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ARTIFICIAL INTELLIGENCE AND SOUTHEAST ASIA'S FUTURE

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IN BRIEF

ARTIFICIAL INTELLIGENCE AND SOUTHEAST ASIA'S FUTURE

Advances in data collection and aggregation, algorithms, and computer processing power have enabled scientists and engineers to make great strides in developing artificial intelligence (AI). Suddenly machines can perform tasks that once required human cognition. In the past, computers could execute only the rigidly defined tasks for which they were programmed. Now they can be given a general strategy for learning, enabling them to adapt to new data without being explicitly reprogrammed. Many such "machine learning" systems already have been put to commercial use. Adoption is growing around the world in sectors such as finance, health care, and transport—and these systems are beginning to have an impact on the region encompassing ten countries that make up the Association of Southeast Asian Nations (ASEAN).

- The two major global hubs of AI development are the United States, which has pioneered many applications, and China, which is still a distant second but coming up fast. ASEAN lags behind, but there is AI activity in each member state. Singapore has made the greatest advances, but there are also promising early signs in places like Malaysia and Vietnam. The technology sector is naturally at the cutting edge of adoption, although AI tools are being deployed in sectors such as transportation, financial services, health care, and media.
- Because they can dramatically boost productivity, AI technologies may have a disruptive impact on the region's economies—and its workers. Previously published MGI research estimated that currently demonstrated technologies have the potential to automate roughly half of the work activities performed in ASEAN's four biggest economies: Indonesia (52 percent of all activities), Malaysia (51 percent), the Philippines (48 percent) and Thailand (55 percent). These tasks currently generate more than $900 billion in wages.

WHAT'S INSIDE

It should be noted, however, that technical feasibility is not the only factor affecting the automation of jobs; companies will also consider the costs of purchasing and implementing technology systems, labour market dynamics, the business benefits, and regulatory and social acceptance. But it seems likely that the nature of many jobs will change, and as more work requires interacting with machines, the region will need to develop new types of workforce skills.

- If harnessed in the right ways, AI technologies have the potential to contribute to positive social outcomes in ASEAN. Machine learning innovations can enhance credit models and financial inclusion, for example. AI solutions can enable new types of preventive and remote health care; they may also improve diagnoses and speed the development of new drugs. Adaptive learning algorithms could play a role in delivering individualised and virtual education. But most of the region will need to build foundational digital infrastructure and data ecosystems to realise these types of opportunities.
- For their part, most of the companies across ASEAN will need to make fundamental changes in management culture, including adopting a data-driven style of decision making, and most importantly, striking innovative partnerships with specialist firms to incubate the scarce skill sets needed for AI efforts; a thoughtful approach to strengthening the data infrastructure is also needed to prioritise effort and investments.
- Although the market will drive the development and adoption of AI, governments will need to play a critical role to deliver benefits across the society. We see three major priorities: establishing a regional policy framework to support AI development and adoption; developing AI talent and encouraging usage at the local level; and focusing public debate on ensuring that AI contributes to inclusive growth and positive social outcomes.

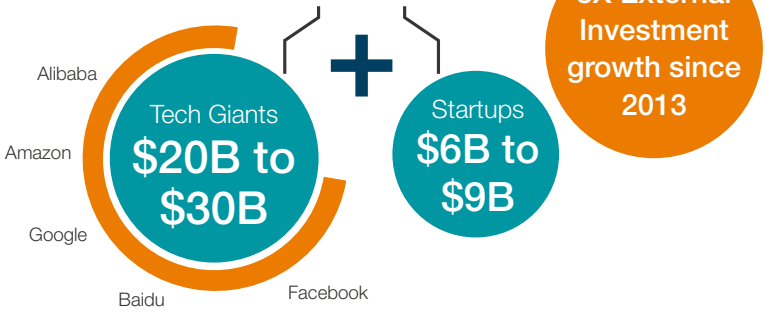
ARTIFICIAL INTELLIGENCE AND SOUTHEAST ASIA'S FUTURE

Global investment in AI is growing rapidly

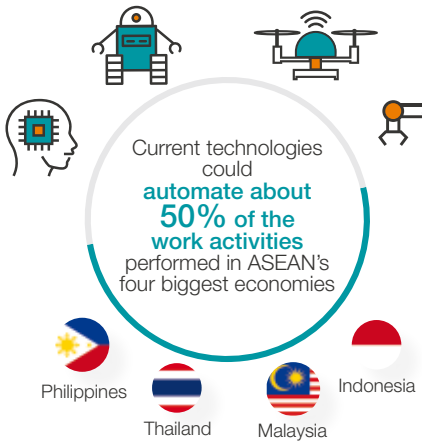
In 2016, companies invested

$26B to $39B

in artificial intelligence



AI technologies can unlock many opportunities in Southeast Asia



These activities currently generate more than **$900 billion in wages**

Potential social benefits if AI adoption is implemented at scale

Machine learning innovations can enhance credit models and financial inclusion

AI solutions can enable new types of preventive and remote health care; they may also improve diagnoses and speed the development of new drugs

Adaptive learning algorithms could play a role in delivering individualised and virtual education

Five elements for AI adoption within companies

1. Clearly defined use cases or sources of value
2. Robust data ecosystems
3. A workforce that is adept at using systems and tools
4. Clear integration with workflows in the core business
5. An open culture that embraces a 'test and learn' approach

1. A VIEW INTO THE FUTURE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to the ability of machines to exhibit human-like intelligence—for example, the ability to solve a problem without requiring detailed, human-developed software. By reviewing voluminous data sets for patterns, machines can "learn" to perform tasks, such as identifying images, recognising speech, identifying relevant information in texts, synthesising information, drawing conclusions, and forecasting. As AI's capabilities have dramatically expanded, so has its utility in a growing number of fields.

There is no universally agreed-upon definition of what constitutes AI. The field is advancing rapidly, and developers often mix and match existing technologies to solve specific problems. The term "AI" therefore covers a broad range of technologies and applications, some of which are extensions of earlier techniques (such as machine learning) and others that are wholly new. In fact, there is no generally accepted theory of "intelligence", and the definition of artificial intelligence changes as people become accustomed to previous advances.[1] While there is disagreement about where to draw the boundaries in this field, there is broad consensus on one thing: AI is the next wave of digital disruption.

AI AND THE IMPACT ON JOB CREATION

There is growing recognition—and anxiety—that AI could have a disruptive impact on labour markets. Previously published MGI research projects that almost half of all work activities have the technical potential to be automated by adapting currently proven technologies. Technology could handle at least 30 percent of the activities that are performed in 60 percent of all occupations (Exhibit 1).[2] Because automation applies at the task level, AI seems likely to change more occupations than it will eliminate outright. This could have a profound impact on the region's

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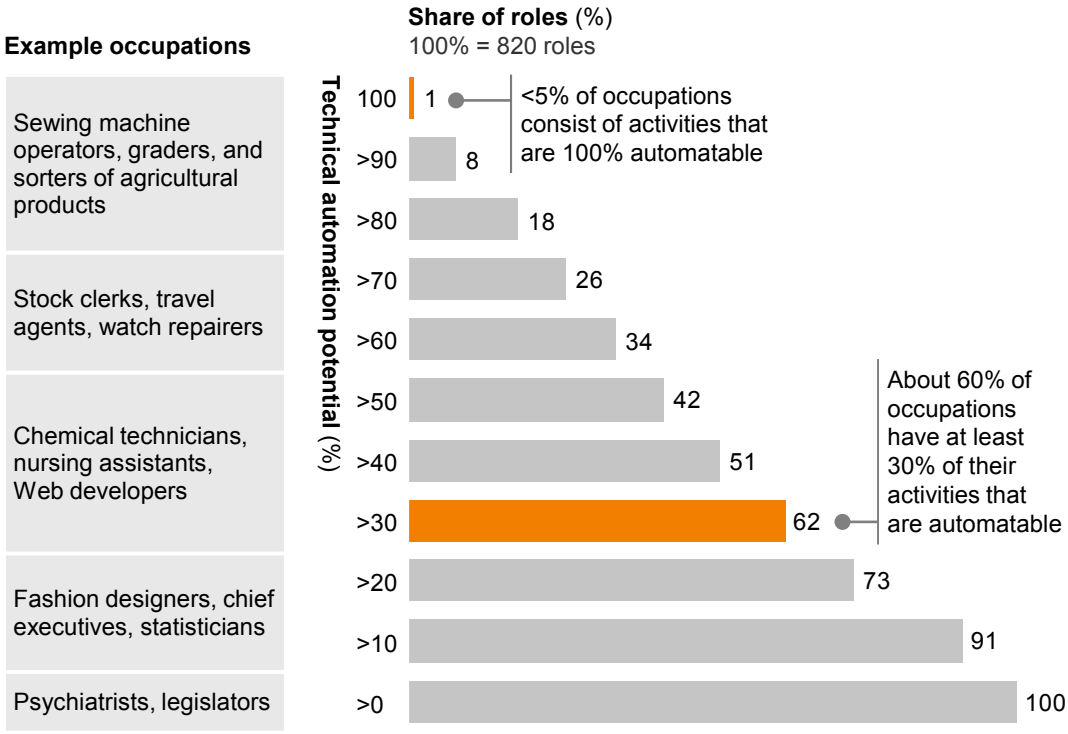
1 Marvin Minsky, "Steps toward artificial intelligence", *Proceedings of the IRE*, volume 49, number 1, January 1961; Edward A. Feigenbaum, "The art of artificial intelligence: Themes and case studies of knowledge engineering", Stanford University Computer Science Department report number STAN-CS-77–621, August 1977; Allen Newell, "Intellectual issues in the history of artificial intelligence", in *The Study of Information: Interdisciplinary messages*, Fritz Machlup and Una Mansfield, eds., John Wiley and Sons, 1983.

2 *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017. Our analysis focuses on work activities rather than whole occupations. We consider work activities a more relevant and useful measure since occupations are made up of a range of activities with different potential for automation. For example, a retail clerk will spend some time interacting with customers, stocking shelves, or ringing up sales. Each of these activities is distinct and requires different capabilities to perform successfully.

Exhibit 1

While few occupations are fully automatable, 60 percent of all occupations have at least 30 percent technically automatable activities

Automation potential based on demonstrated technology of occupation titles in the United States (cumulative)[1]



1 We define automation potential according to the work activities that can be automated by adapting currently demonstrated technology.

SOURCE: McKinsey Global Institute analysis

demand for certain workforce skills and could increase churn in the labour market.

Jobs with a high proportion of time devoted to data collection, processing, or routine physical tasks are going to be the first wave. These vocations include food preparation, office administration, and factory production. The impact on labour markets can be substantial. In Southeast Asia, MGI finds that currently demonstrated technologies could automate about half of the work activities performed in Indonesia (52 percent), Malaysia (51 percent), the Philippines (48 percent) and Thailand (55 percent). These activities currently represent more than $900 billion in wages. But this does not mean that companies will replace workers with machines overnight just because it is technically feasible to do so. The pace and

extent of automation will be determined by how companies view the business case, weighing considerations such as the cost of these technology systems, their ease of use, labour market dynamics, the value that could be created, the customer experience, their own capabilities, and regulatory and social acceptance.

As technology disruptions have done in the past, AI has the potential to deliver a dramatic boost in productivity, which has historically been the key to creating income growth and prosperity. MGI estimates that AI adoption could add between 0.8 and 1.4 percent to global GDP annually, assuming that the displaced human labour could be redeployed to roles where it remains as productive as it was in 2014.[3] But the opportunity is not just about finding efficiencies today; it is also about creating new avenues for growth. In our survey of "AI-aware" executives, 20 percent cited labour cost savings as their primary motivation for adopting AI. But even more (25 percent) said they introduced AI to help their business expand.[4]

AI IS APPROACHING A TIPPING POINT

The expectations surrounding AI are soaring. Computing power has grown exponentially while its cost has fallen, making it more feasible for companies and organisations to run sophisticated algorithms on massive data sets. Algorithms that "train" on large data sets have now managed to surpass human capabilities in areas such as image and speech recognition. Perhaps most important of all, the spread of mobile devices is creating vast quantities of new data with new insights on facets of consumer lifestyle and usage of services. In fact, the world generates some 2.2 exabytes, or 2.2 billion gigabytes, of new data every day. These trends have converged to create major AI advances—and now those advances extend beyond the research lab and into real-life business applications (Exhibit 2).

Machine learning is the bedrock for most current AI use cases. It is based on algorithms that learn by recognising patterns in big data sets without requiring rules-based programming in order to direct actions or draw conclusions. In practical terms, machine learning can be used to project outcomes, such as consumer demand or public health needs. It can optimise equipment maintenance, fine-tune prices, tailor marketing messages, and provide personalised retail experiences.

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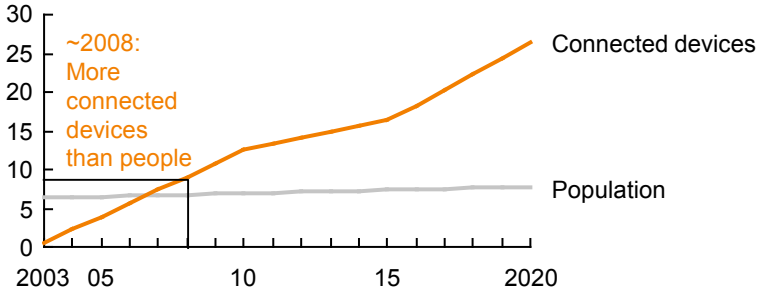
3 *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017.

4 *Artificial intelligence: The next digital frontier?* McKinsey Global Institute, June 2017.

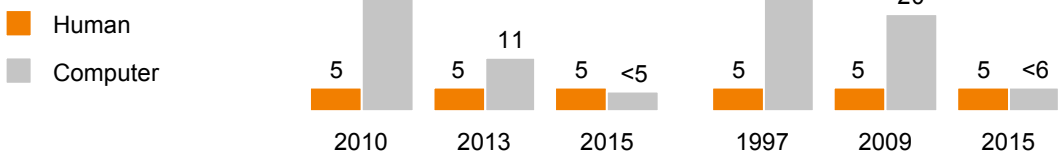
Exhibit 2

AI adoption is reaching a tipping point given a convergence of favourable conditions

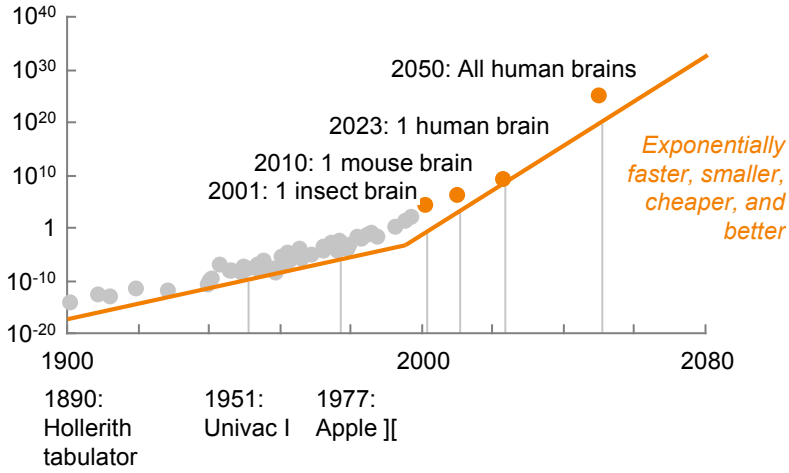
Connected devices and availability of data
Billion



Improved algorithms and training methods
Error rate, %



Exponential improvement of computing power
Number of calculations/ second per $1,000



SOURCE: *The zettabyte era: Trends and analysis*, Cisco, updated June 7, 2017' United Nations; MMC Ventures; Nvidia; McKinsey Global Institute analysis

In conjunction with information processing (such as computer vision and natural language) and actuation technologies (robots and self-driving vehicles), machine learning technologies have the potential to transform many aspects of our daily routines (Exhibit 3).

Exhibit 3

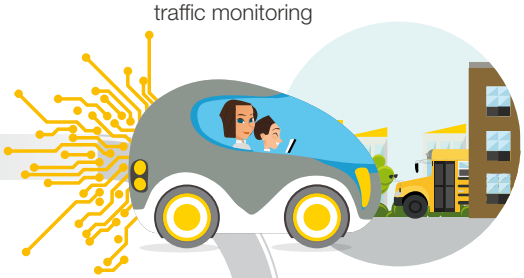
AI will shape our daily routines to enhance quality of life and increase human productivity

Tuti is a mother of a daughter, Andira, and a mid-level manager at a green energy company, based in Jakarta

01 In the morning she goes over her plan for the day with her virtual personal assistant, a conversation that covers:

- A health notification from her doctor
- A suggested grocery order she confirms for delivery that night
- A notification from Andira's school on her homework for the day and how Tuti can engage with her based on machine learning insights

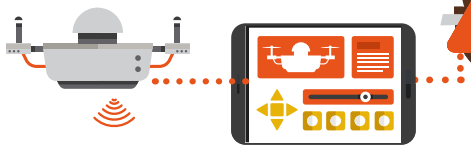
02 Tuti reads with Andira while dropping her off at school in a driverless car that is safer, smoother, and faster than driving herself, due to intelligent route planning and traffic monitoring



03

At work, Tuti is the head engineer for a windfarm. Her virtual assistant provides her with updates from the field. It helps her prioritise her tasks for the day, having learned how and when Tuti is most effective

An abnormality in the output patterns draws her attention to one generator; a robot is able to inspect and fix it for her remotely, minimizing productivity loss and safety hazards



04

After work, Tuti visits the gym for a quick workout. Her virtual assistant picks up a health notification and suggests changes to Tuti's exercise routine. It also triggers an update to her local pharmacy to deliver new medicines to her that evening

05

Back at home, Tuti helps Andira with her homework alongside a virtual tutor, which draws on a global library of lessons to teach her

The virtual tutor also collects data from teaching Andira and feeds into an anonymised national database to improve the teaching quality in Indonesia over time

While the pace of change is uncertain, change is indeed happening—and it is beginning to penetrate even traditional, non-tech industries such as manufacturing. Foxconn, for example, deployed 40,000 robots in its Chinese factories, making the plants less labour-intensive. In fact, the company is going further and aiming to produce 10,000 robots in-house to further its industrial automation goals.[5]

Falling costs, the modular nature of technology components, and the development of more user-friendly tools and interfaces are quickly making AI a viable and essential operational asset for an increasing number of companies. They can now hook up off-the-shelf data-management platforms to their most important assets first to get started with lowest upfront cost.

EARLY ADOPTERS CAN SEIZE A DISPROPORTIONATE ADVANTAGE

As earlier waves of digital technology have shown, early adopters of AI can realise major competitive advantages and maintain them over time—particularly if they view this new technology as a key business capability and a future source of revenue growth rather than just a means to cut costs. Larger firms are better positioned to do this, given their ability to make upfront investments in experimentation, and realise higher return on that investment by scaling across the business.

Globally, we estimate that corporations invested between $20 billion and $30 billion in AI development in 2016. This includes both internal R&D efforts and a steady stream of acquisitions. Tech giants such as Alibaba, Amazon, Baidu, Facebook, and Google account for more than three-fourths of total AI investment to date. From 2011 through February 2017, these companies were behind 29 of 55 major M&A deals in the United States and nine of ten major deals in China.[6]

Aggressive investing is helping these companies acquire pivotal talent, technology, and data sets, potentially erecting barriers for slower-moving competitors. Early adopters are also positioned to make moves into adjacent industries by using AI as a distinctive edge. AI-powered personal assistants such as Siri, Alexa, or Cortana could have applications in entirely new fields such as health care—potentially performing functions such as recommending a specialist or a hospital based on an individual's unique medical history or monitoring chronic disease indicators in real time. These types of possibilities could blur long-standing sector boundaries.

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5 "Foxconn reaches 40,000 robots of original 1 million robot automation goal", *South China Morning Post*, October 2016.

6 *Artificial Intelligence: Implications for China*, McKinsey Global Institute, April 2017.

Digital native companies also have unique advantages to push adoption. They know and appreciate the value of large, clean sets of data delivered from the core business. They typically have an agile "test and learn" approach embedded into their operating style. And they have a clear view of how AI technologies can elevate their core business, be they Amazon's Kiva robots or Facebook's personalisation bots. Incumbent firms in traditional industries can adopt their techniques, but will find it difficult to catch up.

In ASEAN, players in the most digitally savvy industries after high-tech—banking and telecom—are already launching initiatives but they are coming up short. Many telecom operators in ASEAN have begun their initial forays into AI for better customer intelligence, but they have faced difficulty in scaling up, often because they lack critical skill sets in data science and business translation. In absence of bold interventions, it is very likely that players in other industries will hit the same barriers, forcing them to rely on specialist technology providers. Perhaps the most high-profile example of these is IBM's Watson (see Box 1, "IBM Watson, the world's most famous AI system").

Box 1. IBM Watson, the world's most famous AI system

IBM introduced the general public to the concept of artificial intelligence with its Watson supercomputer—an AI system that famously trounced all human contestants on the Jeopardy! quiz show. Since then, IBM has offered Watson's cloud-based predictive analytics capabilities to customers across industries. To replicate a high-functioning human's ability to answer questions, Watson uses its processing power of 80 teraflops—80 trillion floating-point operations per second—to access 90 servers with combined data storage of more than 200 million pages of information. It can mine text, perform complex analytics on huge volumes of unstructured data, and run one of the world's most powerful search engines.

Watson's underlying cognitive computing technology lends itself to a variety of applications, including the following:

- **Health care and medical research:** Watson can process massive sets of patient data, looking for patterns that drug researchers may not see and then generate novel hypotheses for further evaluation. Its processing power is being used to match patients to clinical trials, diagnose cancer and identify treatment options, manage chronic disease, and accelerate R&D for drug development.
- **Education:** AI has enormous potential to personalise instruction to suit each student's learning style and ensure that he or she masters material before moving on to more advanced subject matter. Watson can identify critical insights about individual students based on their demographics, strengths, and challenges, enabling teachers to create targeted and dynamic instructional plans.
- **Public safety:** Watson is being deployed across smart city control centres to predict criminal activity and allow police departments to intelligently deploy their constrained resources. Its capabilities are now being expanded to assess vulnerability to cyber threats and take corrective measures.
- **Sports analytics:** Analytics has assumed a huge role in professional sports, where a tremendous number of performance indicators and variables can be analysed to gain a competitive edge. Watson has been used to analyse the play of a basketball team, determine its skill gaps, and recommend who should be signed and who should get playing time in specific situations.
- **Media broadcasting:** Watson has already automated editing of video highlights, most recently for Wimbledon, a job that would usually require a content operations team. With this technology, turning points in the game can be captured immediately and re-run on alternate social media channels to generate greater buzz.

2. AI CHALLENGES AND OPPORTUNITIES FOR SOUTHEAST ASIA

AI adoption around the world tends to be correlated to the degree of digitisation. In ASEAN, digitisation is growing and the pace of change is accelerating.[7] In 2011, only 6 percent of the region's large corporations mentioned terms such as "big data", "advanced analytics", "AI", "machine learning", and the "internet of things" in their annual reports. By 2016, one-third did, indicating that these technologies are gaining traction and becoming strategic priorities.

Across all industries, we find that early adopters of AI reported higher profit margins relative to their peers (Exhibit 4), particularly in manufacturing, financial services, and transportation and logistics industries. Most of these companies are giving this surplus value to customers in a bid to consolidate the market and eliminate competition. This winner-takes-all dynamic further exacerbates the "digitise or die" scenario that many incumbents find themselves in.

However, adoption of AI has not followed some of the largest value pools. Experimentation and subsequent adoption requires a forward-looking and expansive view of how AI could be applied in a company's core business, and implementation can be daunting for firms in traditional, non-tech industries. To date, high-tech, telecom, and financial services companies have led the way in ASEAN.[8] We also see a burst of activity in public services such as transportation and health care, driven by multiple government agencies and the region's proliferation of "smart city" programs.

At a country level, Singapore is leading the region in AI experimentation across multiple industries. But there are initiatives in countries across the entire ASEAN region (Exhibit 5).

While these sparks of activity are encouraging news, ASEAN will require sharper business cases, more robust data ecosystems, and more concerted talent and capability development if AI is to reach its full potential throughout the region.

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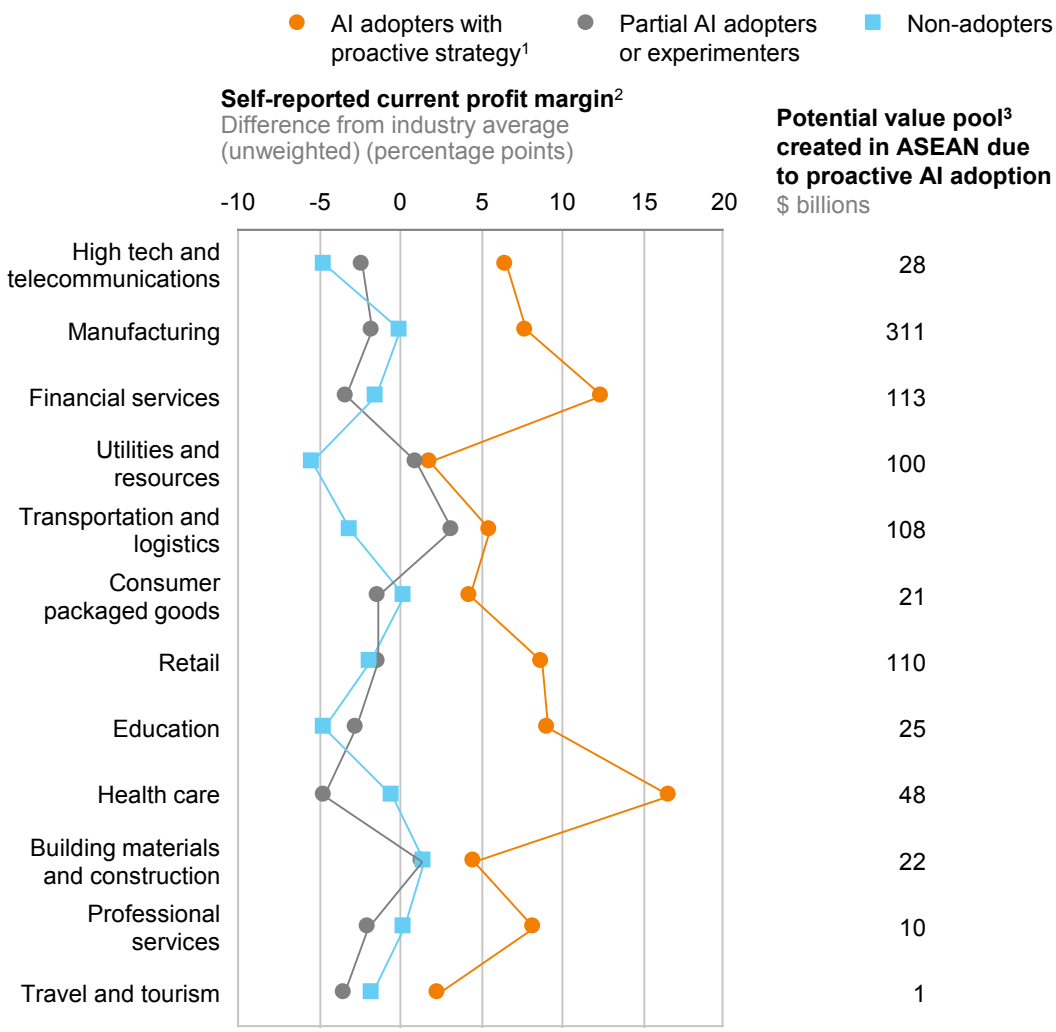
7 *Digital finance for all: Powering inclusive growth in emerging economies*, McKinsey Global Institute, September 2016.

8 High-tech companies often blur the line between AI development and its business use. We include these innovators in our general discussion of adopters but recognise the possibilities for organic tech development in the region.

Exhibit 4

Superior profitability and sizeable value pools created from AI adoption in ASEAN

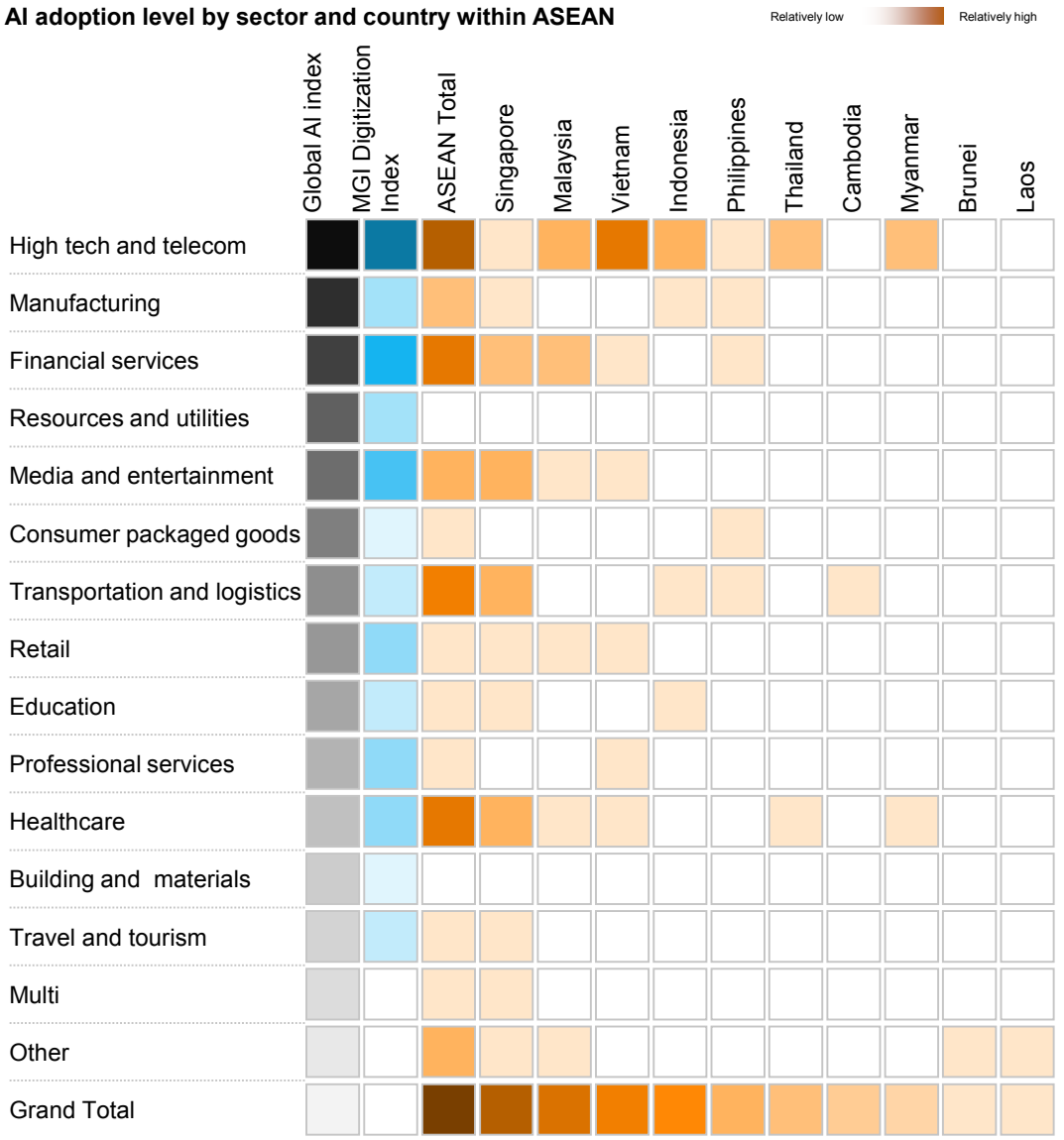


1 Firms that are big data and cloud services users and report their strategic posture toward AI to be: "Disrupting our industry using AI technology is at the core of our strategy," "We have changed our longer-term corporate strategy to address the AI threat or opportunity disruption," or "We have developed a coordinated plan to respond to the AI threat or opportunity but have not changed our longer-term corporate strategy."
2 Operating profit margin for selected sectors as a share of turnover, for continuing operations and before exceptional items.
3 Value pool calculated based on profit margin difference between proactive AI adopters and non-AI adopters multiplied by the CY2015 sectoral revenue in ASEAN

SOURCE: McKinsey Global Institute AI adoption and use survey; McKinsey Global Institute analysis, IHS

Exhibit 5

AI adoption level by sector and country within ASEAN



SOURCE: McKinsey Global Institute AI adoption and use survey; Digital Europe; Pushing the frontier; McKinsey Global Institute, June 2016; Digital America: A late of the haves and the have-mores, McKinsey Global Institute, December 2015, McKinsey Global Institute analysis, Sources for ASEAN index: press search of examples of AI development or adoption achieved or planned – indicative rather than exhaustive

PROGRESS BY SECTOR IN ASEAN

Below we examine the state of AI adoption in specific sectors. We start with two sectors that together comprise about half of all current AI use cases in ASEAN: finance, and high tech and telecom. Following that, we focus on manufacturing and transportation, which have the largest untapped value pools, and two priority public service areas, health care and education, which have the potential to generate disproportionate gains for the society.

Financial services

Southeast Asia's financial-services firms have thus far adopted AI primarily to improve the customer experience. Hong Leong Bank of Malaysia, for example, uses IBM Watson to detect customers' emotions by the way they speak on the telephone. Headquartered in Singapore, DBS has opened Digibank, which uses a virtual assistant to anticipate and answer customer queries. CompareAsiaGroup, a Hong Kong-based startup that operates in five ASEAN countries, uses machine learning to match customers with financial, telecom, and utility services across Asia.

For AI to have a broad, long-term effect on the sector, Southeast Asian banks will likely need to integrate some of the use cases still being developed in the United States and China. Applying AI to functions such as credit scoring, dynamic pricing and digital marketing has demonstrated value elsewhere, but few firms have scaled up these types of applications in ASEAN. Taking advantage of this opportunity will require banks to develop new skills and fintech start-ups to innovate.

First, however, the industry must accelerate its basic digitisation. Digitising customer interactions and setting up data-collection, management, and analytics processes are clear initial priorities, since AI-powered tools need to be fed large quantities of data. The business case for completing this type of digital transformation is further reinforced by the fact that ASEAN's middle-class consumers, the heart of the customer base, are digitally savvy; they naturally move quickly across online options to find the best offerings.

Already, some 300 fintech startups have emerged in the region, providing solutions in payments, micro and peer-to-peer lending, and wealth management.[9] Embedding AI technologies into their products could, in principle, make them formidable competitors in those markets. Tech prowess combined with the ability to design practical applicators for AI that create value for customers and smooth their experience will determine who comes out on top.

[9] McKinsey's Panorama FinTech database.

Progress in these areas would have an important social impact. Some 266 million people across the ASEAN region lack access to the credit needed to thrive.[10] Analytics and eventually AI could play a key role in bringing affordable financial services to disadvantaged and low-income segments of the population that have often been excluded from traditional banking systems. In China, for example, Alibaba leveraged advanced analytics and its rich access to merchant and consumer data to develop Zhima Credit, an in-house credit bureau that could open the way for Alibaba to lend to unbanked groups.

Governments and central banks can help drive AI adoption in financial services. Government regulators will determine the pace of innovation they allow fintech firms to pursue, potentially moving over time to open banking platforms that level the playing field on data access. Regulations that strike a careful balance between data availability and privacy are critical, as the example of Aadhaar identification linked to payments in India shows. Officials may opt to allow pilot runs of AI technologies on test data in a controlled environment.[11]

High tech and telecom

It comes as no surprise that high-tech and telecom players are active early adopters of AI technologies. At a global level, some tech giants have developed AI applications that are disrupting traditional brick-and-mortar industries such as retail (Amazon) and entertainment (Netflix).

Substantial gains are at stake. Amazon cut its operating costs by 20 percent at fulfilment centres, saving $22 million annually at each, after acquiring a robotics firm that automates picking and packing.[12] Netflix, meanwhile, estimates its AI recommendation tool helps it avoid $1 billion in cancelled subscriptions every year.[13]

Similar, if much smaller, efforts are under way in Southeast Asia. Local telecom companies are in the lead, seeking to take advantage of their coverage of the population and the access to data it affords—and by 2020, 90 percent of adults in emerging countries will have mobile subscriptions.[14]

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10 *Digital finance for all: Powering inclusive growth in emerging economies*, McKinsey Global Institute, September 2016.

11 Aditya Sharma and Renny Thomas, "Mastering the new realities of India's banking sector", McKinsey.com, June 2017; Open Data Institute, "Open banking: Setting a standard and enabling innovation", n.d.

12 Eugene Kim, "Amazon's $775 million deal for robotics company Kiva is starting to look really smart", *Business Insider*, June 15, 2016.

13 Nathan McAlone, "Why Netflix thinks its personalized recommendation engine is worth $1 billion per year", Business Insider, June 14, 2016.

14 *Digital finance for all: Powering inclusive growth in emerging economies*, McKinsey Global Institute, September 2016.

Telecom companies have been using analytics to predict customer churn and upsell or cross-sell additional services for quite some time. But the possibilities are now much bigger—including openings to move into entirely new types of markets. People who do not have a bank account today can gain access to basic financial services through their mobile devices, and the data generated by their transactions could lay the foundation for identifying prospective customers for other financial services such as insurance and loans. Telecom companies are using AI to move into other industries as well. Singtel established a data analytics subsidiary, DataSpark, to collect, model, and visualise data on shoppers, while Indosat's analytics unit, Eureka, focuses on digital marketing for retailers and credit scoring for banks. ASEAN also has given rise to small high-tech startups supported by a growing VC ecosystem (see Box 2, "AI-based technology startups in ASEAN").

The high-tech industry, by definition, crosses all other sectors touched by AI—hence the spread of terms such as fintech, health tech, and ed tech. Governments have a stake in nurturing local innovators, who can pave the way to broader AI adoption across sectors. Governments can do so by improving computer science education to close a critical gap in skill sets for specialised high-tech jobs, shaping regulations to facilitate the use of anonymised data, and encouraging cross-industry and cross-border collabouration. Singapore has already taken steps in this direction, such as making it easier to start a business and providing significant government funding. That effort landed Singapore on Startup Genome's 2017 Global Startup Ecosystem Report, ahead of Austin, Texas, and Stockholm.[15] Aside from building startup enablers, government support can add a level of recognition and prestige to retain talent that might otherwise go overseas, a theme we return to in our discussion of AI in the public sector below.

Manufacturing

AI technologies will play an important role in the industry's next stage of growth. Companies will soon be able to manage factory floors and connect their entire value chain with a seamless flow of data, enabling real-time decision making and greater efficiency. This new world of digital manufacturing is often referred to as Industry 4.0 (see Box 3, "What is Industry 4.0?")

Adopting AI and the IoT is a natural progression for ASEAN-based companies. The region's largest firms will likely lead the way, since their scale magnifies the potential benefits. The Thai food and beverage

[15] JF Gauthier, Marc Penzel, and Max Marmer, "Global Startup Ecosystem Report", Startup Genome, March 14, 2017.

Box 2. AI-based technology startups in ASEAN

Total VC investment in the region reached $2.6 billion in 2016, about 60 percent higher than the previous year.[1] Furthermore, lagging economic development and rising social problems are providing opportunities for technology-driven solutions.

Many of these tech entrepreneurs are developing AI technologies with local use-case applications in mind. These regional startups do not have the resources or talent pools that international tech giants enjoy, but they illustrate the importance of identifying market opportunities on the ground and designing locally relevant business models.

Examples of AI-based technologies used by startups in ASEAN include the following:

Natural language processing

- Bindez, in Myanmar, uses natural language processing and text analysis to track online hate speech.
- Kata.ai, in Indonesia, is developing the first natural language processing algorithms for Bahasa, the primary language for more than 250 million people in Indonesia and Malaysia.
- FPT, in Vietnam, designed an AI platform to help apps developers enable automated interaction with end-users, based on a natural language processing interface. Potential application of such platform includes call centre chat bots, virtual agents, and related voice-controlled applications.

Machine learning

- Cloudsek, a cyber-security startup, aims to provide machine learning-based solutions to help corporates to identify and tackle online threats in real-time.
- Ruangguru, in Indonesia, is exploring ways to achieve personalised education services through machine learning by utilising the massive wealth of academic data that it possesses.

Image recognition

- Sero, a Vietnam-based agriculture startup, provides farmers with crop intelligence by leveraging on AI analytics of imagery and in-field data.

[1] "ASEAN startups attracting more venture capital", *Nikkei Asian Review*, April 2017.

Box 3. What is Industry 4.0?

"Industry 4.0" is a term to describe the digital transformation of manufacturing, made possible by combining a wave of next-generation technologies. The internet of things (IoT), artificial intelligence, robotics, and 3D printing can turn factory floors into flexible, self-maintaining operations. Sensors can feed continuous streams of real-time data into machine learning algorithms that can remotely adjust complex systems, processes, and machinery. These same types of systems can be used to coordinate the entire supply chain and to monitor customer usage for insights that inform future product design and new types of service offerings.

Based on numerous studies, McKinsey estimates that Industry 4.0 can boost efficiency by 15 to 20 percent.[1] Leading global manufacturers in places such as Germany have successfully demonstrated the feasibility and value.

- **Predictive maintenance:** Applying machine learning tools to data collected by IoT sensors enables manufacturers to anticipate equipment failures and avoid bottlenecks and downtime through preventive maintenance. Some have managed to reduce overall maintenance costs by up to 10 percent.
- **Yield enhancement:** Industry 4.0 technologies enable manufacturers to optimise the use of raw materials and boost output. One AI-powered semiconductor manufacturing system reduced scrap rates by up to 30 percent by linking thousands of variables across machinery groups and sub-processes.
- **Product design and service offerings:** Smart, connected final products such as intelligent cars can send customer experience data back to product managers. This capability paves the way for new types of service offerings and feeds back into improved product design.

[1] For more on this new era of technology, see "Industry 4.0 demystified: Lean's next level", McKinsey.com, March 2017; *The great re-make: Manufacturing for modern times*, McKinsey & Company, June 2017; and "Digital manufacturing: The revolution will be virtualized", McKinsey.com, August 2015.

conglomerate ThaiBev and Malaysian car manufacturer Proton are just two of the major names aiming to introduce Industry 4.0 technologies in their plants.

But many manufacturers remain hesitant, given the upfront capital investment required to modernise plants and digitise extensive physical assets. Because labour costs are low in ASEAN, firms do not always see the business case for changing their operations in such a profound way.

In the longer term, this calculation may change. Labour costs may rise as the region develops and the population ages, shrinking the size of the available labour pool. This is already occurring in China, where manufacturing wages have doubled in the last decade.[16] Chinese firms have aggressively adopted robotics; in fact, they are expected to invest $59 billion by 2020.[17]

The region's policy makers can encourage a digital transformation in their manufacturing industries as a priority for achieving the kind of productivity gains that can support economic growth. Singapore's government, for instance, supported the launch of McKinsey's Industry 4.0-focused Digital Capability Center (DCC) in Singapore. Located at, and established in partnership with the Advanced Remanufacturing and Technology Centre (ARTC), the DCC Singapore aims to introduce manufacturing firms to new technologies and help them build new capabilities. Malaysia and Thailand are including Industry 4.0 as part of wider economic transformation blueprints.

Transportation and logistics

Rapid urbanisation is stressing transportation systems in cities around the world. And this issue is expensive: the direct cost of congestion is approximately 2–5 percent of GDP in Asia alone.[18] Most major cities in the world are trying to address the problems associated with rapid urbanisation by embracing the Smart City vision, which seeks to integrate AI and the internet of things to improve network efficiency by managing infrastructure in a "smart" fashion.

By 2030, most cities will adopt new automotive technologies such as car-sharing, autonomous driving, and electrification, though this will not all happen at the same pace.[19] In the most radical scenario, "seamless mobility" will deliver people to their destinations from door to door on-

16 "Inside China's plans for world robot domination", Bloomberg, April 2017.

17 "Manufacturing automation to drive China's robotics spending to US$59b by 2020", *South China Morning Post*, April 2017.

18 Asian Development Bank data.

19 *An integrated perspective on the future of mobility*, McKinsey & Company and Bloomberg, October 2016.

demand in the most densely populated cities. Seamless mobility would rely on a combination of self-driving and shared vehicles complementing smart, integrated public transit infrastructure (intelligent and adaptive bus fleets, subways, and traffic management).

Private-sector companies have a role to play in realising this vision of seamless mobility. Traditional auto manufacturers and high-tech giants such as Google and Baidu are investing millions of dollars into self-driving vehicles with collision-avoidance and route-optimisation systems to enhance safety and lower fuel consumption. Ford has pivoted from being an auto manufacturer to being a "mobility" provider. The company has set up a City Solutions division that will use AI to seamlessly integrate many mobility options, from public transit to ride hailing to bike sharing.[20]

Singapore is a front-runner in ASEAN as it executes its Smart Mobility 2030 plan, which calls for an AI system to manage train, bus, car, and bicycle traffic in real time. The Malaysian state of Selangor is pursuing a similar agenda with its Smart Selangor Blueprint 2025 initiative, and smart city programs are underway in Indonesia, Philippines, and Cambodia.

Startup tech companies are emerging as part of this picture. Yogee sells fleet-management software that uses machine learning, so it becomes smarter as it is used on a larger scale. Grab, a ride-hailing platform that operates in seven ASEAN countries, has hired 200 engineers and data scientists to focus on improving customer service using AI and further optimising its driver fleet.

The pressing challenge for city governments is building partnerships with strategic industry players and tech startups. However, integrating and paying for such partnerships is complex. The net benefits to a city—such as less congestion and enhanced safety—are clear. But it is challenging to align incentives for private investment and public rewards. Further, most of ASEAN is focused on automated toll collection and there is little appetite for large public investments. Despite the challenges, the major potential for improving lives in overcrowded Southeast Asian cities makes it essential to forge productive public-private partnerships (a topic we will return to in the final chapter.)

Health care

Globally, AI is beginning to demonstrate potential for improving health care in several ways. Deep learning can enable machines to review large amounts of data on illnesses, treatments, and outcomes to find insights that can improve diagnostics and patient care. IBM, using its AI-backed

[20] Laura Bliss, "A carmaker talks about what comes after driving", CityLab.com, April 27, 2017.

Watson supercomputer, enables physicians to prescribe optimal cancer treatment to patients by sifting through millions of pages of medical evidence in seconds.[21] Wearable robotic devices can track patients' health remotely, deliver tips and alerts, and remind people to take their medicines. Virtual agents already analyse radiology and oncology reports, and advise patients.

Previous MGI research estimates that expanding the use of data in the health-care sector could produce more than $300 billion in value annually, two-thirds of which would come from reducing national health-care spending by about 8 percent.[22]

Health insurance is another promising area for savings. Globally, machine-learning solutions have optimised claims processing, reduced fraud, and improved health-outcome forecasts, which can result in better preventive care and lower claims. While ASEAN insurers generally have not adopted AI, NTUC Income has joined with IBM Watson to digitally process 14,000 hard-copy claims per month.[23]

Widespread AI adoption in patient care is years away in ASEAN, but several examples have arisen. The Singapore government agency IHiS (Integrated Health Information Systems) aims to create a nationwide enterprise analytics platform that aggregates and analyses patient data from multiple health-care systems and generates insights to improve outcomes. This could potentially make it feasible to manage chronic diseases by offering online doctor consultations and at-home diagnostics guided by wearable sensors.[24] Secondary benefits include minimising overcrowding at accident and emergency units and reducing out-of-pocket health-care expenses for patients. Startups such as Holmusk are also developing data and apps for specific use cases, such as diabetes. In Vietnam, the ViCare health-care app offers patients a chatbot on Facebook Messenger to answer basic questions.

Countries with large populations but not enough doctors and specialists stand to gain the most from these technologies. IBM's Watson could be of service in Indonesia, which in 2014 had 41 radiation oncologists for its 250 million people and suffered almost 200,000 deaths from cancer.[25]

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21 *Living longer and healthier lives*, McKinsey & Company, September 2016.

22 *Big data: The next frontier for innovation, competition, and productivity*, McKinsey Global Institute, June 2011.

23 "NTUC Income, IBM announce Singapore AI partnership", *Insurance Business Asia*, June 2017.

24 "Tele-rehab option for physiotherapy to be rolled out at 14 institutions", Today Online, May 2017.

25 World Health Organisation, "Cancer Country Profiles", 2014.

However, there is not enough consolidated data in the region to support the use of advanced analytics, let alone artificial intelligence. Hospitals have data, but often in the form of paper records and institutions have little incentive to share it. Most ASEAN countries require data to stay "onshore", limiting the opportunity to build region-wide data sets. More fundamentally, centralising patient data and opening it to machine learning, even in anonymised form, or tying requirements to use wearable devices to insurance discounts may not be consistent with privacy norms and laws.

Hospitals and insurers will decide how medicine uses AI. But, like legacy banks, hospitals and insurers face challenges in transforming organisations, not only by accumulating data but also by improving their digital capabilities, integrating technology into their workflow, and changing their culture. Innovation may come from digital-native firms. Health-care companies could align with these firms by sponsoring promising startups or hosting hackathons. Some corporations in Singapore already have taken this approach.[26] More can follow—and governments can facilitate the process by providing regulatory guidance on data sharing and by providing public investment where needed.

Education

Education technology, or ed tech, is already a burgeoning field that provides fertile ground for AI to take root. Like fintech, ed tech caters to a huge market: global spending on education is almost 5 percent of world GDP.[27] Investors have taken note, with one investment bank projecting ed-tech investment will grow to $250 billion by 2020.[28]

AI's potential in the classroom is generating excitement. AI-based Intelligent Tutor Systems (ITS), for example, are designed to provide one-on-one teaching at scale.[29] Such intelligent tutors could track a student's performance, detect which concepts the student finds difficult, and identify which learning methods work best for each individual. AI also can relieve teachers of some routine tasks and give them more time for teaching. A Georgia Tech professor built an AI teaching assistant that handled more than 10,000 queries from his online classes in one semester.[30] AI-powered assistants could take on more intelligent work

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26 Jacquelyn Cheok, "NTUC Income programme unveils first batch of startups", *The Business Times*, November 14, 2016.

27 Government expenditure on education, total (% of GDP), World Bank.

28 "2016 Global EdTech industry report: A map for the future of education", EdTechXGlobal and Ibis Capital.

29 Jon Roepke, "How Artificial Intelligence Will Transform Education", *Edtech Digest*, April 24, 2017.

30 Todd Leopold, "A professor built an AI teaching assistant for his courses — and it could shape the future of education", BusinessInsider.com, May 22, 2017.

such as grading and record keeping, enabling teachers to focus on the more creative and value-added aspects of their work.

Some of these technologies are already being adopted in the ASEAN region. Universities in Singapore and Malaysia have experimented with predictive software to guide interventions that can prevent dropouts. But ASEAN has a long way to go before adoption will have a major impact. Most member countries do not collect the kind of comprehensive data from which AI algorithms draw conclusions and make forecasts. Many parts of the region also lack critical IT infrastructure. In 2016, less than half of Asia's population, including majorities in most ASEAN countries, used the internet.[31]

ASEAN countries can focus first on using technology that is already available and more easily implemented to improve access to, as well as the quality and equity of education. Online, self-paced courses such as those at Khan Academy or Malaysia's Asia e-University have boosted access. Quality and equity have improved through devices that come with pre-loaded material and low bandwidth channels useful in remote areas or where there is a shortage of skilled teachers. Algorithms even short of AI have allowed for detailed evaluations in real time, improving performance, efficiency in testing, and evidence-based feedback.

These tools do not guarantee better educational outcomes. Policymakers and local administrators must adapt them to meet students' actual needs and pragmatically account for infrastructure readiness and planning. Ed tech solutions should focus on instruction by blending tech solutions with the advantages of in-person instruction and integrating with locally defined curricula. Building ed tech policy that can evaluate feasibility and performance into national systems will then allow countries to make the most of advances in AI when the time comes.

Similarly, countries can begin preparing now for AI advances later by developing more complete national data sets on which more advanced tech solutions depend. This includes capturing data on student demographics, environmental variables, attendance, school attributes, and individual, school, and regional outcomes. Governments need not aggregate and structure data themselves; they could collabourate with international or local companies. However, governments will need to be involved because they often are the main data collectors and must ensure data privacy.

[31] ICT 2016 Fact and Figures, ITU 2016.

Once such data structures are in place, machine learning algorithms—including those developed outside the region—can learn on national-level data. This will provide education ministries with valuable guidance about how to deploy resources and adjust policies to meet workforce demands, which no ASEAN countries are yet able to implement. At the individual level, national-level data can support ITS and guide teachers, parents, and administrators on how to keep students in school and on track, and what type of interventions mitigate the risk of losing them.

ADDRESSING THE CROSS-SECTOR CHALLENGES AND OPPORTUNITIES

As the sector examples discussed above show, AI can provide a major boost to productivity. Organisations now have access to powerful and sophisticated analytical tools that can improve operational performance and create new market opportunities.

But adoption is not always a simple proposition—and no single organisation acting alone can solve all of the issues surrounding these technologies. There are complex ethical, legal, and security questions to be answered, and the eventual impact on employment remains to be seen. The entire ASEAN region will need to strengthen its digital infrastructure, develop a bigger talent pool with advanced digital skills, and ensure that a thoughtful regulatory framework is put into place. As we discuss in section 3 below, working through these issues will require cooperation and collabouration from the public and private sectors.

Today large parts of ASEAN lag behind in digital adoption. But that is not a reason for the region's companies to assume that next-generation technologies do not have relevance in their home markets. In fact, some of these less technologically advanced regions may harbor some of the most promising opportunities. They are starting from a clean slate, and they are less likely to be bogged down by legacy systems and regulations. Inspiration can obtained from China, which has managed to build a robust digital ecosystem in a remarkably short period of time—and start-ups in the less-developed economies of ASEAN may similarly thrive.

3. HOW SOUTHEAST ASIA CAN UNLOCK THE PROMISE OF AI

As described above, different sectors in ASEAN are currently at varying levels of digital maturity. If left purely to market forces, the early adopters in financial services and in high tech and telecom seem likely to continue pushing ahead with their initial embrace of AI. But much greater value remains largely untapped in other sectors. Capturing this value and realising AI's potential to improve social welfare will not happen organically, however. It will take structural interventions from policymakers combined with a greater commitment from industry participants. Below we explore some of the critical issues that need to be solved, outlining the role that both governments and private-sector companies can play.

For all of AI's potential, it is an awesome responsibility to manage machines that can learn and make decisions without human direction. These technologies are taking societies into uncharted territory. While we know that certain fundamentals around data ecosystems and digital capabilities are needed for AI applications to grow, we do not know what business cases might emerge in second and third iterations of AI technology or how public attitudes may shift. AI adoption also touches on questions of social values that do not have any one-size-fits-all answers. We therefore pose some of these issues as open-ended questions meant to spark further discussion and debate.

AN AGENDA FOR THE PRIVATE SECTOR

For companies, AI adoption follows the road map set by other digital technologies. The elements include clearly defined use cases or sources of value; robust data ecosystems; a workforce that is adept at using systems and tools; clear integration with workflows in the core business; and an open culture that embraces a 'test and learn' approach. For companies across ASEAN, even in industries at the forefront of adoption, data ecosystems, operating culture, and skills tend to be critical stumbling blocks.

Creating robust data ecosystems

AI technologies must be fed a steady diet of reliable, actionable, and secure data; it is how they "learn" and function. But multiple industries in ASEAN are struggling with getting their data foundations in order. Many of them lack the adequate backbone sensor systems required to track operational data. In some cases, real-time streaming flows are required by AI programs to make decisions and trigger actions. For example, multiple telecom operators in ASEAN funnel live network data into their data lakes and use them to trigger highly contextual campaigns and notifications for customers. A simple example of this would be a subscriber getting a

notification as he approaches his data limit. But only a few other industries have implemented these types of solutions at scale.

Even if companies have adequate sensory set up, many of them lack the right infrastructure to store data, aggregate it into actionable form, and make it available to be used for decision making. In many organisations, data sits in silos with fragmented ownership. In others, vast quantities are collected but never analysed. One McKinsey study found that less than 1 percent of the total data captured from 30,000 sensors on an oil rig was actually used.[32]

Now, with the advent of cloud-based data management platforms, the cost of storing and analysing data is falling and the ease of use is improving. Many SMEs and startups are quickly adopting these new technology platforms to realise savings (see Box 4, "Integrated data strategy is required to create a robust data ecosystems"). In order to realise their AI ambitions, players need to embrace these technologies, all the while ensuring the right data governance is in place to manage trade-off between business agility and scale.

Transitioning to a data-driven management style

The most fundamental cultural and organisational shift required for implementing AI in corporations is to embrace data-driven decision making. Decisions once made on instinct can now be made on the basis of evidence—and perhaps even automated. As AI is still a relatively new concept in ASEAN, companies will need to adjust to this new paradigm.

Even companies that have invested in data and analytics may fail to use data effectively in decision making. Some of the pitfalls include the following:

- Poor articulation of the business case and sources of value, leading to weak management support.
- Lack of capability building among mid-level managers and a reluctance to rely on insights derived with AI as the basis for making decisions.
- Limited investment in workforce retraining, especially among front-line workers.
- Lack of workforce buy-in due to fear of job loss.

As with all cultural transformations, leadership is critical to successful AI implementation. A McKinsey Global Institute survey found that

[32] *The internet of things: Mapping the value beyond the hype*, McKinsey Global Institute, June 2015.

Box 4. Integrated data strategy is required to create arobust data ecosystems

Data is increasingly a new form of capital. Cross-industry studies show that on average, less than half of an organisation's structured data is actively used in decision-making, more than 70 percent of employees have access to data they should not, and 80 percent of analysts' time is spent simply discovering and preparing data.[1]

Companies need to take a programmatic approach to building data assets and, with the support of all business segments, use those assets to transform the entire enterprise. The following are three key building blocks for this kind of data-led transformation:

A clear data strategy that goes hand in hand with vision for the business

- The first step is to ask how data can be used to accelerate key business objectives and document use cases
- The next question is to identify the gaps in enterprise data footprint that need to be plugged with either new collection systems or complementary external data; business should also keep an open eye for proprietary assets that provide a distinct edge
- Tying simple cost-benefit analyses to each use case helps assess their importance to the business and guide decisions such as buy-or-build

A master blueprint for the data architecture and implementation roadmap

- Data architecture design starts with a view of the data models that need to be enabled for the organisation and the priority use cases
- The architecture is then designed with an objective to optimise the collection, aggregation, use, and subsequent refreshment of the data while maintaining the accuracy and consistency, and ensuring security
- Technology choices are then made with an eye toward managing the cost of ramping up the system while enabling enough agility for experimentation

Effective data governance for continuous management and enrichment of data

- Definition of data governance mechanisms is driven by the choice of centralised, federated, or completely de-centralised data organisation, and position of the chief data officer in the core management
- Rules for data access and sharing with external parties are defined, based on the importance of the data and its source
- Guidelines are put in place to develop hard assets that enable the interpretation of data, such as enterprise data dictionaries and dashboards to monitor data quality

[1] "What is your data strategy?", *Harvard Business Review*, June 2017.

respondents from firms that have successfully deployed AI technology at scale reported nearly twice the level of C-suite support as those from companies that have not adopted any AI technology.[33]

Building the right skill sets

Across the board, companies report that finding the right talent is the biggest hurdle they face in trying to integrate data and analytics into their existing operations. In a recent McKinsey & Company survey, approximately half of executives across geographies and industries reported greater difficulty recruiting analytical talent than filling any other kind of role.[34]

Data scientists, in particular, are in high demand. These are the people who design, develop, deploy and train AI technologies—and they are in short supply, even in global AI hubs such as Silicon Valley. The shortage is even more acute in ASEAN.

Another equally vital role is that of the business translator who can serve as the link between analytical talent and practical applications to business questions. In addition to being data savvy, business translators need to have deep organisational knowledge and industry or functional expertise. This enables them to ask the data science team the right questions and to derive the right insights from their findings. It may be possible to outsource analytics activities, but business translator roles require proprietary knowledge and should be more deeply embedded into the organisation. Many organisations are building these capabilities from within.

One option for companies is the "build-operate-transfer" model in which experts from external specialist firms are embedded within cross-functional project teams. As these experts work collaboratively with employees, they provide them with a know-how of working with AI technology systems while leveraging operational experience to inject a deeper understanding of the real needs of the company. The company's employees gain new skills that enable them to manage continuous improvement and scaling after the initial deployment phase.

STRUCTURAL CHALLENGES FOR POLICY MAKERS

It will take well-crafted strategies and policies to turn today's innovation into sustainable growth for ASEAN over the longer term. The government can facilitate this by laying a solid policy foundation, setting aspirational goals, and spurring private-sector innovation and adoption.

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[33] *Artificial intelligence: The next digital frontier?* McKinsey Global Institute, June 2017.

[34] "The need to lead in data and analytics", McKinsey & Company survey, McKinsey.com, April 2016.

Policies to support AI development and adoption

ASEAN can help to scale up AI development and adoption by creating region-wide rather than local policies. One of the top priorities would be establishing an open but secure data environment, which is the lifeblood of digital and AI technologies. Our analysis shows that ASEAN countries have a high degree of global connectedness when it comes to all types of global flows, including trade in goods and services, people flows, and capital flows. But they are notably less connected in terms of cross-border data flows (Exhibit 6). Building the region's digital infrastructure is a critical step, and data governance is central to that.

The Trans Pacific Partnership (TPP) had offered an opportunity to address barriers to data flows at scale, and some of its proposed frameworks can be considered at the ASEAN level. These include:

- Establishing standards to protect consumers from online fraud and to clarify how personal information can be exchanged across borders.
- Preventing and responding to evolving cybersecurity threats.
- Protecting digital intellectual property while reducing any barriers to online commerce such as customs, differential access to the Internet, or product discrimination.
- Avoiding "data protectionism" that specifies where companies need to store their data.

Governments can model more open data ecosystems by making their own public data more accessible in machine-readable formats. This can provide a rich set of building blocks for third-party applications, AI developers, and startups.

Governments and civil society will also need to grapple with defining principles of data privacy as new uses are generated by AI. Does the public have a right to know how their data is used by governments and companies if it is anonymised? Do those who use AI have an obligation to explain how their machines arrive at recommendations that bear on the public interest or personal well-being (such as medical diagnoses)?

Governments also have to consider the role they will play in addressing the negative externalities of technological disruption. One of the main strategies will be making long-term investments in education, including systems of continuing education to help mid-career workers keep pace with the changing demands of a digital economy. But this raises a number of questions. How can governments ensure equal access to digital training for women and rural populations? Can they mitigate the risk that digital disruption will widen inequality? Which industries are most ripe

Exhibit 6

Southeast Asian countries are highly connected based on traditional measures of trade and financial flows, but less so for data flows

Southeast Asian global rankings for connectedness and data flows, and GDP per capita

Country	Connectedness rank	Data flow rank	GDP/Capita rank
Singapore	1	6	11
Malaysia	20	43	70
Thailand	22	64	89
Vietnam	37	61	134
Indonesia	51	76	115
Philippines	54	67	126

SOURCE: International Monetary Fund, World Economic Outlook Database, April 2017; *Digital globalisation: The new era of global flows*, McKinsey Global Institute, February 2016; McKinsey Global Institute analysis

for disruption? How should government and the private sector divide the responsibility of retraining? Can AI technologies themselves provide part of the solution?

Governments can use fiscal policy to address unemployment and dislocation. But beyond providing a safety net, are there other ways to distribute the gains from technology that can limit unemployment? If an AI-fuelled economy requires less labour, is it possible to design more flexible work arrangements, working in concert with the private sector?

Finally, there is some risk of monopolistic market structures emerging as early adopters lock in talent, acquire smaller innovators, and capture a disproportionate share of the economic surplus. This possibility is currently outweighed by the benefits of tech diffusion and adoption in the region stimulated by large global players.

When governments do intervene through regulation or fiscal policy, they should be transparent to reassure citizens that their interests are protected. One example would be to ensure that AI systems do not replicate and reinforce the inequalities and biases they detect in the datasets on which they learn.

Support targeted AI initiatives to spur broader momentum

ASEAN governments could support the development of AI "hubs", establishing particular regions as hotbeds of talent and technology development as well as AI commercialisation and entrepreneurship. These initiatives should focus on developing applications that are practical for industries and social objectives in ASEAN—not necessarily the more cutting-edge solutions being developed by global tech giants.

ASEAN's own AI hubs could be designed to concentrate talent, facilitate both collabouration and healthy competition, and provide a central touchpoint for governments to engage with technologists and other stakeholders on regulatory issues and resources. Governments may have to seed these efforts but should leverage unique public-private partnership models to ensure commercial acceptance and eventual contribution to the economy at scale. Today there are just a few major global hubs for AI development, with Silicon Valley attracting 40 percent of all global external investment in AI in 2016.

It is not easy to replicate this kind of ecosystem, but research universities, access to capital, and a robust customer base are among the key enablers. New York City, for example, established itself as an AI hub because of the abundance of early-stage financing in the city, as well as a concentration of media companies eager to buy AI innovations. For same reason as New York, Asian cities such as Beijing and Shenzhen are rapidly developing AI centres, given the convergence of all favourable conditions.

The value of hubs comes, in part, from economies of scale, but it would be prudent to foster multiple initiatives across the region, each specialising in different types of AI applications with local relevance. This could ensure that investment, access, and benefit are more fairly distributed throughout the ASEAN region. Matching use cases to specific locations is an open question, but regional stakeholders should consider developing applications that complement other economic development goals and existing assets. These initiatives could be enhanced by sponsoring their own AI developers and practitioners to participate in fellowships abroad, eventually bringing back the best global best practices and know-how.

Singapore's AI.SG initiative is a pioneering model, backed by 150 million Singaporean dollars in investment over five years to attract resources, talent, and institutional support. It is focused on applying AI to finance, smart cities, and health care—all clear priorities for Singapore, which is a financial centre with constraints on space and an aging population.

Focusing one of these regional hubs on AI in education could have a double benefit: improving the quality of education more broadly while ensuring that the future workforce acquires digital skills. An AI in education hub could advance the goals of improving connectivity as well as building the necessary data sets and standards. ASEAN's big and mid-income countries—Indonesia, the Philippines, Thailand, and Vietnam—have the most to gain from a broad education technology agenda that can extend the reach of quality education to millions.

Establishing another AI hub focused on the delivery of public services would support a broad digital transformation in the region's governments, which in turn supports public adoption. AI applications can be used for public initiatives such as detecting tax fraud, evaluating the effectiveness of government programs, or managing complex infrastructure systems. The overlap of cutting-edge technology and public service would be a powerful draw for talent and would serve as a natural point of collabouration with academic research institutions, industry technology leaders, and government agencies within and across countries.

These hubs are not the only avenue for accelerating AI adoption and harnessing it for the public good. University programs and regional centres of excellence are other options. Korea, for instance, recently established an $800 million public-private research centre for developing specialised talent in core AI technologies.

Broadening public debate around AI

It is important to foster a broad and ongoing public dialogue across the corporate and social sectors to build consensus around AI governance and to ensure that it is used to deliver long-term social benefits. This debate is critical for ensuring that public investment in technology yields the kind of outcome that the public actually supports. It is also vital to create an open process for codifying rights and regulations around issues such as privacy and security.

This debate should not be limited to business uses cases. It should also extend to the human and societal implications of this new world. The rise of AI carries moral, legal, and security questions, some old, some new: Could intelligent machines attack vital power, health, and voting systems, or act as a channel for other to do so? Will AI widen the digital divide enough to challenge social stability? Will dependency on AI erode social capital and autonomy? These have taken on new urgency, spurring governments in places from the United Kingdom to Dubai to issue formal long-term perspectives and goals for AI alongside resource commitments.

Policy makers should not be the only voices in this debate. Business leaders and actors from across civil society will have valuable input into the questions AI will force us to face. Organisation such as OpenAI, the Future of Life Institute, and the Partnership on AI are already grappling with these issues. In Hong Kong, the Digital Asia Hub was recently created to provide a societal-level view of the implications of technological advances. ASEAN will have to find its own answers that work in the cultural, religious, and political context of the region.

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AI is still in its early stages in industry. Even in developed economies, there remains a great deal of work to do in building all the necessary foundations. But the technology itself is racing ahead, thanks to major advances in data availability, algorithm sophistication, and computing power. AI machines have the fuel to carry the next wave of productivity gains, transform the nature of work—and wipe out businesses that do not incorporate them into their core strategies. The key question then becomes how the net gains from this disruption can work to society's benefit.

AI use cases have sprung up across the region, but they are limited in number and scale. Banks and telecom operators are only now adopting digital technologies and advanced analytics, which are the precursors of AI. Singapore's advances in smart city technologies shows promise for how AI can improve urban life in the region. To accelerate the process, ASEAN governments can make data more readily available for entrepreneurs and move toward integrated data systems in education and health. They can also prepare for the negative externalities of labour disruption, provide a stable regulatory framework, and solve barriers to entry due to scale and talent shortages by creating specialised hubs.

These interventions are primarily about guiding an inevitable wave of change to quicker and better impact. But the specific direction this technology is an unknown. For now, we can begin to ask some of the big questions that each society must answer for itself: are we ready to share health data? Will the digital divide only get worse? Which innovations are worthy of public funds and partnerships? Bringing these questions into the open is the most important step in ensuring that AI advances create a better society.

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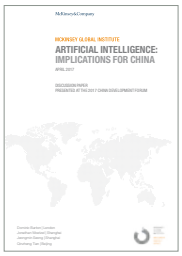

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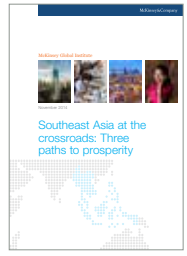

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