investments to address critical infrastructure needed to support widespread AI adoption, such as expanding internet connectivity within their territory and investing in upskilling or training programs for workers or directly contributing

to academic research through grants. However, there is a lack of co-ordination and cohesive approaches toward AI adoption and governance across APEC economies, as each tries to go at it individually.

The Opportunity for APEC

As an international organization with a focus on economic issues and co-operation, APEC has great potential to be the main venue for co-ordination and information exchange in the region, hence aiding in the forging of a more co-ordinated approach to AI. The organization also has the ability to facilitate high-impact, constructive dialogues on international AI governance, as it has done on related digital policy in the past. For instance, APEC successfully created frameworks such as the Cross-Border Privacy Rules (CBPR) for its members that sought to address the emerging issue of data governance. This effort also promoted good practices on personal data management while reducing barriers to international business.

APEC supports a range of capacity-building projects in its member economies, providing skills training and technological know-how. Based on its cross-border efforts, APEC has a great potential to be a key international body for AI governance worldwide.

Insights and Recommendations

This section provides insights and recommendations based on the results of this research study on how to expand and continuously support the already established experimentation, innovation, and usage of AI in APEC to support readiness. Recommendations also focus on APEC's role as a critical forum for policy co-ordination, knowledge exchange, and cross-border collaboration on AI development and governance.

There are three main recommendations for APEC Economic Leaders: to create an enabling regional AI ecosystem; to leverage the role of diverse regional AI leaders; and to build trustworthy AI for APEC. These are detailed below. More specifics on each economy can be found in the Appendix.

1. Create an Enabling Regional AI Ecosystem

Though relatively nascent in development and application when compared to other late technology advancements, artificial intelligence has the potential to advance commercial and economic opportunities across the region. Prioritizing AI by ensuring preparedness for deployment, a supportive policy and regulatory landscape, and increased opportunities for collaboration will increase uptake and make businesses across the region more competitive, ultimately increasing the efficiency of markets and capital allocation.

AI can expand existing strengths in each industry. Cross-border collaboration between academic institutions and networks as well as business-affiliated research institutions could increase sector- and mission-specific application of AI while potentially expanding markets for novel, innovative applications. This could result in an increase in investments for development, deployment, and adoption of AI technologies. Networks such as the Association of Pacific Rim Universities (APRU) could play an essential role in mobilizing the intellectual resources and capabilities from the region's sectoral R&D leaders to inform, build trust in, and push forward a more harmonized regulatory approach on AI in the APEC region. Moreover, pairing sectoral strengths with AI application could allow for a more inclusive ecosystem, bringing economies together and potentially bridging capacity gaps.

RECOMMENDATIONS

- Create a regional multi-stakeholder forum where policy and business leaders can periodically exchange the latest developments in AI governance and policies to improve regulatory coherence. Leverage existing networks of academic institutions and industry

experts (e.g., the APRU) for sector-specific discussions on AI innovation, regulatory frameworks and standards, and regional collaborative opportunities; and

- Mainstream AI across existing working groups and create venues to address sector- or mission-specific issues on AI for regulatory harmonization.

2. Leverage the Role of Diverse Regional AI Leaders

AI ecosystems in APEC member countries vary widely in their level of maturity, policy support, strength in AI application, and local knowledge. APEC should foster AI hubs as sources not just of innovation and research, but also for diffusion and commercialization of AI technologies throughout the region. This is particularly valuable when considering existing regional networks in industry and academia that increase the region's competitiveness in AI.

RECOMMENDATIONS

- Leverage the role of regional AI leaders as hubs for AI adoption, research, best practice sharing, cross-border collaboration, norm diffusion, and commercialization.

3. Build Trustworthy AI for APEC

The APEC CBPR system is a voluntary mechanism that facilitates cross-border data transfers across participating APEC members for businesses. It reduces compliance and administration costs and provides legal certainty for businesses involved in cross-border data transfers. However, only nine economies and 43 firms have joined since the system was founded in 2011. Considering the breadth of economic activity across the region, this uptake is extremely low and serves as a barrier to trade. Further, the CBPR, unlike the General Data Protection Regulation (GDPR) or more up-to-date privacy legislations around the world, does not address processing of personal data, which may limit its effectiveness regarding the regulation of AI.

RECOMMENDATIONS

- Develop and introduce a data sharing framework that addresses risks related to personal data processing by AI systems (e.g., updates to the CBPR or supporting Digital Economy Partnership Agreement [DEPA]).

Appendix:

APEC AI Economic Profiles

This project relied on qualitative research, literature reviews, and interviews with local stakeholders and experts. A non-scientific survey was also circulated through the ABAC Digital Working Group and considered through the research process. Each case study delves into government policies, private sector initiatives, civil society activity and societal factors, and international linkages relevant to AI to assess readiness and identify niche areas of strength and thereby potential ways of creating synergy between different economies.

AI Global Leaders

AI Global Leaders are economies that have strengths in government policy, private sector investment and AI commercialization activities, talent development, and robust international linkages. These economies also have significant influence over AI governance globally due to their market size, leadership in AI research and development, and geopolitical power.

People's Republic of China

INTRODUCTION

China's AI industry has developed extremely quickly over the past years. It is now regarded as a global AI superpower that is able to strategically compete with the United States in many AI fields. China's AI market size was nearly US$6.3B in 2020,[6] and it took a leading position in global share of AI research publications in the same year.[7] China possesses a well-established digital infrastructure, huge amounts of data, and public and private research capabilities driven by global tech giants such as Alibaba and Tencent, and AI technologies are now seeing a great variety of applications in the country. These include computer vision, facial and speech recognition, machine learning, and logistics.

GOVERNMENT

The Chinese government sees AI as a high-stakes strategic priority, and it invests heavily in promoting world-leading AI capabilities and applications. The most influential policy, the New Generation Artificial Intelligence Development Plan (AIDP), charts China's path toward becoming the world's primary AI innovation centre by 2030.[8] Under the guidance of this foundational policy, the government created a number of agencies, such as the AI Plan Promotion Office, with the aim to implement AIDP. Another critical agency is the National New Generation AI Governance Expert Committee, which is responsible for the ethical governance of AI.

In addition to AIDP, China has issued shorter three-year action plans – focusing on Internet Plus and AI in the 2016-2018 period and next-generation AI industry in the 2018-2020 period – that provide short-term guidance to public and private stakeholders. The Ministry of Industry and Information Technology is also actively involved in the national AI strategy.

In addition to the policy directions provided by China's central government, its provincial and municipal governments also play important roles in implementing and carrying out various AI-related initiatives, such as building industrial parks and collaborating with

local institutions on R&D efforts. Total investment on AI from both the central and local governments is so far estimated to be tens of billions of dollars.[9] Shanghai (Pudong), Shenzhen, Jinan-Qingdao, Beijing, Tianjin, Hangzhou, Guangzhou, and Chengdu are recognized as the eight AI innovation and application pilot zones that lead the country's AI development.

PRIVATE SECTOR

China has a sizable AI industry. A quarter of global AI corporations were located in China in 2020, just below the United States with 38.3%.[10] Most of these companies are based in Beijing, Shenzhen, Shanghai, and Hangzhou.[11] Driven by the recent boom in the industry, Chinese AI companies receive a huge amount of investment annually from investors and are growing to be specialized global leaders in many sub-fields of AI. The country has well over 200 unicorns, with approximately 15 so far specializing in AI. China's startups include internationally known names such as Ubtech Robotics, SenseTime, and drone manufacturer DJI. Moreover, China's "BAT" – Baidu, Alibaba, and Tencent – have made considerable progress with their AI divisions, specifically devoting resources to research and commercialization of AI technologies, such as automated vehicles. AI startups in China are in general well supported by industrial clusters formed around established AI "national champions," where government provides support such as incubator spaces to help their growth.[12]

As such, boundaries can sometimes be blurred between the private and the public in the Chinese AI industry. The incentives for private companies to develop commercial results that fall in China's areas of strategic importance are stronger, and public service and governance platforms – such as transportation, health-care, and policing systems – incorporate AI more than do similar digital tools employed by other economies.[13]

SOCIETY

Beijing's policy approach envisions AI playing a central role in the digitalization of Chinese society, which includes a pool of innovative, high-end AI talents. To cultivate the next generation's leading AI experts, China has been laying the groundwork for a supportive educational and research environment. The country has approved AI-related programs in 150 universities and colleges to date. Moreover, China is a front-runner in extending AI education at the secondary and even primary level. The AIDP sets out the goal of making AI education universal, by adding content on AI and coding to the country's K-12 informational technology curriculum, in which pilot cities and schools have the flexibility to work with various private sector partners in the design of courses.

AI technologies have also been introduced to society through health care, solving efficiency problems in the areas of telemedicine and image processing.[14] Applications of AI have also been recently used to combat the COVID-19 pandemic.[15]

The AIDP explicitly states China's goals to set the norms and standards related to the use of AI and has made some attempts to frame the conversations around AI governance both domestically and internationally. While public debates often emerge around the surveillance and privacy aspects of the use of AI technologies, China's approach to AI ethical standards have thus far been largely focused on the high-level principles. However, Beijing has already launched Governance Principles for the New Generation AI and Ethical Norms for the New Generation AI and is promoting their implementation. Beijing's most recent regulatory moves in the tech space, including the antitrust probes and tightened data/privacy oversight targeting technology giants, are further developments to watch that could have significant implications on the AI industry and its many downstream applications.

INTERNATIONAL LINKAGES

China's international co-operation and exchanges on AI have been strengthened in recent years through joint research institutions and projects, as well as efforts that tackle common challenges in AI governance and technological standards. An important channel through which China is internationalizing its AI technologies is the Digital Silk Road (DSR), part of the Belt and Road Initiative that extends to Southeast Asia, Eastern Europe, the Middle East, Latin America, and Africa. The DSR projects allow China to play a key role in some of its partners' AI capacity-building efforts and to set standards more broadly for the next generation of digital infrastructure.[16]

The United States

INTRODUCTION

The United States has been the world's leader and pioneer in the development of AI since the 1960s. The US federal government invests heavily in facilitating AI innovation, research capability, and the commercialization of these results. Projected government funds to be allocated to AI-related research and development have amounted to US$6B in 2021 so far. The country also takes the world's largest share of private investment in AI.[17] AI market size in the United States remains the largest in the world, estimated to reach US$21.9B in 2021.[18] Known as home to some of the world's most powerful tech giants, America's private sector is known for possessing commanding technological breakthroughs and application capabilities across a broad range of areas of AI. Despite China's recent gains in terms of research activities, the United States has accumulated the largest number of AI-related

research publications over the past two decades and remains the largest and deepest AI talent pool in the world. In addition, the wide adoption of AI technologies in end-industries that demonstrate high levels of digital prowess and awareness also acts as a conducive factor for the AI sector to continue its rapid growth.

GOVERNMENT

AI has been one of the federal government's top priorities. The United States' charting of AI strategies began with the Obama administration. The National AI R&D Strategic Plan, first released in 2016 and revised in 2019, acts as the guiding document that sets the overall direction of and strategic priorities for federally funded research and development in AI.[19] The United States launched the Artificial Intelligence for the American People initiative via an executive order in 2019, outlining five key principles including "increasing AI research investment, unleashing Federal AI computing and data resources, setting AI technical standards, building America's AI workforce, and engaging with international allies."[20] This was followed by the release of the *National Artificial Intelligence Initiative Act of 2020* and the establishment of the National Artificial Intelligence Initiative Office to oversee the implementation of the act. As such, the United States has clear mechanisms for inter-governmental agency co-ordination and collaboration on AI policy-making, in which the Office of Science and Technology Policy, the National Institute of Standards and Technology, and the National Science Foundation (NSF) are playing key parts.[21]

Apart from these policy-making efforts focused on the AI sector itself, the US federal government set up several special bodies, such as the Select Committee on Artificial Intelligence, the AI Center of Excellence, the AI Community of Practice, and several summits on AI to support the use of AI technologies in government agencies as well as their engagement with industry stakeholders. At the state and city level, several governments have introduced bills on the accountable and safe use of AI technologies, to protect people from unauthorized and unethical intrusion of privacy and other rights by various forms of AI applications.

PRIVATE SECTOR

Forefront Players

The United States has the world's largest and most-developed AI industry, with 5,751 privately held AI companies in 2020.[22] It continues to be home to the greatest number – 38.3% – of AI corporations in the world.[23] Among them are several of the most important players in the field, such as Microsoft Azure, Amazon Web Services, IBM Cloud, Nvidia, Salesforce, Google Cloud, and Automation Anywhere. Leveraging the well-established entrepreneurial ecosystems in Silicon Valley and their already massive scale, the United States' tech giants

are investing heavily in developing cloud, artificial intelligence, and machine learning divisions to generate technologies at the world's forefront and undertaking the most startup acquisitions (60 during 2016-2020) in the AI space.[24] The country also has a sizable, vibrant, and well-funded AI startup scene.

Wide Applications

The country sees the use of AI in a wide range of sectors, including health care, environmental protection, transportation, education, scientific research, manufacturing, agriculture, and financial services. The use of AI innovation in the US health-care system can be traced to before the COVID-19 outbreak, with AI-enabled solutions such as natural language processing and robotic process automation employed to enhance diagnosis results and the collection of clinical data.[25] The use of AI tools and techniques in combatting the COVID-19 pandemic has, to an extent, accelerated the slow-moving AI adoption in medicine. AI use has increased in patient screening and monitoring, data analysis, modelling and forecasting, treatment, and vaccine development.[26] Another example of the wide use of AI is in environmental protection. SkyTruth is a non-profit, satellite-based environmental watchdog that uses the Automatic Identification System technology to track ship traffic at sea. It collaborates with Google Earth to identify fracking sites and natural gas flaring in the ocean. Both tech companies have partnered with the ocean protection organization Oceana to develop Global Fishing Watch, a platform for real-time monitoring and deterrence of illegal fishing.[27]

Military AI

For the United States, leveraging AI applications to expand its military and defence power has been an established priority for the technology's development. In 2018, Congress created the National Security Commission on Artificial Intelligence to advance AI and machine learning development for national security and defence needs. This was followed by the creation of the Joint Artificial Intelligence Center, tasked with delivering AI-enabled capabilities for the Department of Defense's key missions by partnering with industrial, academic, and military stakeholders. The main areas of focus include perception, predictive maintenance, humanitarian assistance and disaster relief, and cyber sense-making.[28] The United States currently has a number of military AI combat programs, such as Project Maven, but the actual use of relatively new technologies such as driverless AI-powered systems in combat activities are often debated. Some corporate partners like Google have opted out from participating in the development of warfare technologies.[29]

SOCIETY

The United States possesses tremendous AI research and development capabilities that can only be matched by other AI Global Leaders. The country had produced the largest volume

of AI-related research papers for years, until being overtaken by China in 2019. Nonetheless, AI research publications from the United States still outperform those from other countries in terms of quality, as they were cited about 40% more than average.[30] World-renowned US universities in computer science, such as the California Institute of Technology and Carnegie Mellon University, continue to dominate internationally in the space of AI research projects and degree programs. The country also has no shortage of corporate-led and university-led research centres, while the NSF has most recently announced the addition of 11 National Artificial Intelligence Research Institutes, each with specific areas of research focus, to the first round of seven institutes built throughout 2020.[31]

In terms of public debate and standard-setting efforts in the development and use of AI, an overwhelming majority of the US public supports the responsible use and management of AI and regards it as a high-priority governance issue.[32] The focus of public and political discussions often falls on issues like the development of autonomous AI-driven military systems and the subsequent decision-making process, facial recognition technologies, and AI/machine learning-powered social media monitoring. The US government has played a key role in defining the principles of ethical and responsible use of AI since the Obama administration, developing guidelines and sector-specific principles to address public concerns and make sure downstream applications of AI are not only commercially viable but socially beneficial.

INTERNATIONAL LINKAGES

As the global leader in AI, the United States emphasizes the importance of international collaboration and is actively pioneering such efforts through existing international governance mechanisms. It works extensively with its allies and partners by leading a number of AI-themed initiatives, such as the Global Partnership on AI through the G7 network. Washington also actively participates in the OECD AI Recommendations and the G20 AI Principles.[33] Through engagement, the United States seeks both to advance AI innovation and research and to define rules and norms for trustworthy AI.

The US AI industry, academia, and policy-makers also engage with their counterparts in many bilateral settings, by signing formal agreements such as the US-UK co-operation on AI R&D declaration as well as through company-to-company and school-to-school joint efforts. For instance, US tech giants like Google encourage the widespread application of AI to top global issues through initiatives such as the Google AI Impact Challenge. Members of the Challenge have access to a US$25M pool of funding as well as a six-month Launchpad Accelerator program that provides mentorship, expert workshops, and networking opportunities. One successful Challenge grantee was Indian startup Wadhwani AI, specializing in AI-powered

pest control.[34] In addition, Google provides AI and machine learning resources to be applied in the areas of health care, agriculture, and economic and democracy development to a number of developing countries through non-profits and institutions including the U.S. Agency for International Development.[35]

AI Middle Powers

AI Middle Powers are economies that have strengths in government policy, private sector investment, R&D, and commercialization activities. They also have competitive talent pools and continue to expand them through education and upskilling schemes. AI Middle Powers possess capacities on AI that could allow them to play significant roles in AI governance internationally, but they lack the clout and capacity of global leaders in terms of academic and business strengths for AI, and geopolitical influence internationally.

Australia

INTRODUCTION

Australia has a thriving artificial intelligence scene. With a supportive federal government leading and funding various AI initiatives and with active participation from private actors and research institutions, Australia is well positioned to become a future regional or even global leader in the field, particularly in sub-fields of AI such as deep learning, field robotics, and computer vision.[36] As a key pillar of Australia's US$128B (AU$139B) digital economy,[37] AI technologies are already being used across a wide range of sectors, including retail, finance, mining, agriculture, and health care. This trend has been accelerating since the onset of the COVID-19 pandemic, as demand for AI and machine learning applications to address supply-chain and remote work issues has been on the rise. To better cope with this demand, the Australian government unveiled in June 2021 its first dedicated Artificial Intelligence Action Plan, to set out visions and lay out future plans to accelerate the growth of the country's AI capabilities.

GOVERNMENT

With a total US$90.4M (AU$124.1M) investment, Australia's AI Action Plan will channel government support to four focus areas: (1) developing and adopting AI to transform Australian businesses; (2) creating an environment to grow and attract the world's best AI talent; (3) using cutting-edge AI technologies to solve Australia's national challenges; and (4) making Australia a global leader in responsible and inclusive AI.[38]

One of the major actions under this Action Plan – with nearly US$39.2M devoted to it – will be to establish a National Artificial Intelligence Centre and four different AI and Digital Capability Centres over the next four years. The goal of this initiative is to lay a solid foundation to facilitate R&D and boost the application of AI in a collaborative manner

among government, academia, and private sector stakeholders. By better co-ordinating expertise and capabilities, the centres are expected to facilitate the adoption of cutting-edge AI technologies and tools by businesses, especially small and medium-sized enterprises (SMEs).[39]

Another important element in the Action Plan is the Next Generation AI Graduates program, which will seek to attract and train more than 200 Australian AI specialists and to increase the talent supply in areas with the most pressing technology needs.[40] This program builds on a number of existing education and skills-training programs that the federal government has been funding since 2018.[41]

PRIVATE SECTOR

While local branches of internationally renowned big tech brands such as IBM, Google, and Amazon Web Services are the major players operating in Australia's AI industry, the country is also home to more than 500 AI and machine learning startups. Fast-growing local players such as Hyper Anna and Metigy are building up their profiles regionally and internationally.[42]

Australia's Artificial Intelligence Roadmap, co-developed in 2019 by the Department of Industry, Science, Energy and Resources and CSIRO's Data61, the data science and digital arm of the country's national science agency, identified three areas of specialization that have the greatest potential for Australia's AI application.[43] In natural resources and the environment, AI tools are developed to enhance productivity of mining, agriculture, fisheries, and environmental management. One famous example is the world's first AI-driven production optimization tool developed by Origin Energy that can more efficiently manage gas wells while reducing side effects from emissions.[44]

Another area in which AI solutions are being actively explored is infrastructure and construction management. The AI-powered congestion management system in New South Wales is one of the most-cited examples of how "digital twinning" processes, the creation of virtual replicas of physical regions and systems, can transform ex-ante analysis and predictive models.[45]

With regard to deploying AI technologies to support health, aging, and disability, the applications of AI range from vision processing tools and wearable monitoring devices to AI-based platforms that help improve health outcomes.[46]

SOCIETY

Australia is known for its world-leading capacities in AI research. The country is ranked eighth and fourth globally in terms of AI research and development, respectively.[47] In particular,

peer-reviewed AI publications produced by Australian researchers are among the world's most impactful in citations.[48] Yet, a significant gap exists between cutting-edge research results and their real-life application and commercialization. Early business adopters of AI in Australia, while recognizing the importance of such technological deployment to their companies' success, believe that they have been mainly using AI as a tool for catching up and keeping on par with their competition, rather than establishing a distinctive competitive edge.[49] Some of the more recent programs, including the government-funded Cooperative Research Centres Projects Grants and initiatives under CSIRO Data61 are tasked with improving industry–research collaboration so that partners can work together to deliver tangible outcomes.[50]

However, almost half of these business adopters indicated that the shortage of AI researchers, business leaders, and software developers is leading to a "major to extreme AI skills gap."[51] To tackle the lack of AI skills readiness and help the country meet its demand of 161,000 additional AI specialists by 2030, the Australian federal government is topping up its funding in scholarship programs and working with research institutions and universities to set up new programs to foster AI literacy.[52]

The Australian civil society believes in regulated and carefully managed uses of AI. Despite relatively high levels of acceptance of the use of AI for work and business, the general public remains distrustful and cautious of the deployment of AI and facial recognition technologies.[53] Common concerns include accountability and oversight mechanisms, accuracy and discrimination, and data privacy and governance issues.[54] Meanwhile, the Australian government is taking into account the popular demand for upholding ethical and trustworthy AI through numerous policy and regulatory efforts. These include the Australian Human Rights Commission's Human Rights and Technology Report that examines the human-rights implications of AI technologies[55] and the AI Ethics Framework released in 2019 to guide responsible development and use of AI.[56]

INTERNATIONAL LINKAGES

Australia is striving to be a leader in setting and shaping global standards on AI. The country is one of the founding members of the Global Partnership on Artificial Intelligence, a key multilateral mechanism for collaboration on AI.[57] Trade relations with its neighbouring countries, especially opportunities for exporting digital goods and services, are another important venue for Australia's AI norm-building efforts. In addition to traditional regional partners in Oceania, the country has been working closely with India, Japan, and the United States on the broader issues of cybersecurity and emerging technology, which are highly relevant to AI development.[58] The Quad Tech Network, for instance, is one such Track II initiative created by Australia.[59]

Canada

INTRODUCTION

Canada is at the global forefront of the artificial intelligence and machine learning-powered revolutions currently underway. Propelled by its US$182B (C$230B) information and communications technology (ICT) sector, Canada's AI ecosystem is one of the most comprehensive and well developed in the world. Its unique model, in which government investment, venture capital, corporate sponsorship, and research initiatives come together with entrepreneurs and researchers at the centre, has helped generate nearly US$2.4B in investment since 2010 and double the number of active AI firms since 2015.[60] Canada's vibrant AI development scene is fuelled by its strong and capable AI clusters. For example, the Toronto region is known for having the world's highest concentration of AI startups, and Montreal for the highest concentration of AI and deep learning researchers.[61] These are supported by the Canadian federal government, which, in 2017, launched the world's first national AI strategy, the Pan-Canadian Artificial Intelligence Strategy.

GOVERNMENT

Capacity Building

The Pan-Canadian Artificial Intelligence Strategy is the Canadian federal government's keystone effort to strengthen Canada's global leadership in AI. Developed and led by the Canadian Institute for Advanced Research (CIFAR), the program pledged US$99M (C$125M) in initial funding to help meet the objectives, including attracting outstanding AI researchers and establishing a collaborative ecosystem with several centres of scientific excellence.[62] The strategy was renewed in the 2021 federal budget, with a funding commitment of US$350.7M (C$443.8M), to be spent mainly in areas such as commercialization of AI and talent retention, over the next 10 years.[63]

Innovation Superclusters Initiative

Other key government initiatives that support AI's development in Canada include the Innovation Superclusters Initiative, under which the government supports and co-invests in industry-led consortiums to speed up growth of innovation ecosystems. The Digital Technology Supercluster in BC has allowed several AI-powered applications to be deployed in addressing health, economic, and labour challenges, and it supports the growth of the Canadian AI industry through capacity-building programs.[64] The Scale AI supercluster initiative housed in Quebec channels government investment to promote the integration of AI with a range of industries in their supply chains.

Global Skills Strategy

Another key area of the federal government's efforts seeks to retain AI talent in Canada. Policies such as the Global Skills Strategy's fast track program, post-graduate work permits, and residence and citizenship opportunities are helping companies and research institutions attract highly specialized AI talents to Canada.

PRIVATE SECTOR

Vibrant Startup Scene

Currently ranked sixth globally for commercial AI-focused activities on the Global AI Index, Canada's AI industry has been booming in recent years.[65] With Toronto leading in the number of AI startup clusters, Canada saw over 660 AI startups, attracting US$2.4B in investment over the past decade.[66]

Active R&D Efforts

Canada's private sector also participates actively in the AI ecosystem by investing in corporate research labs and institutes dedicated to AI and machine learning technologies. Royal Bank of Canada's Borealis AI and TD Bank's Layer6 are examples of financial institutions working closely with academia, creating a dedicated business unit to explore the deployment of AI solutions in financial services.[67] Several multinational corporations, including Microsoft, Alphabet, and Nvidia, are behind the 40+ private sector-invested AI research labs across Canada.[68]

Applications in Health Care and Beyond

Canada is also looking to advance AI applications in health care. The AI4Health Task Force was created by CIFAR in 2019 to develop a nationally co-ordinated strategy for applying AI innovations in the health sector, focusing primarily on improving health service delivery, informing disease prevention, and developing diagnostic tools and treatments.[69] Several CIFAR-funded AI research projects are already generating tangible results used to enable public health measures against COVID-19.

Given the country's vast geography, the focus of AI industrial development and applications in different regions could vary. AI innovators in Alberta, for instance, are looking to create better synergy with energy and agriculture sectors, while BC is aiming more to embed AI technologies in its finance and high-tech sectors.[70]

SOCIETY

Canada is known globally as a strong AI research base. The three CIFAR-associated national AI institutes – Vector Institute for Artificial Intelligence (based in Toronto), the Montreal Institute for Learning Algorithms, and the Alberta Machine Intelligence Institute – have been working closely with their affiliated universities and corporate partners to not only advance their research priorities and deepen sectoral strengths, but also to facilitate the strengthening of AI innovation ecosystems and collaborative networks across regions. Together, they have supervised more than 1,200 trainees and developed 190 formal industry partnerships since 2017.[71] The University of Alberta, ranked second worldwide in the field of AI and machine learning, leads among the country's higher-education institutions for artificial intelligence research, along with Université de Montréal and the University of Toronto.

In terms of ethics and governance, responsible use of AI has been a key theme since the beginning of policy-making around artificial intelligence in Canada. Some initiatives on responsible AI include the 2018 Montreal Declaration for Responsible Development of Artificial Intelligence, the Advisory Council on Artificial Intelligence, the *Digital Charter Implementation Act*, and the revised *Personal Information Protection and Electronic Documents Act*.[72]

INTERNATIONAL LINKAGES

As a global leader in AI research and responsible uses of AI, Canada proactively engages partner countries across the world. The International Panel on Artificial Intelligence, now known as the Global Partnership on Artificial Intelligence, was first announced by Canada and France in 2018 within the G7 framework and has now developed into a key multi-stakeholder mechanism for advancing international collaboration on AI.[73] Canada also works closely with the United States in the tech space and signed the 2019 Canada-US Innovation Partnership, which included AI-themed projects from the beginning.[74] Most recently, Canadian AI researchers and stakeholders had their collaborative networks expanding into Europe and Asia, forging formal linkages through initiatives such as the Canada-UK AI Initiative and the India-Canada Digital Collaboration through the Digital Technology Supercluster.

Chile

INTRODUCTION

Chile is among the leading Latin American economies, well positioned for AI adoption and development. The country has high internet coverage rates, with over 82% of its population having access to the internet, among the highest in the region. Chile also ranks well in key technology areas relevant to AI adoption. For instance, Chile outranks neighbouring countries in the Global Cybersecurity Index 2020, only following Brazil and Uruguay in South America. Chile also has a strong legal foundation for cybersecurity with a national-level law regularly updated according to international standards.[75] Compared with its regional peers, Chile also leads in the adoption of broadband and fibre optic connectivity, mostly led by government programs addressing the domestic digital divide by increasing internet penetration throughout its territory. Chile is the South American economy with the most fibre optic connections, with broadband penetration of 32%, outranking both Latin American neighbours and the OECD average.[76]

GOVERNMENT

Chile has multiple government initiatives in progress designed to support its digital transformation, including adoption of AI technologies across the public and private sector. Released in 2019, Chile's *Estrategia de Transformación Digital* (Digital Transformation Strategy) has the main objective of promoting the adoption of digital, data-driven tools within government to provide public services for citizens, like digital identification cards. It also provided a roadmap to digitalize public service procedures, reducing bureaucratic red tape and encouraging the adoption of emerging technologies and cybersecurity within government. Also, the *Ley de Transformación Digital del Estado* (Government digital transformation law) entered into force in 2021. The law gives government ministries and agencies five years to remove the use of paper-based documents and procedures, adopt data science for policy-making, and create mechanisms to make cross-agency data interoperable and open.[77]

The country has also been a leader in creating a data ecosystem to fuel the research and adoption of AI solutions. Mainly, the Agenda Digital 2020, a key nationwide roadmap with 60 policy measures to advance sustainable and inclusive development through ICT. The agenda has five strategic pillars it supports through policy and investment: (1) human-rights approach to digital development; (2) digital connectivity; (3) digital government; (4) digital economy; and (5) digital competency and skills. One of the key results from this agenda has been the launch of the Open Data platform, making data from 520 government actors publicly available. However, the platform still struggles with standardizing data formats and

facilitating access to individual citizens.[78] At the same time, the government collaborated with Datawheel – a US-based big data company providing data analysis, integration, and visualization products for governments and the private sector – to create the DataChile public platform that collects and visualizes data from government, making it accessible to civil society and citizens.[79]

The government has also created its own technology business accelerator, Start-Up Chile, already boasting one of the most diverse and largest startup communities globally. The accelerator program provides financing for early-stage startups, with at least 50% of funded enterprises led by women.[80] It also provides mentorship and training for technology entrepreneurs and provides connections to industry networks and to domestic or international investors.[81]

National AI Strategy in Progress

Following its adoption of the OECD's principles of trustworthy AI, Chile began work on its own National AI Strategy in 2019. The strategy was developed by the Ministry of Science in collaboration with an expert committee with 12 members from academia, industry, civil society, and government. They provided the ministry with key technical knowledge and recommendations for policy, data use, and ethical considerations for the adoption of AI. The drafting of the National AI Strategy involved over 1,700 people across multiple sectors and was available for industry and public consultation in December 2020. Slated for final publication in 2021, the National AI Strategy will set the direction and key objectives Chile must follow in the next 10 years to empower citizens to use and develop AI tools and stimulate social debate over the legal, ethical, social, and economic impacts of AI. The draft document emphasizes the government's human-centred and interdisciplinary approach to development and regulation of AI, with key goals of using AI tools to improve Chilean's well being and support sustainable, inclusive economic development. AI must also be guided by principles of transparent, explainable, and secure AI. The strategy will focus on developing three key pillars:[82]

1. Enabling factors for AI, including secure and open data, human capital, and investment in connectivity infrastructure (5G);

2. Strengthening Chile's overall scientific research ecosystem, with support for increased fundamental and applied AI research within public and private sectors. Also includes collaborative projects between academia and industry; and

3. Developing ethical, agile, and human-rights-guided governance for AI and its applications, addressing the socioeconomic impact of AI on the labour market and

transitioning workers to new career opportunities, and establishing key standards for algorithms and AI-driven products in terms of their transparency and other guiding principles.

PRIVATE SECTOR

Chile has one of the most competitive entrepreneurial and innovation ecosystems in Latin America. New businesses have fertile ground thanks to relatively stable macroeconomic conditions and robust infrastructure. Currently, Chile has a thriving startup ecosystem, led by the Start-Up Chile program, with a growing number of emerging tech players with AI products. At the same time, large companies in telecommunications, banking and financial services, and retail in Chile have been early AI and big data adopters.[83]

Certain sectors in Chile are promising for AI application. For instance, according to private sector experts, Chile's forestry, mining, and fishery sectors could reap vast benefits from AI applications. Since these are commodity-dependent industries, AI can add value in supply-chain optimization and transparency, but also in monitoring and addressing their respective environmental impacts. For example, NotCo, an environmentally friendly food commodity business, is a Chilean startup using AI to accelerate its research and development of plant-based alternatives to meat and dairy products.[84]

Due to its geographical location, Chile has also developed a niche expertise in astronomy, particularly centred around observatories in the Atacama Desert. This is another sector where AI can contribute. For instance, the Automatic Learning for the Rapid Classification of Events (ALeRCE) is a Chilean-led scientific community generating and managing vast amounts of data from telescopes, then sharing these databases in real time to astronomers around the globe.[85]

SOCIETY

As explained above, the development of Chile's National AI Strategy has been a consultative, transparent, and open process. In 2019, widespread protests prompted the government to begin drafting a new constitution in Chile. Although this process was delayed due to the COVID-19 pandemic, the administration of President Sebastian Piñera convened the first sitting of the constitutional convention in June 2021, made up of 155 elected members. The convention was charged with the development of Chile's new constitution. This process has emphasized citizen and civil society participation, a model followed in the development of Chile's AI strategy. Throughout its consultative process, the Ministry of Science received over 200 public comments from academia and industry. Also, over 1,300 experts from academia, industry, and civil society participated in roundtables, providing valuable input to the National AI Strategy.[86]

The country has a robust technology education foundation, in both private and public institutions. The top five universities in Chile, which include the Pontificia Universidad Católica de Chile, the Universidad de Chile, and the Universidad de Santiago de Chile, all have undergraduate, graduate, and PhD-level programs in AI. These three higher-education institutions also have established AI research laboratories. Other research and education institutes include the Instituto Milenio Fundamentos de los Datos, a multidisciplinary research organization focused on data science for positive social impact.[87] Further, the Derechos Digitales organization is a non-profit and policy research institute with the goal of protecting human rights in the technological and data fields. Their work centres on protection of freedom of expression, privacy, and protection of personal data.[88]

INTERNATIONAL LINKAGES

Chile has strong trade relationships with China, the United States, Japan, South Korea, and Brazil. As an OECD member, it has adopted the multilateral organization's AI principles, basing its national strategies on AI, infrastructure, and data on OECD recommendations. It is also a member of the Pacific Alliance (PA), along with Colombia, Mexico, and Peru. It is a signatory to PA's technology transfer initiatives, which seek to promote an ecosystem of innovation and entrepreneurship in the region and to facilitate cross-border co-operation with members. The initiative also grants Chile access to competitive and successful digital technologies and knowledge seen in member countries through PA's network of business accelerators (AcelerAP), angel investors (AngelesAP), and innovation agencies (InnovAP).[89] Chile also receives investment from China, with Huawei building its first Latin American data centre in Chile and launching a second one at the end of 2020.[90] US technology companies like Microsoft have also invested in Chile, particularly to further develop the country's cloud infrastructure. Microsoft has also developed upskilling programs for Chileans on technical skills.[91]

Chinese Taipei

INTRODUCTION

Building on its existing competitive strengths in ICT and semiconductors, Chinese Taipei has a robust foundation for the development of intelligent technologies. With a clear aim at two niche markets, namely on-device solutions and sound ecosystem,[92] Chinese Taipei is looking to foster hardware-software collaborations to promote the applications of AI across various industries, with most recent achievements seen in education, traffic management, and drone development.[93] The island's well-established internet infrastructure, top-quality engineering talent pool, and vibrant research environment are reasons that Chinese Taipei is regarded as a top candidate in which to base AI R&D centres. The island is also an investment

destination from global tech giants including Google, IBM, and Microsoft.[94] Moreover, Chinese Taipei's first place on the Global Open Data Index since 2015 gives it another key advantage in developing AI applications.

GOVERNMENT

Chinese Taipei's Ministry of Science and Technology set out five key strategic areas for the 2017-2021 period in what it refers to as the "grand strategy for a small" economy.[95] These areas are: (1) creating a high-speed AI cloud computing platform that serves R&D; (2) establishing four AI innovation research centres to develop technologies and train AI talent; (3) setting up AI robot maker spaces at science parks and launching an AI semiconductor "moonshot" project focusing on ground-breaking capabilities around edge computing; and (4) organizing tech competitions to discover and engage young talent in developing AI applications.[96] A government investment of US$517.5M (NT$16B) is allocated to support this five-year strategy.

In 2018, the Chinese Taipei's government rolled out the AI Taiwan Action Plan (2018-2021) to further specify the near-term initiatives for building a comprehensive AI industry. The initiatives include the AI Talent Program to train more than 10,000 AI technicians and application specialists every year; the AI Pilot Project to develop an AI forward-looking research network; the AI International Innovation Hub initiative to foster 100 AI-related startups and develop innovation clusters; the Test Fields and Regulatory Co-creation initiative that revises relevant laws and regulations to facilitate intelligent applications; and the AI for Industrial Innovation initiative to match AI talents to demands from industry and help SMEs with AI-driven transformation.[97]

PRIVATE SECTOR

High Adoption Rate

About 84% of Chinese Taipei's companies have, to different extents, introduced AI technologies to their businesses, with the fastest pace of adoption seen in manufacturing and high-tech industries, and the most mature uses in banking and finance.[98]

Expanding Semiconductor Success

Capitalizing on its world-leading position in tech hardware production, especially semiconductor manufacturing and IC design, several public-private partnerships have been launched to leverage and expand Chinese Taipei's traditional leadership in these industries. Directed by the AI semiconductor moonshot project and supported by government R&D investment, the semiconductor industry is actively developing AI-powered capabilities in key areas such as next-generation memory chip design, Internet of Things (IoT) systems

and security, and system solutions for driverless vehicles and augmented/virtual reality applications.[99] Chinese Taipei's most valuable AI chip startup Kneron, for instance, specializes in designing and developing edge AI solutions for applications in areas such as IoT and industrial control.

Wealth of Data

Other areas where Chinese Taipei's AI applications are seen under development include finance, retail, health care, and surveillance. AI applications in the health sector, for example, can potentially benefit from over 20 years of accumulated data in Chinese Taipei's National Health Insurance system, if data and privacy protection issues can be properly addressed in future AI research for commercial purposes.

SOCIETY

There is good synergy between the government and universities for conducting Chinese Taipei's AI research. Four government-launched AI centres are based at the National Taiwan University, National Tsing Hua University, National Chiao Tung University, and National Cheng Kung University. These centres specialize in research on AI core technologies, AI for manufacturing, AI services, and AI for medical applications, respectively.

The island's AI and data talent pool has been growing at a fast pace in recent years, albeit still several years behind the AI superpowers. The relatively well-developed hardware industry remains more appealing to domestically trained young ICT professionals, as opposed to software-oriented subsectors such as AI and big data, although this mentality has started to slowly change. Meanwhile, the government has taken several measures to promote AI education in public school curriculums at the elementary and secondary levels.[100]

Ethical questions surrounding the use of AI that are particular to Chinese Taipei's context have so far been largely related to medicine, health-care services, and biotechnologies. Further, discussions are taking place about laws and regulations on the legal management of information security, as well as rights and obligations arising from AI applications. Human-centredness is one of the core values in government guidelines on researching and developing AI solutions that is well understood by private sector practitioners.

INTERNATIONAL LINKAGES

The Chinese Taipei's government proactively encourages the forging of international linkages in the field of AI through setting up R&D centres in partnership with international tech companies. This is seen as a crucial means to nurture the local AI industry and construct a comprehensive AI ecosystem. Microsoft, for instance, established its AI R&D centre in Taipei

in 2018, under the Ministry of Economic Affairs' Global R&D Innovation Partner Program. Areas of focus include computer vision, user intention recognition, and AI applications for vertical industries. Tech multinationals' strong presence in Chinese Taipei's AI industry is also seen in talent and entrepreneurship development. Nvidia, Google, and Microsoft are among the corporations that have been actively collaborating with local research institutions, government agencies, and startups on developing AI training and certificate programs.

Hong Kong, China

INTRODUCTION

The landscape for AI development and adoption is vibrant in Hong Kong, China. It is home to a tech-savvy population and businesses familiar with AI and machine learning concepts. AI applications have been seen in various industries as part of the productivity-enhancing and digital transformation of the city.[101] With its large talent pool and prestigious institutions in computer science and technology, the city is well equipped for AI research and development, and once came in third place among global economies producing the most-cited research papers.[102]

GOVERNMENT

The government of Hong Kong, China (HKC) has long been committed to creating and enhancing an innovation and technology ecosystem that is competitive and cutting-edge in future-oriented technologies, underpinning the importance of AI. The 2017 Smart City Blueprint, HKC's overarching framework for constructing a smart future, specifies three application areas where AI technologies should be embedded: AI-powered sensors to monitor climate change, robotic assistance for elderly people, and efficient data sharing and exchange in public services such as transit system management.[103]

HKC also provides significant R&D funding for AI technologies, such as using part of its US$6.4B (HK$50B) Innovation and Technology Fund to build an R&D cluster for AI and robotics.[104] It also supports AI-related initiatives through a number of quasi-government convening bodies, such as the Hong Kong Science and Technology Park (HKSTP)'s AI Plug initiative to forge a more engaged and connected community of AI stakeholders.

In addition to policy and financial support, the HKC's government is leveraging big data analytics and AI applications to enhance its service systems. It most recently launched the Government Cloud Infrastructure Services platform.[105]

PRIVATE SECTOR

In HKC, the private sector's involvement in developing hard AI technology is limited. It is, however, notable that one of the world's most valued AI companies, SenseTime, was founded in HKC and the regional business hub provides a strong base for some 200 AI innovators and startups. Most other businesses in the city focus on the application side of AI, exploring ways to leverage the benefits of AI to improve current processes in their own areas of expertise.

Being an established global financial hub, HKC's financial and banking services are frontrunners in leveraging AI technologies and combining them with big data for applications in more efficient and more time- and cost-effective underwriting, pricing, risk management, and fraud detection processes.[106] Other areas in which AI finds strong adoption cases in HKC include construction, transportation, logistics, and retail, where digitizing and automating previously labour-intensive tasks are key in helping create a more efficient supply chain and revitalizing the city's most important traditional industries.[107]

Knowing the benefits, businesses in HKC in general display high levels of eagerness to use AI technologies, but actual deployment is still in the early stages and limited to the most relevant teams within the business. Constraining factors include small market scale, insufficient application scenarios, existing data silos, and regulations that are not up to date.

SOCIETY

The public in HKC has a good awareness of AI technologies and is optimistic about the benefits of using them. HKC is ranked among the highest within the Asia Pacific region in terms of readiness to adopt AI, with the majority (65%) of people expecting a positive impact on society from more extensive use of AI.[108] Despite the optimism, the actual everyday usage rate of AI services has yet to pick up in the city, and concerns about data sharing and privacy are key issues that remain to be addressed.

In terms of education and talent training, there are several initiatives addressing the need for talent and to effectively combine AI technologies with sectoral expertise. The HKAI Lab, founded jointly by Alibaba, SenseTime, and HKSTP, is one such platform that fosters local AI talent development and accelerates commercialization of cutting-edge results. The government is also looking at fast-tracking visa arrangements to attract more overseas and mainland technical personnel as a way to expand its AI talent pool.[109] Moreover, recent calls for strengthening the STEM curriculum and incorporating AI and data analytics in school curriculums focus on the mid- to long-term impact on preparing the city's next generation.

As AI usage continues to rise in HKC, specific legislation and regulation related to it are still in the early stages. Some initial regulatory attempts related to the ethical use of AI include

government-led initiatives to set out frameworks for data impact and ethical accountability, and spontaneous, case-by-case assessments conducted by businesses that look at issues pertaining to the specific industry.[110]

INTERNATIONAL LINKAGES

HKC's AI industry engages with partners in mainland China, which is the single most impactful market for the city in terms of industry development, R&D, and the regulatory environment. Working closely with partners on the mainland, AI startups and research institutions in Hong Kong benefit from access to more investment, customers, and opportunities to experiment with market-ready results that were previously constrained in the smaller home market. With the Greater Bay Area initiative looking to build an integrated international business and technology hub, Hong Kong's collaboration with neighbouring Guangdong province on AI and robotics has been further enhanced through research funding opportunities, academic alliances, forums, and publicity campaigns.[111]

Japan

INTRODUCTION

Japan has been known as a technologically savvy economy, but it has been slow in its digitalization. However, with the rising importance of AI, Tokyo has taken steps to build the foundations for accelerating digitalization and AI adoption, leveraging its existing strengths in robotics and manufacturing. Internationally, the Japanese government has shown the intent to play a greater role, leading conversations on AI ethics and data privacy (e.g., Prime Minister Shinzo Abe's Osaka Track).

GOVERNMENT

Bill Concerning Digital Reform (May 2021)

In May 2021, the Japanese National Diet introduced a legislative package called Bill Concerning Digital Reform, which includes six different bills: Cabinet Bills No. 26-31. The six bills propose three main digitalization initiatives: (1) the creation of a data agency to improve the adoption of data and digital systems within the government; (2) updating data governance legislation; and (3) digitalizing public services through the My Number System, an app that allows Japanese citizens to verify their identities and access public services.[112]

National AI Roadmap: Abe's Society 5.0

Prime Minister Abe's Society 5.0 national strategy is centred around solving Japanese societal and economic problems by using Industry 4.0 technology (e.g., artificial intelligence).[113]

This includes developing digital competitiveness strategies such as the Strategic Council for AI Technology to develop the national AI Technology Strategy through inter-ministry co-operation.[114] Society 5.0 was first launched in 2016 through the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) within its fifth Science and Technology Basic Plan, Japan's five-year science and technology strategy. Under Society 5.0, the Strategic Council for AI Technology was established to lead the AI rollout and R&D. In 2017, the Council released its Artificial Intelligence Technology Strategy with the goal of creating an AI industrial ecosystem by 2030.[115]

Research and Development

Japan has a substantial investment in R&D through both the public and private sector. For example, in April 2016 MEXT provided a funding subsidy for the RIKEN Center for Advanced Intelligence Project, which conducts AI research.[116] In 2019, Japan's R&D expenditure made up 3.241% of GDP, above the OECD baseline of 2.475%.[117] Furthermore, while there is proactive AI research being undertaken by private sector tech giants like Mitsubishi's Electric Research Laboratories, there has been less growth in government research.[118]

PRIVATE SECTOR

Japan's industrial manufacturing sector is highly mature, sophisticated, and renowned for its high-quality products. In a 2020 report, McKinsey identified four areas where AI could be applied in the sector: (1) machine learning for probability forecasting; (2) computer vision deep learning for image/object detection and classification; (3) natural language deep learning for text and speech processing; and (4) fully autonomous driving.[119] In this context, the following are three snapshots across Japan's private sector of specific cases where AI is or can be applied:

1. **Looking to the Future: NEC and the Environment**

In an environmentally friendly initiative, Japanese IT and electronics giant NEC partnered with the Japan Agency for Marine-Earth Science and Technology to create an AI-powered microplastic detection system aimed at keeping oceans free of plastic waste. The AI software uses visual imaging recognition to detect micro-plastics in the water and sorts them according to size and shapes at a speed of 60 microplastics per minute.[120]

2. **Upgrading Manufacturing: MusashiAI**

Japanese manufacturing firm Musashi Seimitsu partnered with Israeli tech startup SixAI to create a joint venture called MusashiAI, specializing in AI-powered quality-control robots. This program increases the efficiency of quality control by letting the robots perform the

straightforward inspection (approximately two seconds for a gear piece), therefore freeing up human workers to engage in more creative and critical-thinking tasks, such as investigating why the defect occurred rather than determining whether there is a defect at all.[121]

3. Revolutionizing Fetal Health Care: AI and Detecting Heart Abnormalities

A research group led by the RIKEN Center for Advanced Intelligence Project in collaboration with Fujitsu Ltd. and Showa University has developed an AI system that can detect real-time heart abnormalities in fetuses.[122] Predicting fetal congenital heart diseases has historically been difficult due to the rareness of the diseases and subsequently the limited and incomplete data sets around them. Through machine learning, this AI system can predict the diseases despite the small data sets using the "object detection technique" to visually identify and classify multiple objects.

SOCIETY

Education and Human Capital

Japan faces talent challenges on two key fronts: (1) the lack of digital education and therefore technologically savvy experts; and (2) an aging population and declining workforce. A 2020 report by McKinsey found that there is low digitization from primary to tertiary education. The Japanese government has taken concrete steps in addressing both facets of the human capital shortage. On the education front, MEXT launched the Global and Innovation Gateway for All program, which promotes and subsidizes technology access in education, aiming for every Japanese school to have high-speed internet by 2020 and one laptop per child by 2023. In 2020, MEXT also announced an initiative called Scheem-D (student-centred higher education ecosystem through digitization), which provides university instructors and tech companies with a platform to spread tech innovations among universities across Japan. Finally, Japan is attempting to bolster its tech workforce numbers by encouraging professionals to move to Japan through a 2017 policy change (the highly skilled professional visa) that allows them to gain permanent residency in a year alongside more access to loans and employment opportunities.[123]

Ethics

Japan began addressing AI governance and ethics early when the Ministry of Internal Affairs and Communications organized a committee to develop the 2017 AI R&D Guidelines. This was followed by inter-governmental and multi-stakeholder discussions resulting in the Social Principles of Human-Centric AI published by the Cabinet Secretariat in February 2019.[124] Finally, the 2021 Digital Governance Reform package proposed by the Japanese government covers two initiatives to reform digital governance in Japan. The first is to centralize data

privacy regulations under the Personal Information Protection Commission; the second is to consolidate the *Act on the Protection of Personal Information*, the *Act on the Use of Numbers to Identify a Specific Individual in Administrative Procedures*, and the *Act on the Protection of Personal Information Held by Administrative Organs*.[125]

However, despite the Japanese government's concerted efforts to address AI governance, there have been some ethical controversies around AI. In August 2019, a controversy arose surrounding a recruitment management company selling users' and students' data to client companies, followed by another controversy in November, where a University of Tokyo associate professor and director of an AI company tweeted racist opinions regarding the company's recruitment policy and then claimed that his discriminatory comments were created by machine learning. More recently, another issue emerged when AI technology was used to reproduce performances of two deceased Japanese cultural icons – singer Hibari Misora and Astro Boy creator Osamu Tezuka. Ultimately, while the Japanese government continues its efforts in governing AI, achieving more comprehensive enforcement of AI ethics is still a work in progress.[126]

INTERNATIONAL LINKAGES

Japan has taken an active leadership role in encouraging international leadership on AI. In 2019, Prime Minister Abe introduced the data free flow with trust concept at the World Economic Forum and initiated the "Osaka Track" at the G20 meeting in Japan. Japan is also a founding member of the Canada-led Global Partnership on AI established in 2020. In terms of bilateral partnerships, interviews with two Japanese AI experts (Dr. Arisa Ema at the University of Tokyo and Akihiko Iketani) have identified Canada, India, and Singapore as leading partners for AI collaboration. Canada, in particular, was cited by Dr. Ema as a good partner for collaboration on the intersection between AI and democracy in terms of addressing how AI should be responsible when applied in critical decision-making sectors, given the risk facial recognition and deep fakes pose for democracies.

New Zealand

INTRODUCTION

Although New Zealand is still currently developing a national AI strategy, the economy has undertaken several government-led Fourth Industrial Revolution policy initiatives (including AI) with active participation from industry and civil society. The government recognizes the economic importance of widespread AI adoption, particularly since a 2018 study estimated that AI adoption has the potential of adding US$38B to New Zealand's GDP by 2035.[127] At the same time, the government is keenly aware of the risks this technology can have in

society and for human rights. Through its Ministry of Business, Innovation and Employment (MBIE), New Zealand has engaged in several research and policy efforts, including expanding its own understanding of the country's needs and ethical considerations for future AI policy, and contributing internationally to the development of novel frameworks for AI innovation and regulation.

GOVERNMENT

In 2019, the New Zealand government launched its Industry Strategy, further updating it during 2020 in light of the challenges and digitalization acceleration experienced through the COVID-19 pandemic. The Strategy presents a blueprint for the strengthening and expansion of innovative industries in New Zealand. It is composed of Industry Transformation Plans (ITP), particularly to support the transformation and growth of the domestic digital technology sector.[128] It is under the Digital Tech ITP that New Zealand is developing an AI strategy, along with data-driven innovation and digital skills roadmaps, as critical growth-enabling engines for the present and the future.[129]

The government has partnered with the New Zealand AI Forum, a non-profit membership association founded in 2017 that brings together the domestic AI community. Its members include technology entrepreneurs, industry experts, investor groups, researchers, educators, and end-users. The AI strategy will help New Zealand develop a co-ordinated approach to the use and adoption of AI in the country. It will also help the country build trust in the technology and its widespread use. Another strategic objective is to assist New Zealand in playing a significant role on the international stage in AI products, best practices, and regulation. A drafting update published by MBIE in May 2021 showed that New Zealand's forthcoming AI strategy will rest on five cornerstones:

1. **Uniquely New Zealand:** The AI strategy will build on the country's strengths of innovation, ethics, and inclusiveness to develop a globally recognized brand for domestic AI products. AI implementation in New Zealand will also be guided by Māori worldviews and ethics;

2. **Human-centred and trusted AI:** The country will develop appropriate ethical and regulatory frameworks and standards to govern AI research, development, and commercialization;

3. **Investment in the AI economy:** To support businesses adopting AI, the country will identify and invest in strategic sectors, support AI startups, and continue to promote AI adoption across value chains; and

4. **Preparing the workforce:** New Zealand will invest in training and reskilling the workforce. It will also support researchers in academia and industry.

5. **New Zealand's place in the world:** The country will be a trusted and active partner working with other economies to ensure AI and its impact are equitable, transparent and safe.[130]

PRIVATE SECTOR

New Zealand has a vibrant startup ecosystem, well supported by a highly educated workforce, government support, and readily available private or public funding. The following are some examples:

1. **Humanoid Avatars/Digital Assistants: Soul Machines**

New Zealand tech startup Soul Machines has created an AI-powered customer service system, complete with CGI-generated faces, that makes it seem like users are talking to a real human being on the screen. These AI digital avatars have been rolled out across multiple sectors from telecommunications to finance to real estate. Soul Machines has offices in San Francisco, Los Angeles, New York City, London, Tokyo, Melbourne, and Auckland. Some of its biggest clients include the Royal Bank of Scotland and Australia and New Zealand Banking Group.[131]

2. **Driverless Transportation: Ohmio**

Ohmio's driverless car technology is powered by AI, the first of its kind in New Zealand. Ohmio's products are not only driverless, but also environmentally friendly and scalable. Multiple Ohmio vehicles can be linked together to form a convoy for public transportation. In fact, Ohmio contributed to Auckland's "Smart Village" test run, developing a completely automated shuttle system powered by AI. Ohmio currently has three models available: Hop, Lift, and Lift XT1, which can carry 4-6, 20, and 40 passengers, respectively.[132]

3. **Detecting Skin Cancer: MoleMap**

New Zealand health tech company MoleMap provides revolutionary skin cancer detection technology powered by AI. As a skin-mapping system, MoleMap helps dermatologists and other health-care professionals detect possible cases of skin cancer earlier and more efficiently.[133] This enhanced ability to detect skin cancer (melanoma) earlier has a life-changing impact on skin cancer patients since "early melanoma detection offers a nearly 100% chance of survival within five years."[134] Currently, MoleMap has over 40,000 clinics across New Zealand.

SOCIETY

New Zealand has multiple initiatives to build digital skills among New Zealand's workers. Digital technology has been part of the K-12 curriculum since 2019, including skills like computational thinking.[135] Since 2014, Auckland, Wellington, and South Island established ICT graduate schools, providing a mix of digital upskilling and business focused skills to students.[136]

In terms of research, New Zealand has several higher-education institutions with varied and deep AI expertise. Universities like the Auckland University of Technology, the University of Auckland, the University of Otago, and Victoria University of Wellington have globally recognized expert teams in machine learning, algorithms for data mining and optimization tasks, computer vision, edge detection, segmentation, and object recognition. These institutions also have close ties to industry, with the University of Auckland successfully commercializing startup ventures like Soul Machines. New Zealand's universities are also at the forefront of AI ethics and regulation, with the University of Otago investigating the impacts of AI on law and society and regulatory issues surrounding diverse uses of AI. For instance, the university has released an assessment of potential regulatory challenges in the implementation of predictive models of AI in government departments.

As demonstrated by the work on AI in law and regulation at the University of Otago, New Zealand has extensive and evolving experience and knowledge of AI ethics and regulation. The New Zealand AI Forum has reported on citizens' concerns on AI's potential to make biased, unfair, and inaccurate decisions. The development of a human-centred and trust-building approach to AI will be a key factor in the country's AI policy moving forward. Also, New Zealand will include Māori communities in the identification and discussion of the social, economic, and labour risks and impacts of AI. Key government bodies like Statistics New Zealand have also issued AI-relevant standards, most significantly the Algorithm Charter for Aotearoa New Zealand.[137]

INTERNATIONAL LINKAGES

New Zealand is a founding member of the Global Partnership on AI, along with other APEC members like Mexico, Japan, the Republic of Korea, Singapore, and the United States. The country also participates in other AI-specific international collaboration initiatives such as the Partnership on AI, a non-profit association of academic, civil society, industry, and media organizations developing AI solutions, recommendations, and resources for global stakeholders. New Zealand is also collaborating with the World Economic Forum in 2019 to develop novel regulation for safe, trustworthy, and ethical AI.[138]

Republic of Korea

INTRODUCTION

Ranked first in the 2021 Bloomberg innovation index, South Korea is already a tech powerhouse, and Seoul has been mobilizing its resources to attain international competitiveness in AI. From the National Strategy for AI (2019) to the Korean New Deal (KND), there are various government initiatives that support AI adoption across different industries. Universities, public schools, and civil society organizations have started to develop AI education and training programs. South Korean conglomerates and newly emerged tech giants such as Samsung, LG, Naver, and Kakao have invested heavily in AI, accelerating both R&D and commercial adoption. While concerns remain over its regulatory environment and issues around AI ethics, South Korea's AI agenda is well underway.

GOVERNMENT

Capacity Building

As early as 2017, the Ministry of Science and ICT launched the Mid-to-Long-Term Master Plan in Preparation for the Intelligent Information Society: Managing the Fourth Industrial Revolution policy. This policy covers three main goals, reflecting South Korea's core approach to AI capacity building: establishing a world-class technological foundation; promoting intelligent industry; and revising existing social policies and regulations. Then in 2020, the South Korean government launched the KND to drive the country's COVID-19 economic recovery. Within the KND, the Digital New Deal means C$128.5B ($US102B) is earmarked for digitalization focusing on "DNA" (data, network/5G, and artificial intelligence).[139] Other KND initiatives include green infrastructure (the Green New Deal), and the creation of 1.9 million high-quality jobs by 2025 with social/employment safety nets (the "human" pillar).[140]

National AI Roadmap

In 2018, the Presidential Committee on the Fourth Industrial Revolution (PCFIR) was established to co-ordinate national policies on AI and other emerging technologies based on the I-Korea 4.0 Strategy, which promotes intelligent technology innovation projects in 12 different sectors. The I-Korea 4.0 Strategy focuses on the research, development, and rollout of Industry 4.0 technologies, including AI. It seeks to prepare Korea for the future of disruptive technologies by building growth engine technologies and establishing industrial infrastructure and ecosystems.[141] PCFIR and the I-Korea 4.0 Strategy were followed in 2019 by the National AI Strategy covering "nine strategies and 100 initiatives in the three main areas of AI – establishment of AI ecosystem, utilization of AI, and creation of human-centered AI – by 2030."[142]

Research and Development

The Korean government has made serious commitments to R&D investments for AI. For example, PCFIR launched the AI R&D Strategy in May 2018, committing C$2.66B (US$2.1B) until 2022 for developing AI technology and talent. The next year, President Moon's "manufacturing renaissance strategy" included a US$7.1B investment in the integration of AI across the manufacturing sector, along with the development of non-memory chips, future mobility, and biohealth. In a 2018 report by the Asia Pacific Foundation of Canada, South Korea's financial investment in its R&D strategy was benchmarked at a staggering C$2.66B. Finally, South Korea's private sector has taken the initiative in developing their own AI research centres in addition to government programs. Between 2015 and 2017, a plethora of corporate R&D centres were established, including Naver Labs AI, SK Telecom AI, Samsung Research AI Center, LG AI Lab, SK T-Brain, Kakao Brain, Naver Clova, Samsung SDS AI, and Hyundai Motors AI.[143]

PRIVATE SECTOR

1. Naver: South Korea's Search Giant

Naver has long been one of South Korea's most prolific tech companies. It is the leading search engine in South Korea, used by 59% of South Koreans in 2020. In addition to being a search engine host, Naver also offers cloud, fintech, and e-commerce services. In May 2021, Naver rolled out a "hyperscale" AI platform called HyperCLOVA, capable of various functions including chatting with humans, processing AI training data, and summarizing complex documents. HyperCLOVA has been applied to Naver's portal site and further options for foreign languages, videos, and images are being developed.[144] Later the same year, in July, Naver announced that it had obtained 22 patents to construct a technological convergence building – the first of its kind in the world – that will integrate various Industry 4.0 technologies such as AI, robotics, and cloud connect.[145]

2. LG's US$100M Investment in AI

LG's AI research arm[146] recently partnered with the University of Toronto and announced two new academic papers on Explainable AI, "a technology that easily explains a result of its research to humans by providing reasons and evidence."[147] In February 2021, LG announced that it would be investing US$100M over the next three years to further develop its advanced AI capabilities with the aim of attaining "human-level learning, judging, and thinking capability."[148] Then in June 2021, LG unveiled an AI-powered X-ray detection machine, aimed at helping medical professionals identify lung diseases.[149]

3. AI as a Service: MINDs Lab

MINDs Lab is a leading South Korean tech company with AI at the core of its business. It provides integrated AI services ranging from corporate AI consulting and AI business support through its maum.ai platform to integrating AI into education.[150] MINDs Lab has expanded internationally as far as Canada. The company announced in 2020 that it plans to make Toronto its new headquarters for global growth. Most recently, Korea's Science and ICT Ministry announced that it will be developing a US$37.6M AI-powered immigration system through 11 consortiums including MINDs Lab.[151]

SOCIETY

Education and Human Capital

The South Korean government has taken a comprehensive approach to AI education, beginning at the elementary school level and going all the way through to university and even beyond to public population access. The Ministry of Education has announced a plan to train 5,000 AI teachers by 2024.[152] Local stakeholders are moving quickly as well; in addition to four specialized high schools that have been selected to focus on AI and big data education, the Seoul Education Office has announced plans to upgrade 10 Seoul vocational high schools to specialize in AI or big data. Meanwhile, government funding has also been provided to 10 leading South Korean universities to offer AI graduate programs as of May 2021. Finally, the Korean government has also ensured that AI education resources and vocational training are available to the general population.[153]

Ethics

Since 2018, the South Korean government has made its serious commitment to AI ethics and security clear, with the release of the Ethics Guideline for Intelligent Society in June 2018 under I-Korea 4.0, built on the principles of Seoul PACT (publicness, accountability, controllability, and transparency).[154] Moreover, the Ministry of Science and ICT announced in May 2021 its commitment to invest C$70M for its Implementation Strategy for Trustworthy AI between 2021 and 2025.[155] There is also an official Korea AI Ethics Association, which has published an AI Ethics Charter.[156] However, South Korea still faces difficulties regarding the ethical and secure use of AI technology. One of the most famous incidents in South Korean AI usage is the Lee Luda case. Lee Luda was an AI chatbot developed by South Korean tech startup Scatter Lab that was launched in December 2020. Soon after, Lee Luda garnered intense controversy when it began generating hate speech against women, sexual minorities, foreigners, and people with disabilities. Lee Luda had learned this language from the private messaging data of the Science of Love app users (a dating advice app also owned by Scatter Lab that creates advice based on private conversation analysis). The controversy

caused national backlash on multiple issues – data privacy, AI ethics, and social identity – with some experts calling it a potential watershed moment for South Korea as it grapples with AI ethics.[157]

INTERNATIONAL LINKAGES

South Korea has strong international linkages in all aspects of AI, from research to development to governance. South Korea's digital collaboration with developing economies is integrated directly into its New Southern Policy, New Northern Policy, and official development assistance (ODA) strategies. Notably, South Korea has provided countries like Indonesia and the Philippines with digital public service systems, and has even helped build a data centre in Tanzania. Overall, South Korea has led 130 such ODA projects and has donated US$174.7B worth of ICT projects – forming 15% of its total ODA. Seoul has promised further commitment in international digital development in its new Digital New Deal ODA. Aside from ODA projects, Korea has also been deeply involved in international digital governance through the OECD's Going Digital initiative. It is also one of the five founding members of the Digital Nations, and it was one of the 15 founding members of the Global Partnership on AI. Finally, Seoul's private sector has been just as globally minded as its government in helping digitalize developing economies. Naver, for example, has collaborated with local research groups in building two AI R&D centres in Vietnam.[158]

AI Regional Hubs

AI Regional Hubs are economies that have a combination of strengths in comparison to their neighbours allowing them to serve as hubs. While they may lag behind AI Middle Powers, relative to their neighbours they are ahead on different aspects pertinent to AI, such as research, governance, or education. Due to their relative strengths, they attract talent (in industry or for education), businesses, jobs, and investment in AI from different economies. Often sharing language or cultural ties with geographic neighbours, they also host key academic or industry networks that exchange AI research, best practices, and products with the potential to impact AI ecosystems in peer economies.

Malaysia

INTRODUCTION

Malaysia has pursued its own development by heavily investing in new technologies and attracting foreign investment (as a tool for technology transfer), a trend that has continued as Malaysia enters the Fourth Industrial Revolution. Government support for nascent internet and digital technology was solidified with two major policy programs in the 1990s, setting up the foundation for today's Malaysia. Its early work has paid off, not just guaranteeing consistently high rankings in ease of doing business, but also giving rise to a dynamic digital economy growing at 20% per year before the pandemic.[159] The domestic digital economy is also sustained by a high internet penetration rate of over 80%.[160] Combined with a significant electronics and semiconductor manufacturing sector connected to global supply chains, Malaysia is well positioned for the advent of the Fourth Industrial Revolution technologies such as AI. In 2020, the government also re-directed its policy and funding efforts toward more collaborative policy approaches with industry in a concerted effort to build an ecosystem to allow Industry 4.0 technologies to take root more naturally in the country.

GOVERNMENT

Capacity Building

Both the Sixth Malaysia Plan and the Vision 2020 policy programs were designed to develop Malaysia into a high-income country, advanced manufacturing hub, knowledge-based economy, and leader in digital technologies. These initiatives include programs to incentivize foreign investment into Malaysia through tax breaks, grants, and other financial and ecosystem investments. Notably, Vision 2020 focused on nascent internet technologies

and ensuring Malaysia has the necessary internet infrastructure for domestic businesses to flourish and attract foreign investment.

Malaysia has focused on the building blocks necessary to establish a technology and innovation ecosystem where AI can be widely applied for commercial, industrial, and societal purposes. The 2010 National Broadband Initiative and the 2018 National Fiberisation and Connectivity Plan were implemented to expand internet connectivity throughout the Malaysian territory and ensure affordable, robust, and high-quality 5G and high-speed internet networks across rural and urban Malaysia.[161] With the onset of COVID-19, Malaysia delayed its national AI strategy, announced in 2018, to address the economic repercussions of the pandemic and provide further building blocks for its emerging AI ecosystem. For example, the National Economic Recovery Plan[162] and Jalinan Digital Negara Plan[163] offer direct, long-term investments in the digital economy and Industry 4.0 by providing digital training programs and improving the coverage of 5G networks.

National AI Strategy

While Malaysia has yet to release its own national AI strategy, currently in development by the Malaysia Digital Economy Corporation (MDEC), it does have a variety of long-term planning programs and different government institutions fostering the domestic development and adoption of AI. Two major programs – Vision 2020 and Shared Prosperity Vision 2030 (SPV 2030) – have heavily influenced Malaysia's development direction. These programs progressively look at newer technologies as tools for economic growth, social change, and the establishment of internationally competitive domestic industries. Expanding on Vision 2020, SPV 2030 fosters the adoption of Fourth Industrial Revolution technologies, considered crucial for future sustainable development. Although the document does not outright mention AI, it identifies both preparation and adoption of Fourth Industrial Revolution technologies as critical for Malaysia to build a digital and technology ecosystem where AI would be well supported. In addition, the Industry4ward program under the Ministry of International Trade and Industry (MITI) fosters smart automation adoption in the manufacturing sector with a budget of RM210M (US$50.5M) between 2019 and 2021 to implement the manufacturing sector's transition to Industry 4.0 technologies.[164]

Research and Development

The goals within Vision 2020 and SPV 2030 have been translated into state initiatives and included under the 2020 and 2021 federal state budgets, both of which support various digitization and talent creation initiatives. At the sub-national level, individual Malaysian states have released their own initiatives. For instance, in 2018 the state of Penang released a US$1M Industry 4.0 fund to build a Silicon Valley-inspired tech hub and promote the

adoption of Industry 4.0 technologies.[165] The program builds on Penang's advantages as a key manufacturing hub for electronic components and semiconductors.[166] The state also provides funding and mentorship for tech startups in AI, IoT, and smart manufacturing, among others.[167] At the federal level, the 2020 and 2021 state budgets have targeted key digital ecosystem sectors, most significantly connectivity infrastructure, industrial upgrading, talent development and upskilling, and SME digitization. Several government institutions are also involved in the formulation of science and technology policies, including MDEC, the Ministry of Science, Technology and Innovation, MITI, and the Ministry of Communications and Multimedia (KKMM), all of which offer their own digitization incentives and financial aid.

PRIVATE SECTOR

In addition to public-private partnerships in developing Malaysian AI talent pools, there have also been several intriguing AI applications in Malaysia's private sector. This section highlights three snapshots of private-sector-driven AI adoption, highlighting the potential for widespread AI adoption in the country:

1. **Intelligent Health Care: Predictive Analytics and Telemedicine**

In June 2021, Lenovo announced the launch of its new Device Intelligence Plus in Malaysia. Driven by AI-powered predictive analytics, the tool "collects 10,000 data points every 15 seconds from each device, allowing it to monitor millions of aggregated data points across the fleet in real time" to report and analyze health device trends. Meanwhile, Malaysia's telemedicine scene is rapidly developing.[168] A notable example is DoctorOnCall, which provides health screening, e-consultation, online pharmacy, COVID-19 testing, and COVID-19 vaccination appointment booking services.

2. **The Future of Government and Digital Identities: Public Services in the Cloud and WISE AI**

Microsoft has partnered with local tech firm Enfrasys Solutions to provide cloud services to public service agencies. Access to cloud technology should streamline Malaysia's public services and create better co-ordination and efficiency.[169] Moreover, developments in digital identity management complement this advancement in e-government. Notably, WISE AI is a Malaysian electronic know your customer (eKYC) and facial recognition firm. It specializes in optimizing customer onboarding, identity verification, and customer due diligence for private sector clients.[170] With its cutting-edge technology, it has the potential to make national digital IDs a reality across Malaysia.[171]

3. Revolutionizing Fintech: The Inflection Point

The adoption of digital finance solutions in Malaysia has skyrocketed, with the e-remittance (only one aspect of fintech) total transaction value growing by 106% in 2020.[172] New regulations regarding fintech, such as the use of eKYC, have facilitated this boom, resulting in a plethora of fintech firms and options across the country – as of 2021 there are 223 in total.[173] Some notable examples include superapp giant Grab and gaming/fintech startup Raze.

SOCIETY

Education and Human Capital

Malaysian public discourse on AI mostly revolves around key economic issues, mainly the urgent need for digitization of SMEs in the country, which make up 90% of the economy. According to a survey done by Microsoft and IDC, workers in the business sector are optimistic about the integration of AI in business operations and daily work. The major concerns are not whether AI technologies will render some jobs obsolete, but rather that workers are not prepared to operate and manage new technologies. Over the past few years, Malaysia has concentrated on developing a digital talent pipeline, starting with basic computer skills among children and youth, which should translate into more adults entering the fields of IoT, big data analytics, and AI. Malaysia has included coding as a subject in year six (12-year-old students) since 2016. MDEC has also partnered with the Ministry of Education (MOE) in a variety of long-term talent development programs. In 2019, MOE announced that a design and technology curriculum related to AI and computer programming would be introduced in schools at the beginning of 2020.[174] Most recently, the approved 2021 budget also increased the funding for technical and vocational education and training programs, allocating RM6B of funding.[175]

Ethics

During the COVID-19 pandemic, Malaysia also focused on another AI building block: strengthening its data governance policies. The *Personal Data Protection Act* of 2011 is under review by KKMM, who is working with multiple government agencies, including MDEC, to update it according to current and future technology demands. This is a particularly salient issue as the protections and protocols applied to handling, processing, and storage of data collected through Malaysia's COVID-19 contact tracing application – MySejahtera – remain unclear. Ethical questions for AI applications centre on issues of data protection, use, and privacy. While the *Personal Data Protection Act* from 2010 protects personal data of the domestic data subject, and Malaysian courts have been quite active in enforcing it, the act has not kept up with the amount of new data and types of data generated as Malaysia's

digital economy expands and more operations and businesses come online.[176] The strictest protection in policy is afforded to financial information, something that will be changing in the future as new laws on personal data protection and security standards are expected between 2021 and 2022. Government representatives and civil society organizations are also concerned about how AI (combined with its prerequisite infrastructure foundations like internet access) may exacerbate inequality in Malaysia. Government frameworks and policies like SPV2030 often try to address income inequality by focusing on its low-income group – also known as B40 households – making it a must that educational, welfare, and employment programs contribute to stopping cycles of poverty.

INTERNATIONAL LINKAGES

At the international level, Malaysia endorses several international frameworks related to AI, like data governance and science and technology plans under ASEAN. These include the following:

- Ministerial Understanding on ASEAN Cooperation in Telecommunications and Information Technology (2001), which entails collaboration among ASEAN member states in telecommunications and IT to foster development in the region and an attractive ICT environment;

- ASEAN Agreement on Electronic Commerce: member states agree to foster an enabling legal and regulatory environment conducive to competitive business practices and to facilitate cross-border e-commerce; and

- ASEAN Framework on Digital Data Governance.

Another major multilateral organization for co-operation on AI and related fields has been APEC, which Malaysia chaired through 2020. During this time, Malaysia heavily emphasized the digital economy in the region, framing Fourth Industrial Revolution innovations as opportunities for technology-led development. One of its key goals as chair was to work with other APEC countries in projects and policies that enabled larger segments of industry and society to adopt new technologies.

International entities also play an important part in the development of Malaysia's AI ecosystem. For instance, China's Alibaba has been implementing its smart-city technology in Kuala Lumpur since 2018. The project, endorsed by MDEC, brings a whole suite of AI-enabled smart-city tools, including digital and physical ones like smart traffic lights designed to reduce traffic congestion. The tech giant also collaborated with MDEC in launching Malaysia's first Digital Free Trade Zone (DFTZ) powered by Alibaba's AI and big data analysis

technology. The DFTZ will serve as an international logistics hub facilitating cross-border e-commerce for Malaysian enterprises, particularly to and from China. It also provides talent training and funding for those requiring it.[177] Other capacity-building projects, which will provide technical and policy guidance in the digitization of micro, small, and medium-sized enterprises, are also on the roster, with Huawei[178] and HSBC[179] as partners.

Mexico

INTRODUCTION

Recognizing the opportunities for economic and social development presented by AI, Mexico has prioritized policy formulation and investment in AI since 2017. In 2018, Mexico became one of the first countries in the world to formulate and release a national AI strategy. Since the publication of its national AI strategy, Mexico has made great progress in key building blocks that sustain digitalization and AI adoption, mainly in connectivity and digital talent development. Approximately 72% of Mexico's population used the internet in 2020. However, the digital divide is still a major challenge, particularly between urban and rural areas: 78% of city residents have internet access, compared to 50% of rural residents.[180] The government has committed to nearly universal internet and mobile coverage at a national level by 2023.[181] Government efforts have also focused on several programs that encourage digital inclusion and development of digital skills to prepare its workforce for AI.[182] However, after a change of government in 2018 and the 2020 COVID-19 pandemic, Mexico's priorities have shifted away from its AI agenda.

GOVERNMENT

Capacity Building

Mexico has prioritized digital transformation and created supportive policies to govern data-driven technologies, embodied by its National Digital Strategy released in 2013. The strategy set out a five-year plan to encourage the adoption and development of ICTs, with the purpose of creating a "digital Mexico" and an information- and knowledge-based society. The document has five objectives: (1) government transformation and public service provision through the adoption of ICT; (2) develop a digital economy ecosystem; (3) integrate ICT into the educational system as part of both teaching and learning processes; (4) create a comprehensive digital health policy to increase coverage and access to public health services; and (5) use ICT to prevent social violence and better prepare and mitigate the impact of natural disasters.[183]

Furthermore, according to the OECD, Mexico has progressively built foundational institutional and organizational capacity to leverage the use of data in the public sector. These efforts have led to the successful implementation of the Gob.mx online portal for citizens to access public services. The government also launched a new Digital Academy, an online platform for training and educating civil servants, and has organized digital government training workshops to upskill public workers.[184]

Toward an AI Strategy in Mexico: Harnessing the AI Revolution

Mexico's 2018 national AI strategy was developed by the government of Mexico's National Digital Strategy office, the British Embassy in Mexico, Oxford Insights, and the civil society organization C Minds. The report's recommendations centred on the creation of inclusive governance for AI, with the government as the key leader in developing a multi-sector 2030 AI roadmap. The report also urged the country to strengthen AI research and development through public investment and a national AI research centre. Lastly, it recommended that Mexico increase AI talent development, broadening AI learning beyond computer science and STEM in public and private universities, by teaching computational thinking in schools while increasing the number of graduate students in AI and data science. The federal government recognized the report as a national policy on AI and created an AI sub-commission, led by the Office of the President. The sub-commission has official participation from industry, civil society, academia, and local governments.[185]

Sub-National leadership

Since 2019, the federal government has not been as engaged with or prioritized AI initiatives compared to previous years. However, the 2019-2024 administration has focused on continuing to expand internet connectivity infrastructure to close the domestic digital divide. The current administration has also launched the Data Mexico initiative, providing improved public data for research and evidence-based policy-making. Further, taxation authorities at the federal level have been among the first to adopt and become sophisticated users of AI and data science technologies.[186]

Most leadership in government is seen at the state level, particularly the states of Jalisco and Nuevo León, the special economic zone of Yucatán, and Mexico City (which functions at the same level as a state), where the states continue to act on the recommendations put forth in the 2018 strategy. The state government of Jalisco has emerged as a key hub, supporting AI development and adoption as well as local startups. It has an Innovation, Science and Technology Secretariat at the state level, which supports scientific research for both academic and civil society organizations. It also provides higher-education scholarships for STEM students. Jalisco's Innovation Secretariat has a specialized office for AI supported

by the Inter-American Development Bank and the university Tecnológico de Monterrey. The state agency also works with the private sector to attract investment, particularly for technology development and adoption.[187]

Nonetheless, Mexican stakeholders from academia and civil society interviewed for this project continued to emphasize the key need for government leadership at the federal level. This is particularly needed for the development of more targeted AI regulation for individual applications, cybersecurity standards, and personal data protection regulation. Greater support for funding on AI research, as well as federal government leadership in connecting academia with private sector actors for AI development and commercialization, remain important areas for Mexico to work on.

PRIVATE SECTOR

In the last few years, the entrepreneurial ecosystem for AI technologies in Mexico has been booming. Notable startups have popped up, offering AI-driven productivity tools for business operations to securely facilitate digital interactions with consumers. Businesses developing and commercializing AI products for consumers are also growing in the financial and health technology sectors. For instance, Prosperia Labs is a health tech startup focusing on improving early detection and treatment of chronic diseases through AI and computer vision. It counts on support from the US-based non-profit startup accelerator, MassChallenge.

Financial technology is a key sector for Mexico's AI ecosystem, supported by policy from the Central Bank of Mexico, the National Banking and Securities Commission, and the Ministry of Finance. Mexico has been a leader in fintech, boasting the most fintech companies after Brazil in 2020. It has also been proactive in policy, creating the *Ley para Regular las Instituciones de Tecnologia Financiera* (also known as the Fintech Law) in 2018, which imposed licensing requirements for e-wallet, crowdfunding, and digital banking companies. Mobile payment, remittances, and lending services have been the most active, providing funding and banking services to SMEs as well as to unbanked consumers, who total approximately 50% of Mexico's population. Private investment for fintech startups in Mexico grew by 190% in 2021 alone, with Konfio being a promising newcomer to the scene. The startup provides digital banking and software tools for SMEs, as well as capital loans and corporate credit cards.[188]

Mexico also has key sectors where AI applications can thrive, particularly for process, operations, and logistics automation. A promising sector for AI application is agribusiness, particularly in tools for better tracking the sale and movement of key commodities from producers to market. According to experts in Tecnológico de Monterrey, the Mexican

conglomerates, mainly run by families, are interested in AI tools to better understand and optimize their own supply chains for products in the vegetable, poultry, and meat industries. Similar supply-chain insight and transparency through AI could also aid growth and increased productivity among SMEs.

SOCIETY

Civil Society Leadership in AI

Mexico has numerous civil society organizations and initiatives supporting AI adoption through talent development and policy advising. Motivated by the recommendations for AI adoption in the 2018 strategy, 10 institutions from academia, government, and industry created the IA2030Mx coalition. In collaboration with the AI sub-commission, the association has created and updated the Artificial Intelligence Agenda MX through 2019-2021. The AI agenda identifies challenges and provides recommendations within six strategic pillars: (1) data, digital infrastructure, and cybersecurity; (2) ethics and a human-rights approach to AI development and regulation; (3) research and development, fostering greater cross-sectoral collaboration on AI across academia and industry; (4) government leadership for digital transformation and policy formulation for the application of AI in public services; (5) increasing and diversifying AI-related digital skills and education for workers, students, and micro, small, and medium-sized enterprises; and (6) strengthening engagement with Mexican diasporas living abroad, applying AI tools to improve education among vulnerable, migrant, and displaced groups.[189]

Another key player in Mexico's AI ecosystem and co-founder of the IA2030Mx coalition is C Minds, an institution led by women dedicated to fostering innovation and accelerating the impact of disruptive technologies like AI in Mexico and Latin America. C Minds is the volunteer co-ordinator of the coalition through 2019-2020 and a major stakeholder working with civil society, academia, and government to align AI adoption with Mexico's sustainable development goals.[190]

Similarly, higher-education institutions have been key to developing AI-ready talent, conducting research, and pushing the national AI agenda. This includes both the Tecnológico de Monterrey and the Universidad Nacional Autónoma de México (UNAM). Both institutes offer post-graduate and PhD-level education and research opportunities in AI. UNAM in Mexico City focuses mainly on foundational AI research, while Tecnológico de Monterrey in Guadalajara is an AI hub focusing on industry needs like cybersecurity and smart manufacturing. Similar AI-related programs are also available in multiple public and private higher-education institutions in the country. Hence, Mexico has a large pool of tech talent, from PhDs to software engineers, with a high bilingual proficiency in Spanish and English.[191]

INTERNATIONAL LINKAGES

In terms of AI policy frameworks, Mexico is a signatory to the OECD's AI principles, but the application of specific recommendations is still in its early stages. Mexico's closest AI and technology linkages are with the United States. The technology hub in the state of Jalisco and its capital, Guadalajara, attract major US-based tech companies including Intel, HP, and IBM. Amazon and Intel also have research and development facilities there. More recently, Mexico has strengthened its relationships and partnerships with South Korea and Germany, mainly through university ties. Mexico is a key recipient of South Korean investment, with funds increasing by 144% in the last five years.[192]

Singapore

INTRODUCTION

Singapore is a high-income economy and leader in the digital economy space.[193] In fact, "the majority of recent e-commerce investments in the region went to companies based in Singapore and Indonesia."[194] Singapore also has the geographic advantage of being located at the heart of Southeast Asia. In 2020, a joint report by Google and the investment firm Temasek forecasted that Southeast Asia's digital economy will boom to over US$200B by 2025.[195] Singapore is the undoubted leader in Southeast Asia for AI adoption and is a global trailblazer as well. Proactive government policies and infrastructure, built on a robust innovation and technology framework, are coupled with serious monetary investment.

GOVERNMENT

Capacity Building

The Singaporean Infocomm Media Development Authority released an overarching Digital Economy Framework for Action that provides the foundation for the rollout of AI and other Industry 4.0 technologies in Singapore.[196] Under this framework, Singapore is working to grow its digital economy by developing four main "enablers": workforce talent, research and innovation, policies and regulations, and physical and digital infrastructure.[197]

National AI Strategy

In 2019, Singapore released a National AI Strategy document through the Smart Nation and Digital Government Office and the National AI Office. The strategy has three main goals: (1) identifying AI development priorities on which to focus national resources; (2) strategizing how the government, academia, and industry can work collaboratively to fully utilize AI; and (3) addressing the possible risks of AI adoption.[198] Through these three approaches,

Singapore hopes to become a global leader in AI by 2030.[199] The national strategy takes a two-pronged approach, tackling national AI projects and AI ecosystem enablers.[200] Under the National AI Strategy, there are five ecosystem enablers "to anchor AI innovation and adoption across the economy."[201] The first and core enabler is the triple helix partnership, which brings academia, industry, and government together through AI Singapore, the national AI research program established by the National Research Foundation in 2017.[202] The second enabler is AI talent and education development programs. The third enabler is developing data architecture through the 2018 Government Data Architecture Strategy, which strives to increase government use of data by 2023.[203] Fourthly, the Singaporean government works to gain its citizens' trust through its Model AI Governance Framework, which provides guidance on the responsible use of AI for any organization.[204] Finally, the fifth enabler of the AI National Strategy is focused on growing neutral international collaboration both regionally and globally.[205]

Research and Development

The state-run National Research Foundation will invest S$150M over five years into AI Singapore.[206] In 2020, Singapore also allocated S$24B over the next three years to help businesses adapt to the post-COVID world, with S$1B earmarked for helping firms adopt digital solutions, including AI.[207]

PRIVATE SECTOR

The Services and Digital Economy Technology Roadmap is a key component of the Digital Economy Framework for Action. The focus of the roadmap is to visualize the future of Singapore's "Services 4.0" – or how new services and technologies can be successfully incorporated into the Singaporean services industry. Some of the roadmap's key goals include making new technologies more accessible and creating a more inclusive ecosystem for all sizes of companies.[208] Under the National AI Strategy, there are also five national AI projects that seek to establish AI adoption across a breadth of sectors including transportation, logistics, smart cities, health care, education, and security.[209] The following are three snapshots of AI applications across different segments of Singapore's private sector:

1. **Revolutionizing Health Care: Diagnosing Heart Disease and Screening for Mental Health Illnesses With AI**

Singapore's medical sector is booming with AI-powered tools that revolutionize the quality of health care. First, a joint research team from the Nanyang Technological University and the National Heart Centre Singapore developed a heart disease screening tool powered by AI that analyzes electrocardiogram signals to identify healthy patients versus those with cardiovascular diseases. The pilot study's results were over 98.5% accurate in identifying

three unique heart conditions.[210] AI has also been applied to a software program that screens for mental health illnesses in the elderly by analyzing facial expressions for positive and negative emotions in real time.[211]

2. **Rethinking Digital Wealth Management: Bambu's AI Robo Advisor**

As early as 2018, Bambu was identified as a top Singaporean fintech company to watch. Founded in 2016, Bambu announced that it would be expanding operations outside of Asia in March 2020.[212] Over the last few years, Bambu has leapt from success to success, providing AI-powered digital wealth technology to prestigious firms like HSBC and Standard Chartered Bank[213] all around the world. Bambu offers finance robo-advisor services as well as a wealth management Application Programing Interface (API) library and a portfolio-builder program.

3. **Looking to the Future: Infrastructure Maintenance and the Military**

In late June 2021, the Republic of Singapore Air Force announced that it plans to trial the use of AI-powered drones to help detect and assess runway damages at the Paya Lebar Air Base, thereby reducing the time and labour needed to deal with such damages. These trials are part of a broader initiative to integrate multiple Industry 4.0 technologies (i.e., robotics, data analytics, and artificial intelligence) into air force operations.[214]

SOCIETY

Education and Human Capital

Under the National AI Strategy, human capital is identified as a crucial component for AI adoption. The second enabler under the Strategy is AI Talent and Education development, which aims to keep Singapore's workforce properly skilled to match the economic disruptions caused by AI adoption by offering post-graduate fellowships, an AI Apprenticeship Program, and the SkillsFuture for Digital Workforce Programme.[215]

Ethics

As a society, Singapore takes technology ethics very seriously both in regulation and research. In addition to the AI Governance arm included under AI Singapore, the Research Programme on the Governance of AI and Data Use established by the Singapore Management University School of Law provides further scholarly research on the ethics and regulations of AI and data usage.[216] There is also the AI Ethics and Governance Body of Knowledge, a live digital repository of AI guidelines jointly maintained by the Singapore Computer Society and the Infocomm Media Development Authority.[217] Meanwhile, the FEAT Principles (2018)

address AI and data analytics ethics in the finance sector[218] alongside Veritas (2019), which provides guidance on how financial institutions can verifiably enact the principles in their operations.[219]

INTERNATIONAL LINKAGES

Singapore has successfully sought to establish itself as a regional and global leader in AI and AI's accompanying foundational requirements like cybersecurity. In 2016, it hosted the inaugural ASEAN cybersecurity conference and proposed the ASEAN Cyber Capacity Program.[220] When it took over as ASEAN chair in 2018, Singapore made it clear that cyber issues, e-commerce, and the digital economy were top priority concerns,[221] and in 2021 it gained approval for the establishment of an ASEAN cybersecurity centre for excellence in Singapore.[222] Singapore is also a founding member of the DEPA, which explicitly addresses ethical AI usage and regulation.[223] Beyond the region, Singapore has engaged with global organizations like the World Economic Forum through the WEF Centre for the Fourth Industrial Revolution to develop and promote the Model AI Governance Framework.[224] Finally, Singapore has also pursued bilateral AI R&D partnerships with French research institutions.[225]

Emerging AI Economies

Emerging AI Economies are in the process of building readiness and advancing capabilities in private sector activities and investment, talent development, and international linkages. They have great potential to accelerate AI adoption because they have certain strengths in AI (e.g., large population, strong AI national strategy, high AI adoption in key sectors, and thriving startup environments).

Indonesia

INTRODUCTION

Indonesia's national policies all consider AI as the key instrument to revitalize industries such as petrochemicals, textiles, and so on that play a significant role in the Indonesian economy but have struggled to gain international competitiveness. For example, Making Indonesia 4.0 is the roadmap for adoption of AI in five key industrial sectors: food and beverage, textiles and clothing, automotive manufacturing, petrochemicals, and electronics. Under the roadmap, Jakarta hopes to improve the production capabilities of the textile and other manufacturing industries using Industry 4.0 technology, including AI, through efficient automation and supply-chain management.[226] Indonesia aspires to join the world's top 10 economies by 2030 through technology-led development. The National Industrial Development Master Plan 2015-2035 also supports innovation and adoption of Fourth Industrial Revolution technologies (AI, IoT, 3D printing, etc.) to accelerate development and catch up with already developed economies. However, Jakarta hopes to not only promote self-reliance in the industrial sector and reduce dependence on the export of raw materials, but also to create a self-reliant AI ecosystem in Indonesia that is competitive internationally.

GOVERNMENT

Capacity Building

Indonesia has numerous technology policies that support the adoption of AI and other Industry 4.0 technologies: Vision of Indonesia 2045 (Visi Indonesia 2045) released in 2019, Making Indonesia 4.0 (2018), National Industrial Development Master Plan 2015-2035, Presidential Regulation No. 95 of 2018 on Electronic Based Government System, and Indonesia E-Commerce Road Map 2017-2019. Of these policies, Visi Indonesia 2045 is the main national development strategy that ties the archipelago's multiple technology policy programs to its sustainable development goals.[227]

National AI Strategy: Stranas KA

In August 2020, Indonesia released its national AI strategy, known as Stranas KA (Strategi Nasional Kecerdasan Artifisial in Bahasa), drafted by a consortium of government, academic, and industry stakeholders led by the Ministry of Research and Technology and the National Research and Innovation Agency. Stranas KA is intended to serve as the blueprint for domestic research, development, and application of AI technologies from 2020 to 2045. It targets four key areas of support to promote Indonesia's nascent AI ecosystem: (1) ethics and policy; (2) talent development; (3) infrastructure and data; and (4) industrial research and innovation. Stranas KA also outlines Indonesia's industry areas where AI applications offer the most promise for development and achieving the Visi Indonesia 2045 goals: (1) improving telemedicine and further digitizing health-care systems; (2) AI applications for e-government services, informing policy-making, and reducing bureaucratic processes; (3) using AI to standardize education curriculums while simultaneously providing some level of customization; (4) using AI technology to track agricultural and fishery production, improve and forecast yields, predict crop failures, and manage food and natural resources to minimize food security issues; and (5) developing smart cities where AI aids in city planning, transportation management, and citizen services.[228]

Research and Development

Indonesia's AI ecosystem also has numerous think tanks – independent or associated with various universities – actively involved in several AI initiatives and providing consultation to the government. The ELSAM research centre, for instance, has advocated for issues such as personal data protection, cybersecurity standards, and a human-centred approach to AI.[229] From a policy perspective, there is the National Research Master Plan 2017-2045, which seeks to apply AI toward research in national research priorities: food security, energy and renewables, health and pharmaceuticals, ICT, defence and security, and advanced materials. However, R&D funding is still woefully low, with the most recent World Bank data (2018) for Indonesia showing that R&D expenditure only accounts for 0.23% of national GDP. It should be noted that this statistic encompasses overall R&D expenditure and not just AI-specific R&D.

PRIVATE SECTOR

AI adoption among businesses in Indonesia is quite high, leading the region with a quarter of tech companies adopting AI, according to IDC. Indonesia's e-commerce, ride-hailing, tourism, and fintech (i.e., micro-lending, P2P loans) have been the most successful sectors in terms of investment attraction and commercialization. Indonesian startups and other industry players in several sectors have created formal and legally recognized associations for mutual support, capacity building, education for policy-makers on technology, public

advocacy, and consumer engagement. They also collaborate with academics and other experts and set up industry best practices. The following are three snapshots of AI adoption across different segments of Indonesia's private sector:

1. **Rise of the Superapps: Gojek and Grab**

The creation of "superapps" – a single app housing multiple, distinct services – is perhaps the Indonesian tech sector's crown jewel. The two superapp giants (and rivals) in Indonesia are Gojek and Grab. Both tech startups have their roots in ride sharing but have quickly grown to offer AI-powered services from ride sharing and digital wallet services, to e-commerce and health care. Grab, for example, uses AI in its ride-hailing service to streamline operational efficiency by matching drivers and riders based on multiple factors such as the driver's profile, location, and the time of day.[230] Grab is further planning to expand its use of AI to improve transportation across Southeast Asia, targeting issues such as traffic congestion and transportation safety. Meanwhile Gojek, which completed a merger with Indonesian e-commerce giant Tokopedia in June 2021,[231] uses AI facial recognition in its drivers' login system as a security measure.[232] Notably, both Gojek and Grab use AI facial recognition to prevent user fraud across their services.[233]

2. **Intelligent Telemedicine: Good Doctor, Halodoc, and Alodokter**

In the health-care industry, Indonesia is making huge strides in rolling out AI adoption in telemedicine. In the Indonesian telemedicine sector, there are three key players: Good Doctor Technology (GDT), Halodoc, and Alodokter. GDT is a major signifier of the booming Indonesian AI telemedicine market that attracts substantial foreign investment. GDT is the product of collaboration between three different tech firms: Indonesia's Grab, China's Ping An Good Doctor, and Japan's SoftBank.[234] The Good Doctor app provides AI-powered booking and e-consultation services with medical professionals as well as a linked pharmacy service for prescription purchasing and delivery. Similarly, Halodoc and Alodokter both provide medical e-consultations and medicine delivery, partnering with the government to provide free telemedicine services during the COVID-19 pandemic.[235]

3. **Building Cities of the Future: Nodeflux and Smart Cities**

Nodeflux specializes in facial recognition algorithms, and it has partnered with the Indonesian government on smart cities, developing software to identify vehicles with unpaid taxes. Nodeflux technology is also used by the police in enforcing security, such as by identifying suspects on public CCTV.[236] Other Indonesian tech giants like Tokopedia, Grab, and Gojek are also involved in smart city development, specifically regarding transportation systems and the creation of a "smart economy."[237]

SOCIETY

Education and Human Capital

In education, Indonesia faces concerning disparity between men and women. While Indonesia has relatively high percentages of female graduates in STEM and ICT fields and the country scores well for leadership opportunities for women in industry, Indonesia still has one of the widest gaps in internet access among emerging economies. Women and girls in Indonesia also have less access to mobile phones and internet access than men, with 72% of women owning a mobile phone compared to 80% of men.[238] On a positive note, the private sector also has been very proactive in addressing national strategic goals, mainly the talent shortages in Indonesia. While Indonesia has a young and growing population, it faces a deficiency in properly skilled workers for an increasingly digital future. Numerous sector-specific projects for research and education in AI have cropped up, like Tokopedia's AI research centre in partnership with the University of Indonesia.[239] Bukalapak, another e-commerce leader, also jointly founded the AI and Cloud Computing Innovation Centre for education and research with the Bandung Institute of Technology.[240]

Ethics

High-profile data leaks have become more frequent, making the matter of data protection more salient. For instance, in 2020 Tokopedia reported a data leak affecting approximately 91 million users.[241] There have also been conversations on the ethical ramifications of certain AI-enabled digital products, particularly in the fintech space, where P2P lenders have been infamous for unethical and privacy-violating practices in the interest of collections. There are also discussions about the level of de-anonymization of data sets earmarked for AI uses, with some advocates arguing that information like political affiliations should also be considered personally identifiable.

As the world's fourth-most populous country, with a 2019 population of 266.91 million people, and Southeast Asia's largest market, Indonesia has the potential to become a data generation giant comparable to China.[242] Effective data governance that balances innovation and privacy protection is a top priority for the Indonesian government and industry. Indonesia has looked at the European Union's GDPR as a benchmark, but it lacks comprehensive and clear privacy regulations and data governance frameworks, particularly cybersecurity standards and enforcement and law-backed protocols on data collection, use, and sharing. To address this gap, Jakarta has submitted a draft of the Personal Data Protection law to parliament, which is projected to be passed in 2021.[243] The need for data sovereignty is explicitly highlighted in Stranas KA as a key goal of the roadmap. Jakarta has clearly expressed its preference for data localization, which would provide greater agency

over data generated within Indonesia, while international tech leaders with investments in Indonesia have advocated for freer flow of data across its borders.

INTERNATIONAL LINKAGES

Stranas KA emphasizes the need for Indonesia to collaborate with other countries on the joint development of AI. Indonesia is also looking to further its collaboration efforts with international universities on research, algorithm development, and practical applications within the identified five priority areas. Like Malaysia and the Philippines, Indonesia has strong regional ties through ASEAN. Moreover, Indonesia is a member of the G20 and ascribes to the G20 AI principles put forth in Osaka in 2019. This is also a platform for engagement with other countries on AI governance and research.

Peru

INTRODUCTION

Peru has prioritized digitalization and the adoption of new technologies since 2006 with the launch of its first Digital Agenda. The country also established the Secretariat of Digital Government and Digital Transformation in 2017, a government agency tasked with overseeing and leading digitalization in Peru. The agency handles the implementation of key policies relevant to AI adoption and manages the government's platforms for public services. While the Andean economy is not among the largest in Latin America (in market size), it has been one of the best-performing economies in the region, also boasting a rapidly growing startup scene.

GOVERNMENT

Peru's government has been very active in issuing policies that support the adoption of new, internet-enabled technologies. The new Bicentennial Digital Agenda, published in February 2020, outlines the strategies, goals, and concrete actions to promote and deploy digital technologies (including AI) to foster economic growth and competitiveness and improve Peruvians' quality of life. To date, this major policy program has published three national strategies on data governance, cybersecurity, and artificial intelligence. Strategies for digital innovation and digital talent creation are currently under development.[244]

Peru's National AI Strategy has been proposed for the period of 2021-2026 and will be updated every two years according to technological advancements and Peru's internal situation. The strategy has six pillars:

1. **Talent:** Train and attract AI professionals for research, development, and use of AI. Close education and training opportunity gaps for women and minority groups;

2. **Economic model:** Promote the development of AI and its adoption to boost economic development and welfare. Support national-level and local governments in development and adoption of AI tools for evidence-based policy-making and public service delivery. Create and expand programs to support startups and encourage private sector R&D on AI;

3. **Digital infrastructure:** Strengthen digital and telecommunications infrastructure in the country to facilitate widespread use of AI. In addition to investing in 5G infrastructure, particularly through public-private partnerships, this pillar also includes better educational infrastructure for AI and machine learning in higher-education institutions in growing need of broadband connectivity and computer equipment;

4. **Ethics:** Adopt ethical guidelines for the sustainable, transparent, and replicable use of AI with clearly defined data protection and responsibility principles. Also, implement the OECD's principles on AI, and create regulatory sandboxes to monitor, support, and promote ethical and responsible uses of AI;

5. **Data:** Make Peru a leader in the accessibility of open data in government. Also, turn Peru into a open and trusted source of diverse data, such as Peru's Indigenous languages and biodiversity; and

6. **Collaboration:** Create a collaborative AI ecosystem within Peru and abroad. Under this pillar, the government seeks to promote collaboration between industry and academia, among domestic universities, and with international research and higher-education institutions. Peru has also proposed the creation of a Pacific Alliance for Artificial Intelligence.

The AI strategy also calls for the creation of a national AI centre of excellence, as a critical organization to foster talent development and AI adoption across public and private sectors. The centre would be a research institute for AI with individual projects or with projects in collaboration with industry or academia. The centre would also identify and research key niche areas for AI with high impact for Peru's digital economy.[245]

PRIVATE SECTOR

AI development and adoption in Peru's private sector is led by large companies and economic groups. The main organizations using AI in the country include family-owned conglomerates like Breca Group and Intercorp. Banks and telecommunications companies in Peru are also

sophisticated AI users, employing AI for better customer communications, as well as risk scoring, know your customer, and fraud detection processes.[246]

Mining is a critical economic sector in Peru that is also rapidly adopting AI applications. Peru is rich in mineral resources such as copper, gold, silver, and lithium. It is the world's second-largest producer of copper and silver. It is also the largest gold producer in Latin America. According to the country's Energy and Mines Ministry, Peru has over 200 mines operating currently and 48 additional projects in development between 2020-2025.[247] Peru's mines are adopting AI to improve metal extraction from mined materials and throughout the grinding process. Mining companies like Volcan are also using sensors and AI to inform decision-making on operations and monitor mine safety.[248]

Financial technology is another promising sector with ample opportunities and growing adoption of AI. Peru has approximately 120 fintech startups providing banking and financial services to underbanked populations and SMEs.[249] Around 14 million Peruvians do not have a bank account, providing a fertile market for fintech startups working on financial education and inclusion.[250] Top services provided by fintech startups include digital payments, remittances, foreign exchange, and financial management tools for individuals and small businesses. Large banks have also warmed to the idea of partnering with up-and-coming financial startups.[251] For instance, in collaboration with Peruvian banks BBVA, Interbank, and Scotiabank, YellowPepper (a Miami-based startup) launched PLIN, an app facilitating peer-to-peer money transfers.[252]

Peru also has vast opportunities for AI applications in its e-commerce and agricultural sector. E-commerce has boomed in the country over the COVID-19 pandemic, with lockdowns and other mobility restrictions keeping small businesses shuttered. Small, family-run shops have increased their use of messaging applications like WhatsApp and digital payment/e-wallet platforms like Yape, PLIN, and Tunki (all Peruvian fintech startups) to operate their businesses. At the same time, they have also increased their uptake of B2B e-commerce platforms to reach out to and purchase from suppliers.[253] The sector is further supported by other startups providing delivery and shipping logistics such as Chazki (Peru-based) and Rappi (Colombian food delivery startup). Despite the ravages of the pandemic, Peru's agricultural sector remained stable, with the production of eggs, chicken, pork, and milk increasing significantly.[254] AI applications within the agricultural supply chain for such food staples could facilitate growth, cost-reduction, and transparency, particularly for small producers.[255]

SOCIETY

Peru's largest challenge by far is addressing its digital divide. According to the World Bank, approximately 65% of Peruvians have access to the internet.[256] Internet use is also limited by high prices for mobile data plans and for acquiring a device.[257] The Secretariat of Digital Transformation identified a large gap in schools with internet connections and proper technological equipment for teaching in 2018. According to UNICEF, 9 in 10 homes in Lima had internet access in 2019. However, the number drops for other urban centres (8 in 10 households), and more significantly for rural areas, where only 4 out of every 10 households had internet connections.[258] While free internet programs created by the government have contributed to connecting students from rural and remote areas over the 2020 pandemic,[259] closing gaps to internet access in the long term, particularly for education, will be critical for AI talent development.

According to the Inter-American Development Bank, Latin America suffers from a lack of public trust in government actors, with Peru being no exception.[260] This issue was also highlighted by Peruvian experts interviewed for this project, noting that the public tended to disbelieve policy promises and the government's capacity to enforce or adequately fund programs for education or poverty alleviation. This same distrust can also colour society's perspectives on AI development and adoption, with citizens doubting Peru's capacity for monitoring and enforcement of trustworthy AI.[261]

Despite the challenges, Peru has multiple advantages conducive to widespread AI adoption. First, it has robust research on AI coming from both public and private universities. According to the Government and Digital Transformation Secretariat, Peru's top 10 universities have published research on AI. Research publications on AI grew by 400% over the last seven years, peaking in 2020 (to date). Most of Peru's publications on AI comes from researchers in the fields of engineering, computer science, and medicine, key scientific and talent strengths for the country.[262] Second, Peru has an active and engaged civil society sector promoting AI uses and providing research and policy guidance for government and industry. For instance, Lima-based non-profit Hiperderecho promotes digital literacy on emerging technologies like big data and AI. It also conducts research on public policy and best practices to safeguard the rights of Peruvians in digital spaces. In the areas of research and education, KapAITech is a group of researchers working on AI fundamentals, deep learning, and operationalizing privacy principles in AI. Data Science Research Peru is also a non-profit focused on talent development and research to tackle social challenges in Peru.

INTERNATIONAL LINKAGES

Peru is increasingly connected in the technology fields, starting with being one of six Latin American economies that have adopted the OECD AI principles. The Andean country is also a member of the Pacific Alliance (PA), which also includes Mexico and Chile within APEC. PA focuses on regional integration to facilitate the mobility of goods, services, resources, and people within member countries. The alliance also has a digital agenda, promoting the growth of digital economies, connectivity, and digital government in member economies. Peru has also had strong collaboration on technology programs with South Korea since 2017. Seoul supported the creation of the Korea-Peru e-Government Cooperation Center to aid in the digitalization process of government services and open data. Both economies will work together on a National Center for Digital Innovation to promote the use of and research on data science and AI.[263] Canada and Peru also have a strong trade relationship, particularly in mining ore products. The Andean economy is also the second-largest destination for Canadian direct investment in the region.[264]

Philippines

INTRODUCTION

The Philippines is in the early stages of AI development but has progressed rapidly, hitting major landmarks. The country has a cohesive National AI Roadmap, bolstered by other government legislation. In terms of cybersecurity, there is the Data Protection Act of 2012 and the new Cybersecurity Plan 2022.[265] For digital infrastructure development, the government has passed the National Broadband Roadmap, the Common Tower Policy, and the new Philippine National ID System.[266] The Philippine government has released more industry-specific initiatives, such as the E-Commerce Roadmap for the e-commerce sector and the IT-BPM Roadmap for the information technology and business process management industry.[267] As an emerging economy in transition, the development and implementation of AI nationally will play an integral role in the country's future.

GOVERNMENT

Capacity Building

The overarching national program leading digitalization in the country is the Inclusive Innovation Industrial Strategy (i3S). Under i3S, the government published the Draft Inclusive Filipinnovation and Entrepreneurship Roadmap in 2019. The roadmap illustrates six strategic actions: (1) building the Philippines' innovation and entrepreneurship ecosystem; (2) embracing Industry 4.0 technologies; (3) integrating the production system, strengthening domestic supply chains, and increasing involvement in global value chains;

(4) promoting innovative enterprises and startups; (5) investing in digital and other physical infrastructure; and (6) upskilling/reskilling human capital nationally.[268]

National AI Roadmap

In addition to iS3, the Department of Trade and Industry recently released an AI Roadmap in May 2021. The roadmap identifies four dimensions of AI readiness: (1) digitization and infrastructure; (2) research and development; (3) workforce development; and (4) regulation. These dimensions are supported by 42 strategic actions, which are divided into six categories: (1) improve data access and data value extraction; (2) build a robust connected and networked environment; (3) transform institutions to maximize the impact of AI R&D; (4) build an AI ecosystem "conscience"; (5) transform education and nurture future AI talents; and (6) upskill and reskill the workforce. With the roadmap so new, it remains to be seen how successful the Philippine government will be at achieving the listed targets. A comprehensive plan of action detailing how and when the 42 goals will be achieved has not yet been released.[269]

Research and Development

In terms of R&D, funding has been disappointingly low. According to the 2019 i3S Strategy Document released by the Department of Trade and Industry, "in the last four years, government expenditure for R&D (GERD) in the Philippine national budget has not reached 0.1% of GDP."[270] There is also a lack of strong government incentives to encourage private sector innovation and AI adoption. While the new National AI Roadmap calls for the establishment of a National AI Center for Excellence and has increased funding for both domestic and international co-operation for R&D, a concrete and substantial budget for said initiatives is sorely lacking.[271]

PRIVATE SECTOR

Adoption of AI in the Philippine private sector is still in its early stages and is not yet widespread. However, there have been notable pioneer initiatives in several industries, including the financial, IT-BPM, agriculture, e-commerce, infrastructure, and energy production industries. With a strong digital economy and continuously improving technology infrastructure, the Philippines is well positioned to roll out AI nationwide. AI application in three Philippine private sectors – finance, IT-BPM, and agriculture – demonstrates that the country is on a good path to further digitizing its economy with AI.

1. Bridging the Past and the Present: Agriculture and E-Commerce

The Philippine agriculture sector is particularly struggling to keep up with the boom of e-commerce. However, the implementation of AI has proven to be an unexpected boon for

local farmers. For example, the creation of Krops, an Azure-based e-commerce platform supported by Microsoft's AI-grounded Power BI analytics tool, enables farmers to reach consumers directly through a mobile app, cutting out the intermediary and reducing operational sales costs. Farmers can also use the app to track supply and demand of goods and thereby adjust their production. On the consumer side, location, price, and produce availability are all accessible through the app.[272]

2. Revolutionizing Contemporary Banking: The Financial Sector

A pioneering example of the adoption of AI in the financial sector is the Union Bank of the Philippines' trial in adopting the SAP Data Intelligence system to collect and process data used in the bank's "data science factory" model. The model aims to help customers "hyper-personalize" their accounts and thereby improve customer service. It also aims to streamline operations by increasing the bank's efficiency in providing AI-led services such as automated loan approval.[273]

3. Looking to the Future: Disruption and Growth in the IT-BPM Sector

The IT-BPM industry is at a crossroads with the growing importance of AI adoption in the Philippines. Although the industry has grown to constitute 8% of national GDP in under 20 years, it faces significant logistical hurdles and the threat of decreasing global revenue. On one hand, AI will prove to be a major disruption to the industry as thousands of low- and mid-level skilled jobs are threatened by automation and chatbots. On the other hand, if the Philippines can keep apace by effectively upskilling its workforce, the industry will be boosted further up the global value chain, securing the Philippines' prominence as a major player in the digital economy.[274]

SOCIETY

Education and Human Capital

While the Philippines has a young and growing population ready to enter the workforce and use AI technologies, there is a need to improve workforce skills and education in the country. For instance, while the Philippines performs well in the IMD rankings for science graduates, there is still a need to update school curriculums to further train a forward-looking labour force.[275] Even in the country's leading digital economy sector, the business process outsourcing sector, there has been an urgent need to upskill its workforce in order to move higher up the global value chain and remain a leader in the global digital economy.[276] In its own assessment of digitalization in the country, the Philippine government has acknowledged that the country also lacks the necessary human resources, skilled engineers, and scientists to support AI adoption. Even in basic education, the Philippines has performed

poorly according to the most recent World Bank education report, which was based on the 2019 Program for International Student Assessment. The report found that 80% of Filipino students failed to meet minimum proficiency for their grade levels and placed last in reading and second-to-last in science and mathematics categories. It is critical that the Philippines invests in education and capacity-building programs to prepare students and workers for AI labour market disruptions and to promote innovation in AI applications and commercialization.

Ethics

The Philippines main challenges remain data privacy and protection, as well as cybersecurity, which impact the trust and adoption of technologies like AI domestically. Despite being the second ASEAN country to adopt a data privacy act, low trust from consumers on privacy and security of digital services has constrained adoption of technologies like digital payments.[277] Consumers and small businesses remain very vulnerable to data hacking and other cyber attacks. According to the 2021 study by Cisco, 57% of small and medium-sized businesses in the Philippines suffered cyber attacks in the past 12 months.[278] AI ethics is also a key aspect of the National AI Roadmap; however, the country lacks formal legislation specifically for the ethical use of AI and big data. As AI adoption continues to accelerate nationally across a multitude of sectors from health to law enforcement, ethical and robust government regulation centred around rule of law is essential to the long-term, holistic success of AI in the Philippines.

INTERNATIONAL LINKAGES

The Philippines is blessed with a key geostrategic location at the heart of Southeast Asia that encourages bilateral and multilateral economic linkages with its neighbours. Notably, the Philippines is an active member of ASEAN, giving it strong existing ties to leading tech nations like Singapore and Japan. While the country is lacking in robust R&D, the Philippines can benefit from partnerships with these countries to develop its capabilities for R&D and provide a favourable digital economy for foreign investors. Moreover, as a member of the Belt and Road Initiative and with growing economic relations with China, the Philippines has also benefited from an accelerated pace in the development of critical infrastructure like 5G. Continuing these partnerships and forms of international capacity building is integral to the widespread adoption of AI nationwide.

Thailand

INTRODUCTION

While Thailand has not formulated a national AI policy, the government still considers AI critical for transforming the country into a high-income, knowledge-based, and innovation-driven economy. Thailand's AI landscape, though in an early stage, is developing rapidly, and the government is focused on capacity building, reskilling, and upskilling. The development of AI has received strong support from various ministries in Thailand, notably, the Ministry of Higher Education, Science, Research and Innovation and the Ministry of Digital Economy and Society.

GOVERNMENT

Capacity Building

Thailand's 20-Year National Strategy (2018-2037) includes two key strategies for AI capacity building domestically. Under the Strategy on Competitiveness Enhancement, Thailand primarily aims to develop future industries and services of the Fourth Industrial Revolution (including AI) to enhance the country's competitiveness, and to apply these technologies in the manufacturing and services sectors. Under the Strategy on Developing and Strengthening Human Capital, Thailand aims to develop a modern public health service system by integrating AI to assist with consultation, diagnosis, and disease forecasting. The strategy also highlights the importance of public-private partnerships in investing and carrying out AI projects that create more use cases.

National AI Policy: A Work in Progress

Policy regarding AI in Thailand can be divided into four main components. First is the 20-Year National Strategy,[279] which is central to promoting the development of key industries and services such as robotics, big data, and AI. This central policy is translated into various Five-Year National Economic and Social Development Plans to enhance national competitiveness and economic development via the application of AI, which is the second component. In this category, the two key policies include the 12th National Economic and Social Development Plan and Thailand 4.0. The two strategies advocate for increased R&D efforts in AI and expanding Thailand's AI talent pool. The third main component is to develop an AI ethics guideline. The last component of the policy regarding AI focuses on methods to communicate and increase public understanding of AI.

Research and Development

Thailand is still in the early stages of AI adoption but is seriously pursuing the development of its AI research and other capacities. According to a 2020 study by EDBI and Kearney, AI investment in Thailand, reaching US$0.37 per capita, was the second highest in Southeast Asia.[280] However, it still lags far behind Singapore at US$68 per capita. There have also been public-private partnerships to support R&D growth in Thailand, such as a Huawei-built 5G research centre in September 2020 and the construction of the Chinese tech giant's third data centre worth US$23M in 2021.[281] Finally, the Digital Government Development Agency launched the country's first state-backed AI centre in November 2020 to promote more AI-based platforms within government agencies and upskill state officials on AI and data analytics.[282]

PRIVATE SECTOR

Public-private partnerships have played an important role in Thailand's AI development. This began with a formal endorsement from the government in the 12th National Economic and Social Development Plan, encouraging the private sector to increase investment in key technologies including AI. There is also Thailand 4.0, introduced in May 2016, a sector-specific industrial policy in which the government aims to transform the economy to a digitally oriented and innovation-driven one, focusing on high-value-added manufacturing and services. Thailand has three promising sectors for AI application: infrastructure, medicine, and manufacturing.

1. **Bridging the Past and Present: Manufacturing**

Manufacturing is traditionally a major driver of Thailand's economic development, accounting for 25.3% of the country's GDP[283]. As Thailand's manufacturing sector is plagued by several barriers, such as labour shortages, rising wages, and a maturing consumer market, many manufacturing companies are transitioning to Industry 4.0 by employing AI, big data automation, robotics, and IoT to increase output and productivity.

2. **Revolutionizing Contemporary Health Care: Thailand as a Leading Medical Hub**

Thailand has a strong public health sector, and the government aims to use AI to maintain its position as Southeast Asia's medical hub. Thailand's Board of Investment has actively supported investment and development in the medical robotics sector. In 2017, doctors at Ramathibodi Hospital successfully performed the first robot-assisted brain surgery in Asia. In addition, an AI program to screen for diabetic eye diseases between Google and state-run Rajavithi Hospital was announced in 2018.[284]

3. Building Infrastructure for the Future: The Rise of Thai Smart Cities

AI plays a key role in Thailand's smart-city plans. Aside from being popular tourist locations, Phuket, Chiang Mai, and Khon Kaen were piloted as the first domestic smart cities, home to digital industries and international research and innovation centres. By 2022, Thailand aims to develop 100 smart cities in accordance with Thailand 4.0. In November 2019, the Ministry of Digital Economy and Society signed a memorandum of understanding with Microsoft to establish an AI lab to create advanced solutions for smart farming and smart-city programs.[285]

SOCIETY

Education and Human Capital

Thailand faces a large aging population and labour shortages in its manufacturing and services sectors, which constitute 40% of its GDP.[286] Also, 95% of jobs in Thailand will likely be impacted by change over the next three years, with 30% of the jobs outsourced, automated, or rendered obsolete.[287] However, the number of new jobs created by technological advancement is roughly equal to the number displaced, and 35% of the labour force can be retained. Thailand has so far garnered a strong response in the face of its human capital challenges. Thammasat University, for example, joined the Thailand AI Consortium, which aims to develop a workforce trained to work with AI.[288] There have also been strong public-private partnerships such as the memorandum of understanding between Microsoft Thailand and the Ministry of Higher Education, Science, Research and Innovation to provide digital training classes.[289] Finally, there is Thailand's Smart Visa program, which encourages science and technology talent to live and work in Thailand.[290]

Ethics

Thailand has two key legislations regulating data: The Data Governance Framework (DGA) released in May 2018,[291] and the *Personal Data Protection Act B.E. 2562* (2019) (PPDA) released in May 2019. The DGA provides guidance on the duties of public sector stakeholders regarding the operation and management of data, while the PPDA addresses data localization and transfer processes, supported by the 2019 *Thailand Cybersecurity Act*. Regulating AI more directly is the AI Ethics Guideline Draft, which was submitted by the Ministry of Digital Economy and Society to the Cabinet for endorsement in November 2020. The AI Ethics Guideline demonstrates that Thailand takes a human-centred approach to the development and use of AI, which are the shared responsibilities of all involved parties, both in the public and private sectors.

INTERNATIONAL LINKAGES

Thailand has made efforts to bilaterally engage with other states in developing its digital economy. For example, in June 2021 it began negotiations with Singapore on a digital trade agreement. The agreement notably covers issues like co-operation in developing ethical guidelines for AI, among other Industry 4.0 technologies, and promoting the digital trade participation of SMEs.[292] Thailand is also a member of the ASEAN Smart Cities Network (ASCN) proposed by Singapore in 2018 with the aim of synergizing the efforts of member states in developing their own smart cities. In line with the ASCN, Thailand endorsed Bangkok, Chonburi, and Phuket as its pilot cities within the network. Beyond Southeast Asia, Thailand formed another partnership at a state level with the UK to work on smart-city projects.[293] An example of a project under this program is improving the flood management system of Lat Phrao, a district in the capital city of Bangkok.[294] Meanwhile in the private sector, Thailand has partnered with the global network of the City Possible program, pioneered by Mastercard, to accelerate smart-city development in Thailand's 27 cities.[295]

Vietnam

INTRODUCTION

Vietnam's AI landscape is still in an early stage, focusing on capacity building, reskilling, and upskilling. Since Prime Minister Nguyen Xuan Phuc embraced the Fourth Industrial Revolution in his speech at the country's 2016 ICT Summit,[296] the development of core Industry 4.0 technologies such as AI, blockchain, and IoT and the urgency of building a future-ready workforce have been mentioned in a multitude of government documents and speeches. The first key government document was Directive No. 16 on strengthening the national innovation capabilities to prepare for the Fourth Industrial Revolution, issued in May 2017.[297] Throughout the next four years, various ministries embraced the development and use of emerging technologies in their strategies and programs.

GOVERNMENT

Capacity Building

The COVID-19 pandemic has accelerated digital transformation in Vietnam. In June 2020, the government approved the National Digital Transformation Roadmap 2025, reaffirming the objectives and initiatives of the Industry 4.0 strategy for e-government, e-economy, and e-society. Vietnam's overarching Digital Transformation Program (2025-2030), emphasizes the need for a digital government, economy, and society.[298] It seeks to address many of the basic infrastructure concerns needed to successfully roll out AI, such as improving national connectivity (e.g., fibre optic and 5G services available nationwide).[299]

National AI Policy

In March 2021, the landmark National Strategy on R&D and Application of Artificial Intelligence was released.[300] The strategy sets high goals for the deployment of AI in the country from 2020 until 2030, with the aim of boosting Vietnam to upper-middle income status.[301] It calls for the establishment of three national innovation centres, ten research institutes, and three national big data hubs.[302] Using AI nationwide, Vietnam hopes to improve public sector productivity and strengthen national security.[303]

Research and Development

In September 2018, Vietnam's Ministry of Science and Technology released the Plan for Research and Development of Artificial Intelligence 2025 to increase the research and commercialization of AI technology and develop homegrown AI products. In the past five years, Vietnam has committed to developing a thriving tech ecosystem across three major hubs – Hanoi, Da Nang, and Ho Chi Minh City – under the Program on Supporting the National Innovative Startup Ecosystem to 2025 (Project 844).[304] Project 844 has been tasked with creating a favourable environment for the growth of startups and providing support to 2,000 tech projects and 600 tech startups, of which 100 will successfully attract follow-up investment of C$120M by 2025. Via these objectives, Project 844 has a bigger task of forming closer relationships between the triple helix agents – government, industry, and universities – in Vietnam's innovation ecosystem.[305] Private sector groups like Samsung and Naver have also contributed to R&D efforts in Vietnam through substantial funding, building R&D centres, and co-operating on AI research with Vietnamese universities.

PRIVATE SECTOR

Although the COVID-19 pandemic has certainly upended many innovation programs, Vietnam has capitalized on the crisis. For example, in June 2020, Hanoi University of Science and Technology revealed its plan to launch a US$2M venture fund to invest in early-stage startups.[306] But despite strong government support and increased digitalization during COVID-19, the regulatory landscape for innovation in Vietnam has remained fragmented. Tech startups in the country urgently need a pipeline to efficiently and safely develop, test, and commercialize innovative tech solutions, such as regulatory sandboxes. Still, Vietnam has made progress, as showcased in the following three private sector snapshots:

1. **Supporting SMEs: Pique**

Formerly known as Next Smartly, Pique specializes in AI-powered customer personalization and recommendation services to promote digital engagement, aimed at SMEs. Pique

was recently acquired in June 2021 by Vietnamese e-wallet firm, MoMo, with the goal of maximizing data from its 25 million registered users.

2. **Natural Language Processing: Viettel**

Viettel's AI-backed natural language processing (NPL) is one of the top Vietnamese-language voice-recognition services.[307] Viettel's NPL technology is used in assessing its call-centre services to analyze customer complaints. Viettel also provides the technology to private and public sector clients, for example, for text-to-speech software in online newspapers and for automated notetaking. Viettel's high accuracy in Vietnamese-language NPL services highlights the importance and advantage domestic AI startups have in developing services for local populations, which also have the potential to serve global customers.

3. **Digital Identities and Banking: WeeDigital and ABBank**

WeeDigital uses AI-powered biometric security technology and deep data analytics to help firms manage client digital identities. One of WeeDigital's most notable clients is Vietnam's An Binh Commercial Joint Stock Bank (ABBank). The partnership, called Wee@ABBank, allows ABBank's clients to use facial recognition when authorizing transactions. WeeDigital has also partnered with Vinpearl resorts by providing facial recognition technology to screen guest access to resort services.

SOCIETY

Education and Human Capital

Vietnam's key comparative advantage is its young and abundant tech talent, which has attracted many foreign tech companies to the country. However, there are large skill gaps associated with Vietnamese tech talent. Though they have excellent technical skills, they have low English proficiency and lack skills in problem-solving and creative thinking. Increasing training in STEM has been the focus in all Industry 4.0-related government decrees. The latest effort was the issuance of a dispatch on implementing STEM in secondary-level curriculum by the Ministry of Education and Training on August 14, 2020. The Ministry of Planning and Investment also launched the Vietnam Innovation Network Initiative in August 2018 to encourage overseas Vietnamese tech experts to return home. Leading groups Vingroup and FPT Telecom are attracting overseas talent with their extensive resources and increasing number of AI projects, such as Vingroup's VinAI research lab and residency program. In recent years, the country has been experiencing a "reverse brain drain," in which many Vietnamese tech experts, working at leading tech companies worldwide, are returning to Vietnam to contribute to the country's development of AI and growing startup ecosystem.

Ethics

As Vietnam has not had a strong intellectual property regime, Prime Minister Phuc approved Vietnam's first-ever National Intellectual Property Strategy until 2030, a guideline designed to promote Vietnam's intellectual property regime, in August 2019. This was followed by the release of the National Industry 4.0 Strategy, which identifies 5G, AI, blockchain, and cloud computing as key technologies for economic restructuring and development of a digital economy, which includes the building of a digital government and supporting STEM talent development.[308]

INTERNATIONAL LINKAGES

Vietnam has been actively seeking partnerships with key partners in the region and beyond to further strengthen its innovation capacity. Under Project 844, the government has tasked the Ministry of Science and Technology to build a network of startup support centres across the country. In July 2020, Saigon Innovation Hub (SIHUB) launched a joint incubation program with international partners, namely Shinhan Future's Lab (Korea), Expara (Singapore), and Jica (Japan). Since July 2019, SIHUB has partnered with Singapore's government-owned enterprise development agency, Enterprise Singapore, as part of its Global Innovation Alliance network, an initiative to connect Singapore with overseas partners with a focus on technology and innovation. Under this partnership, Singapore's tech startups collaborate with partners, investors, and clients in Ho Chi Minh City, connecting with Vietnam's emerging innovation scene. Finally, Japan and South Korea have been top foreign investors in Vietnam and are now tapping into Vietnam's large pool of tech talent by hiring local engineers and setting up R&D centres.[309]

Nascent AI Economies

Nascent AI Economies refer to the economies that are at the starting point of building up their AI ecosystems. They require significant action and investment in advancing government policy, private sector activities, talent development and education, and international linkages for AI.

Brunei

INTRODUCTION

Brunei is still at its most nascent stages of AI development. Current national policies focus more on capacity building rather than direct AI implementation. Under Wawasan 2035, its national development strategy, Brunei established a National Vision task force in 2004 and officially launched the plan in 2008. Wawasan has three main goals to be accomplished by 2035: education and a skilled population, high quality of life, and a dynamic and sustainable economy. Wawasan 2035 serves as a foundation for the overall development strategy, including AI.[310]

GOVERNMENT

Capacity Building

Over the last few years, Brunei has taken concrete steps to lay a solid foundation for AI rollout. In August 2020, the government established Cyber Security Brunei to safeguard the country's digital operations. Then, in April 2021, the government launched its pilot 5G project.

National AI Policy

Brunei lacks a specialized national AI policy, and its current progress toward AI adoption centres around building up the country's digital infrastructure foundation necessary for AI development through the Digital Economy Masterplan 2025 developed by the Brunei Digital Economy Council. Under the masterplan, government, industry, and society are to collaborate around these three main digital structures: digital ID, digital payment, and a people hub to become a smart nation.[311]

Research and Development

More financial investment is needed to develop Industry 4.0 technologies including AI. Despite being a high-income country, Brunei's R&D investment in 2018 was only 0.278% of its GDP, only a marginal increase from the last data point obtained by the World Bank in 2004 of 0.037%.[312] In the Global Innovation Index 2020, it scored 29.82 out of 100, below the median score of 30.94 and ranking 71st.[313]

PRIVATE SECTOR

Widescale adoption of AI in Brunei's industries and government is limited due to the lack of a cohesive national strategy and digital infrastructure. However, there are some existing and potential AI private sector applications worth noting.

1. **Health Care Today: Fighting COVID-19**

During the COVID-19 pandemic, the government rolled out an AI-powered web application that provided self-assessment and health education resources. The app also contained a map feature where users could track confirmed COVID-19 cases. Users could also access information on nearby medical service centres.

2. **AI Analytics and Telecommunications: The Imagine Sdn Bhd-Lynx Analytics Partnership**

In May 2021, Brunei telecommunications firm Imagine Sdn Bhd announced a new partnership with Singapore-based Lynx Analytics. As a contribution to Brunei's Smart Nation government program, the partnership incorporates AI-powered data analytics across several industries such as banking, telecommunications, and retail. More specifically, Imagine Sdn Bhd aims to use data analytics and predictive modelling to improve customer service and optimize business operations in Brunei.

3. **Looking to the Future: Protecting the Environment, Overhauling the Oil and Gas Industry**

As early as 2016, a Bloomberg study forecasted that Brunei would be the most oil-dependent economy in the world by 2018, estimating that 60.3% of Brunei's national GDP would come from oil exports.[314] According to World Bank data from 2019, fuel makes up 91% of Brunei's total merchandise exports.[315] AI applications, such as predictive monitoring of carbon emissions or optimization of carbon dioxide storage, could enhance Brunei's oil and gas industry by improving its operational efficiency while addressing environmental concerns.

SOCIETY

Brunei has been taking steps to encourage AI education among youth, building up its future AI and technology workforce. The Teens in AI program, for example, encourages Brunei youth to develop their skills in technology and AI outside the classroom through workshops and competitions.[316] Brunei startup InTurn Co. collaborates with the Authority for Info-communications Technology Industry of Brunei Darussalam and the Science Technology Environment Partnership Centre at the Ministry of Education in hosting the program. The program is also sponsored by large firms and organizations such as Brunei Shell Petroleum.[317]

INTERNATIONAL LINKAGES

Citing the ASEAN Digital Masterplan 2025, Brunei has called for increased regional co-operation to accelerate digitalization, particularly in areas like cybersecurity and data governance. Furthermore, Brunei has proactively engaged in bilateral partnerships with other economies. For instance, Brunei's central bank, the Autoriti Monetari Brunei Darussalam, and the Monetary Authority of Singapore signed a fintech co-operation agreement. Together, the two organizations will work to digitize Brunei's financial system and share information on emerging fintech trends.[318]

Papua New Guinea

INTRODUCTION

Papua New Guinea's economy largely depends on natural resource extraction, and much of its commercial activities remain informal. Currently, only 15% of the Papua New Guinean population has access to both fixed and mobile internet subscriptions.[319] Therefore, Port Moresby's development strategy focuses on building infrastructure and human capital and acknowledges the importance of digitalization. While AI adoption could potentially contribute to the economy's development policies and specific sectors and missions, more widespread adoption will likely require more robust connectivity infrastructure.

GOVERNMENT

Capacity Building

Papua New Guinea's development policies emphasize the importance of addressing the lack of digital infrastructure. With only 15% of the population with access to the internet (therefore limited data generation), on top of limited market infrastructure, it is difficult for Papua New Guinea's private sector to actively adopt AI. PNG Vision 2050 seeks to increase the economy's communication access from 10% to 100% and establish a National Information Database Management System by 2050.[320] Its Long Term Development Strategy 2010-2030

seeks to increase the number of mobile subscribers to 80% of the population and provide internet access to 70% of the population by 2030.[321]

Papua New Guinea's Digital Transformation Policy

Currently, there is no AI-specific strategy in Papua New Guinea. However, Papua New Guinea's Digital Transformation Policy highlights Port Moresby's priorities regarding digitalization and therefore potential areas of AI adoption moving forward.

Launched in 2020 with the leadership of the Department of Information and Communication Technology, the policy builds on Papua New Guinea's existing development policies, as well as the APEC 2018 priorities such as improving connectivity, promoting inclusive and sustainable growth, and strengthening economic growth through structural reform. The policy highlights the following six priorities:

- Digital infrastructure;
- Digital government;
- Digital skills;
- Innovation and entrepreneurship;
- Cyber safety and privacy; and
- Financial inclusion.[322]

Clearly, Port Moresby seeks to take leadership to provide critical digital infrastructure and adopt digitalization from the government level with a very limited private sector. In this context, the most tangible opportunities for AI adoption can be found in digital government, such as public health, education, or digitalization of government services.

PRIVATE SECTOR

1. NiuPay: Papua New Guinea's Fintech Leader

NiuPay offers end-to-end fintech services in collaboration with the Papua New Guinean government, its state-owned enterprises, and SMEs. NiuPay successfully created Papua New Guinea's e-visa payment system for the Immigration and Citizenship Authority. It also worked on a project with the Department of Lands and Physical Planning in which machine learning is used to reconcile payments for leasing government lands. NiuPay has

also entered into an agreement with one of Papua New Guinea's main banks, Kina Bank, to help SMEs integrate online payment as digital payments become more prevalent in light of COVID-19.[323]

2. Opportunities for Smart Mining

Papua New Guinea is heavily dependent on the export of natural resources, especially precious metals such as cobalt, gold, and silver. In 2012 (most updated information), raw materials contributed to 38.13% of Papua New Guinea's total export, and multinational corporations such as Chevron are actively engaged in this sector.[324] AI application in this sector could lead the way with the adoption of the technology in Papua New Guinea, maximizing the efficiency of mining operations while minimizing their environmental impacts. For instance, Canada's Minerva Intelligence conducted an evaluation for Freeport Resources' Star Mountains mines with its AI-powered DRIVER system.[325]

SOCIETY

Education and Human Capital

Education and training will be essential for Papua New Guinea's digitalization. More than two-thirds of all jobs in Papua New Guinea are susceptible to automation. The Digital Transformation Policy acknowledges this point and has made digital skills one of its six pillars.

Ethics

Papua New Guinea has one of the largest tropical rainforests with unique biodiversity, and illegal logging has been an ongoing issue. Approximately 70% of logging in Papua New Guinea is estimated to be illegal.[326] In this context, initiatives such as those of Rainforest Connection, which uses sensors and machine learning to identify illegal logging, could be useful.

INTERNATIONAL LINKAGES

Papua New Guinea is heavily dependent on foreign development aid, especially from Australia, which provided approximately A$479.2M (US$380.5M) in the 2020-2021 fiscal year, and multilateral organizations such as the Asian Development Bank, IMF, and the World Bank.[327] It was the APEC host country in 2018, and it has closely aligned its domestic policy, including the Digital Transformation Policy, with the APEC goals.

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