THE NEXT GREAT DIVERGENCE
WHY AI MAY WIDEN INEQUALITY BETWEEN COUNTRIES

AI for Productivity and Empowerment in Agriculture, Health, Education, and Transport

Iyad Rahwan
Max Planck Institute for Human Development
Michael Muthukrishna
London School of Economics and Political Science

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Iyad Rahwan, Max Planck Institute for Human Development, and Michael Muthukrishna, London School of Economics and Political Science

Artificial intelligence represents a new frontier for innovation and competitiveness. As with previous technological waves, however, it can either expand human potential or entrench existing hierarchies. Its impact will depend not on the algorithms themselves, but on how we deploy them, who they are designed to serve, and whether they advance the freedoms that underpin true human development. AI-driven solutions – from smart farming to virtual tutors – can empower individuals and communities. With the right policies and institutions, AI can expand people's capabilities: not only enabling them to be more productive, but also to learn and express themselves, and to be healthier and participate fully in their economies and societies.

History is punctuated by transformative technologies that changed our lives and rearranged global power. The steam engine sparked the Industrial Revolution, unleashing unprecedented productivity and altering global geopolitical dynamics. It led to what economic historians call the "Great Divergence", marked by the widening economic gap between industrializing nations and other regions in the 19th century, driven in large part by access to energy and the ability to convert that energy to productive work[1]. Later waves of innovation – electricity, oil, mechanization – added power to that productivity, remaking cities, societies, and economies, leading to an overall rise in human development.[2]

Among these shifts, the standardization of the shipping container in the 20th century deserves special mention for its unique impact on Asia and the Pacific. Before containerization, global trade was slow and expensive, with goods loaded and unloaded manually at each port. Once containers became the norm, the cost of shipping fell dramatically. Countries like China, Japan, Republic of Korea, and Malaysia with their lower manufacturing costs were poised to benefit from the removal of the friction in trade with the global markets. Efficient trade logistics underpinned export-led growth across East and South-East Asia, reshaping global value chains and lifting millions out of poverty. This illustrates how technological innovations, when coupled with the right policies and capacities, enabled parts of Asia and the Pacific to rapidly integrate into the world economy.[3]

The late 20th century brought the computing revolution and later the internet - transformations of information rather than industry. These digital technologies further shrank distances and lowered the cost of knowledge, creating new pathways for development. We now find ourselves at the cusp of another epochal shift: the era of Artificial Intelligence, and in particular Generative AI. Observers compare this moment to the arrival of the internet or even the steam engine in its potential scale of impact. But AI – especially Generative AI – is a qualitatively different kind of technology, one that offers new capabilities and affordances.

What is generative AI?

Generative artificial intelligence (GenAI)[4] refers to AI systems capable of creating new content - text, images, video, code, and more - that mimics the data on which they were trained. In essence, GenAI models learn the patterns of language, images, and more in the world from vast datasets, and can then produce novel outputs following those patterns. This goes beyond previous software tools that could only follow explicit instructions. GenAI can compose an essay or a poem, create a realistic image from a prompt, or carry on a conversation, exhibiting what experts call "emergent" capabilities.[5] This is for two reasons:

- First, in order to generate data that is similar to the training data, GenAI algorithms effectively need to learn the underlying (e.g. physical, cognitive, or

social) processes that generated the original data. That is, the AI must learn a good model of the world,[6] approximating how the world (e.g. described in words, images or videos) evolves over time.

- Second, once the AI has learned a world model, the AI can be engineered to use this knowledge in new ways through a variety of techniques (such as fine-tuning on specific data, reinforcement learning from specific human preferences, or prompt engineering). That is, the AI can be further taught to generate more helpful, more factual or more original answers. It can be taught to generate suggestions that reflect contextual ethical values. It can be taught to generate more aesthetically appealing images or prompted to generate images in a particular artistic style, and so on.

In sum, so-called GenAI 'foundation models' contain extremely rich representations of all kinds of knowledge, and this knowledge can subsequently be adapted to all kinds of specific purposes.[7]

What sets GenAI apart, and makes it transformative, is its profound impact on cognitive work and creativity. Unlike earlier digital tools that helped us calculate or retrieve information, GenAI tools can reason, summarize, translate, simulate scenarios, draft content, and even invent new designs or solutions. In short, they do not just store and process information, they can autonomously generate new ideas and content. If traditional computers are like libraries – holding and indexing information – then GenAI is like having a creative assistant who can instantly read all the books and produce a tailored output for a given task. This represents a fundamental shift: many tasks once requiring human judgment or creativity can now be partly or fully automated. Such a shift carries immense promise and uncertainty – especially for the diverse countries of Asia and the Pacific.

GenAI has taken the world by storm. ChatGPT, a conversational AI (bot) offered by OpenAI, has been the fastest-growing computer application in history.[8] GenAI systems helped generate an artwork sold for $432,500 at the prestigious auction house Christies,[9] defeated world-class players in strategic games,[10] helped guide human intuition to discover new mathematical theorems,[11] and vastly improved the prediction of protein folding,[12] earning its creators the 2024 Nobel Prize in Chemistry.[13]

How could AI increase human development in Asia and the Pacific?

GenAI offers new capabilities and affordances, but just because AI can do something, doesn't mean that it is the best or cheaper option than current or alternative practices. The Asia-Pacific region is marked by enormous diversity in economic context, institutional capacity, and human development levels. Cutting-edge applications that make sense in Seoul or Singapore might not be viable or what is needed in Vientiane or Kalimantan. Wages, infrastructure reliability, and state capacity differ vastly: an AI solution that is cost-effective in a high-income city may not be the best option in a lower-income community with unreliable internet connectivity or electricity. Some parts of the region, like Republic of Korea and Singapore, are AI power houses, investing heavily in talent, research, and industry adoption. Other parts, like Kiribati, Afghanistan, or rural Nepal, struggle with basic connectivity and human capital gaps. Within countries, too, inequalities persist. Urban-rural divides are stark: a teenager in Bangkok or Kuala Lumpur may already be using AI-powered learning tools, while their rural peer in the same country lacks even stable internet. Women often have less access to digital tools and STEM opportunities than men, and many people with disabilities or linguistic minorities are overlooked by tech design. In short, if left purely to market forces, AI could easily mirror and magnify existing inequalities – concentrating benefits in well-connected hubs and among more privileged groups.

Yet, AI also represents a potential leapfrogging opportunity for developing countries. Just as cell phones allowed many nations to bypass the need for universal landlines, and solar panels now offer off-grid energy where power grids do not reach, AI could let countries skip certain developmental bottlenecks. For example,

an acute shortage of doctors or teachers might be partly alleviated by AI-driven diagnostic tools or tutoring systems reaching remote areas. Weak administrative capacity could be strengthened by AI decision-support that improves targeting of social programs. These prospects are not automatic, however. Realizing them requires addressing affordability, skills, and infrastructure so that AI is usefully deployed in low-resource settings – and doing so in a way that doesn't simply entrench the advantages of a few. The central question is not just what AI can do, but what it should do in the Asia-Pacific context to maximize human development gains. In what sectors and tasks can AI deliver the biggest boost to productivity, inclusion, or service quality? Who stands to gain the most, and who might be left behind? And critically, what policies and investments are needed to ensure AI narrows gaps rather than widens them?

This chapter examines how AI is already affecting – and could radically reshape – innovation and competitiveness in Asia-Pacific economies, while also probing its impact on inequality. Our aim is to imagine what's possible, backed by emerging evidence, and to offer concrete policy guidance for steering AI toward a better trajectory for human development in the region. In doing so, we pay close attention to who benefits from AI-driven innovation, and how deliberate strategies can ensure that AI adoption enhances inclusive growth, builds local capacity, and expands human capabilities and freedoms – instead of entrenching existing disparities or creating risks of dependency.

Research questions and scope

Artificial Intelligence is a general-purpose technology and force multiplier across virtually all sectors.[14] Like electricity or the internet, it can embed itself into daily operations from agriculture to manufacturing, from education and healthcare to governance. This ubiquity means AI's impact will be pervasive. In this study, we focus on several central questions for the Asia-Pacific region:

1. *How can AI drive sector-specific innovation and economic development in the Asia-Pacific region?* Where are the opportunities to boost productivity or quality via AI, and in which sectors or industries are these opportunities most significant?
2. *Which domains offer the greatest potential for competitiveness gains through AI adoption — and for whom?* Are certain countries, communities, or groups positioned to gain more (or less) from AI-driven improvements in, say, farming, manufacturing, finance, or service delivery?
3. *How can governments, industries, and institutions shape AI deployment to reduce, rather than reinforce, inequalities?* What approaches can ensure that AI benefits marginalized groups (rural populations, women, small enterprises), instead of only well-resourced firms or urban elites?
4. *What policies can help developing countries leapfrog developmental bottlenecks through AI, and what safeguards are needed to prevent unintended harms?* Essentially, how can Asia-Pacific nations harness AI to overcome challenges like lack of doctors or teachers, while avoiding pitfalls such as data misuse, or misuse of technology for surveillance or control?

To address these questions, our analysis is organized around three thematic pillars that structure the discussion:

1. Sector-specific innovation and frontier technology adoption

First, we examine how AI is being applied in key sectors that are central to competitiveness and human development: agriculture, manufacturing, services (including finance), education, and healthcare. Each sector faces unique challenges and is beginning to experiment with frontier AI solutions. For instance, AI-enhanced crop monitoring in Bangladesh is helping smallholder farmers detect pests early, boosting yields and incomes. In Bhutan, AI-equipped mobile vans are bringing tuberculosis screening to remote villages,

bridging healthcare access gaps. Fintech innovations are expanding credit access for unbanked communities, as seen with Bangladesh's mobile money platforms. These are not just theoretical promises – they are already happening in parts of the region, albeit unevenly. The same technology that improves outcomes in one context might less effective – or even exacerbate inequalities – in another, due to differences in infrastructure, literacy, or affordability. Thus, a core task is to identify where AI is working, under what conditions, and how to replicate successes more broadly.

2. Inequality and inclusion: AI across divides

Second, we analyze how AI intersects with existing divides – between countries, within countries, and between different demographic groups. AI does not emerge in a vacuum; it enters ecosystems already shaped by inequality, and it can easily widen those gaps. We consider multiple dimensions:

- *Geographical divides* – Urban centers in Asia and the Pacific (from Bangkok to Jakarta to Suva) often enjoy better connectivity, tech talent, and pilot projects, while rural areas lag behind in digital access. AI initiatives must confront this urban-rural gap – otherwise, they risk mainly benefiting city dwellers. For example, while a major city might use AI for smart traffic control, many villages still lack basic internet for an AI application in agriculture to even function.
- *Gender disparities* – Women in many Asia-Pacific countries are under-represented in STEM fields and have less access to digital tools. They also predominate in sectors vulnerable to AI-driven job disruption (e.g. routine clerical work, textiles, call centers). Without intentional design, AI could worsen gender inequality – whether by entrenching biases in algorithms or by automating jobs predominantly held by women. Yet AI could also be a lifeline in crisis-affected or restrictive environments, where online platforms (some using AI translation/tutoring) are one of the only avenues for women and girls to continue learning despite severe barriers to access.
- *Income and digital literacy* – Many AI applications assume a minimum threshold of access – a smartphone, an internet connection, basic literacy. In lower-income settings, these prerequisites are not a given. We explore how AI initiatives can be designed to include those at the margins (for example, delivering AI-driven advisories via simple feature phones or through community intermediaries), so that the benefits reach people without high-tech devices.
- *Inter-country gaps* - Regionally, there is a widening gulf between nations investing heavily in AI and those barely online. A handful of Asia-Pacific countries – notably China, Republic of Korea, Singapore, and Japan – are pouring resources into AI research, talent development, and infrastructure. Many others – e.g. Nepal, Cambodia, Papua New Guinea – are still working on basic digitalization. Without intervention, AI could drive a new kind of divergence: not between industrial and non-industrial economies, but between AI-empowered and AI-dependent countries. The former will shape the technology and reap most of the gains; the latter risk becoming mere consumers of foreign AI products, with little capacity to innovate or govern these tools. We consider strategies to prevent this, emphasizing regional cooperation and capacity-building to democratize AI benefits.

3. Leapfrogging or locking-in: strategic AI deployment in development contexts

Third, we look at AI from a development strategy perspective: can AI enable countries to leapfrog traditional development paths, or might it "lock in" new forms of dependency or exclusion? There is optimism that AI will allow countries to overcome long-standing hurdles – for example, AI tutors to compensate for teacher shortages, or diagnostic algorithms to reach patients in remote clinics. Indeed, we document cases where this is already starting. However, leapfrogging with AI is not automatic. It requires strategic investment in locally relevant AI solutions (not just importing tech from

abroad), institutional capacity to deploy and regulate AI responsibly, inclusive data so that AI systems work for local populations (and do not ignore underrepresented groups), and regulatory foresight to avoid unintended consequences (like monopolies or IP barriers). Without these, there is a risk of "locking-in" patterns where local users rely heavily on external AI ecosystems, value from local data is not fully retained, or labor markets are disrupted before safety nets can adapt. Our research highlights not just where AI is being used in development, but where it could be used more effectively – and how proactive policy can ensure that AI becomes a tool for inclusive development and national technological learning, rather than a source of new vulnerabilities.

The research presented in this chapter highlights not just where AI is being used, but where it could be used more effectively — and how countries can avoid the "lock-in" of extractive models where local users become passive consumers of foreign AI systems.

By examining these pillars, this study aims to build an evidence-driven picture of AI's current and potential impacts on innovation and inequality in Asia and the Pacific. The next section (Thematic Analysis) groups findings by sector, diving deeper into concrete examples – from farms and factories to classrooms and clinics – to illustrate how AI-driven innovation is unfolding on the ground. Cross-cutting insights are then derived regarding the risks and downsides that must be managed. Finally, the report turns to policy implications and recommendations, proposing how stakeholders can maximize AI's benefits for competitiveness and human development while mitigating its pitfalls.

Thematic analysis

In this section, we present a sector-by-sector analysis of AI-driven innovation in Asia and the Pacific, highlighting both measurable gains in competitiveness and contributions to human development, as well as the risks and inequality concerns arising in each domain. The sectors covered are agriculture, manufacturing, services/finance, education, healthcare, and urban infrastructure, followed by a discussion of cross-cutting risks. Each sector analysis first outlines recent precursor projects (pilots or early deployments that signal the potential of AI in that field), then discusses emerging opportunities on the horizon, and notes any evidence of inequality impacts or inclusion efforts.

Agriculture

PRECURSORS

Agriculture remains a livelihood backbone for much of Asia and the Pacific, and there is growing recognition of AI's potential to transform this sector – from boosting yields and reducing input waste, to making farming more climate-resilient. Many current efforts are still pilots or small-scale, but they point to what is possible.

- *Bhutan* – a team of young innovators developed an AI-powered mobile app for crop disease monitoring that won a regional innovation award in 2024.[16] Farmers can snap photos of their plant leaves with a smartphone; the app's AI model instantly identifies pests or diseases and suggests treatments, putting expert knowledge directly into farmers' hands. Such a tool can be transformative in rural communities where agricultural support services are not readily available.
- *Bangladesh* – A consortium is piloting the "Groundnut Integrated Pest Management (IPM)" app. Using image recognition, this app diagnoses peanut crop pests from a farmer's photo and recommends specific management steps, even linking farmers to nearby suppliers of appropriate pesticide or fertilizer. Early results are promising: by integrating GPS and weather data, the system gives context-specific advice and has the potential to help thousands of smallholders avert crop losses. A pilot would target 1,000 farmers across two districts.[17] These kinds of AI-driven advisory apps – also being tested for rice, wheat, and other crops – effectively bring precision agriculture to small farms.

- *Thailand* – Several countries are leveraging AI beyond crop pest management. Thailand, for instance, is actively promoting "AgriTech" solutions; its AI-in-agriculture market was valued at around $80 million in 2023 and is projected to reach $114 million by 2029.[18] The National Electronics and Computer Technology center (NECTEC) has developed HandySense B-Farm, an AI+IoT platform that provides farmers with real-time data on weather, soil moisture, and seedling health to optimize farming decisions. This platform exemplifies how partnerships can bring advanced tools to farmers.[19]

- *China* – Meanwhile, China has gone even further in integrating AI with farming. The Chinese government has set up dozens of unmanned pilot agriculture zones – testing autonomous tractors, drone crop dusters, and AI systems that can monitor and manage large farms with minimal human labor. Chinese agri-tech startups have rolled out platforms like Nongpinhui, which uses AI to balance supply and demand in produce markets, reportedly facilitating over 200,000 transactions and generating more than ¥5.9 billion (≈$800 million) in farmer income by intelligently connecting growers with buyers. Even in livestock, AI is making inroads: "smart" pig farms in China equipped with automated feeding, climate control, and AI health monitoring have dramatically scaled up productivity – one case saw pig-rearing capacity jump tenfold (from roughly 500 to 5,000 animals) with feeding costs cut by 20 percent after AI systems were introduced.[20]

- *Viet Nam and Bangladesh* – AI is also being applied to aquaculture and fisheries, crucial industries for many Asia-Pacific economies. World Bank-backed projects use AI and sensors to monitor fish health (for example, detecting early signs of disease in ponds) and to optimize feeding schedules, which has improved yields and resource efficiency.[21]

- *Kiribati* – In the Pacific Islands, where vast ocean territories make monitoring challenging, AI is aiding enforcement against illegal fishing. Kiribati has piloted the analysis of satellite data to detect suspicious vessel movements in its exclusive economic zone.[22] This contributed to a successful enforcement action with a $1-million fine for illegal fishing[23] – supporting enforcement efforts in a small island nation with limited patrol capacity. Similarly, initiatives like FishGuard deploy affordable AI-guided drones and machine-vision systems to help governments of Small Island Developing States survey their waters.[24] These examples illustrate AI's potential to strengthen resource management and governance in agriculture and fisheries, even for countries with constrained human resources.

- *Nepal* – a 2024 initiative showcases how AI can empower marginalized groups in agriculture. Heifer International and a local AI group launched the AI for Women Farmers Challenge, focusing on rural women-led cooperatives.[25] One project uses AI-based optical character recognition to digitize handwritten farm ledgers and financial records. By turning paper records into analyzable data, these women farmers can access insights on their operations, improve their financial planning, and even build credit histories to approach formal lenders. This kind of innovation addresses a common issue in developing contexts – fragmented, manual data – and shows how AI can support financial inclusion and better decision-making at the grassroots level.

Across these cases, from Bhutan's disease-detection app to Nepal's smart farms – we see local experiments turning into real results. They remain modest in scale today, but they paint a picture of what could soon be commonplace. Notably, they also highlight inequities. Most AI-agriculture projects are still in pilot stages or in relatively wealthier locales; the poorest and most remote farmers often lack smartphones, reliable connectivity, or even awareness of these tools. In some areas, digital literacy is a barrier – an app is only useful if farmers can navigate it and trust its advice. These challenges temper the successes and underscore that without deliberate inclusion efforts (such as training programs or providing analogue interfaces like radio/SMS outputs), AI could bypass those who arguably need it most.

OPPORTUNITIES

Despite the hurdles, the trajectory for AI in agriculture over the next decade is very promising – and potentially transformative for rural areas in Asia and the Pacific. Generative AI and foundation models are lowering the cost and skill barrier for developing new, localized applications. It is becoming feasible for a small team to build an AI that understands a niche crop or a minority language, which means local agricultural knowledge can be scaled out faster and cheaper than before. We anticipate that the first breakthrough applications in this domain will be AI-driven decision- support systems for farmers. Imagine a single application that a farmer can speak to in their own dialect: the farmer could ask why her rice leaves are turning brown, snap a photo of the field, and the AI – now capable of processing images and text multilingually – would diagnose the likely problem (say, a fungal disease) and suggest remedies, all in simple terms. Thanks to advances in multimodal AI, such a tool can combine capabilities (vision, speech, language) and does not require massive local data to be effective, because it builds on global foundation models. This drastically lowers the development time for niche solutions, meaning even less-popular crops or small language groups could get customized AI support.

Within 5–10 years, AI could help unlock a shift toward climate-smart, highly productive agriculture in Asia and the Pacific. One opportunity is AI-augmented crop breeding – analyzing genomic and environmental data to develop crop varieties that are more nutritious and climate-resilient. This could strengthen food security in the face of climate change. Another is the convergence of AI with robotics: affordable, autonomous farm machinery (for planting, weeding, harvesting) guided by AI could address labor shortages in aging rural communities and improve precision. For this to work, it has to be affordable relative to local labor and easily maintained given local skills and material availability. Nevertheless, we are already seeing policy support in this direction. For example, India is advancing public digital infrastructure for agriculture[26] and public-private "AI for Agriculture" partnerships to encourage data-driven farming.[27] Similarly, agricultural sectors in China are using cloud-based AI systems to remotely monitor crop trials and speed up breeding cycles.[28] As governments invest in these enabling systems, the economics of farming could change – AI can help farmers do more with less land, less water, and fewer chemicals, which is crucial for sustainable growth.

AI can also enhance government planning and resource allocation in the agricultural sector.

- *Viet Nam* – The coffee sector is experimenting with satellite imagery and AI (the "Coffee Vision" project[29]) to map deforestation and climate risks in coffee-growing regions. The system generates geospatial data to inform where interventions are needed, and such an approach could be extended to other crops and countries.

In the Pacific, where climate change threatens fisheries and agriculture, AI-based models for climate forecasting and land-use planning could help leaders make proactive decisions (e.g. identifying which areas will remain arable, where to invest in irrigation or flood defenses).

A particularly exciting medium-term development is the use of digital twins in agriculture. Some Asia-Pacific researchers are creating digital replicas of farms or even entire agricultural zones to simulate different scenarios.

As computing power becomes cheaper, more countries could deploy such virtual modelling to support their farmers – testing, for instance, how altering planting dates or fertilizer application might affect yields under various weather patterns, all in a simulated environment.

In the fisheries domain, the next few years may bring AI-enhanced local fishing advisories. By combining satellite data, oceanographic models, and historical fish catch data, AI can forecast where fish shoals are likely to be on a given day. This information delivered via mobile phone can help small-scale fishers in countries like Indonesia, the Philippines, or Fiji to reduce fuel wasted searching for fish, improve their catch efficiency, and avoid overfished areas.

These innovations – from high-level monitoring systems to on-the-ground advisory apps – could significantly boost resilience and productivity for both subsistence and commercial farmers/fishers, if they can be scaled and made accessible.

In sum, if these advances materialize, the impact on human development could be substantial. Higher and steadier crop outputs mean better farmer incomes and improved nutrition; AI-optimized use of water and fertilizer supports environmental sustainability; and critically, the knowledge gap between large agribusinesses and smallholders could narrow, promoting greater equity in rural areas. The major challenge will be ensuring inclusivity – that even small farmers with limited means can access and trust these AI tools. Solutions like Bhutan's approach (having local agriculture extension centers use the AI app on behalf of farmers without smartphones) will be important. So will investments in rural connectivity and digital literacy. With enabling policies, AI-driven agricultural innovation could herald a new green revolution across Asia and the Pacific – one focused not just on yield, but on sustainable, inclusive growth in the countryside.

Manufacturing and Industry

PRECURSORS

Manufacturing has long been the engine of economic growth in the Asia-Pacific region, from the textile factories of South Asia to the high-tech electronics plants of East Asia. Today, AI is beginning to transform manufacturing processes through automation, intelligent quality control, and supply-chain optimization. However, there is a marked disparity: advanced economies and larger emerging economies are rapidly adopting cutting-edge practices, while lower-income manufacturing hubs risk falling behind.

- *The Republic of Korea* – The country is a global leader in industrial automation – it has the world's highest density of industrial robots, over 1,000 robots per 10,000 workers.[30] Korean conglomerates across automotive, electronics, and chemicals are investing in AI-driven predictive maintenance systems and autonomous production lines. The Government is actively supporting this through initiatives like the AI Autonomous Manufacturing Pilot Project. In late 2024, the Ministry of Trade, industry and Energy (MOTIE) announced 26 AI Autonomous Manufacturing pilot projects with private companies, expected to increase to 200 by 2027.[31] This reflects a national strategy to maintain competitiveness by pushing the productivity frontier. These investments are yielding results in efficiency and consistency of output, and they are helping some firms move up the value chain from low-cost labor-based production to more sophisticated, higher-value manufacturing.
- *Thailand* – In middle-income countries, certain industries are also moving toward AI-enhanced manufacturing. Examples include Thai electronics firms using AI for predictive maintenance – sensors on machinery feeding data to machine-learning models that predict failures before they happen, thus reducing downtime.[32]
- *Malaysia* – In Malaysia's automotive parts plants, AI-powered computer vision is used for quality control, with cameras that automatically detect defects faster and more consistently than manual inspection.[33]
- *India* – Aan Industry 4.0 strategy through the National Association of Software and Service Companies (NASSCOM), has projected that AI and related digital tech could account for 40 percent of all manufacturing spending by 2025 (up from 20 percent in 2021). This signals that even labor-abundant countries see value in AI automation not just as labor saving, but for accuracy and quality assurance. Some Indian textile factories, for instance, are piloting AI-driven fabric inspection systems that use high-speed cameras and neural networks to find weaving flaws in real time, preventing defective rolls from progressing downstream.[34] [35]

- *Indonesia* – In Indonesia, large manufacturers — especially in oil and petrochemicals — are partnering with multinational tech providers to introduce AI for process optimization.[36]
- *Bangladesh* – In Bangladesh's garment factories – which employ millions, predominantly women – trials are underway on a limited scale: e.g. using AI for production planning (to optimize line balancing and reduce idle time).[37]

The implications for inequality are large. Within countries, as factories automate, there is a concern for the workers – often less-skilled – whose jobs may be eliminated. Without robust retraining and social protection, this could worsen unemployment or push workers into informal jobs. Between countries, there is a risk of a new divide: an "automation gap" where countries that can afford and deploy AI in industry surge ahead in productivity, while late adopters lose out on investments and orders. For example, if Viet Nam's factories embrace AI and IoT quickly (and Viet Nam is investing in smart manufacturing in its electronics sector),[38] they might attract more foreign direct investment compared to a slower-adapting economies. A new Great Divergence and competition for effective use of AI is underway and will reshuffle the Asia-Pacific region.

OPPORTUNITIES

In the short term, AI offers "low-hanging fruit" to many manufacturers in Asia and the Pacific: predictive maintenance, energy management, and supply chain optimization. These are applications that usually pay for themselves by reducing costs. AI-driven maintenance systems can extend the life of expensive machinery by predicting failures – something particularly valuable in places where capital is costly and equipment downtime is disruptive. Even mid-sized factories can install IoT sensors and use cloud-based AI services to start seeing benefits without huge upfront investment. Governments and industry bodies could accelerate this by setting up shared AI demonstration centers or subsidized programs for factories (some countries are doing this – e.g. Singapore's model factories, or India's AI hubs for SMEs). Such moves would help small and medium manufacturers adopt AI, not just the big multinationals.

Another immediate opportunity is in quality control and process optimization. AI computer vision systems can drastically improve defect detection rates in industries like electronics, apparel, or food processing. By deploying AI, the company cut rework costs and improved customer satisfaction. Multiply such gains across thousands of factories in Asia, and the aggregate competitiveness gains are substantial. Additionally, AI can potentially optimize supply chain logistics – predicting demand surges, managing inventory, and routing shipments efficiently.

Over a 5–10 year horizon, we may see a more profound AI-driven transformation of manufacturing in the region. One prospect is the rise of fully smart factories: highly automated facilities that leverage AI at every step, from design to delivery. In such factories, AI could autonomously adjust production in real time in response to market data (for example, ramping up certain products if online trends show a spike in demand). Generative design AI might create optimized product designs or factory layouts that humans then implement – already companies are using AI to design lighter car parts and more efficient circuit boards that a human engineer might not conceive of. Asia-Pacific's advanced economies are likely to pioneer these approaches, but importantly, they could spread to emerging economies via multinational networks. For example, if a global apparel brand implements an AI-driven design-to-manufacture system, its supplier factories in Bangladesh or Cambodia might be integrated into that system, thus indirectly adopting AI even if they aren't leading it. This could help with global value chain participation, ensuring developing Asian manufacturers remain part of high-tech supply chains rather than being bypassed by automation in rich countries.

Another medium-term development is AI-driven mass customization. Asia has long been the workshop of the world for mass production. AI can enable a shift

to mass customization – producing smaller batches of highly customized products efficiently. This could open new markets and business models for manufacturers in the region. Imagine local factories using AI to produce custom-fit clothing or personalized electronics on demand for individual consumers worldwide. Already, some Chinese manufacturers use AI to rapidly switch production lines to new designs based on real-time e-commerce data. By 2030, this trend could allow even smaller countries' industries to tap into global niches, provided they invest in flexible manufacturing systems guided by AI.

From a development perspective, it will be crucial that the productivity gains from AI in manufacturing translate into broader societal benefits (higher wages, more jobs in complementary roles, cheaper goods for consumers) rather than just higher profits or a concentration of wealth. This will require policies to retrain workers for new roles (such as robot maintenance, AI system supervision, or more creative tasks in the production process). Countries like Republic of Korea are already proactive on this: the country's national AI strategy includes worker training and even re-thinking education to prepare the next generation for AI-augmented workplaces. Middle-income countries will need to adapt quickly to avoid a skills gap.

Finally, AI adoption in manufacturing should be seen not only as an economic necessity but as an opportunity for greener industry. AI can significantly improve energy efficiency in factories – for instance, by intelligently controlling heating, ventilation, and air conditioning systems or optimizing the operation of energy-intensive equipment during off-peak hours. It can also reduce material waste by catching defects early or optimizing cutting patterns in textiles. For Asia-Pacific countries balancing industrial growth with climate commitments, these AI applications will be valuable for sustainable industrialization (contributing to SDG 9 and SDG 13). We might see governments incentivize AI for green manufacturing through subsidies or carbon credit schemes.

In summary, AI is set to redefine manufacturing competitiveness in Asia and the Pacific. Those who move quickly to integrate AI will likely gain productivity and quality advantages, attract investment, and climb up the value chain. Delayed adoption may lead to reduced industrial competitiveness and labor market challenges. The upside scenario is one where AI-augmented manufacturing leads to better jobs (more high-skilled positions managing automated systems), safer workplaces (robots taking over dangerous tasks), and more innovation (AI-designed products). The downside is significant job displacement and a widening tech gap between firms and countries. Managing this transition with foresight – through training, phased adoption, and social dialogue – will determine whether AI in industry becomes a story of shared prosperity or one of deeper inequality.

Services and Finance

PRECURSORS

The services sector, including finance, has been a major driver of growth in many Asia-Pacific economies. Here, AI is making inroads through fintech innovations, e-government services, retail and customer service enhancements, and more. A standout area is financial services – where AI can help expand inclusion and efficiency. For example, in Mongolia and Bangladesh, banks and fintech startups are deploying AI-based alternative credit scoring to reach people with little or no formal credit history.

- *Mongolia* – In Mongolia, fintech innovators have developed an AI-driven credit scoring system that analyzes alternative data to instantly assess loan applicants. Since launch, LendMN has disbursed over $70 million in micro-loans to nearly 4,000 businesses, many of which previously lacked access to credit.[39]
- *Bangladesh* – Several banks have rolled out similar AI credit analytics. One program notably allocated over 30 percent of its new micro-loans to women

borrowers – actively countering gender bias in lending by using non-traditional data points that do not penalize women's lack of collateral or formal employment. These efforts illustrate AI's role in empowering marginalized groups (women, rural entrepreneurs) by looking beyond conventional metrics and expanding financial inclusion.

- *China* – Payments and e-commerce are also being transformed. China's digital finance giants, like Ant Group's Alipay and Tencent's WeChat Pay, use AI algorithms to analyze users' purchase behavior and bill payment history, thereby offering small loans or "buy now, pay later" services to customers who never had formal credit cards. These platforms also rely on AI-powered fraud detection to monitor millions of daily transactions and have sharply reduced fraud losses, boosting public confidence in digital finance.

- *Brunei Darussalam* – Meanwhile, smaller economies are innovating in their own niches. In Brunei Darussalam, an app called BloodKad applies AI and mobile tech not to finance per se, but to social services – it matches blood donors to hospitals in need, using AI to optimize the donor–recipient matching and timing.[40] This example shows how local startups are leveraging digital platforms (with AI algorithms) to solve community problems, supported by an emerging fintech ecosystem.

- *Bhutan* – The Bank of Bhutan has launched BoB Loan, a digital lending portal where AI algorithms approve small loans without requiring a branch visit.[41] This dramatically improves access for people in remote areas of Bhutan's mountainous terrain, who previously might have had to travel hours to a bank.

Across these examples, the common theme is streamlining processes and reducing barriers: AI In Viet Nam's Mekong Delta, is cutting paperwork, removing the need for collateral by using new data, and speeding up decisions – thereby widening participation in the formal economy. The human development benefits are clear: more people can save, borrow, invest, or insure themselves, which supports poverty reduction and entrepreneurship, and small businesses find it easier to get capital, spurring inclusive growth. A notable application in finance is fraud detection and security.

- *Thailand* – Take Thailand's Krungthai Card (KTC), a major credit card issuer which has integrated AI to detect fraudulent transactions in real-time. The result has been exceeding their fraud detection targets by 85 percent, and improving detection of certain scams by 1.5× (detection rate jumped from 33 to 50 percent). The AI models analyze transactional patterns and customer behavior, flagging anomalies (like an unusual location or spending spree).[42] By catching fraud faster, banks reduce losses and increase trust in digital banking – which is crucial for convincing users to adopt cashless services. Many banks in the region are following suit, using machine learning to monitor everything from credit card usage to online banking logins for suspicious activity. Policymakers are beginning to catch up with these innovations.

Beyond fintech, AI is also permeating other service areas. In health insurance, for instance, companies use AI to detect fraudulent claims and to personalize premiums. In customer service, AI chatbots are handling routine inquiries for telecom providers, utilities, and retail companies across Asia, improving response times and freeing human agents for complex cases.

- *Malaysia* – For example, Malaysia's national electricity company has introduced an AI chatbot that handles billing inquiries 24/7, resulting in higher customer satisfaction and lower call-center loads.[43]

Crucially, many of these innovations in services carry an inclusion dimension. For instance, conversational AI that supports multiple languages is helping extend services to linguistic minorities.

- *Indonesia* – An example is Indonesia's online marketplaces using AI chatbots that understand Javanese or Sundanese, not just Bahasa Indonesia, thereby enabling rural users to comfortably engage in e-commerce in their mother tongue. This reduces language barriers in accessing services.[44]

OPPORTUNITIES

In the near term (next two to three years), AI could further democratize finance and commerce across Asia and the Pacific. A key opportunity is mainstreaming AI-driven credit for the unbanked. Many countries are on the cusp of adopting regulations to allow alternative-data credit scoring at scale; considerations around risks and biases will be critical to ensure application is truly inclusive (see chapter 4 for a more detailed discussion). For example, Bangladesh Bank's new guidelines for credit bureaus include the use of using AI and non-traditional data to assess creditworthiness.[45] This could inform related approaches in other contexts, enabling partnerships with tech firms on AI models that consider utility payments, mobile top-up patterns, and even social media data to score "credit-invisible" customers. The impact could be millions of new borrowers – farmers able to get small loans for better seeds, women entrepreneurs financing home businesses, etc. These models can be more inclusive than traditional ones. As noted, Bangladesh's AI-based system significantly increased loans to women. We expect similar outcomes in less gender-equal societies where women lack formal credit histories – AI can help bypass biased legacy metrics.

Another imminent development is the rise of AI virtual assistants in banking and financial literacy. We already see chatbots in banking apps, but the next generation will be more advanced "financial coaches." Imagine an AI assistant on a smartphone that speaks Nepali or Vietnamese, which can guide a user through budgeting, alert them if their spending on, say, mobile data is unusually high this month, or advise them on choosing a micro-insurance product. In countries where bank branch networks are sparse, such AI assistants can essentially provide personalized financial advice to people who've never had access to a human financial advisor. This improves financial literacy and planning, contributing to household empowerment. There is also potential for AI to streamline government-to-person payments (like social welfare transfers) by automating identity verification and reducing leakage – something a few Indian states are testing with AI facial recognition for pension disbursements (though this raises privacy issues to monitor).

E-commerce will also get a boost. In the short term, small merchants can use AI tools for tasks like demand forecasting and inventory management, which were once the domain of big companies. For example, a family shop on India's Flipkart platform could use an AI plugin to predict next month's popular products and plan stock accordingly. This can increase their sales and reduce waste from unsold inventory. On the consumer side, AI-powered translation and localization will make cross-border online shopping easier. A shopper in rural Lao PDR might browse a Malaysian or Korean e-commerce site and see product descriptions automatically translated into Lao, with prices converted to Kip in real-time. By removing language and currency barriers, AI can open up regional markets to consumers and sellers who previously stuck to local channels. This contributes to regional integration and gives consumers more choice (often at better prices). It is also a way for small businesses to reach international customers without needing specialized expertise.

Security will remain a parallel focus – as digital transactions grow, so do cyber risks. We expect a surge in AI-based cybersecurity for financial services. AI systems can detect anomalies in network traffic or login patterns far faster than human IT teams, helping to block phishing or hacking attempts proactively. This is crucial for maintaining trust in digital finance, especially among first-time users who may be wary of fraud. If people trust that their mobile wallet or online bank is safe (because, say, the app warns them "this transaction looks suspicious – are you sure?" thanks to AI), they are more likely to embrace cashless finance. Countries like Singapore are already investing in AI cybersecurity at the national level, and those tools can be shared or adapted region-wide.

Over a five-to-ten year span, AI could truly revolutionize financial services and commerce, driving inclusion in ways that directly advance development goals. One medium-term prospect is the emergence of AI-driven "financial health" platforms. Instead of siloed services (separate apps for budgeting, loans, insurance), we might see integrated super-apps that use AI to holistically manage an individual's financial life. By 2030, for example, an app could automatically allocate a user's income each month: it pays their utility bills on time, sets aside some savings based on their goals (e.g. education fund for a child), invests a portion into micro-investments or bonds, and offers affordable micro-insurance, all customized by AI to that person's needs and risk profile. This kind of "autopilot" for personal finance could improve household financial stability and resilience – especially for lower-income users who struggle to plan for emergencies or navigate complex financial options. It essentially gives them a virtual financial advisor and money manager in their pocket.

For small and medium enterprises (SMEs), which form the backbone of many Asia-Pacific economies, AI could help close the persistent financing gap. Banks often hesitate to lend to SMEs due to perceived risks and lack of data. But AI can analyze granular business data (point-of-sale records, supplier transactions, even social media reviews) to better assess SME creditworthiness. China's MYBank (an Ant Group offshoot) has already used AI to extend credit to over 20 million SMEs – often approving loans in minutes using algorithms.[47] By 2030, we expect such models to be adapted across Asia and the Pacific, enabling tens of millions more SMEs – from a handicraft cooperative in Fiji to a parts manufacturer in Viet Nam – to access the credit they need for growth. This would fuel job creation and innovation at the grassroots, contributing to dynamic and inclusive economies.

Cross-border payments and remittances (hugely important in Asia and the Pacific, which has many migrant workers sending money home) could become much cheaper and faster with AI. AI can optimize currency exchange timing and routing of payments. Already, Ant Group's Alipay+ connects hundreds of millions of users across Asian digital wallet platforms; by using AI to predict forex rates and net settlements across these networks, opportunities exist to reduce remittance transaction costs. Cheaper remittances mean more money reaches families for spending on health and education. By five-to-ten years, we might see near-real-time AI-optimized remittance corridors across Asia, benefiting countries like the Philippines, Nepal, and Pakistan that rely on remittance income.

Looking further, the medium-term vision is that digital finance becomes so ubiquitous and user-friendly that even a street vendor in a remote village can use a suite of financial tools on her phone for all her needs – payments, savings, credit, insurance. Achieving this will directly support multiple SDGs: reducing poverty, enabling business growth, promoting gender equality (since women often benefit greatly from financial inclusion), and fostering innovation. The caveat is that regulators will need to keep up. Issues of data privacy, algorithmic bias (e.g. if an AI unintentionally redlines a neighborhood), and competition (ensuring big-tech platforms do not monopolize markets) will need active oversight. Encouragingly, some Asia-Pacific regulators are exploring RegTech and SupTech – using AI themselves to monitor financial markets and detect risky behaviors or biases in algorithms.[48] For instance, future regulators might use AI to simulate and catch a lending algorithm that consistently offers worse terms to women or minorities and mandate fixes.

In summary, AI's infusion into services and finance holds tremendous promise for inclusive development. It can extend the reach of financial systems to those historically excluded, provide personalized services that improve quality of life, and make markets more efficient. The region is already seeing glimmers of this, and with sensible policies (around interoperability, consumer protection, and innovation sandboxes), Asia and the Pacific could leapfrog to a scenario where a farmer's daughter in a remote village can access a loan for

university, get insurance via her phone, start an online business, and even invest small savings – all enabled by AI-driven platforms. That vision, if realized, means more equitable growth and empowerment across society.

Education

PRECURSORS

Education is a sector with arguably the most direct long-term impact on human development and competitiveness. AI in education (often dubbed "EdTech") is quickly spreading around the world and Asia and the Pacific is no exception.

- *Bhutan* – Aan EdTech pilot integrating a Finnish AI-driven, math-learning platform (called Eduten) into primary schools showed impressive results. Over a 10-week trial with nearly 1,000 fifth-grade students, those using the AI-assisted system improved their numeracy scores by 11 percentage points more than control groups. Teachers reported that the platform's gamified exercises kept students engaged and that its AI analytics provided real-time feedback and helped tailor difficulty to each student's level. Off the success of this pilot – supported by Bhutan's Ministry of Education and UNICEF – Bhutan is now scaling the AI-enhanced math program nationwide for Grade 5. This shows that even a lower-middle-income country with limited connectivity can adopt cutting-edge AI tools in classrooms with the right partnerships and training.[49]

- *Afghanistan* – In a very different context, in Afghanistan, we see how technology can provide lifelines where traditional systems face disruptions. For instance, where access to formal education is suspended, digital platforms can serve as critical avenues for continued learning. In response, thousands of Afghan women turned to online learning platforms.[50] While these platforms aren't government-run (they include international MOOCs and NGO initiatives), they demonstrate AI's potential role: e.g. automatic translation tools can enable an Afghan student to take an online course in a foreign language, or AI tutors can be available on messaging apps to answer questions. Despite infrastructure challenges (patchy internet, electricity issues, and more recent additional restrictions to internet access), this phenomenon exemplifies resilience through technology – and underscores how crucial inclusive digital access is for education equality.

- *Republic of Korea* – On the higher-income end, Republic of Korea is pioneering a national rollout of AI-powered digital textbooks. Korean schools have introduced AI-enhanced textbooks in subjects like English and math for certain grades.[51] These e-textbooks use AI to adjust content difficulty to each learner's pace, and they provide teachers with data-driven insights (dashboards) on student progress. The goal is to personalize learning at scale – something that traditional one-size textbooks cannot do. The Government's plan was to expand these AI textbooks to all grades by 2028, potentially benefiting millions of students. Early trials indicated improved engagement and learning outcomes, and importantly, the initiative is accompanied by guidelines on safe and age-appropriate AI use in schools (including drafting rules to address privacy and bias issues in EdTech). While this program was discontinued following stakeholder feedback, the potential for interactive textbooks remains.[52]

- *Malaysia* – Malaysia has launched an initiative called AI untuk Rakyat ("AI for the People")[53], which offers free AI literacy courses in multiple local languages to both civil servants and the public. This program, part of Malaysia's digital inclusion strategy, explicitly targets underserved and rural populations to ensure they are not left behind in the AI era. By improving basic AI awareness and skills across society, Malaysia aims to foster a more equitable digital economy. This is an example of a government proactively trying to narrow the coming knowledge gap by treating AI literacy as a public good.

- *Pakistan* – Initiatives to reach marginalized groups are also emerging. Pakistan, for example, in partnership with UNESCO, set up "Smart Classrooms" in 40 girls' schools in remote areas.[54] These classrooms are equipped with AI-powered interactive learning tools (like adaptive quizzes and educational games) aimed at boosting engagement and retention for girls who face barriers to schooling. Early reports suggest improved attendance and a sense of empowerment among students. Such initiatives align AI deployments with human development goals – here, gender parity in education (SDG 4 and SDG 5).

Across these diverse examples – Bhutan's primary schools, Korean smart textbooks, Pakistan's girls' classrooms – there is a common pattern: AI has potential to personalize learning, reach marginalized learners, and support teachers in ways previously not possible. At the same time, these initial efforts are quite modest relative to need. They also face common challenges such as patchy infrastructure (devices, electricity, internet), teacher shortages, workload and buy-in, and content localization. In many places, introducing fancy AI tools without strengthening basic systems can even backfire as the failed One Laptop per Child program illustrated,[55] where without tech and maintenance support, localization, teacher training, and curriculum support, laptops were used for games, broke down, or gathered dust.

OPPORTUNITIES

In the immediate future, there are some "low-hanging fruit" uses of AI that could substantially improve education delivery and equity in Asia and the Pacific. One is language translation at scale. AI can now translate text and even speech between dozens of languages with reasonable accuracy. This could enable students to access a much larger corpus of educational materials in their mother tongue, including minority and indigenous languages. For example, an AI could translate math or science content from English into Bislama or Tagalog instantly, and even read it out via speech synthesis for the blind. Students from linguistic minority communities – whether indigenous peoples in South Asia or remote Pacific islanders – could receive quality learning resources in their first language as the list of machine translatable languages grows. Commercial publishers and governments could collaborate to use AI translation to produce textbooks and videos in multiple local languages quickly, at low cost. This would be a step toward inclusive education, preserving linguistic diversity while expanding access (and also represents a market opportunity for content providers).

Another short-term opportunity is the rise of AI tutors. With multilingual generative AI models becoming available, we can expect more AI-powered tutoring platforms accessible via smartphone. Imagine a student in a remote village who has no access to after-school tuition: an AI tutor app could help answer their questions, explain concepts in different ways until the student understands, and provide practice problems tailored to their level. Importantly, such AI tutors can operate 24/7 and do not get tired or frustrated. Early versions exist (like Khanmigo, an AI tutor developed by Khan Academy in partnership with OpenAI), which can create lesson plans in minutes and give learners step-by-step hints instead of outright answers. AI has the potential to undermine learning or create dependence, but as we learn what works, it could have an overall positive effect.[56] A human-centered approach to AI in education, where AI augments teachers rather than replacing them is likely to be a more effective approach. For Asia and the Pacific, this could mean that community volunteers or less-qualified teachers in remote areas could deliver better education outcomes with AI support.

In the next few years, we'll also likely see AI helping with teacher workloads – automating administrative tasks like grading multiple-choice tests or summarizing student performance. For example, an AI may instantly grade quizzes and even provide analysis like "Topic X needs reinforcement, 40 percent of the class missed question 5." This frees teachers' time to focus on lesson planning or individual student support. Some schools in Japan

and Singapore are already testing AI-assisted grading and analytics. If scaled, this could be particularly helpful in countries where teachers are few and stretched thin – AI may act as a force multiplier for the teaching force.

Another area is inclusive education for learners with disabilities. AI can generate real-time captions or sign language interpretations for deaf students (through computer vision that outputs sign language from speech, for example) or convert text to audio in local languages for visually impaired students. These technologies exist and could be implemented in classrooms with proper equipment, facilitating better access to regular curricula – an often overlooked aspect of inequality.

Overall, in the next two-to-three years, AI is poised to make learning more engaging and tailored, potentially contributing significantly to SDG 4 (Quality Education for All). By enabling personalized support at scale, AI tools can help students from various backgrounds catch up or excel at their own pace, which in turn can reduce learning gaps between rich and poor, urban and rural. As AI spreads into classrooms, governance will be key to ensure it is used ethically and equitably.

- *Japan* – We can draw lessons from early movers: Japan's MEXT has issued national guidelines (Ver. 2.0, Apr. 2025) for using generative AI in primary and secondary education, emphasizing human centered use and strengthened information literacy.[57] Japan's draft guidelines stress transparency in AI use (students should know when they're interacting with AI), age-appropriate content filtering, and teacher training to use AI properly. Similar frameworks may emerge in other economies, possibly informed by UNESCO or other international organizations, so that AI in education enhances learning without causing harm or deepening divides (such as a divide between well-resourced schools that can afford AI and those that cannot).

Looking at the 5–10 year horizon, AI could catalyze more profound, systemic changes in education across the Asia-Pacific region. The integration of AI tools into classrooms may become increasingly prevalent. By 2030, a typical classroom might have a teacher with an army of AI teaching assistants, supplementing lessons, monitoring each student's understanding in real time, and offering highly personalized learning pathways. If AI can reduce teachers' workloads, it would also allow them to spend more time on the human side of teaching, such as mentorship, encouragement, and one-on-one instruction for those who most need it.

Another medium-term shift will be in lifelong learning and workforce upskilling. As technology evolves, workers will need continuous training. AI can provide on-demand, personalized training modules to adults. Envision upskilling programs where an AI tutor helps a factory worker learn to operate a new machine, or teaches a rural entrepreneur how to use e-commerce tools in her local language. This could vastly expand access to adult education and make economies more adaptable, thereby improving workers' income prospects and supporting economic transitions (important for aging societies and those facing automation of certain jobs).

We might also see AI-integrated assessments and credentials. Looking ahead, education systems may explore the feasibility of integrating AI tools into national assessments—potentially to support proctoring integrity or assist in evaluating practical components (like coding challenges or virtual science labs). Done well, this can make exams more holistic and fairer (testing real skills, not just rote memorization) and help universities or employers identify talent that might be missed by conventional tests. However, it will require careful implementation to avoid bias.

In summary, by the early 2030s, AI could help achieve inclusive, quality education by personalizing learning, supporting teachers, and reaching those who were hard to reach before. Each learner could, in theory, have access to one-on-one style guidance – something only the elite had in the past – if AI tutors become widely available. The big "ifs" will be infrastructure (devices, connectivity), political will to invest in equal access,

and training for educators to harness AI effectively. If implemented well, Asia and the Pacific could see significant improvements in learning outcomes, narrowing rural-urban and rich-poor education gaps, and a better-prepared workforce for the knowledge economy.

Healthcare

PRECURSORS

Healthcare is emerging as a prime frontier for AI-driven innovation across Asia and the Pacific, with early projects – many still small in scale – foreshadowing broader transformations to come.

- *Bhutan* – Bhutan recently deployed a "clinic on wheels" to fight tuberculosis in remote areas. In 2024, a mobile medical van was outfitted with a digital X-ray and Qure.ai software to scan for TB on the spot. The AI can analyze chest X-rays within minutes to flag likely TB cases, enabling immediate confirmatory tests and treatment in villages far from any hospital.[58] This approach is bringing advanced diagnostics directly to high-risk communities and helping bridge the rural healthcare gap.
- *Brunei Darussalam* – In a different context, Brunei Darussalam has introduced its first medical AI to combat diabetic blindness. With diabetes affecting roughly 13 percent of Bruneians and one in three diabetic patients developing retinopathy (a leading cause of blindness), the Government launched SELENA+ in 2024 – an AI system at the national eye center that analyzes retinal images for early signs of disease. By catching problems early, this tool aims to enable preventive treatment before patients lose vision.[59] These examples illustrate how even smaller nations are beginning to adopt AI for critical public health needs.
- *Bangladesh* – Local social enterprises have developed digital health platforms using AI chatbots and analytics to facilitate confidential access to essential health services and mental well-being support via mobile phones.[60] With over 3.5 million subscribers, it provides education, symptom screening, and referral advice remotely, which is particularly valuable for youth and women in areas where clinics or specialists are scarce.
- *Mongolia* – As part of Mongolia's commitment to fight cervical cancer,[61] innovations are supporting a vast country where specialist resources are concentrated in the capital – a startup called AI Medi Mongolia teamed with a Korean tech firm to introduce CerviCare AI in 2023, an AI system for early cervical cancer detection intended to screen women in remote provinces who rarely get traditional screenings.[62]

At the other end of the spectrum, the Asia-Pacific region's more advanced economies have been pioneering AI integration in mainstream healthcare.

- *China* – Tech giants like Ping An, Alibaba, and JD.com have rolled out AI-powered health platforms that serve millions. Ping An's "One-Minute Clinics" – essentially unmanned telemedicine kiosks – use AI to triage patients, provide instant medical consultations, dispense basic medications, and even process insurance claims on the spot.[63] In parallel, online services, such as AliHealth and Ping An Good Doctor, deploy AI chatbots for initial consultations and health Q&A, a boon for elderly or rural Chinese patients who struggle to travel long distances for care.

These cutting-edge deployments remain limited in number, but they demonstrate what is technologically possible. Across these diverse cases – from Bhutan's mountain villages to China's megacities – AI is already proving its value in healthcare. The projects are modest in scale today, yet they paint a vivid picture of how AI could become a routine part of medical practice, saving lives and improving efficiency in the near future. Notably, they also reveal challenges that temper the excitement, especially around equitable access and inclusion, which we explore further below.

OPPORTUNITIES

Over the next decade, AI's role in healthcare is projected to expand, opening new frontiers in patient care, public health, and medical research. In the short term, there are several "low-hanging fruit" applications that many Asia-Pacific health systems can adopt relatively quickly to boost efficiency.

One is automating routine administration and documentation in clinics and hospitals. Generative AI tools are increasingly capable of transcribing doctor-patient conversations and summarizing clinical notes. By acting as tireless medical scribes, they can free up doctors and nurses from paperwork to spend more time with patients. For example, an AI assistant could automatically draft a patient's discharge summary or flag abnormal lab results for follow-up, reducing the cognitive load on overburdened staff. Some hospitals in technologically advanced cities (like Singapore's Tan Tock Seng or Seoul's Asan Medical Center) are already testing such systems that listen during consultations and produce first-draft notes. Even in middle-income countries, simpler AI chatbots can handle patient triage and scheduling – answering common health questions, booking appointments via messaging apps, and sending medication reminders in local languages. These applications usually pay for themselves by streamlining operations: a triage bot can direct non-urgent cases to a nurse or telemedicine call instead of clogging emergency rooms, for instance. Implementing these widely could markedly improve service delivery in both urban and rural settings without requiring massive new infrastructure.

Another immediate opportunity lies in AI-assisted diagnostics, building on the pattern- recognition prowess of modern AI models. In the coming years, we can expect AI "second opinions" to become commonplace for interpreting medical images and tests. AI algorithms are demonstrating high levels of precision in analyzing X-rays, CT scans, and ultrasounds – tasks such as spotting tuberculosis lesions on a chest X-ray or identifying tumors in an MRI. Scaling this up could effectively put a virtual radiologist or pathologist in every district hospital. A clinic in a remote province of Indonesia or Papua New Guinea, for example, might use a cloud-based AI to analyze chest X-rays for TB or pneumonia, getting results in minutes instead of waiting weeks for a specialist. Likewise, an AI could analyze a digital scan of a blood smear or a biopsy slide, flagging potential indicators of diseases like malaria or cancer to support early diagnosis.

Beyond imaging, generative AI models hold promise as on-demand medical consultants. Imagine a rural health worker who can describe a patient's symptoms to a smartphone-based AI (potentially in the local language) and receive clinical decision support or potential management options informed by comprehensive medical protocols. This kind of AI-powered decision support could augment human capacity – not replacing doctors and nurses, but equipping them with instant expert guidance. It could also enhance medical training: junior doctors might practice on AI-driven simulators or consult an AI for complex cases to double-check their reasoning. In fact, simulators are becoming more sophisticated. China's experimental AI hospital, for instance, uses AI "doctor" agents to create realistic training scenarios for medical students, hinting at future AI-assisted education for healthcare workers across the region.

AI can also enable predictive analytics for public health and personalized care. Health authorities in Asia and the Pacific are increasingly interested in using AI to forecast disease outbreaks and track health trends in real time. By analyzing a combination of epidemiological data, climate patterns, human mobility, and even social media signals, AI systems strengthen public health surveillance capabilities to forecast, say, a dengue fever outbreak weeks in advance or identify the early spread of a new influenza strain. Given the region's vulnerability to epidemics (from SARS to COVID-19), such predictive modelling could save lives by enabling proactive measures (vector control, vaccination campaigns, travel advisories) before a crisis peaks.

Some pilot projects are already underway: for example, Sri Lanka and Thailand have experimented with AI to map mosquito breeding sites and optimize dengue prevention, while research groups in India have modelled COVID-19 spread using machine learning to inform lockdown policies. Over a longer horizon, AI could be integral to a global disease early warning system, and Asia-Pacific countries – with their experience and data – stand to contribute significantly to that effort.

On the personalized medicine front, the convergence of AI with genomics and wearable technology supports the potential for more personalized therapeutic strategies. In the next five-to-ten years, it is plausible that AI will help doctors choose the best therapy based on a patient's genetic makeup, predict who is at higher risk for conditions like diabetes or stroke, and recommend highly individualized prevention plans. For instance, AI could analyze data from a patient's fitness tracker, diet app, and genome sequence together to alert them and their physician about subtle health changes or risk factors, prompting early interventions. This would represent a shift from one-size-fits-all healthcare to precision health, which could particularly benefit populations in Asia with diverse genetic backgrounds and disease profiles (e.g. South Asian populations' predisposition to diabetes or Pacific Islanders' risk of cardiovascular disease could be managed with more nuance).

Crucially, emerging AI solutions are becoming more accessible and user-friendly, which could help bring quality healthcare to underserved groups. Enabled by multimodal AI (which processes images, speech, and text together), a new wave of health interfaces will not require full literacy or English fluency to use. We might soon see AI health assistants that a person can simply speak to in their native language and describe their ailment or show a picture of a rash or injury – and the AI will understand and respond with advice or a diagnosis in simple terms. Consider a villager in the highlands of Papua New Guinea or a mother in a remote Bangladeshi char (river island): instead of traveling hours to the nearest doctor, she could interact with a voice-based AI agent on a basic smartphone to access initial health information, potentially facilitating critical referrals (for example, flagging symptoms associated with a dangerous pregnancy complication and urging her to seek help).

With the Asia-Pacific region's linguistic diversity, the trend of training large language models on local languages is pivotal – and it is underway. We are seeing the beginnings of AI systems conversant in everything from Bahasa Indonesia to Hindi to Khmer. As this progresses, it will greatly expand the reach of health information and services. In short, AI offers a chance to leapfrog some of the traditional barriers in healthcare: rather than requiring a full clinic with specialists in every village, a health worker with a tablet and an AI app could deliver a significant fraction of primary care services on-site. Additionally, AI-enabled devices and robotics may further extend reach – for instance, drones guided by AI are being tested to deliver medicines and vaccines to isolated Pacific islands, and simple robotic assistants (like automated pill dispensers or elder-care robots) could help aging societies like Japan, the Republic of Korea, or Thailand care for their seniors with fewer human caregivers.

All these opportunities, from smart diagnostics to predictive public health, align with a vision of more innovative and competitive health systems: ones that are efficient, adaptive, and inclusive. Countries that harness these AI tools effectively could see healthier populations (boosting productivity and human capital) and also foster domestic industries around health tech. The potential is substantial – but realizing it will depend on how the region navigates the inequality dynamics associated with AI, ensuring the benefits reach everyone.

Without deliberate efforts, the digital divides within and between countries would almost certainly translate into health divides, where some groups enjoy AI-augmented care and others are left further behind. Within countries, a key concern is the gap between urban, well-resourced settings and rural or marginalized communities. Urban hospitals and private clinics are often the first to

adopt new technologies, from AI diagnostic tools to telehealth platforms, while rural clinics may still lack basic internet or even reliable electricity. For example, Bhutan's experience with AI-driven TB screening showed immense potential, but also highlighted that many rural health posts lacked connectivity or trained staff to use such tools initially. Similarly, in Bangladesh and India the rollout of mobile health apps and AI chatbots has been fastest in cities, whereas rural villagers – especially those without smartphones – have had limited access.

There is a risk that AI could bypass those who need it most: the poor, the elderly, and the less educated. Digital literacy is a significant barrier – an AI app is only useful if people can navigate it and trust its advice. Older patients and those with varying levels of digital literacy may face usability challenges. Indeed, Brunei Darussalam found that many older citizens and rural residents were initially hesitant to use the new AI features in its national health app, prompting the Government to pair the app rollout with on-the-ground outreach and training to avoid widening gaps.

Gender disparities are another facet: in specific contexts within South Asia and the Pacific, women may face disproportionate barriers to accessing technology and information, influenced by factors such as localized social norms. If AI health solutions (like a maternal health SMS service or an online consultation platform) are not designed with these constraints in mind, women could benefit less. On the other hand, inclusive design can empower under-served groups – for instance, Bangladesh's SuSastho.AI platform provides confidential health guidance on sensitive issues, which can be especially empowering for young women who might feel uncomfortable seeking help in person. The lesson is that inclusion must be baked in: governments and NGOs may need to subsidize devices or data plans for low-income users, offer voice-based interfaces for the illiterate, and deploy community health workers as intermediaries who use AI tools on behalf of those who cannot. Without such measures, the AI revolution in healthcare might end up mostly helping the urban middle class and affluent, potentially widening internal health inequities.

The inequality challenge is even more pronounced between countries. Asia and the Pacific spans some of the richest and poorest places on earth, and their starting points in healthcare are vastly different. At one end, you have high-income economies like Singapore, the Republic of Korea, or Australia that boast advanced hospitals, high doctor-to-patient ratios, and robust digital infrastructure. At the other, there are countries like Afghanistan or Pacific states (e.g. Solomon Islands, Papua New Guinea) where healthcare facilities are sparse and skilled health workers are in critically short supply. Singapore, for instance, has around 28 doctors per 10,000 people, while Solomon Islands has only about 2-3 per 10,000.

On the one hand, AI has the potential to act as a great equalizer by alleviating some of these resource gaps (for example, AI tools could help a single doctor in a Pacific Island manage a workload that would normally require several specialists). On the other hand, there is also the very real risk of an AI-driven health divide: wealthier nations will quickly implement life-saving AI technologies (and even develop homegrown AI industries, exporting their solutions), whereas poorer nations might lack the bandwidth – financially, technically, and politically – to do the same. If a country cannot afford the latest AI diagnostic algorithms or fails to build the digital infrastructure needed for telemedicine, it could see its health outcomes stagnate while neighbors improve, affecting everything from life expectancy to economic productivity. In an extreme scenario, diseases that become easily managed by AI in rich countries (say, an AI that detects and controls hypertension early) might continue to cause high mortality in poorer countries that do not have access to that innovation. Such divergence would not only be unjust but could also undermine regional development goals – a population in poor health struggles to participate in the economy, reducing the competitiveness of that country in the long run.

To prevent these gaps from widening, collaborative and inclusive strategies are required. One approach is knowledge and technology transfer: high-capacity countries (or companies within them) can help open-source certain AI health tools or adapt them for low-resource environments. Multilateral organizations and regional forums can play a convening role, ensuring that standards and best practices for ethical, inclusive AI are disseminated widely. Investment in infrastructure remains pivotal: without broader internet access and electricity, even the most advanced AI application is moot.

Capacity building is equally important – training more healthcare workers in digital skills and AI literacy, so they can effectively use these tools and also contribute local data and insights to improve them. UNDP and other development partners are increasingly viewing digital public goods (like AI algorithms for common health issues) as something to support and scale in less-developed countries, analogous to providing essential medicines. Policymakers will also need to address regulatory and ethical questions to maintain trust: ensuring AI systems are transparent, respect patient privacy, and are tested for biases (for example, an AI diagnostic should be validated on local populations to make sure it works equally well for all ethnic groups and genders).

In sum, the trajectory of AI in healthcare carries both tremendous promise and critical risks for inequality. If guided with foresight, AI could help Asia-Pacific countries leapfrog toward universal health coverage – bringing quality care to remote villages, strengthening disease prevention, and easing the workload on overstretched clinics. This would translate to tangible human development gains: longer, healthier lives, lower medical costs, and a more productive workforce powering economic growth. It could also spur home-grown innovation, with Asia-Pacific firms designing affordable AI solutions for the world.

However, without conscious inclusion, the opposite outcome is possible – a scenario where advanced hospitals in big cities or rich countries reap most of the AI benefits (better outcomes, higher efficiency) while rural communities and least-developed nations see little improvement, or even relative decline as the gap widens. Managing this transition will determine whether AI in healthcare becomes a story of converging outcomes (narrowing health gaps between and within societies) or one of divergence. The challenge for leaders is to ensure that the AI revolution in healthcare is not just technologically transformative, but also socially equitable – that it truly serves all of the Asia-Pacific region's 4.3 billion people, not just the connected and fortunate few.

Urban planning and transportation

PRECURSORS

Asia and the Pacific is home to some of the world's largest and fastest-growing cities, and these urban centers face challenges like traffic congestion, pollution, and strained public services. AI is emerging as a tool to help manage and plan cities more efficiently. A prominent application is intelligent traffic management. In Dhaka, Bangladesh, a mega-city facing significant urban congestion, authorities have piloted an AI-based traffic signal control system. Cameras and road sensors feed real-time data on vehicle flows into an AI that dynamically adjusts the timing of traffic lights.[64]

Early trials on a few intersections showed the AI could respond to changing traffic conditions faster and more efficiently than manual control – reducing average wait times, though Dhaka's chaotic traffic (with frequent rule-bending by drivers) poses unique challenges. Still, despite the mixed results, this pilot signals openness to data-driven traffic solutions. Ulaanbaatar, Mongolia, for example, has partnered with Google on a "Green Light" project to network 170 traffic signals citywide. By late 2024, the city will centrally manage these lights using Google's AI algorithms, joining a roster of cities globally that saw reduced commute times and emissions from similar systems.[65] Even Auckland, New Zealand – a developed city – has implemented adaptive traffic lights.[66] These examples illustrate that there are common use cases for AI, such as traffic management, but also that each city has

unique challenges. Traffic management in Auckland is very different to that in Dhaka, but a platform developed in Dhaka may hold greater relevance for cities with similar urban dynamics, such as New Delhi.

Beyond traffic, cities are using AI for various public services. In China, the cities of Shanghai and Hangzhou have implemented "City Brain" platforms (developed by Alibaba) that integrate data from thousands of cameras and IoT sensors to optimize multiple urban systems. In Hangzhou's case, City Brain started with traffic management and reportedly reduced congestion by 15 percent and cut ambulance emergency response times by nearly half in pilot districts. It does so by, for example, clearing routes for ambulances or adjusting traffic signals across a whole corridor when it detects heavy buildup. City Brain has since expanded to other functions like detecting accidents or crimes on CCTV and dispatching responders. While those are high-end systems requiring extensive infrastructure (and raise privacy concerns with so many cameras), they illustrate what's possible when AI is applied at a city-wide scale.[67]

Smaller scale but impactful uses include public transit optimization. In Wellington, New Zealand, transit planners are testing AI analytics to better design bus routes and schedules, aiming to match services. Wellington is modernizing real-time transit information (RTI 2.0) with improved tracking and onboard capacity measurement; planners use operational data/analytics to refine routes and timetables.[68]

Cities are also exploring AI for environmental monitoring. Researchers in Seoul use AI to predict air quality a day in advance, based on weather and emissions data, which helps authorities issue alerts and adjust policies (like factory operations or traffic restrictions) proactively.[69]

Auckland piloted sensor-equipped bins and data-driven route-optimization software: fullness data from public litter bins was used to dispatch trucks only where service was needed and to optimize routes. In a 135-bin pilot, route time fell from ~7.5 hours to ~4 hours, with projected city-wide CO_2 reductions if scaled.[70]

In Thailand, large retail/logistics firms (like Central Retail Logistics) are using AI in transport management to optimize delivery routes and inventory movement, reducing costs and improving on-time performance. While this is a private sector use, it contributes to overall urban efficiency (less congestion from delivery trucks taking smarter routes) and shows that AI logistics is catching on in emerging markets too.

Malaysia provides a strong example of public-private collaboration for smart transport: PLUS, the country's biggest highway operator, partnered with a startup (Tapway) and NVIDIA to deploy an AI-powered, barrier-free toll system. Highways often cause jams at toll booths; this system uses computer vision (cameras with AI) to recognize vehicles at speed (up to 40 km/h) and automatically charge tolls without requiring cars to stop. The AI achieves 97 percent accuracy in identifying vehicle license plates and types within 50 milliseconds. With this, over 1.5 million daily commuters on PLUS highways experience smoother travel and reduced congestion around toll plazas. This demonstrates how AI can modernize infrastructure to deliver tangible benefits for daily mobility.

Japan is pushing the envelope with projects like a priority lane for self-driving trucks on a roughly 100-kilometer section of the Shin-Tomei Expressway. AI systems could coordinate self-driving trucks/platoons to address driver shortages and reduce fuel use on this route. This not only helps logistics efficiency but can cut emissions and improve road safety.[71]

All these cases share a theme: AI helping city authorities make data-driven decisions in real time, leading to tangible benefits like shorter commutes, lower emissions, or more reliable services. However, they also highlight prerequisites – reliable electricity, widespread connectivity, and good data governance – which vary widely across Asia and the Pacific. A well-off city like Singapore can deploy a comprehensive smart-city platform easily, whereas a city in a least developed country might struggle to even maintain traffic lights. So

while the positive impacts of AI in urban management are evident, scaling these solutions equitably is a challenge.

OPPORTUNITIES

In the short term, many Asia-Pacific cities could implement proven AI solutions relatively quickly. One immediate opportunity is expanding intelligent transport systems (ITS) from pilots to broader coverage. As noted, it is not just megacities – mid-size cities like Colombo, Jakarta, Cebu, or Kathmandu could benefit immensely from AI-coordinated traffic signals and better bus scheduling. The technology and know-how exist; often it is a matter of political will and modest investment. Given how much economic loss happens due to congestion, even a 10–15 percent improvement via AI would have big economic and quality-of-life payoffs. Additionally, smoother traffic means lower idle emissions and fuel waste – a public health and climate benefit. So we foresee more cities adopting AI traffic control and bus rapid transit optimizations.

Another short-term trend is using AI for urban safety and infrastructure maintenance. Many cities can deploy AI vision systems to monitor infrastructure – for instance, identifying potholes, or cracks in bridges, from camera feeds, or detecting when garbage dumpsters are full. In India, Bengaluru's civic body BBMP is piloting AI-enabled cameras mounted on vehicles to detect and map potholes across arterial and sub-arterial roads.[72]

AI can also help cities respond better to climate and disaster risks in the short term. A case in point is flood management. Cities in the Philippines, Viet Nam, Thailand and others face frequent floods. AI models that take in rainfall forecasts, drainage data, and soil saturation levels can give early warnings of which neighborhoods are likely to flood and how severely. Some pilot systems in Ho Chi Minh City are doing exactly this – researchers have used machine-learning surrogate models to forecast urban flood depths, supporting faster scenario testing.[73]

City authorities can also amplify AI's impact through open data initiatives. By opening transit data, traffic data, etc., to developers, they enable local startups or civic tech groups to build AI-powered apps – like real-time bus trackers, carpool matching services, or mapping tools for disabled-friendly routes. We see hints of this: in Malaysia, a community-developed app uses AI to suggest carpool matches for commuters, reducing traffic volume. Such participatory approaches can generate early benefits and solutions adapted to a city's context.

In summary, the next couple of years present a chance for Asia-Pacific cities to deploy proven AI solutions for cleaner, safer, more efficient urban living. Many of these technologies are not prohibitively expensive, especially compared to hard infrastructure. The key is capacity: city officials need the know-how to procure and manage these systems, and the public needs assurance (through policy) that AI use will respect privacy and equity.

In the longer term (five to ten years), AI could fundamentally reshape how cities are planned and managed, leading to smarter and more sustainable urbanization. One major medium-term opportunity is the adoption of AI-driven digital twins for cities. A digital twin is a virtual model of a city that updates with real-time data.

By 2030, it is projected that hundreds of cities globally will use digital twins, potentially saving billions in infrastructure costs by simulating and optimizing designs virtually before implementing them. In Asia and the Pacific, rapidly growing cities like Ho Chi Minh City (or Jakarta, which is even planning a new capital city – Nusantara) could use digital twins to test different urban development scenarios. For example, an AI-enhanced digital twin could simulate how building a new housing complex in one district would affect traffic, or how adding a park could improve air quality and temperatures, or how various flood defense designs would perform under extreme rain. This helps urban planners make better decisions that balance growth with quality of life and resilience. Singapore is already working on a city-wide digital twin, and Dubai too – their experiences will provide lessons on both the benefits and challenges. For developing cities, partnerships and donor support might make such sophisticated tools accessible.

Energy efficiency in cities will be another focus. By the early 2030s, many cities – from Canberra to Kuala Lumpur – could deploy AI to manage city-wide energy grids more smartly. This includes dynamically controlling street lighting (dimming when no one's around), optimizing HVAC (heating, ventilation, air conditioning) in public buildings by learning usage patterns, and managing charging of electric vehicles to avoid peak loads. These AI optimizations can substantially reduce urban energy consumption and carbon footprints, helping countries meet climate targets and saving municipal budgets which can be redirected to social services. Some cities in Australia and Japan are already testing such systems on small scales (like smart streetlights), and broader adoption will likely follow as the tech proves its return on investment.

Transportation in the medium term will venture into autonomy. Several Chinese and Japanese cities have ongoing pilots of self-driving buses and AI-guided metro trains. Within a decade, it is plausible that in controlled environments (campus towns, dedicated lanes, less complex urban areas), autonomous shuttles and buses could be operating at scale. This has inclusion benefits: it can provide mobility in areas or hours that aren't profitable for human-driven services, thus extending public transport access (for example, late-night autonomous minibuses in a suburb). It can also bring down costs in the long run, making public transit cheaper and more extensive – key for low-income users. And of course, AI drivers do not get tired or distracted, which could improve road safety if managed well. The caveat is that a mix of autonomous and human drivers is tricky; likely we'll see phased introduction (maybe autonomous public transport in segregated lanes first).

AI will also embed itself into urban governance. City officials could use AI to analyze vast datasets on population distribution, service usage, and socioeconomic indicators to identify optimal locations for new schools, clinics, or affordable housing. Instead of political guesswork, decisions on where to invest could be guided by algorithms highlighting areas of greatest need – e.g., an AI might identify gaps in service coverage within specific neighborhoods, providing data to support the placement of a clinic there to optimize impact. If coupled with participatory planning (getting community input), this could lead to cities that have more equitable in-service provision, ensuring resources go where they are most needed.

In summary, the medium-term future points to AI-integrated cities that are not just high-tech for the sake of it, but fundamentally more inclusive and sustainable. A child growing up in a medium-sized Asian-Pacific city in 2030 might breathe cleaner air because AI optimizes traffic and energy use, spend less time in traffic thanks to smart transport, and benefit from public services (school, clinic, library) optimally placed by AI analytics. However, to reach that point, investments in digital infrastructure are needed now, along with frameworks to safeguard privacy (smart cities generate a lot of personal data) and prevent a "techno-authoritarian" turn (e.g., using city AI systems for unwarranted surveillance or social control). The inclusive smart city is achievable – one where technology serves all citizens – but it must be pursued consciously, with communities involved in design and clear guardrails on how data and AI are used.

Risks and costs: disruption and exclusion

Up to this point, we have mostly highlighted the many potential benefits of AI-driven innovation across sectors with mentions of some specific risks. Here we summarize some of the cross-cutting risks, disruptions, and new inequalities that AI can introduce if not managed properly. These risks are not hypothetical – many are already materializing, and they tend to mirror existing structural inequalities, often magnifying them.

- *Market monopolization and concentration of power* – Advanced AI requires access to large datasets, significant computational power, and highly skilled talent – resources that are overwhelmingly concentrated in a few big tech firms and in wealthier nations. This gives a huge first-mover advantage to those actors. As AI scales, there is a danger that markets

tip toward monopolies. Smaller domestic companies in developing countries could be edged out if they cannot compete with AI-powered multinationals. For instance, if one firm's AI credit scoring platform becomes the standard, it might be hard for alternatives to emerge – potentially locking in that firm's biases or priorities. Globally, we already see a handful of companies dominating AI research and cloud infrastructure. Without intervention, AI could entrench these power asymmetries, making it harder for new innovators (especially from developing countries) to catch up. Furthermore, countries with advanced AI ecosystems might capture disproportionate economic gains, while others become reliant on imported AI solutions, leasing AI as a service without building local capacity.

- *Workforce disruptions and potential deskilling* – AI's ability to automate tasks means many jobs will be transformed or even eliminated. While new jobs will also be created, the transition could be very disruptive. In manufacturing, routine assembly or quality inspection jobs are at risk; in services, clerical roles or support jobs could shrink. Even in education or healthcare, AI might take over certain tasks (grading, basic diagnoses) that professionals used to do. There is a risk of mass displacement of workers, particularly those in roles with repetitive tasks. For developing countries with large youthful populations, this is worrying – it could exacerbate unemployment if economies do not create new roles or retrain workers fast enough. Another subtle issue is deskilling: if workers come to overly rely on AI tools without understanding them, their own skills may atrophy over time. For example, junior doctors might lose diagnostic skills if they always defer to AI, or teachers might lose some creativity in lesson planning if they rely on AI-generated content. Over-reliance without understanding can reduce the long-term innovative capacity of the workforce.
- *Intellectual property (IP) and innovation bottlenecks* – AI blurs traditional IP frameworks. For instance, who owns an AI-generated design or artwork? If laws are unclear, it can create a chilling effect on innovation. In countries with weak legal systems, there is a risk that big players could exploit local data or content to train AI, then claim the outputs without benefiting the source communities. Startups might hesitate to invest in AI solutions if they fear their innovations can be easily replicated by a tech giant that scrapes their data (a form of IP capture). Moreover, global IP regimes could evolve in a way that favors those who already hold AI patents, potentially locking out newcomers. If, say, fundamental AI algorithms or pre-trained model weights get patented or dominated by a few, late-coming countries might have to pay steep licensing fees – a scenario of digital dependency.
- *Bias, discrimination, and exclusion in AI systems* – AI systems are only as good as the data and design behind them. If the training data is not representative, the AI's decisions will not serve everyone equally – in fact, they can actively discriminate. This is a well-documented risk: an AI health diagnostic trained on urban hospital data might misdiagnose rural patients because their profiles differ. A lending algorithm could inadvertently "redline" (deny credit to) entire neighborhoods if their data patterns differ from the mainstream that the AI considers "creditworthy." Facial recognition AIs have famously had higher error rates for darker-skinned individuals because of biased training sets – raising serious concerns if such tech is used in policing or public services. In Asia and the Pacific, where societies are often heterogeneous and stratified, the danger is that AI could reinforce social biases (gender, caste, ethnicity, urban/rural) under a veneer of objectivity. For example, if an AI hiring tool is fed past data that under-represents women in tech jobs, it may "learn" to favor male candidates, perpetuating gender gaps. Without local calibration and inclusive design, AI can end up serving only the majority or the elite, sidelining minority needs and even causing direct harm through false predictions or unjust decisions.

- *Techno-authoritarianism and erosion of privacy* – A specific risk in governance is that AI can be used as a tool of surveillance and control. Advanced facial recognition, sentiment analysis on social media, and predictive policing algorithms are already being used by some governments to monitor citizens. In the absence of strong legal protections, there is a risk of techno-authoritarian practices spreading – where regimes use AI to stifle dissent (e.g., by identifying protest participants via surveillance cameras) or to manipulate public opinion (through AI-generated propaganda, deepfakes, etc.). The export of such technologies is a concern: for instance, if one country perfects AI-driven censorship or citizen scoring systems and sells them to others, it could undermine democracy and human rights in multiple settings. This risk is particularly salient as some Asia-Pacific governments have shown interest in systems like "social credit" scoring or extensive CCTV networks. Policymakers must ensure that AI deployment is bound by privacy laws and democratic oversight. Human development is not just economic; it includes political freedoms and human rights – and AI, if misused, can threaten those.

It is important to note that these risks are not equally distributed. They tend to hit the already disadvantaged harder. Within countries, as mentioned, those with lower digital literacy, less education, or from marginalized communities are more likely to be adversely affected by biased AI or job automation without a safety net. Between countries, the less technologically developed ones risk falling into a dependency trap. While a tech-forward country can mitigate some risks through its own innovation and regulation, a tech-dependent country might simply have to accept whatever AI tools are imported, even if they are not aligned with local needs or values.

In essence, AI could usher in a new era of inequality – between those who develop and control AI versus those who merely use it. If unchecked, we may witness a scenario where a few countries and companies reap most of the AI dividends (greater productivity, wealth creation, strategic advantage), while others are left to deal with AI's downsides (job losses, privacy invasions, and a brain drain of their tech talent to AI hubs abroad). This would compound existing divides. For instance, countries like China, the United States, and the Republic of Korea – already investing massively in AI – attract more investment and talent, extending their lead. Conversely, countries still building digital foundations, like Lao PDR or Papua New Guinea, might fall further behind as AI advancements raise the bar for competition. They could end up as passive consumers of AI products from elsewhere, with little ability to adapt or resist those technologies.

Over time, these disparities can create feedback loops. Early AI adopters get more competitive, drawing more talent and capital, which helps them make even more advanced AI – a virtuous cycle for them, but a vicious cycle for laggards. The laggards might find that by the time they are ready to engage, the rules of the game (standards, platforms, patents) are already set by others, forcing them into subordinate roles in the digital economy.

In summary, AI's transformative potential is clear, but so is the risk of deepening exclusion. The challenge ahead for Asia and the Pacific is not simply to adopt AI or transplant solutions from the external markets, but to integrate it wisely and carefully adapt it to local context or even develop local solutions. This means actively shaping AI's rollout such that it reduces inequalities rather than exacerbating them. It means building local capacity – so countries are not just consumers but creators of AI solutions – and updating policies to safeguard fairness, competition, and rights in the AI era. In the next section, this report turns to exactly those policy implications and recommendations, aiming to ensure that the coming AI-driven age is one of equitable innovation and human-centric development rather than a scenario of concentrated benefits.

Policy implications and recommendations

The world now stands at the threshold of a new technological era. The policy decisions made today – about what to incentivize, what to regulate, where to invest – are expected to significantly influence whether AI becomes a force for inclusive prosperity or one that entrenches inequality. Given the region's vast diversity in development levels and capacities effective policies are context-sensitive, yet guided by a shared principle: AI adoption should enhance innovation and competitiveness without entrenching inequality or dependence. The following policy recommendations aim to provide concrete, evidence-based guidance for national governments, development partners, and regional bodies to harness AI for human development.

1. Build adaptive and inclusive national AI ecosystems

Countries that have advanced in AI did not achieve this by accident. They cultivated entire ecosystems: coherent national strategies, funding for research and innovation, strong education pipelines, and public-private partnerships to deploy AI solutions. AI offers an unprecedented ability to personalize and adapt to local context, which can only be realized with the right ecosystem. Developing countries in Asia and the Pacific will need support to build their own ecosystems, tailored to their context, offering a catalytic role for organizations like the UNDP.

- *Develop National AI Strategies aligned with development goals.* Every country should craft a national AI strategy or action plan that sets a vision for AI in society – not just for economic growth, but for broad human development priorities. This strategy should identify key sectors where AI can drive progress (e.g. agriculture for food security, healthcare for universal coverage, education for quality improvements) and lay out ethical principles and governance structures. For example, Bangladesh's National AI Policy 2024 explicitly links AI initiatives to its Sustainable Development Goals and is a promising model. The strategy should also delineate roles: which ministry leads, how academia and industry are involved, and how progress is monitored.
- *Invest in enabling digital infrastructure.* Without basic infrastructure, even well-designed AI tools will not scale. Governments, possibly with donor support, must invest in data centers and cloud services, widespread broadband/5G connectivity, and affordable compute resources (including exploring regional cloud hubs). For rural and remote inclusion, innovative solutions like community networks or satellite internet should be considered. Donors and development banks can help fund these foundational investments, treating digital infrastructure as critical development infrastructure, much like roads or electricity.
- *Nurture local innovation and skills.* An AI ecosystem thrives on local talent and experimentation. Policymakers should establish R&D grants and innovation challenge funds to spur problem-solving AI applications (for local language NLP, agri-tech, etc.). Setting up regulatory sandboxes allows startups to pilot AI solutions (in fintech, health, etc.) under relaxed regulations but with oversight, accelerating learning without putting consumers at risk. Incentives for AI startups (tax breaks, seed funding, incubation programs) can also be effective. Additionally, countries should build capacity to adopt global AI advances quickly into local apps – for instance, training local developers to fine-tune large language models for local use cases, even if they cannot build those models from scratch. This lowers the barrier to adoption and ensures locals are adapting AI to cultural and practical realities.
- *Leverage South–South and regional collaboration*. Many developing countries share similar challenges that AI could address – be it agriculture pests or disaster response. Peer learning and joint projects can save time and resources. Asia-Pacific nations should strengthen channels for South–South collaboration on AI. For example, middle-income countries like Viet Nam and Bangladesh could exchange lessons on

applying AI in the garment industry or rice farming. Regional bodies (ASEAN, the South Asian Association for Regional Cooperation, the Pacific Islands Forum, APEC, etc.) can facilitate knowledge exchange, set up regional centers of excellence, or even pool resources for big projects (like a shared regional dataset for disaster management AI). Such collaboration can be more relevant than trying to copy Silicon Valley models in every context. There is also scope for forming regional norms (akin to the EU's approach) so that smaller countries have a collective voice in setting standards around AI ethics and data governance.

2. Design for equity and representation from the start

Ensuring AI does not deepen inequality requires proactive measures upstream, at the design and data collection phase – not just downstream fixes. Equity must be a core design principle in AI projects, whether by government or private sector.

- *Mandate inclusive data practices* – Governments (especially funders of AI projects) should require that datasets used for AI training reflect the diversity of the population. This might mean including data from rural areas, from different ethnic groups, all genders, various income groups, etc. For instance, if a national AI health program is developing a diagnostic tool, the training data should include patients from different regions (not just the capital's main hospital) and groups. This could be enforced by funding conditions or review boards that check data bias. Open data initiatives can help provide diverse datasets. In cases where local data is scarce (like for rare languages), authorities should invest in data collection (e.g., via crowdsourcing or incentivizing data sharing) to avoid the easy path of using only foreign or non-representative data.
- *Ensure accessibility of AI tools* – In low-resource settings, high-tech solutions must meet people where they are. That means designing for low literacy and low connectivity. Governments can promote or provide multimodal interfaces – e.g., AI services accessible via voice (IVR systems) or SMS for those without smartphones. A good example comes from Bhutan: agricultural AI advisories are delivered through local extension centers to farmers without smartphones. Similar approaches (using community health workers to mediate an AI health app, or teachers to mediate EdTech) can bridge the last mile. Governments should also require usability testing of public-facing AI with target communities (women with low literacy, disabled users, etc.) before scale-up.
- *Avoid language lock-in* – The AI revolution shouldn't be confined to English, Chinese, or a few major languages. Public funding and regional cooperation should support AI development in local languages, including minority and indigenous languages. This can involve translating open-source model interfaces, creating language datasets, and sponsoring research on AI language models for languages like Khmer, Tagalog, Fijian, etc. Ensuring linguistic inclusion will both expand AI's market and preserve cultural diversity.
- Foster participatory AI development – A recurring lesson is that AI solutions work best and gain trust when the target community is involved in their design. Governments and NGOs should use co-creation models, involving teachers in designing an education AI tool, or farmers in defining features for an agri-advisory app. Such participatory approaches improve relevance, build community ownership, and can pre-empt misuse or cultural mismatches.

3. Regulate for fairness, competition, and autonomy

AI's rapid deployment in the market can outpace traditional regulations, potentially leading to unfair practices, anti-competitive behavior, or threats to individual autonomy. Policymakers must update and enforce regulations to get ahead of these dynamics, especially in contexts where existing safeguards (like antitrust enforcement or privacy laws) are weaker.

- *Prevent platform lock-in and monopolies* - To keep markets open and competitive in the AI era, regulations should encourage interoperability and data portability. For example, if a farmer uses a certain smart farming app, they should be able to export their data to another service if they switch – this prevents one company from "owning" all agricultural data. Governments might mandate common standards for data formats in sectors like finance and health to avoid vendor lock-in. Open Application Programming Interfaces (APIs) should be promoted for dominant platforms so that smaller players can build on them (with appropriate security). Competition authorities should be vigilant about big AI players acquiring local startups in ways that stifle competition.

- *Address labor transitions proactively* – Anticipating job displacement is crucial. Governments need to implement policies for reskilling and upskilling workers whose jobs are at risk from AI. This could mean expanding technical and vocational education to include digital and AI-related skills, or offering mid-career training programs (for example, training assembly line workers in maintaining and programming the robots that might replace some of their old tasks). Countries might establish worker transition funds (funded by a small levy on companies benefiting most from AI productivity gains) to support displaced workers through unemployment benefits and retraining. Importantly, the introduction of AI in workplaces should be guided by a principle of augmentation, not just automation. Where possible, encourage adoption of AI systems that assist human workers rather than replace them outright. For instance, the Republic of Korea's approach in education – deploying AI to enhance teachers' capabilities (like dashboards that help teachers focus on students' needs) rather than to replace teachers – is a model. Governments might offer tax incentives or grants for companies that choose AI solutions which augment human labor or that are implemented alongside a plan to retrain employees for higher-skill roles.

- *Clarify intellectual property and data ownership rights* - Legal uncertainties around AI-generated content and data rights must be resolved to promote local innovation. Countries should update IP laws to address questions like: if an AI-generated invention is created, can it be patented and by whom? If a local dataset is used to train an AI, do the data providers have any rights to the resulting model or its profits? A balanced framework can protect creators and innovators without overly favoring big tech. For instance, ensuring that local researchers or startups can use pre-trained models or global datasets under fair-use exceptions could spur innovation. Also, protecting traditional knowledge and community data from exploitation (e.g., by requiring benefit-sharing if such data informs AI products) might be considered. In short, clear rules of the game will reduce fear of IP theft or legal risks and thereby encourage more actors to develop AI solutions.

- *Safeguard individual rights and privacy* - From health records to facial images, AI raises serious privacy issues. Many Asia-Pacific nations currently lack robust data protection laws or face challenges in enforcement. It is imperative to enact comprehensive data protection legislation that covers AI use – including rules on consent for data usage, individuals' right to know when AI is being used, and redress mechanisms if AI decisions cause harm. Special attention should be given to sensitive use cases like facial recognition, where misuse can infringe on civil liberties. Some jurisdictions might decide to ban or strictly limit use of AI in surveillance without warrants or oversight. Additionally, AI ethics boards or review committees can be institutionalized for public-sector AI deployments (as done in Singapore and to some extent in Japan) to evaluate implications on rights. Crucially, regulators (like data protection authorities) need to be empowered and independent, with technical capacity to audit AI systems. This might require training or seconding tech experts to government, or pooling expertise at a regional level for smaller countries.

4. Focus on implementation and institutional capacity

Well-crafted policies mean little if countries lack the institutions and skills to implement them. A recurring development challenge is the "policy-practice" gap, especially with complex tech like AI. Hence, a major focus must be building the institutional capacity to execute, regulate, and scale AI initiatives. As one might say, policies without implementation are just wishes.

- *Strengthen regulatory and procurement capacity* – Governments need skilled personnel who understand AI sufficiently to evaluate vendors, audit algorithmic systems, and manage AI procurements. For example, if a city is buying an AI traffic system, do officials know what questions to ask about the algorithm's performance and biases? If a national health service adopts an AI diagnostic tool, is there capability to independently test its accuracy on local populations? To build this, countries may need to invest in training programs for civil servants and regulators on AI and data science. Regional cooperation can help: perhaps establish a regional AI training academy or facilitate secondments – e.g., sending officials to more tech-forward agencies (Republic of Korea's digital agency, Singapore's GovTech) for hands-on learning. Donors could support such exchange and capacity-building initiatives, as they are foundational for sustainable AI uptake.

- *Embed monitoring and evaluation (M&E) frameworks in AI projects* – Governments and development partners should treat AI interventions like any development project: measure their outcomes, not just outputs. This means up front, define what success looks like (e.g., did an AI education pilot actually reduce learning gaps? Did a fintech AI increase loans to small businesses without raising default rates?). Then, collect data to evaluate these questions. Because AI impacts can be complex, it is important to go beyond technical metrics (accuracy, etc.) to social impact metrics: are the benefits reaching the intended groups? Is anyone being unintentionally excluded or harmed? Such evaluations will inform scaling decisions and allow mid-course corrections. They also help build public trust if transparently reported. Thankfully, AI facilitates this by being self-documenting in many cases (using AI to monitor AI), but it is essential that what is measured isn't just deployment - not AI rolled out to 10,000 classrooms, but AI reduced freed teacher time by 20 percent which was used for mentorship and reduced learning gaps by 12 percent.

- *Pilot, then scale (with iteration)* – Pilot projects, rigorously evaluate them, and scale up what works – with adaptations as needed. This prevents costly failures and allows local customization. Many successful examples we cited (Mongolia's agriculture pilots, Bhutan's TB vans, etc.) began as small experiments. Governments should maintain sandbox environments for pilots and encourage a culture of experimentation in public services. However, they must also be ready to terminate or redesign pilots that do not show results, to avoid pilot-itis (lots of demos, no systemic change). Many current evaluation frameworks may not be fit for purpose if they assume time-consuming evaluation in a world where AI itself can provide evaluation data, analysis, and interpretation in real-time for immediate, even mid-study intervention.

- *Ensure fiscal and operational sustainability* – A known issue is that many AI (or ICT) projects in developing countries start with donor funding or as pilots and then flounder when that support ends. From the outset, plan for the long term: who will maintain the AI system? Where will funding come from for updates, for cloud compute costs, etc.? If an AI solution is donor-funded (say an agriculture app), a strategy should be in place to transition it to local ownership or integrate it into government services with budget allocated. Possibly involve the private sector in models where they can sustain the service (through reasonable fees or cross-subsidies) if appropriate. Also, consider appropriate cost-recovery models – e.g., maybe farmers pay a

small subscription for an AI advisory after a free trial, or a public healthcare AI is funded by savings it creates elsewhere. Public-private partnerships could help sustain certain AI infrastructures (like national clouds or broadband for AI connectivity) if well-regulated.

Finally, it is worth emphasizing a mindset: resist "techno-solutionism". AI is not a magic wand to fix systemic issues overnight. Policymakers must invest in the "boring" but essential work of ecosystem-building, human capacity, and governance. The prize, if done right, is not just more innovation per se, but equitable innovation, innovation that broadens opportunities, builds sovereignty, and narrows gaps between and within nations.

To summarize our 12 key policy recommendations for harnessing AI for innovation and inclusive development in Asia and the Pacific:

1. Develop National AI Strategies grounded in human development priorities, with clear sectoral focuses and ethical guidelines.
2. Invest in digital infrastructure (connectivity, data, compute) as a foundation for AI.
3. Support local innovation ecosystems – through funding, sandboxes, and partnerships – so home-grown solutions emerge.
4. Mandate inclusive data and design practices to ensure AI systems work for all segments of society.
5. Promote language and cultural inclusion in AI tools (do not leave anyone behind due to language).
6. Deliver AI through trusted intermediaries or appropriate interfaces in low-connectivity or low-literacy areas (to ensure accessibility).
7. Enforce interoperability and open standards to prevent tech monopolies and platform lock-in.
8. Anticipate labor impacts with strong reskilling programs, social safety nets, and by choosing augmentation over pure automation.
9. Clarify IP and data rights to encourage innovation while protecting local interests.
10. Build regulatory and procurement capacity so governments can effectively evaluate and deploy AI.
11. Integrate monitoring and evaluation to measure AI's social impact, not just its tech performance.
12. Plan for sustainability and scaling from the start, including securing budgets for maintenance and integrating successful pilots into broader systems.

CONCLUSIONS

Artificial Intelligence represents a new frontier for innovation and competitiveness in Asia and the Pacific. But as with previous technological waves, it presents a choice – it can either entrench existing hierarchies or expand human potential. Its impact will depend not on the algorithms themselves, but on how we deploy them, who they are designed to serve, and whether they advance the freedoms that underpin true development.

Used wisely, AI can help remove long-standing obstacles to human development in the region: lack of access to quality healthcare or education, financial exclusion, information gaps for farmers, inefficiencies that waste public resources. We have seen how AI-driven solutions – from smart farming to virtual tutors – can empower individuals and communities. With the right policies and institutions, AI can expand people's capabilities: not only to be more productive, but to learn and express themselves, to be healthier, to participate more meaningfully in the economy and society. It can help a rural woman gain financial independence, or a child in a remote village to access world-class learning, or a small nation to better manage its limited resources.

As AI and digital infrastructure become so integral to opportunity, we believe that access to them will be seen as fundamental as access to electricity or education – a prerequisite for full participation in modern life. Without such access, people and countries risk being left behind from the emerging knowledge economy;

with it (and the preparation to use it effectively), even remote communities can find new pathways to growth and dignity.

This, ultimately, is the promise of AI for Asia and the Pacific: not just faster economic growth, but the expansion of human freedom. If we get it right – through inclusive innovation and thoughtful governance – AI can help countries leap over historical barriers: bridging gaps in infrastructure, overcoming isolation, democratizing information and services. It can lead not just to greater productivity, but to greater possibility for all citizens. The true measure of success will not be how intelligent our machines become, but how much more empowered our people become – how AI expands what individuals and communities are free and able to do. The choices we make now will determine whether the AI revolution in the Asia and the Pacific is one that uplifts and includes, ensuring this new era is one of increased but shared prosperity rather than a new era of inequality.

END NOTES

1. (Wrigley, 2010; Pomeranz, 2021)
2. (Martínez and Ebenhack, 2008; Muthukrishna, 2025)
3. (Levinson, 2016)
4. (Jebara, 2004)
5. (Wei et al., 2022)
6. (Vafa et al., 2024)
7. (Bommasani et al., 2021)
8. (Hu, 2023)
9. (Alleyne, 2018)
10. (Silver et al., 2016)
11. (Davies et al., 2021)
12. (Jumper et al., 2021)
13. (Royal Swedish Academy of Sciences, 2024)
14. (Eloundou et al., 2024)
16. (FAO, 2024)
17. (Shahzaib, 2024)
18. (Eurogroup, 2025)
19. (Nation, 2025)
20. (Cong and Minglai, 2025)
21. (Credence Research, 2025)
22. (Moody, 2016)
23. (Global Fishing Watch, n.d.)
24. (GRID Arendal, n.d.)
25. (Heifer International, 2024)
26. (Dobhal and Pathak, 2023)

27. (Business Market Insights, 2022)
28. (Xinhua, 2025)
29. (Google, n.d.)
30. (IFR International Federation of, 2025)
31. (Smart City Korea, 2024)
32. (Johnson, 2025)
33. (Vimatic, 2025)
34. (Textile Magazine, 2024)
35. (Kaur et al., 2024)
36. (FPT, 2025)
37. (Papri, 2025)
38. (Nat, 2025)
39. (Emanuel-Burns, 2025)
40. (Digital Brunei, 2020)
41. (Zangmor and Tshomo, 2024)
42. (Choo, 2025)
43. (Lei, 2025)
44. (Light Reading, 2025)
45. (Bangladesh Bank, Banking Regulation and Policy Department, n.d.)
46. (Kim, 2025)
47. (MyBank, n.d.)
48. (Asian Development Bank, 2022)
49. (UNICEF Global Learning and Innovation Hub, 2024)
50. (Greenfield and Yawar, 2023)
51. (Jung Da-hyun, 2024)
52. (Light Reading, 2025)
53. (MyDigital, n.d.)
54. (UNESCO, 2025)
55. (West, 2023)
56. (Wang and Fan, 2025)
57. (Japan Ministry of Education, Culture, Sports, Science and Technology, 2025)
58. (Chhophyel, 2025)
59. (Nova Group, 2024)
60. (Lima et al., 2025)
61. (World Health Organization, 2025)
62. (엔티엘헬스케어, 2023)
63. (Koh, 2019)
64. (Mahmud, 2024)
65. (Өнөболд, 2024)
66. (OurAuckland, 2024)

67. (Beall, 2018; Zhang et al., 2019)
68. (Greater Wellington Regional Council, 2023)
69. (Koo et al., 2024)
70. (DATACOM, no date)
71. (Japan Times, 2025)
72. (Times of India, 2024)
73. (Dang et al., 2024)

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