PREPARING FOR AI:

The Implications of Artificial Intelligence for Jobs and Skills in Asian Economies

August 2019

αlphaβeta
strategy x economics

This report was prepared by AlphaBeta on behalf of Microsoft.

CONTENTS

A GOOD UNDERSTANDING OF THE IMPACT OF AI ON JOBS AND SKILLS COULD ALLOW ASIAN ECONOMIES TO FULLY HARNESS ITS BENEFITS

IMPACT ON THE NATURE OF WORK IN ASIA

Traditional, non-digital sectors such as healthcare could reap

UP TO 3 TIMES

the level of productivity benefits from AI technologies that could be gained by digital sectors

A study in Australia shows that by shifting worker tasks to higher order thinking roles, AI and automation technologies could

INCREASE THE INCOMES OF LOW-SKILL WORKERS BY 10% BY 2030

Studies in Australia and Japan show that AI adoption could

REDUCE WORKPLACE INJURIES BY 11%

through the elimination of dangerous physical tasks, and also

IMPROVE JOB SATISFACTION LEVELS BY 20%

IMPACT ON OVERALL EMPLOYMENT IN ASIA

There is wide variation in the estimates of potential job displacement from AI,

RANGING FROM 7-49%

for the same country. These appear to be driven by differences in estimation methodology (particularly on whether automation impacts are analyzed at the job or task level)

AI technologies could also be an important driver for job creation through multiple channels. A study in China shows that there could be a

12% NET INCREASE IN JOBS BY 2037

Jobs directly supporting AI development could account

FOR LESS THAN A FIFTH

of 'in-demand' positions in the future, while

ALMOST 60%

could be roles requiring interpersonal, creative and/or strategic decision-making tasks

ACTION AGENDA FOR ASIAN ECONOMIES

1 **STIMULATE GREATER** AI adoption and worker reskilling efforts

2 **PROMOTE A SHIFT** in emphasis from qualifications to skills

3 **BUILD INCLUSIVENESS** in the labor market to extend the benefits of AI to all workers

EXECUTIVE SUMMARY

Artificial Intelligence (AI) technologies could have far-reaching effects on economies and societies in Asia. In Southeast Asia alone, firms that proactively adopt AI reported up to 15 percent higher profit margins than the industry average across different sectors,[1] and AI adoption is described to have risen rapidly in a short period of time – from 8 percent of businesses in 2017 to 14 percent in 2018.[2] Substantial productivity benefits from AI are also anticipated outside of Southeast Asia, for example, in economies impacted by aging populations, such as Japan, which is estimated to benefit from more than a tripling of its projected growth rate by 2035.[3]

As a technology that has the potential to be widely adopted, AI does have important implications for the future of work – specifically for employment, and for the nature of work. Despite the large and growing volume of research on this topic, there are still several gaps in the understanding of the detailed implications of AI for jobs and skills in Asia. These include (a) an uneven coverage of studies across different countries in Asia; (b) a lack of detailed understanding of how jobs and skills will be impacted, particularly on those jobs and skills that could see growing demand; (c) limited exploration of the non-economic impacts of AI on jobs and skills (such as job satisfaction and workplace safety); and (d) a lack of comprehensive understanding of the different policy and business actions available for tackling the risks and capturing the upside potential of AI.

This report seeks to bridge these gaps through a thorough review of the existing literature in Asia on the impact of AI on jobs and skills, with particular focus on the following eleven countries: Australia, India, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Thailand and Vietnam. This fact base is crucial as maximizing the positive impacts of AI and managing any potential negative impacts needs to be based on solid evidence – not assumptions about impacts – and needs to be grounded in an understanding of the region's unique opportunities and challenges.

Despite fears of large losses of jobs, previous waves of technological change tended to have broadly positive impacts on incomes and overall job creation, even if there were concentrated losses.[4] New technologies displaced some jobs, but created complementary new tasks and the productivity benefits led to higher incomes, in turn supporting further job creation. However, could the impact of AI technologies on the labor market be different from these previous technological waves? For example, it could be argued that given the vast potential of AI technologies to transform cognitive work, the impact on labor markets may be significantly greater than experienced during some of these past technological innovations.

The existing research on the impact of AI on the labor market in Asia provides a generally optimistic perspective, although with some significant caveats linked to the

1. McKinsey Global Institute (2017), Artificial Intelligence and Southeast Asia's future.
Available at: *https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20SE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.ashx*
2. Microsoft and IDC (2019), Microsoft-IDC study: Artificial Intelligence to nearly double the rate of innovation in Asia Pacific by 2021.
Available at: *https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/#_ftnref1*
3. Accenture and Frontier Economics (2017), AI is the future of growth. Available at: *https://www.accenture.com/_acnmedia/PDF-57/Accenture-AI-Economic-Growth-Infographic.pdf#zoom=50*
4. International Monetary Fund (2018), Technology and the future of work. Available at: *https://www.imf.org/external/np/g20/pdf/2018/041118.pdf*

effectiveness of government, private sector and civil society action. Despite a number of gaps in the evidence base, the current literature shows that AI has the potential to not only significantly boost the productivity, safety and enjoyment of work, but also become a driver of new job creation. However, it is equally clear that some level of disruption in the labor market is inevitable and, if not managed carefully, has the potential to fuel inequality. In order to maximize the positive impacts of AI and mitigate potential negative impacts there are significant lessons to be learned from within Asia. Many Asian countries, businesses, and civil society organizations are pursuing innovative approaches to shaping the labor market impacts of AI, and there is a significant opportunity to learn from each other. Three broad imperatives emerge: stimulating greater AI adoption and worker re-skilling, promoting a shift in emphasis from qualifications to skills, and extending AI benefits to all workers through an inclusive approach.

The more detailed findings from this review of the existing literature include:

- **AI has the potential to have positive impacts on worker productivity, incomes and satisfaction.** The largest productivity beneficiaries of AI are estimated to come from non-digital sectors such as healthcare and education services, where the estimated productivity benefits could be almost three times as large as those benefits received in digital sectors. In particular, middle-income countries could see the highest productivity gains of up to 52 percent by 2021, as compared to the scenario of no AI adoption. While AI could create downward pressure on wages through the substitution of labor for capital (creating potentially an imbalance of demand and supply for certain occupations), it could also drive wage improvements through three other channels: by improving the productivity of workers, by allowing workers to shift to higher-order tasks, and in the form of wage premiums attached to workers who can perform jobs supporting the development of AI. Although it has been argued that income gains would only be captured by higher skill workers, a study in Australia has shown that the real wages of low-skill workers could grow by 10 percent by 2030. By removing mundane, manual and dangerous tasks, AI also has the potential to improve workplace safety and job satisfaction – albeit at the expense of greater job stress.

- **AI could potentially create more jobs than it displaces in Asia, but disruption is likely and there may be net losses of jobs concentrated in specific sectors.** There is wide variation in the estimates of potential job displacement from AI (e.g., ranging from 7 to 49 percent for the same country), which appear to be driven by differences

in the estimation methodology – particularly on whether automation impacts are analyzed at the job or task level. For example, it has been argued that the occupation-based approach (focused on understanding displacement impacts at the job level, rather than the task level) could overestimate job displacement potential due to its obscuring of non-automatable tasks within occupations that were deemed automatable, as well as an overly blunt assumption that workers within the same occupation have identical task structures. Interestingly, despite these variations in estimates, job displacement impacts are generally estimated to be larger in higher-income countries than in lower-income countries (which appears consistent with the faster pace of AI adoption and higher wages in higher-income countries). For example, estimates of job displacement from AI range from 10 percent of jobs in the Philippines to 49 percent of jobs in Japan. Job displacement impacts also vary widely across sectors, ranging from anywhere from 8 to 26 percent of jobs being affected. Those sectors in which there are more jobs with routine and repetitive tasks (such as manufacturing) are generally projected to see higher job displacement impacts.

- **The potential of AI technologies to create new jobs has received limited focus in the media; however, some of the existing literature suggest that the positive impacts on the labor market could be significant.** Displacement effects could potentially be more than offset by the job creation impacts of AI – directly within the AI sector, indirectly in other related sectors and at the broad economy level (through AI stimulating higher productivity and rising incomes resulting in greater aggregate demand). For example, taking into account jobs both potentially lost and created, AI has been estimated to be able to boost overall employment by up to 12 percent by 2037 in China, which is equivalent to an additional 93 million jobs. However, the interaction of these effects varies across sectors, and net losses could still be seen in sectors with more repetitive and routine tasks, as well as relatively income-inelastic goods and services (e.g., agriculture, manufacturing and utilities). AI could also boost workforce participation rates through job-matching platforms, tools that enhance the employability of underserved groups and by creating opportunities for new flexible forms of labor.

- **To fully harness the potential benefits and mitigate the risks of AI for jobs and work in Asia, an appropriate action agenda must address the unique challenges the region faces.** These challenges include a highly varied AI adoption landscape across firms and workers, inadequate awareness of the benefits of and opportunities for reskilling, the inability or reluctance of some governments and employers to implement worker retraining programs, the risk of underserved groups being excluded from AI benefits, a lack of effective lifelong learning models, the inability of educational curriculums to keep pace with the evolving skill needs of an AI economy, and a lack of social protection measures for flexible workers.

- **Many Asian governments, businesses, and civil society organizations are pursuing innovative approaches to tackle these challenges, and there is a significant opportunity to learn from each other.** Drawing upon experiences in Asia, an action agenda for governments, businesses and civil society organizations includes stimulating greater AI adoption and worker reskilling efforts, promoting a shift in emphasis from qualifications to skills in educational curriculums, and building inclusiveness to ensure that the benefits extend to all workers in the economy (Exhibit E1). In short, Asian economies have a lot to learn from each other in terms of how they could manage the evolving technology landscape of AI.

EXHIBIT E1:

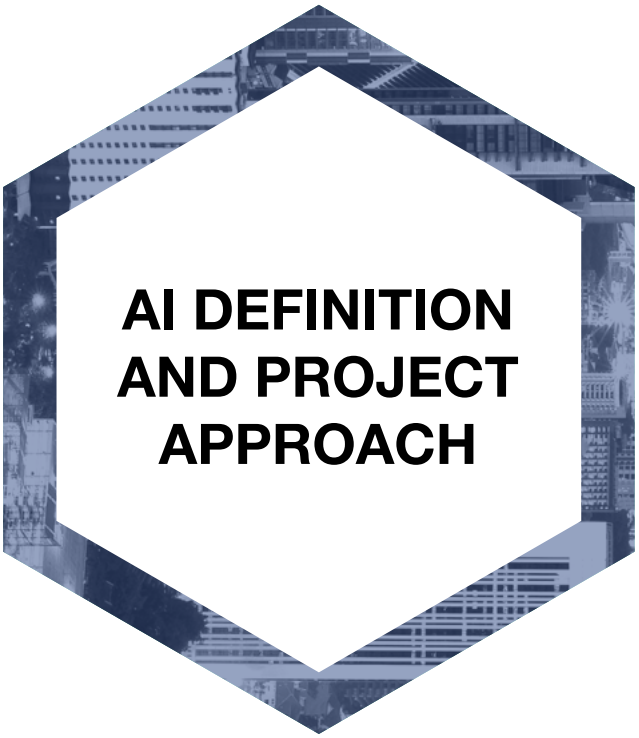
BEST PRACTICE APPROACHES AND LESSONS LEARNT WERE IDENTIFIED TO DEVELOP AN ACTION AGENDA FOR AI IN ASIA

ACTION AGENDA	KEY ACTION	EXAMPLES OF COUNTRIES IN ASIA WHERE GOVERNMENTS, INDUSTRY AND/OR CIVIL SOCIETY ACTORS HAVE IMPLEMENTED ACTION
Stimulate greater AI adoption and worker reskilling efforts	1 Ensure strong and even adoption of AI across firms and workers	
	2 Build awareness of reskilling benefits, critical skills and training opportunities	
	3 Incentivize and encourage employers to retrain their workers	
	4 Foster close collaboration between governments, industry and civil society to create relevant and effective nation-wide retraining frameworks	
Promote a shift in emphasis from qualifications to skills	5 Establish effective and skills-focused lifelong learning models	
	6 Ensure relevance of educational curriculums to emerging skill needs	
	7 Encourage focus on skills rather than just qualifications in both recruitment and national labor market strategies	
Build inclusiveness to extend AI benefits to all workers	8 Build inclusive models that allow underserved groups to benefit from AI	
	9 Create social protection mechanisms for flexible workers	

SOURCE: Literature review, AlphaBeta analysis

“ Although the terms ‘automation’ and ‘AI’ are often used interchangeably, the technologies are different. With automation, systems are programmed to perform specific repetitive tasks… AI, on the other hand, is designed to seek patterns, learn from experiences, and make appropriate decisions… automated machines collate data – AI systems understand it. ”

- Microsoft (2018), The Future Computed



AI DEFINITION AND PROJECT APPROACH

WHAT IS MEANT BY AI?

AI refers to the ability of software or hardware to exhibit human-like intelligence. This entails 'a set of technologies that enable computers to perceive, learn, reason and assist in decision-making to solve problems in ways that are similar to what people do'.[5] Examples of AI applications include virtual assistants, autonomous vehicles and speech recognition tools.

HOW DOES AI DIFFER FROM AUTOMATION?

Although the terms are often used interchangeably, AI is, in fact, a subset of automation. Automation refers to hardware or software that is capable of doing tasks automatically without human intervention. On the other hand, AI is one of the levers that, when applied to automation technologies, allow them to mimic human behavior and intelligence. For example, factory assembly lines that do not deploy AI technologies may repetitively manufacture goods based on pre-programmed sets of instructions. With AI, these assembly lines could additionally perform higher-order functions such as predictive maintenance, quality control and parts-building based on raw design blueprints without the need for programming.[6] It should be noted that although this study focuses on AI, the insights identified are likely to be relevant for automation to a large extent as well.

5. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf
6. Jean Thilmany (2018), "Artificial intelligence transforms manufacturing", ASME.
Available at: https://www.asme.org/engineering-topics/articles/manufacturing-design/artificial-intelligence-transforms-manufacturing

PROEJCT APPROACH

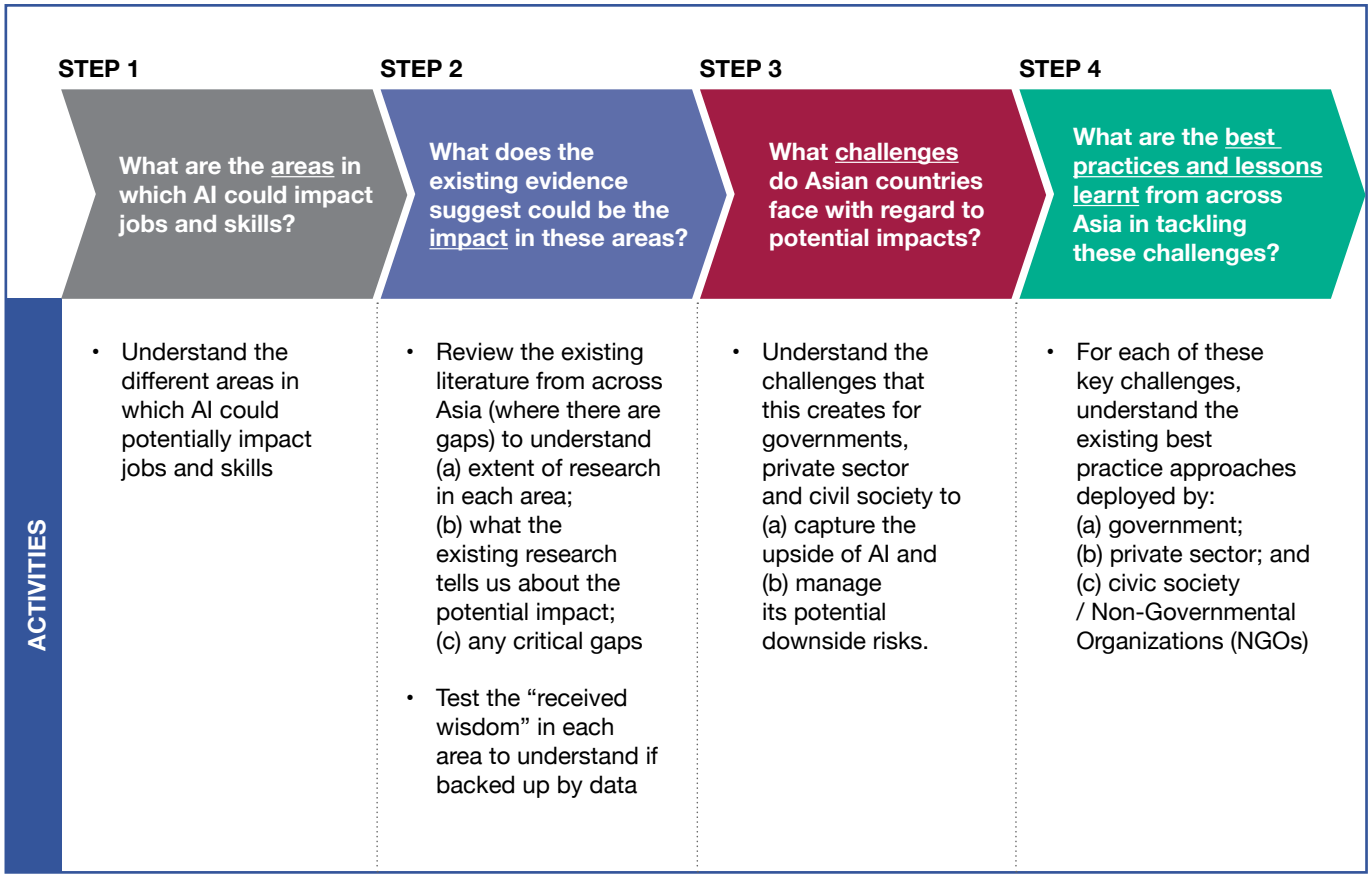
A four-step approach was used to understand the possible implications of AI for jobs and skills in Asia, and identify an action agenda for governments, employers and workers to maximize the benefits and minimize the costs of AI (Exhibit 1).

The steps are as follows:

1. **Identify the areas through which AI impacts jobs and skills.**
2. **Review the existing evidence of AI impacts in the identified areas.**
3. **Understand the challenges faced in Asia.**
4. **Identify best practices and lessons learnt in Asia to develop action agenda.**

EXHIBIT 1:

A FOUR-STEP APPROACH HAS BEEN USED TO UNDERSTAND THE CONCERNS RELATING TO AI FOR JOBS AND SKILLS, AND IDENTIFY AN ACTION AGENDA TO ADDRESS THEM



STEP 1:
IDENTIFY THE AREAS THROUGH WHICH AI IMPACTS JOBS AND SKILLS

Six potential impacts of AI on jobs and skills in Asia were identified. These impacts relate to overall employment and the nature of work (Exhibit 2).

EXHIBIT 2:

6 POTENTIAL IMPACTS IN TWO MAIN AREAS WERE IDENTIFIED

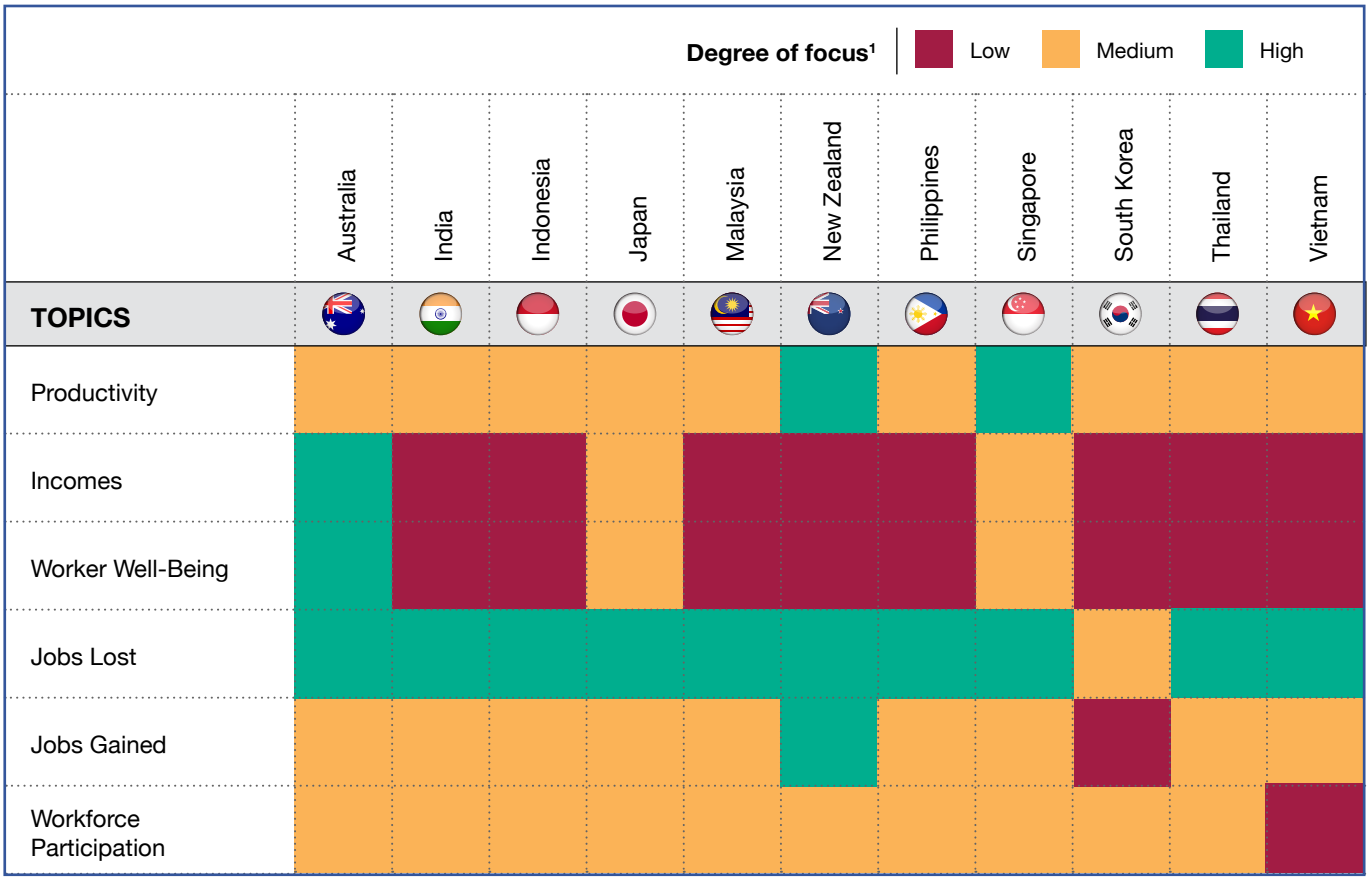
HOW COULD AI CHANGE THE NATURE OF WORK IN ASIA? 	1	**Productivity**	• How could AI impact one's productivity at work? • How might this vary by sector?
	2	**Incomes**	• How could AI impact worker incomes? • How is AI likely to impact existing income inequalities across workers of different skill levels? • What is the likely premium associated with new skills in demand?
	3	**Worker Well-Being**	• How could workplace safety be impacted with increased AI adoption in the workplace? • How could job satisfaction shift?
HOW COULD AI IMPACT OVERALL EMPLOYMENT IN ASIA? 	4	**Jobs Lost**	• How could AI impact the type of jobs that are done? • How might this vary by sector?
	5	**Jobs Gained**	• How could AI support the creation of new jobs? • What might be the in-demand skills in an AI economy?
	6	**Workforce Participation**	• How might AI impact workforce participation, particularly for groups that currently face barriers (e.g. mothers re-entering the workforce, people with disabilities)?

STEP 2:
REVIEW THE EXISTING EVIDENCE OF AI IMPACT IN THE IDENTIFIED AREAS

A comprehensive literature review of academic articles, institutional reports and survey findings covering the impact of AI both in Asia and elsewhere was conducted to understand (a) the extent of research in each area; (b) the findings in the identified impact areas; and (c) critical gaps that may require additional research or analysis.[7]

Exhibit 3 provides an overview of the state of existing research in the six areas for the main countries of focus in Asia. While there is a variety of literature on the impact of AI on employment (i.e., jobs lost, jobs gained and workforce participation), literature on the impact of AI on certain attributes of work, particularly for incomes and worker well-being, has been more limited. More studies on the impact of AI have also been conducted in most high-income Asian economies including Japan, Australia and Singapore; however, studies on South Korea as well as lower-income countries such as Vietnam and the Philippines have been more limited. For more information on the AI literature reviewed for each country across the areas of focus, please refer to the Appendix.

EXHIBIT 3:
THE EXTENT OF EXISTING RESEARCH BY AI TOPIC VARIES ACROSS COUNTRIES IN ASIA



1 Refers to existing academic research on each topic for the given country. "Low" reflects no existing research on the topic in that country; "Medium" reflects a limited number of studies (e.g. less than 5) on that topic within the country; "High" reflects a large number of studies (e.g. greater than 5) on that topic within the country.

SOURCE: Literature review, AlphaBeta analysis

7. In areas where the literature directly relevant to AI was scant, the findings on the broader topic of automation were taken as proxy.

STEP 3:
UNDERSTAND THE CHALLENGES FACED IN ASIA

Analysis of the available literature was conducted to understand the unique challenges faced in Asia that could prevent economies in the region from harnessing the full benefits of AI, while managing these risks. The challenges identified apply to governments, employers and workers across Asia.

STEP 4:
IDENTIFY BEST PRACTICES AND LESSONS LEARNT IN ASIA TO DEVELOP AN ACTION AGENDA

For each of the identified challenges, relevant best practice approaches as well as lessons learnt from policies, programs and practices implemented by governments, businesses and civil society actors in Asia were reviewed. Insights drawn from these approaches were used to develop an action agenda to allow key stakeholders in Asia to maximize the potential benefits, while managing the possible risks from AI.

“ AI-enabled technologies have been estimated to potentially add between 0.6 percent (in India) and 1.6 percent (in South Korea) to annual GDP growth across Asian economies between 2017 and 2030. ”

Chapter 1:

IMPACT OF AI ON THE NATURE OF WORK IN ASIA

There has been a substantial amount of literature discussing the broad macroeconomic benefits of AI to Asian economies. AI-enabled technologies have been estimated to potentially add between 0.6 percent (in India) and 1.6 percent (in South Korea) to annual GDP growth across Asian economies between 2017 and 2030.[8] However, what has been less examined is the impact of AI on the nature of work for the individual worker. A thorough analysis of the existing research demonstrates that AI has the potential to have a positive impact on worker productivity, income and satisfaction in Asia. In fact, the largest productivity beneficiaries of AI are estimated to be in non-digital sectors such as healthcare and education services, where the estimated productivity benefits could be almost three times as large as those benefits received in digital sectors. In particular, middle-income countries could see the highest productivity gains of up to 52 percent by 2021, as compared to a scenario without AI adoption. While AI could create downward pressure on wages through substitution of labor for capital, the literature suggests that AI could also drive wage improvements through three channels: by improving the productivity of workers, by allowing workers to shift to higher-order tasks, and in the form of wage premiums attached to workers who can perform jobs supporting the development of AI. Although it has been argued that income gains would only be captured by more highly skilled workers, a study in Australia has shown that the real wages of low-skill workers could grow by 10 percent by 2030.[9] By removing mundane, manual and dangerous tasks, AI also has the potential to improve workplace safety and job satisfaction – albeit at the expense of greater job stress (as demonstrated in a survey in Japan).

8. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: *https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning*
9. AlphaBeta (2017), The automation advantage. Available at: *https://www.alphabeta.com/our-research/the-automation-advantage/*

This chapter examines the impact of AI on the nature of work in Asia – namely, productivity, incomes and worker well-being. Exhibit 4 shows a list of common perceptions relating to these areas and corresponding evidence based on analysis of the available literature. The rest of this chapter explains each of the key insights in detail.

EXHIBIT 4:

HOW COULD AI CHANGE THE NATURE OF WORK IN ASIA?

	PERCEPTION	EVIDENCE
Productivity	The largest productivity beneficiaries of AI will come from digital sectors	1 Traditional, non-digital sectors such as healthcare are expected to reap up to **three times** the productivity benefits from AI to digital sectors
	The largest productivity gains from AI will be captured by high-income countries	2 Middle-income countries like the Philippines could see the highest employee productivity gains of up to **52% in 2021**
Incomes	Worker wages will decline as more work tasks become displaced by AI	3 While there is a potential for wages to be reduced through a substitution of labor by capital, there are **three** other channels through which AI could cause wages to rise
	Most of the income gains from AI are likely to be received only by workers who maintain their jobs	4 Displaced workers have the potential to improve their wages if they manage to secure jobs with lower risk of substitution by AI technologies or new AI-supporting roles For example, a study in Australia shows that if low-skill workers (who could potentially be displaced) learn to perform higher-order tasks, their real wages could be **10% higher by 2030**
		5 Retraining to support job transition will be critical to reduce a future increase in income inequality. A study in Australia showed that retraining **75%** of potentially displaced workers could **more than halve** future increases in income inequality
	Low and middle wage jobs will be the hardest hit by AI	6 By allowing workers to work more independently and require less managerial oversight, AI adoption could in fact increase the ratio of low and middle-wage jobs to high-wage jobs
Worker Well-Being	Workplace safety could be threatened by combining people with AI	7 A study in Australia shows that workplace injuries could fall by **11%** as automation eliminates some of the most dangerous physical tasks in the economy
	Job satisfaction will deteriorate as AI will remove the most interesting components of jobs	8 Studies in Australia and Japan have shown that AI adoption could increase job satisfaction levels by **20%**, but the study in Japan showed that work stress could also rise

SOURCE: Literature review, AlphaBeta analysis

PERCEPTION:
"THE LARGEST PRODUCTIVITY BENEFICIARIES OF AI WILL COME FROM DIGITAL SECTORS."

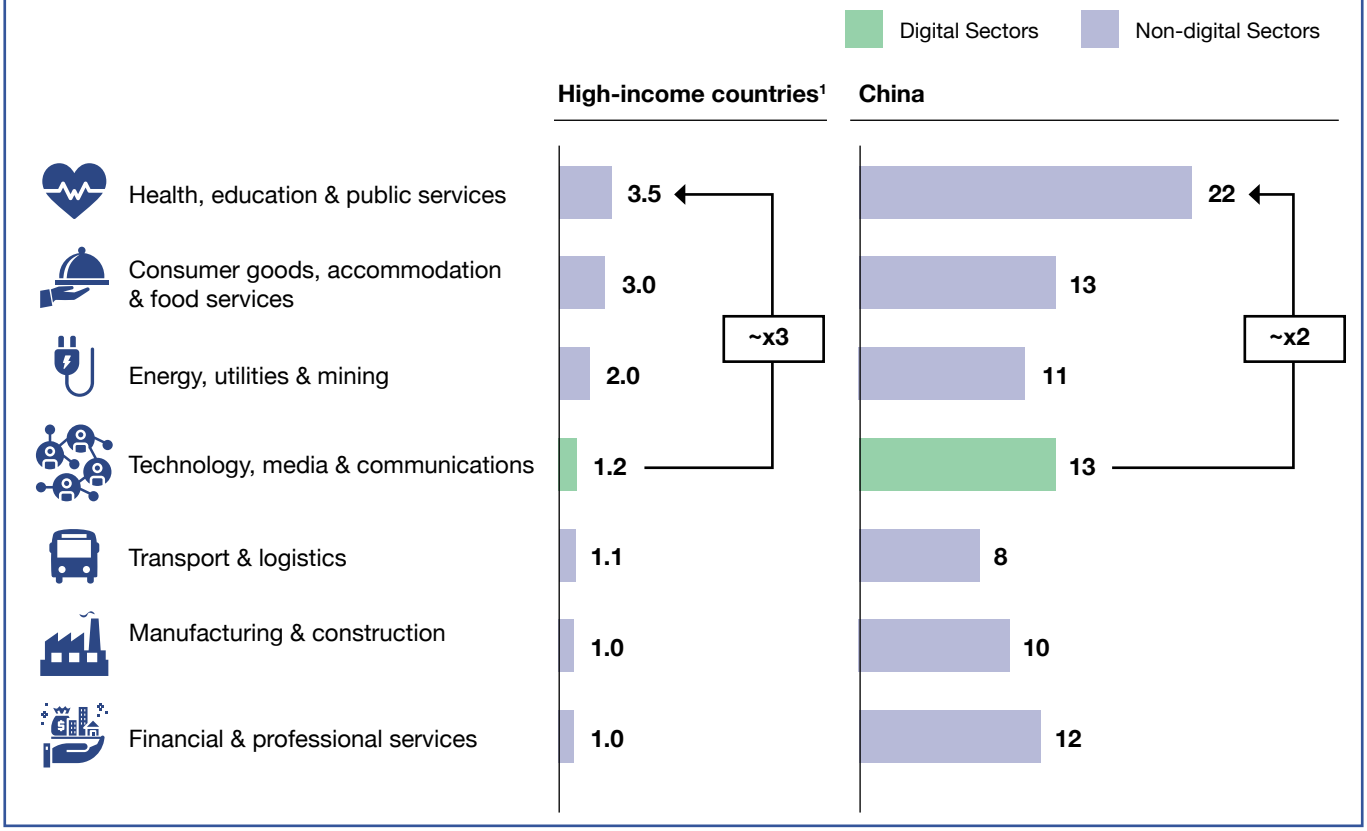
1. TRADITIONAL, NON-DIGITAL SECTORS ARE EXPECTED TO REAP UP TO THREE TIMES THE PRODUCTIVITY BENEFITS FROM AI TO DIGITAL SECTORS

A study of AI-driven productivity gains quantified in the form of projected GDP impact in 2030 across middle- and high-income Asian economies reflects that it is the traditional, non-digital sectors that could see the highest productivity benefits from AI. In particular, the estimated AI-enabled productivity gains to health, education and public services in 2030 could be between two to three times the productivity gains anticipated for the digital sectors of technology, media and communications (Exhibit 5).[10] In healthcare, significant efficiency gains could accrue, for example, from AI-enabled precision surgery, remote health monitoring services, diagnostic tools as well as drug development processes.[11] As for education, adaptive learning algorithms could play a role in delivering individualized and virtual education without having to invest significantly in more teaching resources.[12]

EXHIBIT 5:

TRADITIONAL, NON-DIGITAL SECTORS SUCH AS HEALTHCARE ARE EXPECTED TO REAP UP TO THREE TIMES THE PRODUCTIVITY BENEFITS FROM AI TO DIGITAL SECTORS

PROJECTED GDP IMPACT IN 2030 RESULTING FROM AI-ENABLED PRODUCTIVITY GAINS BY INDUSTRY SECTOR IN ASIAN COUNTRIES, %



1. Countries studied include Japan, Mongolia, South Korea, Singapore and Taiwan
SOURCE: PWC (2018), The macroeconomic impact of artificial intelligence; AlphaBeta analysis

10. PricewaterhouseCoopers (2018), The macroeconomic impact of artificial intelligence.
Available at: https://www.pwc.co.uk/economic-services/assets/macroeconomic-impact-of-ai-technical-report-feb-18.pdf
11. Forbes Insights (2019), "AI and healthcare: A giant opportunity". Available at: https://www.forbes.com/sites/insights-intelai/2019/02/11/ai-and-healthcare-a-giant-opportunity/#370de8404c68
12. McKinsey Global Institute (2017), Artificial intelligence and Southeast Asia's future.
Available at: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20SE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.ashx

PERCEPTION:
"THE LARGEST PRODUCTIVITY GAINS FROM AI WILL BE CAPTURED BY HIGH-INCOME COUNTRIES."

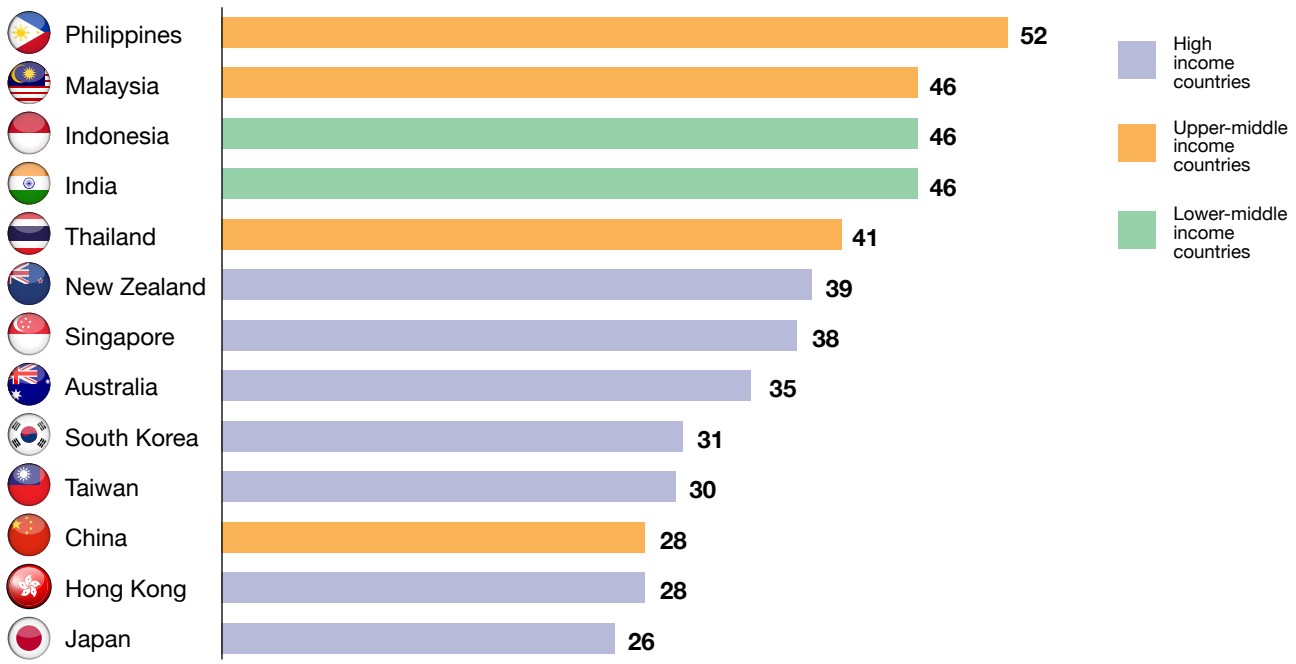
2. MIDDLE-INCOME COUNTRIES LIKE THE PHILIPPINES COULD SEE THE HIGHEST EMPLOYEE PRODUCTIVITY GAINS OF UP TO 52 PERCENT IN 2021

Contrary to the conventional wisdom that the largest productivity benefits from AI will be captured by high-income countries, it has been found that middle-income countries could see the highest gains. As shown in Exhibit 6, a survey by Microsoft and IDC showed that lower- and upper-middle-income countries in Asia stand to gain relatively higher employee productivity gains than high income countries.[13] The Philippines (upper-middle-income), Malaysia (upper-middle-income), Indonesia and India (lower-middle income) have been projected to gain the highest employee productivity gains from AI of 46 to 52 percent by 2021.[14] These are higher as compared to high-income countries such as Singapore (38 percent), South Korea (31 percent) and Japan (26 percent). This difference could be attributed to the relatively lower labor productivity bases in lower- and upper-middle-income countries as compared to high-income countries, which allow any productivity gains from AI adoption to be more significant relative to the baseline scenario of no AI adoption. The Philippines, for example, placed second to lowest among 63 countries in terms of labor productivity in the latest World Competitiveness Yearbook ranking, pointing toward a great opportunity for AI technologies to contribute to significant productivity gains in the country.[15]

EXHIBIT 6:

MIDDLE-INCOME COUNTRIES LIKE THE PHILIPPINES COULD SEE THE HIGHEST EMPLOYEE PRODUCTIVITY GAINS OF UP TO 52% IN 2021

PROJECTED RATE OF AI-ENABLED EMPLOYEE PRODUCTIVITY GAINS IN 2021 (AS COMPARED TO THE SCENARIO OF NO AI ADOPTION) BY COUNTRY IN ASIA PACIFIC REGION[1], %



Income classification of country based on World Bank's classification. As of 1 July 2018, World Bank defined 'low-income economies' as those with a GNI per capita of USUS$995 or less in 2017; lower middle-income economies are those with a GNI per capita between US$996 and US$3,895; upper middle-income economies are those between US$3,896 and US$12,055; high-income economies are those with a GNI per capita of US$12,055 or more.
SOURCE: Microsoft-IDC APAC AI survey (2018); AlphaBeta analysis

13. 1,605 business leaders and 1,585 workers were surveyed across markets in Asia Pacific, which include: Australia, China, Hong Kong, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. Source: Microsoft-IDC (2019), "Future ready business: Assessing Asia Pacific's growth potential through AI". Available at: https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/
14. Income classifications of countries based on World Bank classification and data on Gross National Income per capita. Available at: https://data.worldbank.org/
15. Hong Kong University of Science and Technology and the Association of Pacific Rim Universities (2019), Transformation of work in Asia Pacific in the 21st century. Available at: http://www.bm.ust.hk/en-us/media-resources/overview/publications/reports

PERCEPTION:
"WORKER WAGES WILL DECLINE AS MORE WORK TASKS BECOME DISPLACED BY AI."

3. WHILE THERE IS A POTENTIAL FOR WAGES TO BE REDUCED THROUGH A SUBSTITUTION OF LABOR BY CAPITAL, THERE ARE THREE OTHER CHANNELS THROUGH WHICH AI COULD CAUSE WAGES TO RISE

The literature reflects that worker wages could be impacted by AI through four different channels. As illustrated in Exhibit 7, these are:

- **Substitution effect:** By being able to substitute work tasks typically performed by workers, AI could reduce workers' bargaining power in the labor market and in turn, their wages.[16]
- **Productivity effect:** By complementing and improving the productivity of labor, and perhaps even boosting the quality of their work, AI could allow workers to command higher wages in the labor market.[17]
- **Shifts to higher-order tasks:** By taking care of repetitive and routine tasks, AI frees up more time for workers to perform more higher-order tasks, allowing them to command higher wages.
- **Switches to new AI-supporting jobs:** Completely new jobs that arise to support the deployment of AI across different sectors typically have a wage premium attached to them due to a shortage of the requisite skills in the labor market.

While the literature is clear on the theoretical impact of each of these effects on worker wages, it is lacking in two key areas. One, there is no analysis comparing the effects of each on worker wages in the Asian context. Two, quantitative analysis of exactly how much worker wages could be impacted due to each of these effects is also lacking in the literature. There is hence much room for detailed analysis of the possible magnitude of these effects in the Asian context. The next section shares some of the evidence for different types of workers in Asia.

EXHIBIT 7:

AI COULD IMPACT WORKER WAGES THROUGH FOUR DIFFERENT CHANNELS

CHANNEL OF IMPACT	KEY ACTION	IMPACT ON WAGES
Substitution Effect	By being able to substitute work tasks typically performed by workers, AI could reduce workers' bargaining power in the labor market and, in turn, their wages	↓
Productivity Effect	AI could improve the productivity of workers and perhaps even boost the quality of their work, allowing them to command higher wages in the labor market	↑
Shifts to Higher-Order Tasks	By taking care of repetitive and routine tasks, AI frees up more time for workers to perform more higher-order tasks, allowing them to command higher wages	↑
Switches to New AI-Supporting Jobs	Completely new jobs that arise to support the deployment of AI across different sectors typically have a wage premium attached to them due to a shortage of the requisite skills in the labor market	↑

SOURCE: Literature review, AlphaBeta analysis

16. Sources include: Daron Acemoglu and Pascual Restrepo (2017), Robots and jobs: Evidence from US labor markets. Available at: https://www.nber.org/papers/w23285; Carl Frey and Michael Osborne (2013), The future for employment: How susceptible are jobs to computerization? Available at: https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf
17. Sources include: David Autor and Anna Salomons (2017), Is automation labor-displacing? Productivity growth, employment, and the labor share. Brookings Paper on Economic Activity. Available at: https://www.brookings.edu/wp-content/uploads/2018/03/1_autorsalomons.pdf;
George Graetz and Guy Michaels (2015), Robots at work. Centre for Economic Performance. Available at: http://cep.lse.ac.uk/pubs/download/dp1335.pdf; James Bessen (2017), AI and jobs: The role of demand. Boston Univ. School of Law, Law and Economics Research Paper No. 17-46. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3078715; McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages; PricewaterhouseCoopers (2018), The macroeconomic impact of artificial intelligence. Available at: https://www.pwc.co.uk/economic-services/assets/macroeconomic-impact-of-ai-technical-report-feb-18.pdf

PERCEPTION:
"MOST OF THE INCOME GAINS FROM AI ARE LIKELY TO BE RECEIVED ONLY BY WORKERS WHO MAINTAIN THEIR JOBS."

4. DISPLACED WORKERS HAVE THE POTENTIAL TO IMPROVE THEIR WAGES IF THEY MANAGE TO SECURE JOBS WITH LOWER RISK OF SUBSTITUTION BY AI TECHNOLOGIES OR NEW AI-SUPPORTING ROLES

There are concerns that any income gains from AI would only be received by a subset of workers – particularly those with higher skills and who are therefore less likely to lose their jobs. While there is no existing research demonstrating the extent to which this applies to the Asian context, an analysis of studies on wages in Asia reflect that displaced workers who manage to secure jobs at lower risk of substitution by AI technologies, or even 'in-demand' AI-supporting roles, could also receive wage gains. Drawing upon the earlier analysis of wage impact channels to different classes of workers, Exhibit 8 illustrates the potential wage impacts to different classes of workers in an AI economy.

As illustrated in Exhibit 8, different outcomes could be observed for workers who maintain their jobs, and for displaced workers:

- **Workers who maintain their jobs, or switch to new AI-supporting roles.** Workers who are able to maintain their jobs (most likely in AI-complementing roles) have great potential to benefit from wage increases through the productivity effect and shifts to higher-order tasks. Existing evidence on the AI productivity effect for wages in Asia is scant, but studies do show a strong correlation between labor productivity improvements and wage growth. For example, it has been found in New Zealand that wages have tended to follow productivity increases; a 1.5 percent increase in labor productivity growth led to an equivalent increase in real wages paid by firms over the period 2000-2018.[18] Shifts to higher-order tasks have also been demonstrated to improve worker wages, with such improvements potentially even stronger for low-skill workers. AlphaBeta's study in Australia, for example, found that the real wages of low-skill workers could rise if they were to reallocate time away from routine, automatable tasks towards less automatable tasks (Exhibit 9).[19] The study found that a worker who spends 40 hours a week on non-automatable tasks (e.g. teaching students, devising new business strategies) earns approximately 20 percent more per hour as compared to someone who spends 40 hours a week performing automatable tasks (e.g., packaging deliveries, operating heavy machinery). Based on this, it projected that if low-skill workers could learn to perform more uniquely human tasks and firms also accelerated their rate of automation, real wages for this group could be 10 percent higher by 2030 as compared to 2015, translating into an annual income gain of approximately A$6,000 (US$4,300) per worker. Workers who switch to AI-supporting roles could also experience large income boosts, with wage surveys in Asian countries reflecting large increases in the salaries offered for such jobs due to a shortage of such talent. For example, over the course of a year, salaries for AI developers in China and Japan rose by 60 percent and 20 percent on average respectively.[20]

- **Displaced workers.** Displaced workers could face two different sets of outcomes, depending on their

18. New Zealand Productivity Commission (2015), Who benefits from productivity growth? The labour income share in New Zealand. Available at: https://www.productivity.govt.nz/sites/default/files/nzpc-wp-who-benefits-from-productivity-growth-cttc.pdf
19. AlphaBeta (2017), The automation advantage. Available at: https://www.alphabeta.com/our-research/the-automation-advantage/
20. Nikkei Asia Review (2019), "Chinese tech salaries jump in global race for talent". Available at: https://asia.nikkei.com/Business/Business-trends/Chinese-tech-salaries-jump-in-global-race-for-talent

EXHIBIT 8:

WAGE IMPACT COULD VARY BY WORKER TYPE

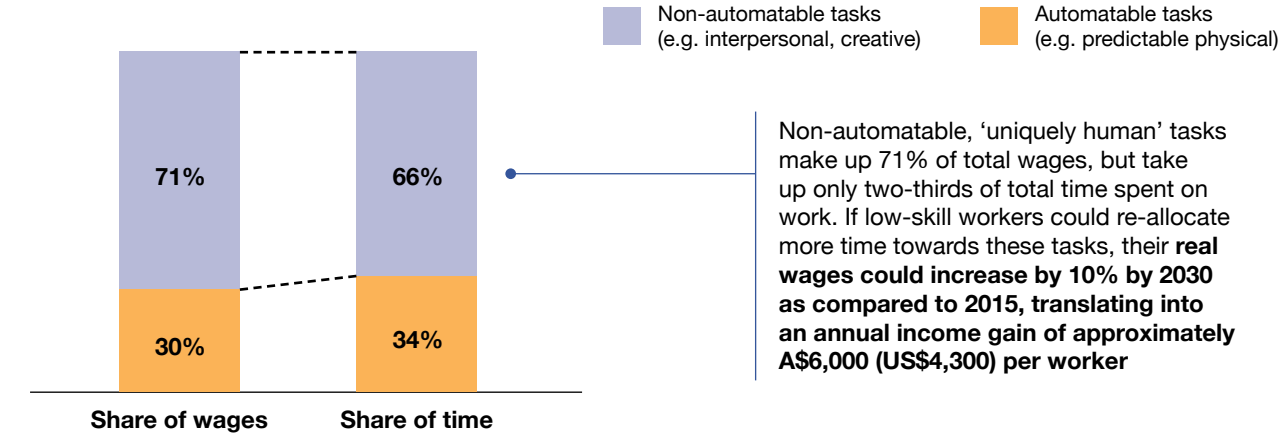
	IMPACT ON WAGES	POSSIBLE CHANNELS OF IMPACT	EVIDENCE FOR ASIA
Workers who maintain their jobs or switch to new AI-supporting roles	↑	Productivity Effect	A working paper by the New Zealand Productivity Commission showed that wages have tended to follow productivity increases: between 2000 and 2018, a 1.5% rise in labor productivity growth led to an **equivalent increase** in real wages paid by firms
		Shifts to Higher-Order Tasks	A study in Australia found that the real wages of low-skill workers could increase by **10%** if they could reallocate time away from routine, automatable tasks toward less automatable tasks such as those requiring creative and critical thinking
Displaced workers who manage to secure jobs at lower risk of substitution by AI, or new AI-supporting roles	↑	Switches to New AI-Supporting Jobs	High demand for AI professionals in Asia have led to a huge boost in the salaries offered for these jobs: AI developers in China in 2019 earn up to **US$120,000** annually on average – up from **60%** a year ago. Such salaries in Japan rose by **20%** over the past year to roughly **US$110,000**
Displaced workers who struggle to find jobs at lower risk of substitution	↓	Substitution Effect	There are rising concerns that AI could force Asian manufacturing workers to compete for a diminishing supply of low-skilled work, pushing them into a **'race to the bottom'**; a study indicates that **56%** of manufacturing workers in Cambodia, Indonesia, Thailand, the Philippines and Vietnam face this risk

SOURCE: Literature review, AlphaBeta analysis

EXHIBIT 9:

A STUDY IN AUSTRALIA SHOWS THAT IF LOW-SKILL WORKERS LEARN TO PERFORM HIGHER-ORDER TASKS, THEIR REAL WAGES COULD BE 10% HIGHER BY 2030

SHARES OF TOTAL WAGES AND TIME SPENT ON WORK TAKEN UP BY AUTOMATABLE AND NON-AUTOMATABLE TASKS IN AUSTRALIA (2015-2030), %



SOURCE: AlphaBeta (2017), The automation advantage; AlphaBeta analysis

access (and efforts to access) to new opportunities. Displaced workers who manage to secure jobs at lower risk of substitution by AI technologies could stand to benefit from wage increases from the productivity effect as well as shifts to higher-order tasks enabled by AI. Those who re-skill themselves sufficiently to be able to switch to new AI-supporting roles could access even larger potential boosts to their income, as earlier exemplified. On the other hand, displaced workers who struggle to seek any new forms of employment at all could be forced to compete for a diminishing supply of low-skilled work, pushing their wages even lower than before (substitution effect). Existing analyses quantifying this effect on wages in Asia have not been conducted. However, some research has demonstrated the magnitude of this impact in terms of the number of workers affected: a study indicates that 56 percent of manufacturing workers in Cambodia, Indonesia, Thailand, the Philippines and Vietnam could face this risk.[21]

5. RETRAINING TO SUPPORT JOB TRANSITION WILL BE CRITICAL TO REDUCE FUTURE INCREASES IN INCOME INEQUALITY. A STUDY IN AUSTRALIA SHOWED THAT RETRAINING 75 PERCENT OF POTENTIALLY DISPLACED WORKERS COULD MORE THAN HALVE FUTURE INCREASES IN INCOME INEQUALITY

In relation to the earlier point that displaced workers could face very different wage outcomes depending on whether they manage to transit into new jobs, it has been demonstrated that retraining will be key to managing future increases in income inequalities.

In particular, a study in Australia shows that over the period of 2016-2030, retraining 75 percent of potentially displaced workers in preparation for AI adoption could more than halve future increases in income inequality (Exhibit 10).[22] This study showed possible levels of income inequality (measured using the Gini coefficient[23]) in 2030 across three scenarios: no retraining, retraining 25 percent of potentially displaced workers, and retraining 75 percent of potentially displaced workers. In the 2030 scenario without retraining, income inequality could rise by 27 percent from a Gini coefficient of 0.32 in 2016 to 0.41 in 2030. In the scenarios where 25 percent and 75 percent of potentially displaced workers are retrained, potential increases in the Gini coefficient would be lower at 23 percent (0.39) and 11 percent (0.36) respectively. Hence, in the scenario where every three in four potentially displaced workers are retrained, future income inequality increases could therefore be reduced by more than half, as compared to a scenario where no retraining is done (27 percent versus 11 percent).

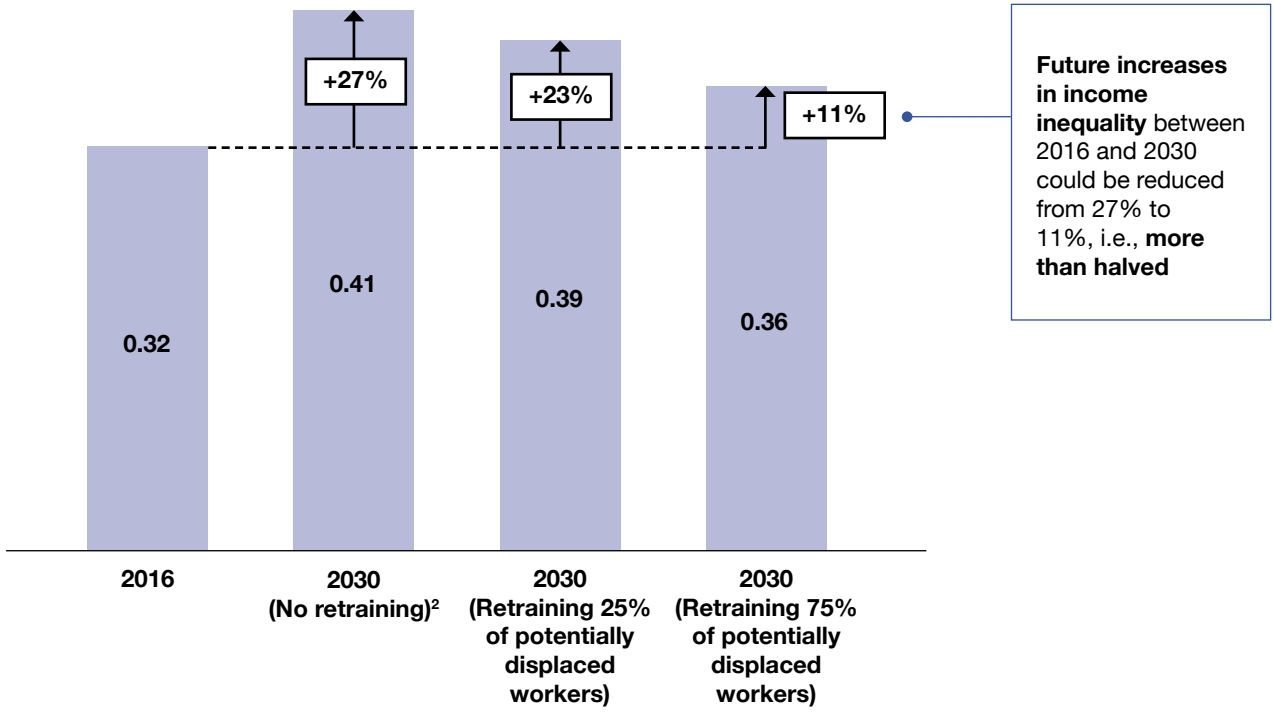
21. Thomson Reuters Foundation (2018), "Asian factory workers face slavery risks with rise of automation in manufacturing: analysts".
Available at: *https://www.japantimes.co.jp/news/2018/07/12/business/asian-factory-workers-face-slavery-risks-rise-automation-manufacturing-analysts/#.XOuo6ogzY2w*
22. McKinsey and Company (2019), Australia's automation opportunity: Reigniting productivity and inclusive income growth.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth*
23. The Gini coefficient is a statistical measure of income inequality. The closer the figure is to 1, the higher the level of income inequality.

EXHIBIT 10:

A STUDY IN AUSTRALIA SHOWED THAT RETRAINING 75% OF DISPLACED WORKERS COULD MORE THAN HALVE FUTURE POTENTIAL INCREASES IN INCOME INEQUALITY

IMPACT OF RETRAINING POTENTIALLY-DISPLACED WORKERS ON INCOME INEQUALITY IN AUSTRALIA (2016-2030)

Income inequality under current (2016) and future (2030) scenarios of retraining,
Gini coefficient (Index 0-1)[1], Percent change (%)



1. The Gini coefficient is a statistical measure of income inequality. The closer the figure is to 1, the higher the level of income inequality.
2. Baseline income inequality 2030 were computed by MGI (2019) based on expected wage trends due to the impact of automation on labor supply and demand dynamics for five occupational groups: managers and professionals, technicians and associate professionals, service and retail workers, administrative workers and trade and manual workers. Potential changes to income inequality from 2016 to 2030 in the various retraining scenarios were calculated based on the assumption that retraining has led to workers who would otherwise be displaced by automation to qualify for higher-skill and higher-paying roles.
SOURCE: MGI (2019), The automation opportunity; AlphaBeta analysis

PERCEPTION:
"LOW AND MIDDLE WAGE JOBS WILL BE THE HARDEST HIT BY AI."

6. BY ALLOWING WORKERS TO WORK MORE INDEPENDENTLY AND REQUIRE LESS MANAGERIAL OVERSIGHT, AI ADOPTION COULD IN FACT INCREASE THE RATIO OF LOW- AND MIDDLE-WAGE JOBS TO HIGH-WAGE JOBS

Counter to the narrative that low and middle wage jobs will be hardest hit by AI, case studies of middle-income Asian countries have demonstrated that the share of low- and middle-wage jobs could in fact increase with AI adoption.[24]

For example, a survey of over 1,100 manufacturing firms in China conducted in 2016 revealed that firms that adopted AI in their factories employed eight times as many low- and middle-wage workers as high-wage workers, as compared to four to five times for firms that had not adopted AI (Exhibit 11).[25] This was attributed to the fact that with AI, low and middle wage workers could perform their roles more independently and with less managerial oversight, therefore requiring a lower manager-to-worker ratio.

EXHIBIT 11:

A STUDY IN CHINA SHOWED THAT AI-ADOPTING FIRMS EMPLOYED 8 TIMES AS MANY LOW- AND MIDDLE-WAGE WORKERS AS HIGH-WAGE WORKERS, AS COMPARED TO 4-5 TIMES FOR FIRMS THAT HAD NOT ADOPTED AI

PROJECTED GDP IMPACT IN 2030 RESULTING FROM AI-ENABLED PRODUCTIVITY BY INDUSTRY SECTOR IN ASIAN COUNTRIES, %

Low-wage workers refer to "production workers" in the survey; middle-wage workers refer to "technical workers"; high-wage workers' refer to "managers" and owners of the company.
SOURCE: Asian Development Bank (2018), Asian development outlook 2018: How technology affects jobs; AlphaBeta analysis

24. Sources include: Reuters (2019), "AI to hit hardest in US heartland and among less-skilled: study". Available at: https://www.reuters.com/article/us-usa-economy-labor/ai-to-hit-hardest-in-us-heartland-and-among-less-skilled-study-idUSKCN1PI0D8; Chris Middleton (2018), "Robotics, AI will create 58 million jobs, decimate middle-class careers: World Economic Forum". Available at: https://internetofbusiness.com/robotics-a-i-will-create-jobs-but-decimate-middle-class-careers-wef/; James Vincent (2017), "Automation threatens 800 million jobs, but technology could still save us, says report", The Verge. Available at: https://www.theverge.com/2017/11/30/16719092/automation-robots-jobs-global-800-million-forecast
25. Asian Development Bank (2018), Asian development outlook: How technology affects jobs.
Available at: https://www.adb.org/publications/asian-development-outlook-2018-how-technology-affects-jobs

PERCEPTION:
"WORKPLACE SAFETY COULD BE THREATENED BY COMBINING PEOPLE WITH AI."

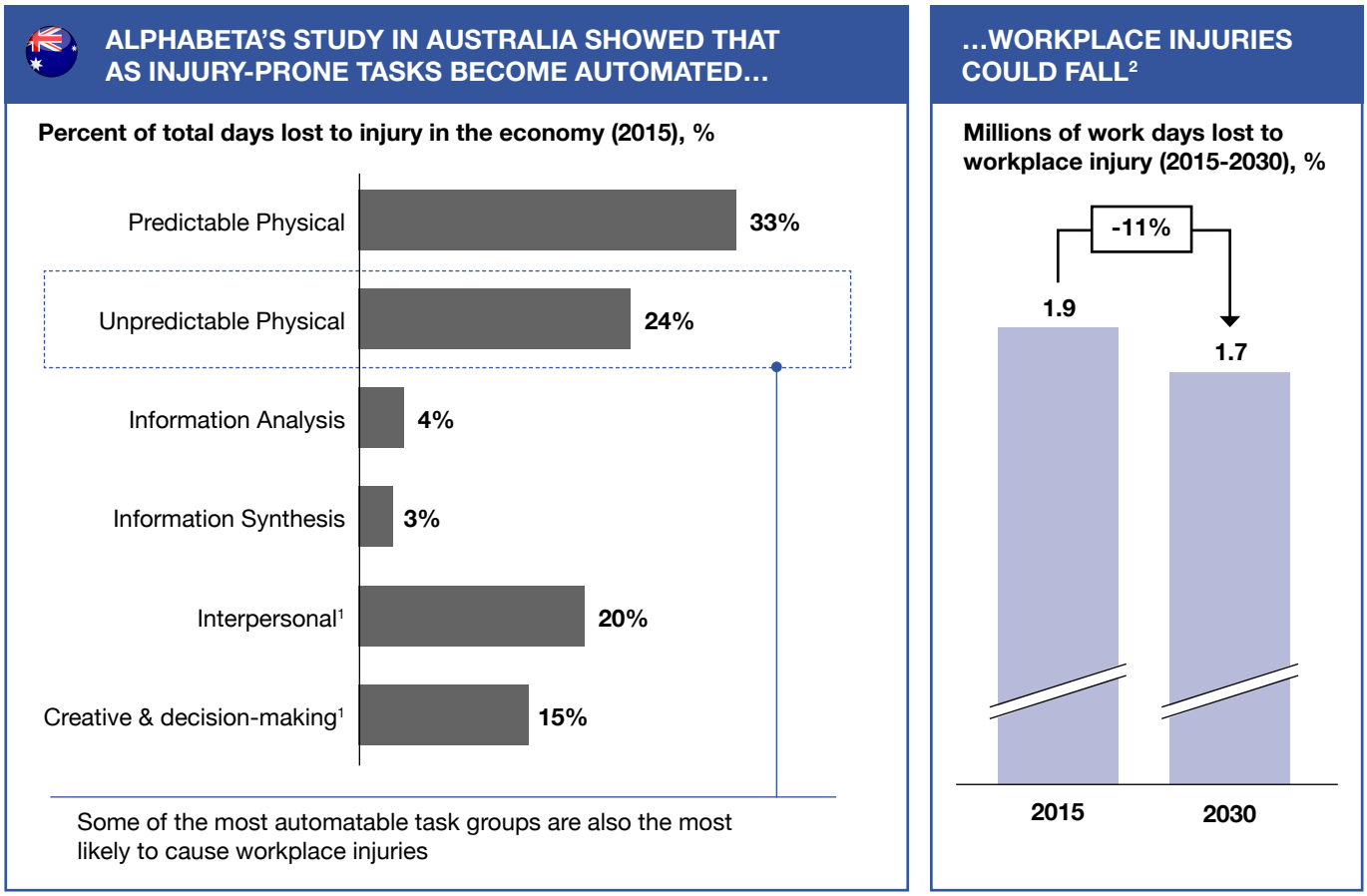
7. A STUDY IN AUSTRALIA SHOWS THAT WORKPLACE INJURIES COULD FALL BY 11 PERCENT AS AUTOMATION ELIMINATES SOME OF THE MOST DANGEROUS PHYSICAL TASKS IN THE ECONOMY

As physical tasks become automated, workplaces become safer. This is because the activities that are easiest to automate, such as physical work, are typically among the most dangerous.

AlphaBeta's study in Australia found that physical tasks use up only around one quarter (27 percent) of all work hours in our economy but cause an outsized number of work accidents.[26] As shown in Exhibit 12, it also found that physical tasks accounted for more than halve (57 percent) of all sick days workers took to recover from injuries sustained on the job in 2015. In particular, 'unpredictable physical' activities – which have greatest potential to be disrupted by AI technologies – were estimated to account for 24 percent of total days lost to injury. Assuming the pace of AI adoption continues based on past trends, the study projected that the total number of work days lost to injuries sustained from physical work in the Australian economy could fall by 11 percent from 1.9 million in 2015 to 1.7 million in 2030 (Exhibit 12).[27]

EXHIBIT 12:

A STUDY IN AUSTRALIA SHOWS THAT WORKPLACE INJURIES COULD FALL BY 11% AS AUTOMATION ELIMINATES THE MOST DANGEROUS PHYSICAL TASKS IN THE ECONOMY



1. "The share of total days lost to injuries in the economy caused by interpersonal and creative and decision-making tasks appear disproportionately high due to the disproportionate amount of time spent on these tasks in the economy
2. Figures adjusted to exclude increase in injuries due to labor force growth
SOURCE: AlphaBeta (2017), The automation advantage; AlphaBeta analysis

26. AlphaBeta (2017), The automation advantage. Available at: https://www.alphabeta.com/our-research/the-automation-advantage/
27. AlphaBeta (2017), The automation advantage. Available at: https://www.alphabeta.com/our-research/the-automation-advantage/

PERCEPTION:
"JOB SATISFACTION WILL DETERIORATE AS AI WILL REMOVE THE MOST INTERESTING COMPONENTS OF JOBS."

8. STUDIES IN AUSTRALIA AND JAPAN HAVE SHOWN THAT AI ADOPTION COULD INCREASE JOB SATISFACTION LEVELS BY 20 PERCENT, BUT THE STUDY IN JAPAN SHOWED THAT WORK STRESS COULD ALSO RISE

AI and automation technologies have the potential to improve job satisfaction. Exhibit 13 illustrates two studies that reflect this finding.

AlphaBeta's study in Australia found that AI adoption could increase job satisfaction particularly for low-skill workers who are often required to perform the most dangerous, strenuous and repetitive jobs in the economy.[28] It estimated that if automation trends in Australia continued at their current pace, 62 percent of low-skill workers would be happier in their jobs by 2030 as compared to 2015. The study also found that high-skill workers could benefit, with 30 percent of them likely to report higher job satisfaction in 2030 if they could swap some of their automatable routine work for more complex and routine tasks.

This trend of improved job satisfaction from AI deployment was similarly reflected in a 2017 survey of over 10,000 workers in Japan.[29] This survey found that employees in companies that had adopted AI reported a 20 percent increase in job satisfaction levels, as compared to 5 percent decrease for companies that had not adopted AI. However, alongside greater job satisfaction was a higher level of work-related stress felt by employees who had to learn new skills to adapt to the new technologies. A 55 percent increase in the level of work-related stress was reported for employees from companies adopting AI, as compared to 30 percent for those from companies that had not.[30]

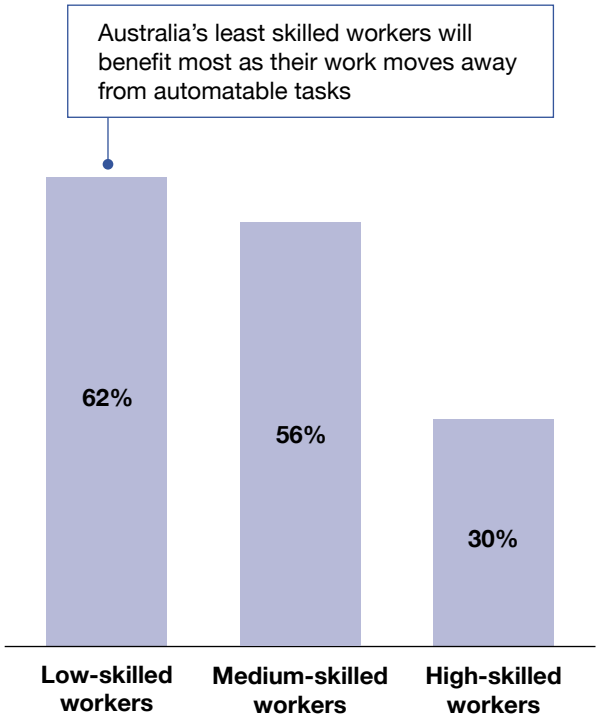
28. AlphaBeta (2017), The automation advantage. Available at: https://www.alphabeta.com/our-research/the-automation-advantage/
29. Yamamoto Isamu (2018), "The impact of Information Technologies such as artificial intelligence on worker stress", Research Institute of Economy, Trade and Industry. Available at: https://www.rieti.go.jp/en/columns/a01_0500.html?ref=rss
30. Yamamoto Isamu (2018), "The impact of Information Technologies such as artificial intelligence on worker stress", Research Institute of Economy, Trade and Industry. Available at: https://www.rieti.go.jp/en/columns/a01_0500.html?ref=rss

EXHIBIT 13:

STUDIES IN AUSTRALIA AND JAPAN HAVE SHOWN THAT AI ADOPTION COULD INCREASE JOB SATISFACTION LEVELS BY 20%, BUT THE STUDY IN JAPAN SHOWED THAT WORK STRESS COULD ALSO RISE

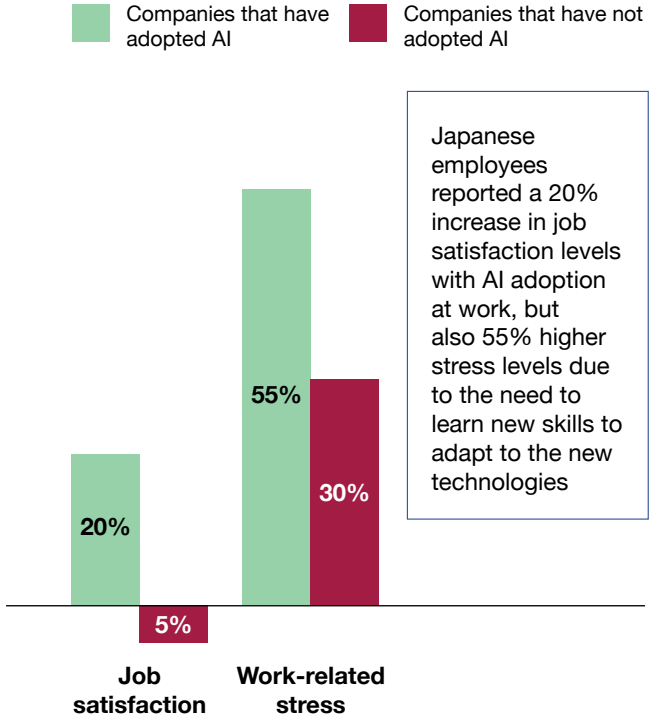
ALPHABETA'S STUDY IN AUSTRALIA SHOWED THAT AUTOMATING ROUTINE TASKS WILL INCREASE JOB SATISFACTION, PARTICULARLY FOR LOW SKILLED WORKERS...

Estimated percentage of workers with improved satisfaction after AI adoption in Australia (2015-2030), %



...A SURVEY OF OVER 10,000 WORKERS IN JAPAN SIMILARLY REFLECTED THAT JOB SATISFACTION DOES INCREASE WITH AI ADOPTION, BUT SO DOES WORK-RELATED STRESS

Percent change in levels of worker job satisfaction and stress due to AI adoption in Japan (2017), %



SOURCE: AlphaBeta (2017), The automation advantage; JST-RISTEX Planned Survey Report for Fiscal 2017 (2017); AlphaBeta analysis

“ Displacement effects could potentially be more than offset by the job creation impacts of AI – directly within the AI sector, indirectly in other related sectors and at the broad economy level (through AI stimulating higher productivity and rising incomes resulting in greater aggregate demand). ”

Chapter 2:

IMPACT OF AI ON EMPLOYMENT IN ASIA

AI could potentially create more jobs than it displaces in Asia, but disruption is likely and there may be net job losses concentrated in specific sectors. There is wide variation in the estimates of potential job displacement from AI, ranging from 7 to 49 percent for the same country, which appear to be driven by differences in methodology (particularly on whether automation impacts are analyzed at the job or task level). Interestingly, despite these variations in estimates, the impact on job displacement is generally estimated to be larger in higher-income countries than in lower-income countries (e.g., 10 percent of jobs in the Philippines as compared to 49 percent of jobs in Japan), which appears consistent with the faster pace of AI adoption and higher wages in higher-income countries. The impact of job displacement also varies widely across sectors, ranging from 8 to 26 percent of jobs being affected. Those sectors in which there are more jobs with routine and repetitive tasks (such as manufacturing) are generally projected to see higher job displacement impacts.

However, the potential of AI technologies to create new jobs has received limited focus in the media. The existing literature suggests that the positive impact on the labor market could, in fact, be significant. Displacement effects could potentially be more than offset by the job creation impacts of AI – directly within the AI sector, indirectly in other related sectors and at the broad economy level (through AI stimulating higher productivity and rising incomes resulting in greater aggregate demand). For example, through the income effect alone, it was estimated that AI could potentially boost overall employment by up to 12 percent by 2037 in China, which is equivalent to an additional 93 million jobs. However, the interaction of these effects varies across sectors, and net losses could still be seen in sectors with more repetitive and routine tasks, as well as relatively income-inelastic goods and services (e.g., agriculture, manufacturing and utilities). AI could also boost workforce participation rates through job-matching platforms, tools that enhance the employability of underserved groups and by creating opportunities for new flexible forms of labor.

This chapter examines the impact of AI on overall employment in Asia – namely, jobs lost, jobs gained and workforce participation. Exhibit 14 shows a list of common perceptions related to these areas and corresponding evidence based on analysis of the available literature. The rest of this chapter explains each of the key insights in detail.

EXHIBIT 14:
HOW COULD AI IMPACT OVERALL EMPLOYMENT IN ASIA?

	PERCEPTION	EVIDENCE	
Jobs Lost	AI is going to lead to mass unemployment in Asia across all countries and sectors	1	There is wide variation in the estimates of potential job displacement from AI (e.g., ranging from **7 to 49%** for the same country), which appear to be driven by differences in methodology
		2	Job displacement estimates are larger in higher-income countries (e.g., **49%** of jobs in Japan) than in lower-income countries (e.g., **10%** of jobs in the Philippines)
		3	Job displacement impacts also vary widely across sectors, ranging from **8 to 26%** of jobs being affected
		4	Historical waves of technological disruptions demonstrate that past concerns about mass unemployment were unwarranted. However, with AI, short-term adjustments in the form of job or task switches are likely to be necessary
Jobs Gained	The job creation effects of AI are limited, and any jobs created will not be enough to offset those displaced	5	AI could create new jobs through three channels: directly within the AI sector ("direct effect"), indirectly in other related sectors ("spillover effect"), and at the broad economy level ("income effect")
		6	The income effect of AI could more than offset its displacement effect to lead to net job gains; a study in China estimated an overall **12%** increase in jobs **by 2037** – which is equivalent to **93 million new jobs**
		7	However, the interaction of these effects varies across sectors; those with more routine tasks and income-inelastic goods are likelier to see net losses
	The jobs and skills in highest demand will be those that directly support AI development	8	Jobs that directly support AI development could account for **less than a fifth** of 'in-demand' positions, while almost **60%** could be positions that require interpersonal, creative or strategic decision-making tasks
		9	While technological skills will continue to be important in the future, soft skills such as higher cognitive, social and emotional skills will be critical for workers in Asia
Workforce Participation	AI could potentially reduce workforce participation by automating jobs	10	AI-enabled job matching platforms have the potential to increase workforce participation, creating additional employment for **31.6 million workers** and a GDP boost of about **US$494 billion** across ten Asian economies in 2025
		11	AI could bring about the greater inclusion of underserved groups in the workforce through AI-enabled work tools and technologies, improved access to digital skills training, as well as more opportunities for flexible work

SOURCE: Literature review, AlphaBeta analysis

PERCEPTION:
"AI IS GOING TO LEAD TO MASS UNEMPLOYMENT IN ASIA ACROSS ALL COUNTRIES AND SECTORS."

1. THERE IS WIDE VARIATION IN THE ESTIMATES OF POTENTIAL JOB DISPLACEMENT FROM AI (E.G., RANGING FROM 7 TO 49 PERCENT FOR THE SAME COUNTRY), WHICH APPEAR TO BE DRIVEN BY DIFFERENCES IN METHODOLOGY

The 'displacement effect' of AI refers to job reductions resulting from the labor-substitution impact of AI technologies.[31] Due to differences in methodology and assumptions across studies, estimates of potential job displacement impacts from AI have varied widely for the same country. For example, estimates in the literature for Japan range from 7 to 49 percent of jobs that could be displaced by AI by the 2030s (Exhibit 15). This wide variance is driven by differences in methodology, particularly between the task and occupation-based approaches, which relate to whether displacement effects were analyzed at the task or job level. By analyzing whole occupations that could be displaced by AI, the occupation-based approach tends to produce larger estimates of jobs displaced than the task-based approach, which focuses on the displacement of tasks within occupations, rather than whole occupations.

"...ONE OF [THE] MAJOR LIMITATIONS [OF PAST STUDIES] IS THAT THEY VIEW OCCUPATIONS RATHER THAN TASKS AS BEING THREATENED BY AUTOMATION.... MANY WORKERS IN OCCUPATIONS THAT HAVE BEEN CLASSIFIED AS VULNERABLE TO AUTOMATION IN THESE STUDIES MAY IN FACT BE LESS EXPOSED TO AUTOMATION THAN PREVIOUSLY THOUGHT."

- Arntz, Gregory and Zierahn (2016), *The Risk of Automation for Jobs in OECD Countries*

Another reason for the variance in estimates is the level of technological development assumed. As shown in Exhibit 15, although the studies by McKinsey Global Institute, PricewaterhouseCoopers and Arntz, Gregory and Zierahn all adopted the task-based approach, the estimates of the first two studies (26 and 24 percent respectively) are much higher than the estimate of the third (7 percent). This is due to one study being based on the current known level of technology development of AI, while the other two studies (with higher displacement estimates) were based on assumptions around the future evolution of AI technologies. When inferring job displacement impact in the literature, it is therefore important to consider differences in the approaches and underlying assumptions used in different studies – see Box 1 for a detailed explanation.

31. The definition of 'displacement effect' pertaining to AI is reflected in a variety of key literature on the topic. Examples include: Daron Acemoglu and Pascual Restrepo (2018), Artificial intelligence, automation and work, MIT Economics. Available at: https://economics.mit.edu/files/14641; Georgios Petropoulos (2018), The impact of artificial intelligence on employment, Bruegel. Available at: http://bruegel.org/wp-content/uploads/2018/07/Impact-of-AI-Petroupoulos.pdf

EXHIBIT 15:

THE LARGE VARIANCE OF 7% TO 49% IN JOB DISPLACEMENT ESTIMATES FOR JAPAN IS DRIVEN BY DIFFERENCES IN METHODOLOGY AND ASSUMPTIONS

DIFFERING JOB DISPLACEMENT ESTIMATES FOR JAPAN IN THE LITERATURE

Source	Estimate	Methodology and Assumptions
Nomura Research Institute, Frey and Osborne (2015)	**49%** of jobs at high risk of automation by 2035	• **Occupation-based approach:** Based on share of occupations deemed automatable; identical task structures assumed for each occupation • Assumed **current** level of technology
McKinsey Global Institute (2017)	**26%** of jobs displaced by automation by 2030	• **Task-based approach:** Based on estimated share of work activity hours for each task that could be reduced due to automation • Assumed **future** level of technology
PricewaterhouseCoopers (2018)	**24%** of jobs at high risk of automation by early 2030s	• **Task-based approach:** Jobs are deemed to be at high risk of automation if they consist of tasks of which 70% or more are automatable • Assumed **future** level of technology
Arntz, M., T. Gregory and U. Zierahn (2016)	**7%** of jobs at high risk of automation by 2035	• **Task-based approach:** Jobs are deemed to be at high risk of automation if they consist of tasks of which 70% or more are automatable • Assumed **current** level of technology

SOURCE: Nomura Research Institute, Frey and Osborne (2015); MGI (2017); PwC (2018); Arntz et al (2016); AlphaBeta analysis

BOX 1:
AI AND AUTOMATION JOB DISPLACEMENT IMPACTS – UNDERSTANDING THE NUMBERS

When reviewing estimates of job displacements from AI and automation in the literature, it is important to consider the different estimation approaches and assumptions used.
Two key **estimation approaches** have been used to project job displacement effects:

1. **Occupation-based approach.** This approach considers the occupation as a whole, and derives job displacement estimates based on the share of occupations in the economy that are deemed to be automatable. This approach was notably used by Frey and Osborne (2013)[32] to estimate the share of employment in the US that could be at high risk of displacement by the 2030s.

2. **Task-based approach.** This approach considers the specific tasks that are involved in each occupation, rather than the occupation as a whole. There have been two ways in which job displacement shares have been estimated using this approach: one, based on the estimated reduction in the amount of time spent on tasks within different occupations due to automation (e.g., Oxford Economics and Cisco 2018[33], McKinsey Global Institute 2017[34]); two, based on the composition of automatable tasks within each occupation (e.g., Arntz et al 2016[35] and PricewaterhouseCoopers 2018[36] both deem occupations with 70 percent or more automatable tasks to be at 'high risk').

Both approaches have produced sharply contrasting results. For example, using an occupation-based approach, Frey and Osborne (2013) and Arntz et al (2016) respectively estimated 47 percent and 9 percent job displacement rates in the US, and 35 percent and 10 percent in the UK. It has been argued that the occupation-based approach could overestimate job displacement potential due to its obscuring of non-automatable tasks within occupations that were deemed automatable, as well as a blunt assumption that workers within the same occupation have identical task structures.[37]

Even within task-based approaches, **methodologies used to estimate the extent to which tasks will be displaced differ**. For instance, McKinsey Global Institute (2017) assumed that each hour of work that could be automated would result in proportional job loss (for example, if 10 percent of current work activity hours in an occupation could be automated, it assumed that 10 percent of jobs in that occupation would be displaced). However, such an approach does not consider the redistribution of efforts towards other existing or new activities as a result of automation.[38] This is in contrast with the task-based approach taken by Oxford Economics and Cisco (2018), in which estimates of the extent to which different tasks could be automated were derived from consultations with local experts in each of the countries studied.

Finally, it is also important to consider the **assumptions of the level of technological advancement** used in studies, which greatly influence the impact AI could have on job displacement. While some studies are based on today's known technological advancements (e.g., Frey and Osborne 2013), others assume a certain level of technological improvement beyond what could be seen today (e.g., PricewaterhouseCoopers 2018) or derive estimates based on multiple scenarios of technological advancement (e.g., McKinsey Global Institute 2017).

32. Carl Benedikt Frey and Michael A. Osborne (2013), The future of employment: How susceptible are jobs to computerisation?
Available at: *https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf*
33. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies.
Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf*
34. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*
35. Melanie Arntz, Terry Gregory and Ulrich Zierahn (2016), The risk of automation for jobs in OECD countries. OECD Social, Employment and Migration Working Papers No. 189. Available at: *http://www.ifuturo.org/sites/default/files/docs/automation.pdf*
36. PricewaterhouseCoopers (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation.
Available at: *https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf*
37. Melanie Arntz, Terry Gregory and Ulrich Zierahn (2016), The risk of automation for jobs in OECD countries. OECD Social, Employment and Migration Working Papers No. 189. Available at: *http://www.ifuturo.org/sites/default/files/docs/automation.pdf*
38. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*

2. JOB DISPLACEMENT ESTIMATES ARE LARGER IN HIGHER-INCOME COUNTRIES (E.G., 49 PERCENT OF JOBS IN JAPAN) THAN IN LOWER-INCOME COUNTRIES (E.G., 10 PERCENT OF JOBS IN THE PHILIPPINES)

The existing literature on the job displacement effects of AI in Asia reflects higher projected effects in higher-income countries as compared to lower-income countries. Exhibit 16 shows the projections of such effects for 11 Asian economies by three key studies: Oxford Economics and Cisco (2018), McKinsey Global Institute (2017) and Arntz, Gregory and Zierahn (2016).[39] All available estimates for each country have been represented in the Exhibit to illustrate the range of projections from these studies.[40] Comparing the various estimates by country, these studies clearly demonstrate that displacement effects are forecast to be higher in higher-income countries such as Japan (between 7 and 49 percent of jobs) and South Korea (between 6 and 26 percent of jobs), as compared to lower-income countries such as India (between 9 and 14 percent of jobs) and the Philippines (10 percent of jobs).[41] This has been attributed to two key factors. One, higher-income economies are estimated to have higher AI adoption rates in future, which could therefore trigger greater displacement effects. Two, relatively higher wages in higher-income countries would make the business case for deploying automation and AI technologies stronger.[42]

3. JOB DISPLACEMENT IMPACTS ALSO VARY WIDELY ACROSS SECTORS, RANGING FROM 8 TO 26 PERCENT OF JOBS BEING AFFECTED

Job displacement effects also vary across sectors. As shown in Exhibit 17, two studies covering Southeast Asian economies and high-income Asian countries reflect that the projected displacement effects are likely to be higher in the manufacturing, transport and professional services sectors (up to 26 percent), as compared to the energy, utilities, and public and personal services sectors (up to 10 percent). On the whole, job displacement estimates are higher in the study on high-income Asian economies as compared to those in the study on Southeast Asian economies (in which four of the five countries examined were middle-income countries). This could be attributed to the same reasons of higher AI adoption rates and wages, as explained in Point 2.

39. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies. Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf;* McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages;* Melanie Arntz, Terry Gregory and Ulrich Zierahn (2016), The risk of automation for jobs in OECD countries. OECD Social, Employment and Migration Working Papers No. 189. Available at: *http://www.ifuturo.org/sites/default/files/docs/automation.pdf*

40. Note that these studies employed varying approaches to job displacement projections. Oxford Economics and Cisco (2018) and McKinsey Global Institute (2017) both proxied share of jobs displaced based on the estimated share of current work activity hours that could be automated for all occupations. However, the former forecasted this for the period 2018-2028 and computed job displacement shares based on current (2018) workforce, while the latter forecasted based on the period 2016-2030 and computed job displacement shares based on future (2030) workforce. On other hand, PWC (2018)'s approach differs from the two in that it computed the share of jobs at high risk of automation based on definition that such jobs consist of 70% or more tasks that could be automatable by the 2030s. Job displacement estimates were forecasted for the period 2018-2037 and computed based on current (2018) workforce.

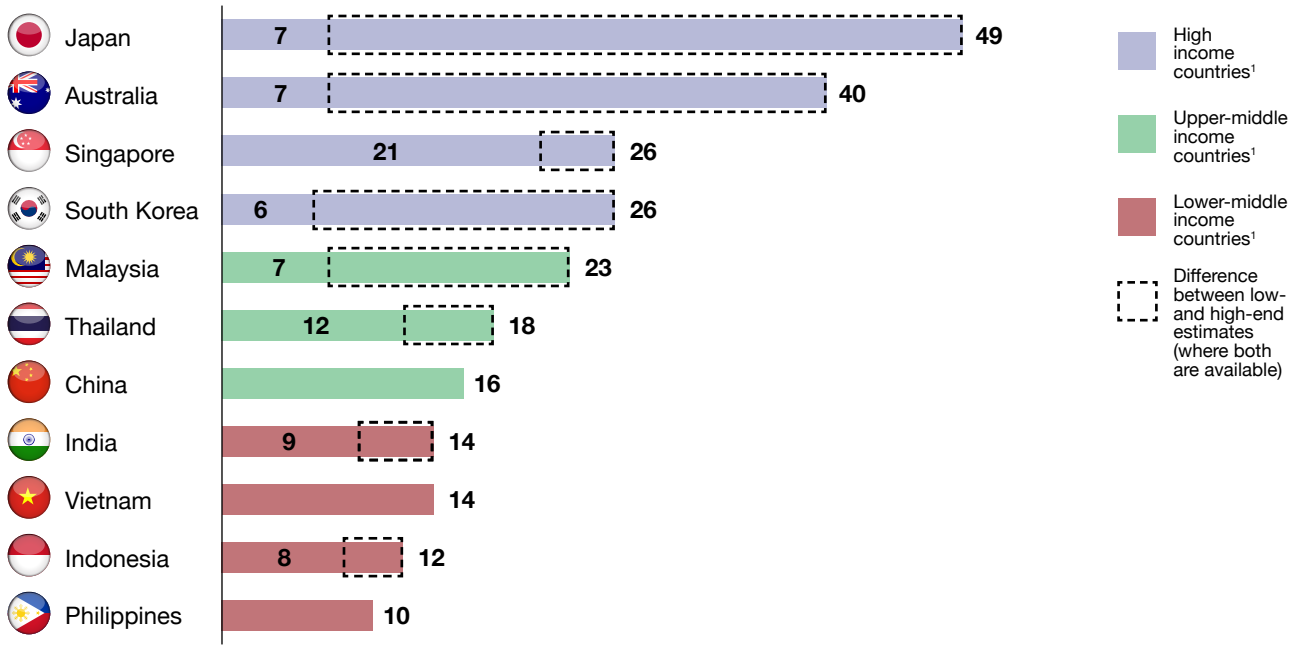
41. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies. Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf;* McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages;* PricewaterhouseCoopers (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: *https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf*

42. Both reasons are supported by a variety of sources, including: Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies. Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf;* McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages;* PricewaterhouseCoopers (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: *https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf*

EXHIBIT 16:

JOB DISPLACEMENT EFFECTS RANGE FROM 10% IN LOWER-INCOME COUNTRIES TO 49% IN HIGHER-INCOME COUNTRIES

PROJECTIONS OF SHARES OF JOBS DISPLACED BY AI AND AUTOMATION TECHNOLOGIES ACROSS ASIAN ECONOMIES DERIVED FROM THE LITERATURE (LOW- AND HIGH-END ESTIMATES), %

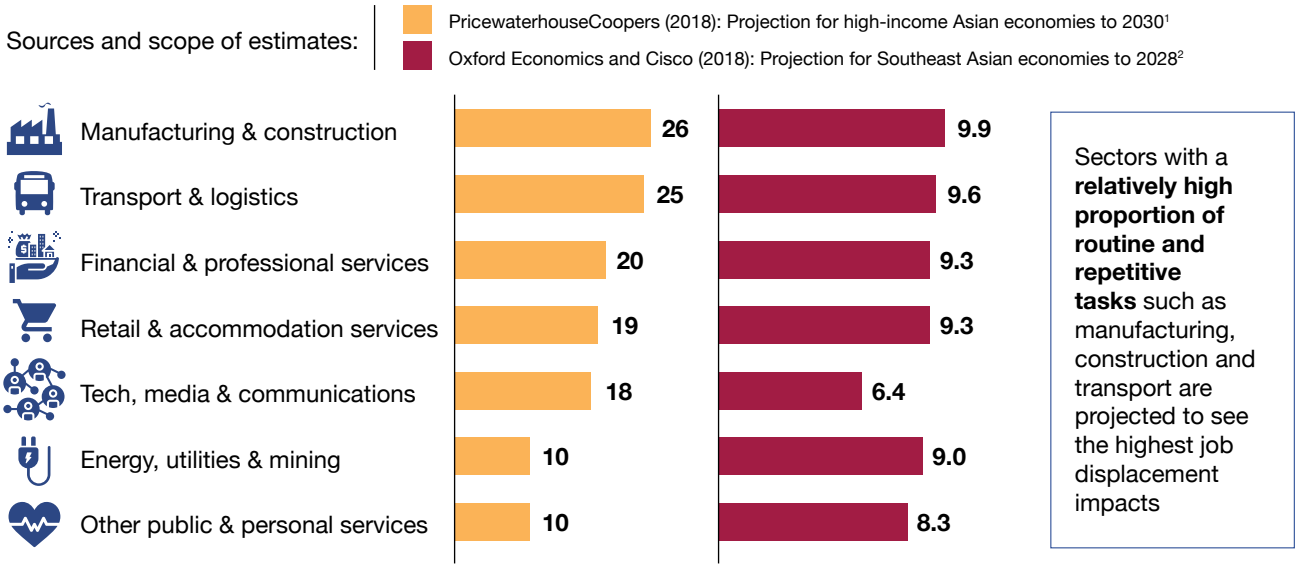


Classification of countries based on World Bank.
SOURCE: MGI (2017), PWC (2018), Oxford Economics and Cisco (2018), Arntz et al (2016), OECD (2018) Nomura Research Institute (2015), CEDA (2015); AlphaBeta analysis

EXHIBIT 17:

JOB DISPLACEMENT ESTIMATES RANGE FROM 8-26% ACROSS SECTORS, AND ARE HIGHER IN SECTORS WITH MORE ROUTINE TASKS SUCH AS MANUFACTURING

PROJECTED SHARE OF JOBS DISPLACED BY AI AND AUTOMATION TECHNOLOGIES BY SECTOR ACROSS DIFFERENT ASIAN ECONOMIES, %



Sectors with a **relatively high proportion of routine and repetitive tasks** such as manufacturing, construction and transport are projected to see the highest job displacement impacts

1. Countries studied include Japan, Mongolia, South Korea, Singapore and Taiwan.
2. Countries studied include Indonesia, Malaysia, Singapore, Thailand, Philippines and Thailand. To compare job displacement effects in ASEAN and high-income Asia based on the same sector groups highlighted in PWC (2018), simple averages of related industries were taken to derive the estimated share of jobs displaced for each of the sector groups outlined. For example, the estimate of 9.9% for 'Manufacturing & construction' was derived based on a simple average of 10.3% for manufacturing and 9.4% for construction.
SOURCES: Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs; PWC (2018), The macroeconomic impact of Artificial Intelligence; AlphaBeta analysis

4. HISTORICAL WAVES OF TECHNOLOGICAL DISRUPTIONS DEMONSTRATE THAT PAST CONCERNS ABOUT MASS UNEMPLOYMENT WERE UNWARRANTED. HOWEVER, WITH AI, SHORT-TERM ADJUSTMENTS IN THE FORM OF JOB OR TASK SWITCHES ARE LIKELY TO BE NECESSARY

Historically, concerns about 'technological unemployment' (referring to the substitution of labor by technology) have proven unwarranted, with no evidence of persistent negative impacts of technologies on overall employment.[43] Studies have reflected that while technologies had displaced some jobs, complementary new tasks were created.[44] With respect to AI, however, it should be noted that the negative impact on employment could be more extensive as compared to previous technology waves due to their impact on cognitive tasks as well.[45] Current analyses in Asia reflect that while AI is unlikely to impact overall labor demand in the economy, short-term adjustments – be they in the form of task or job changes – are likely to be necessary.

In higher-income economies, it has been demonstrated that most of the impact of AI is likely to be greater on tasks within jobs, rather than on whole jobs. For example, it was projected in a study by AlphaBeta for Australia that less than a third of the number of working hours impacted by AI and automation technologies would actually lead to workers having to change jobs (Exhibit 18). This study showed that between 2015 and 2030, automation and AI technologies could lead to a two-hour fall in the average weekly work time spent on routine and repetitive tasks.[46] Of this expected reduction in work hours, 29 percent (35 minutes) could be due to workers moving between jobs, while the remaining 71 percent (1 hour 25 minutes) could be due to workers remaining in their jobs but changing the tasks that they do.

Although there has been more limited research on the dynamics of AI for jobs versus tasks in lower-income Asian economies, existing research in these economies, however, suggests a higher propensity for job switches across sectors. A study on middle-income Southeast Asian economies predicted that with increased AI adoption leading to shifts in tasks would trigger a shift from lower-value agricultural and manufacturing jobs (which involve more routine and manual tasks) towards higher-value service sector jobs (which involve more interaction with computers and higher cognitive tasks).[47] Exhibit 19 shows such findings to be consistent in Indonesia, the Philippines and Vietnam, where, over the period 2018-2028, tasks involving interaction with computers and critical thinking were projected to see an increase of 68 to 140 percent and 9 to 31 percent respectively, and routine information capture could see a decline of 40 to 62 percent. It was further established that while overall employment in these countries was likely to remain stable, there would be a shift from agricultural and manufacturing jobs towards higher-value service sector jobs. The study predicted that, of the new jobs that would be created in Southeast Asia[48] between 2018 and 2028, 40 percent will be created in the manufacturing sector, while the majority 60 percent will be created in the service sector, with job losses being experienced in the agricultural sector.[49] This potential sectoral shift in jobs due to AI in lower-income Asian economies has also been reflected in the other literature.[50]

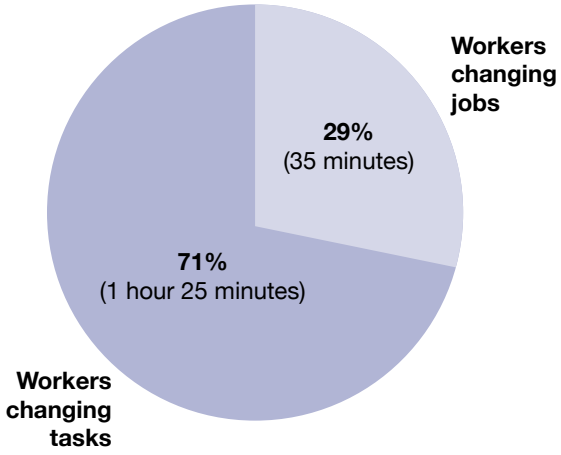
43. Sources include: Deloitte (2019), The path to prosperity: Why the future of work is human. Available at: *https://www2.deloitte.com/au/en/pages/building-lucky-country/articles/path-prosperity-future-work.html;* IMF (2018), Technology and the future of work. Available at: *https://www.imf.org/external/np/g20/pdf/2018/041118.pdf;* AI Forum New Zealand (2018), Artificial Intelligence: Shaping a future New Zealand. Available at: *https://aiforum.org.nz/wp-content/uploads/2018/07/AI-Report-2018_web-version.pdf*
44. IMF (2018), Technology and the future of work. Available at: *https://www.imf.org/external/np/g20/pdf/2018/041118.pdf;* AI Forum New Zealand (2018)
45. IMF (2018), Technology and the future of work. Available at: *https://www.imf.org/external/np/g20/pdf/2018/041118.pdf;* AI Forum New Zealand (2018)
46. AlphaBeta (2017), The automation advantage. Available at: *https://www.alphabeta.com/our-research/the-automation-advantage/*
47. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies.
Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf*
48. Referring to the six largest economies in Southeast Asia, which include Indonesia, the Philippines, Malaysia, Singapore, Thailand and Vietnam, which were examined in the study by Oxford Economics and Cisco (2018).
49. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies.
Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf*
50. The World Bank (2017), "Trouble in the making? The future of manufacturing-led development"
Available at: *https://www.worldbank.org/en/topic/competitiveness/publication/trouble-in-the-making-the-future-of-manufacturing-led-development*

EXHIBIT 18:

A STUDY IN AUSTRALIA SHOWS THAT LESS THAN A THIRD OF THE WORKING HOURS IMPACTED BY AI ARE LIKELY TO LEAD TO JOB LOSSES

IMPACT OF AI AND AUTOMATION ON AUSTRALIAN WORKERS

Expected fall in average weekly work hours spent on automatable tasks from 2015-2030



The study showed that automation technologies are expected to lead to **2 less hours of routine and manual work in an average Australian work week by 2030.** Of this expected reduction in work time, over two-thirds (71%) could come from people doing the same job, but completing fewer manual and routine tasks on the job. **Less than one-third (29%) of the impact was estimated to lead to people changing jobs**

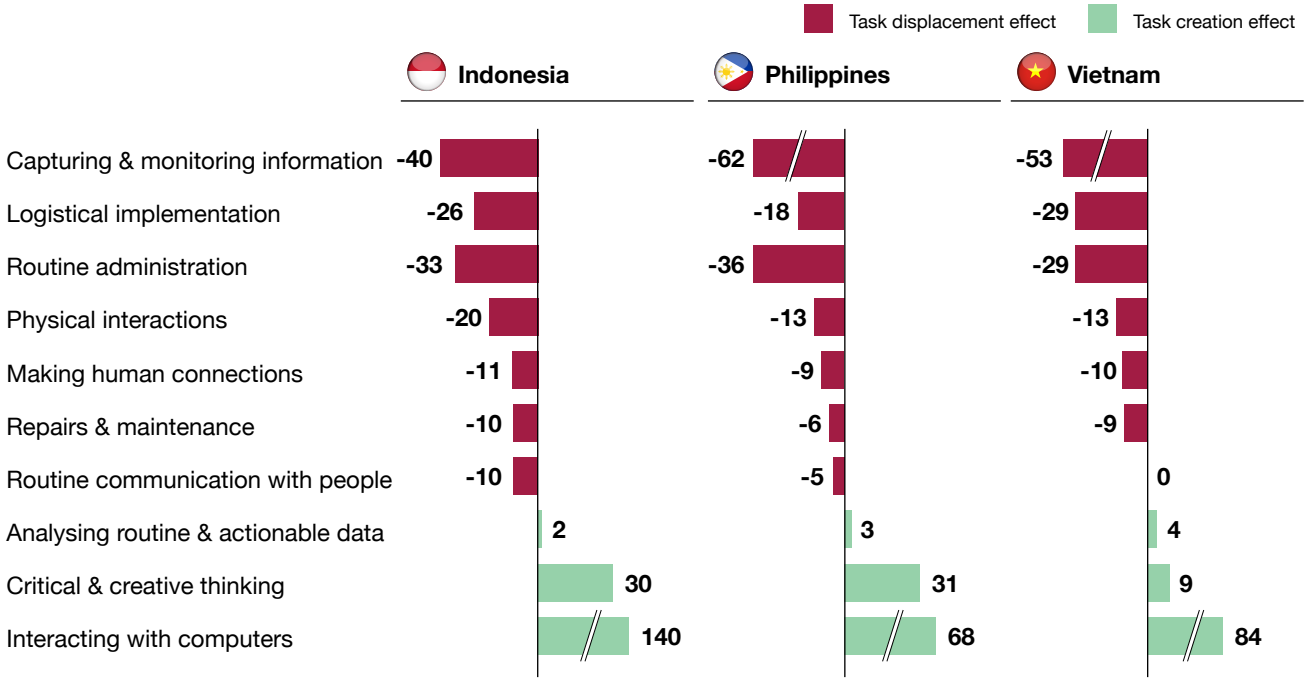
SOURCE: AlphaBeta (2017), The automation advantage

EXHIBIT 19:

A STUDY IN THREE SOUTHEAST ASIAN ECONOMIES PREDICTED THAT AI WILL LEAD TO A SHIFT FROM ROUTINE TASKS TOWARDS MORE INTERACTION WITH COMPUTERS AND HIGHER COGNITIVE TASKS

POTENTIAL EFFECT OF AI ON DIFFERENT WORKER TASKS 2018 AND 2028, BY TASK CLUSTER FOR 3 ASEAN COUNTRIES

Projected displacement or creation effect based on local expert consensus for each country[1] (%)



1. For each of the above countries, local experts from the country were asked to form a collective judgement on the question, "To what extent will businesses become more productive at performing certain tasks, such that fewer workers will be needed to produce the same output?"
SOURCE: Oxford Economics and Cisco (2018), Technology and the future of jobs

PERCEPTION:

"THE JOB CREATION EFFECTS OF AI ARE LIMITED, AND ANY JOBS CREATED WILL NOT BE ENOUGH TO OFFSET THOSE DISPLACED."

5. AI COULD CREATE NEW JOBS THROUGH THREE CHANNELS: DIRECTLY WITHIN THE AI SECTOR ("DIRECT EFFECT"), INDIRECTLY IN OTHER RELATED SECTORS ("SPILLOVER EFFECT") AND AT THE BROAD ECONOMY LEVEL ("INCOME EFFECT")

AI could lead to the creation of new jobs through three channels – directly in the technology sector that support the development of AI, indirectly in other relevant sectors through the spillover effect, and at the broad economy level through general income effects (Exhibit 20).

The first channel relates to the direct effect in which new jobs will be required to create, maintain and improve AI technologies. Studies both within and outside Asia have demonstrated that such jobs have been and are likely to continue experiencing the fastest growth within the job market. The MIT Technology Review, for example, predicted that 'AI engineer' and 'machine trainer' would be the two most frequently-appearing jobs on US job boards in 2018.[51] LinkedIn data also reveals that in Singapore, 'data scientist' jobs were the fastest-growing jobs as compared to other listed jobs on the portal, having increased at a rate of 17 times from 2013 and 2017.[52]

The second channel relates to an indirect 'spillover effect', in which new jobs will be required to support the adoption of AI technologies across other sectors. This trend was observed for past technology waves; for example, it was estimated that the introduction of the automobile created 6.9 million net new jobs in the US between 1910 and 1950, with 90 percent of the new jobs created in enabled industries and occupations that use the automobile.[53] Such jobs are harder to predict, as they are likely to be jobs that do not yet exist today. A study in New Zealand acknowledged that the difficulty of ascertaining the likely net impact of AI on jobs in the country lay in the challenge of forecasting the new jobs that could arise with AI.[54] Taking reference from the past, this is likely to be significant; for example, jobs that experienced the fastest growth in India over the period 2005 to 2015 were those that supported the deployment of automation such as computerized numerical control (CNC) operators and programmers.[55] These new job titles had emerged to support the increased adoption of automation technologies during this period.

The third channel of job creation relates to the economy-wide 'income effect' of AI technologies. The 'income effect' refers to the series of economic movements through which AI deployment by firms ultimately results in more jobs being created. AI-enabled productivity improvements result in cost savings to firms that are passed onto consumers in the form of lower prices. This in turn increases their spending power and demand for goods, inducing firms to hire more workers to respond to the additional demand.[56] A study in China has reflected that strong income effects alone could more than offset

THIS TREND WAS SIMILARLY OBSERVED IN THE UNITED STATES.

"THE MOST RAPIDLY GROWING CATEGORY OF JOBS, IN THIS LARGE STUB OF OCCUPATIONS THAT THE DEPARTMENT OF LABOR RECORDS, WAS 'OTHER'. THAT IS TO SAY, CATEGORIES THAT WERE NOT BIG ENOUGH YET TO WARRANT THEIR OWN LINE."

– Richard Cooper,
Maurits C. Boas Professor of
International Economics, Harvard University

(Source: Interview with McKinsey Global Institute, 2014. Available at: *https://www.mckinsey.com/featured-insights/employment-and-growth/automation-jobs-and-the-future-of-work)*

51. Eric Winick (2018), "Five jobs that are set to grow in 2018", MIT Technology Review. Available at: *https://www.technologyreview.com/s/609644/five-jobs-that-are-set-to-grow-in-2018/*
52. Claudia Chong (2018), "Here are the 5 fastest-growing jobs in Singapore, says a LinkedIn survey." The Straits Times.
Available at: *https://www.straitstimes.com/business/economy/here-are-the-5-fastest-growing-jobs-in-singapore-and-why-many-are-filled-by-foreign*
53. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
See: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*
54. AI Forum New Zealand (2018), Artificial Intelligence: Shaping a future New Zealand. Available at: *https://aiforum.org.nz/wp-content/uploads/2018/07/AI-Report-2018_web-version.pdf*
55. Asian Development Bank (2018), Asian development outlook: How technology affects jobs.
Available at: *https://www.adb.org/publications/asian-development-outlook-2018-how-technology-affects-jobs*
56. The definition of 'income effect' pertaining to AI is reflected in a variety of key literature on the topic. Examples include: Daron Acemoglu and Pascual Restrepo (2018), Artificial intelligence, automation and work, MIT Economics. Available at: *https://economics.mit.edu/files/14641;* Georgios Petropoulos (2018), The impact of artificial intelligence on employment, Bruegel.
Available at: *http://bruegel.org/wp-content/uploads/2018/07/Impact-of-AI-Petroupoulos.pdf*

AI-triggered displacement effects, leading to net job gains of 12 percent between 2017 and 2037.[57] This example is further elaborated in the next point.

These impacts of job creation were also reflected in a global study by the World Economic Forum (WEF). The study had projected that while AI could displace 75 million jobs globally by 2022, it could also create 133 million new jobs through these channels, translating into 1.8 jobs gained for every job displaced.[58] However, the breakdown of these jobs into the various channels was not reflected in the study.

EXHIBIT 20:

AI COULD CREATE NEW JOBS THROUGH THREE CHANNELS: THROUGH THE "DIRECT EFFECT", "SPILLOVER EFFECT" AND "INCOME EFFECT"

	DESCRIPTION	EVIDENCE IN ASIAN COUNTRIES
Direct effect (in tech sector)	People will be required to **create, maintain and improve AI technologies**	ICT jobs supporting AI development have been growing the fastest in Singapore, with data scientist jobs in particular growing by **17 times** over the period 2013-2017
Spillover effect (in related sectors)	People will be required to take up **new jobs that do not exist today, which involve supporting the adoption of AI** in situations where it does not completely replace humans (e.g., assistants at automated airport check-in and supermarket checkouts)	With the wave of automation technologies occurring in India over the past decade, jobs that experienced the fastest growth during this period were those supporting the deployment of automation technologies (e.g., CNC operators and programmers)
Income effect (economy-wide)	People will be required to produce the **higher level of goods and services** that will be demanded in an economy where AI-enabled productivity gains have led to increased incomes through cost savings	A study for China reflected strong income effects that could more than offset displacement effects, resulting in net job gains of **12%** between 2017 and 2037

SOURCE: Literature review, AlphaBeta analysis

57. PricewaterhouseCoopers (2018), What will be the net impact of AI and related technologies on jobs in China? Available at: *https://www.pwc.com/gx/en/issues/artificial-intelligence/impact-of-ai-on-jobs-in-china.pdf*
58. World Economic Forum (2018), The future of jobs report 2018. Available at: *https://www.weforum.org/reports/the-future-of-jobs-report-2018* Note: These findings were modelled based on a survey of 313 multinational companies across a wide range of sectors (except agriculture), collectively representing over 15 million employees from countries that represent about 70 percent of global GDP. Given this, the study caveats the projections primarily represent the impacts of AI on large multinational employers, and that a complementary analysis on small- and medium-sized enterprises could reflect different results.

6. THE INCOME EFFECT OF AI COULD MORE THAN OFFSET ITS DISPLACEMENT EFFECT TO LEAD TO NET JOB GAINS; A STUDY IN CHINA ESTIMATED AN OVERALL 12 PERCENT INCREASE IN JOBS BETWEEN 2017 AND 2037 – WHICH IS EQUIVALENT TO 93 MILLION NEW JOBS

There has been limited examination of the full employment impact of AI that also takes into account jobs created by AI. In the few studies that do project the number of future new jobs created by AI in Asian economies, these projections either do not capture the impact of AI alone,[59] or assume a constant long-term employment rate that disregards any potential changes to the total quantum of jobs.[60] As such, it is challenging to distinguish the magnitude of job creation arising from AI alone, and compare this positive impact across different economies.

One study in China, however, shows a comparison of AI-related job displacements and gains through the income effect. It offers some encouraging news for employment, with jobs displaced predicted to be more than offset by jobs created through the income effect.[61] By creating more jobs through the income effect that it displaces, AI was estimated to be able to boost employment by up to 12 percent between 2017 and 2037 in China, which is equivalent to an additional 93 million jobs.[62] Exhibit 21 shows that this net positive impact on jobs was projected for all sectors except agriculture, in which a net loss of 10 percent in jobs by 2037 was estimated. This is due to the low projected demand growth for agricultural goods even with the productivity-fueled boost to consumer incomes, given the basic nature of these goods (i.e., such goods are generally income-inelastic). Further explanation of how different sectors could see different net job impacts is described in the next point.

It has been further demonstrated that the income effect of AI technologies could be reinforced by future rising incomes due to the forecast growth of the consuming class in middle-income Asian countries. For example, a study by the McKinsey Global Institute projected that based on such trends in China, 95 percent more new jobs would be created than displaced by AI and automation by 2030, without even taking into consideration the new jobs that would be created by these technologies.[63] The study projected this figure to be even larger in India – at 100 percent (i.e., there will be twice as many jobs created due to rising incomes in India than jobs displaced due to AI and automation).[64]

59. For example, projections of future jobs created by 2030 by the McKinsey Global Institute (2017) takes into account non-AI related labor demand catalysts such as rising incomes, healthcare demand, investments in buildings and infrastructure, and marketization of unpaid work. Source: McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. See: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
60. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies. Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf; McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
61. PricewaterhouseCoopers (2018), What will be the net impact of AI and related technologies on jobs in China? Available at: https://www.pwc.com/gx/en/issues/artificial-intelligence/impact-of-ai-on-jobs-in-china.pdf
62. PricewaterhouseCoopers (2018), What will be the net impact of AI and related technologies on jobs in China?
Available at: https://www.pwc.com/gx/en/issues/artificial-intelligence/impact-of-ai-on-jobs-in-china.pdf
63. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
64. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

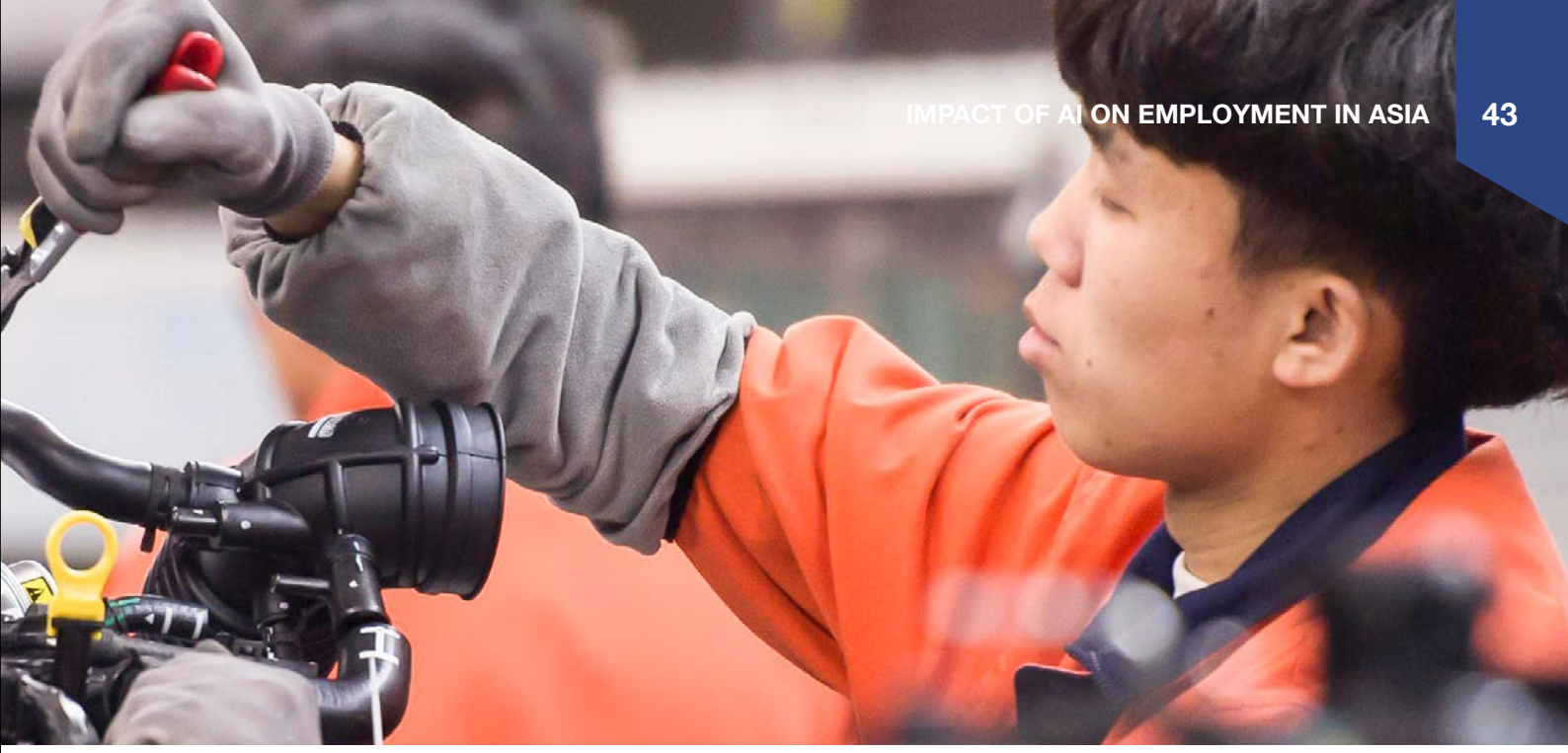


EXHIBIT 21:

A STUDY IN CHINA SHOWED THAT THE INCOME EFFECT OF AI COULD MORE THAN OFFSET ITS DISPLACEMENT EFFECT TO CREATE A NET INCREASE IN JOBS OF 12% BY 2037, WHICH IS EQUIVALENT TO 93 MILLION NEW JOBS

PROJECTED AI-RELATED EFFECTS ON JOBS BY SECTOR IN CHINA (2017-2037), %

SOURCE: PwC (2018), What will be the net impact of AI and related technologies on jobs in China?; AlphaBeta analysis

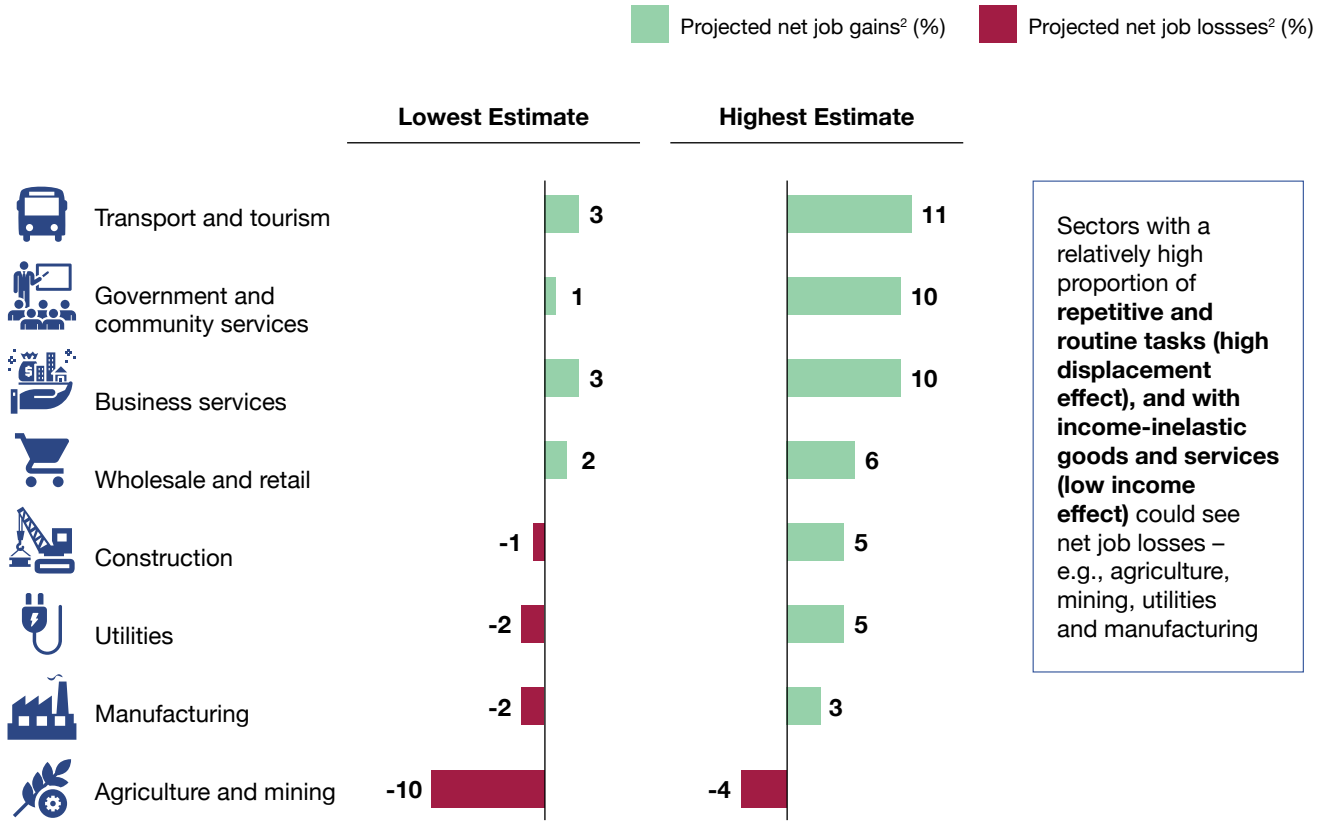
7. HOWEVER, THE INTERACTION OF THESE EFFECTS VARIES ACROSS SECTORS; THOSE WITH MORE ROUTINE TASKS AND INCOME-INELASTIC GOODS ARE LIKELIER TO SEE NET LOSSES

Even though overall income effects could outweigh displacement effects in some economies, this may not be in the case in all sectors. As shown in Exhibit 22, a study for five Southeast Asian economies showed that displacement effects have the potential to outweigh income effects for some sectors.[65] These sectors tend to exhibit a relatively high proportion of repetitive and routine tasks (leading to relatively strong displacement effects), and income-inelastic goods and services (for which demand may not rise by much even as incomes rise, leading to relatively weak income effects). Such sectors, such as agriculture and mining, manufacturing and utilities, could see net job losses.

EXHIBIT 22:

A STUDY ON FIVE SOUTHEAST ASIAN COUNTRIES SHOWS THAT SECTORS WITH MORE ROUTINE TASKS AND INCOME-INELASTIC GOODS COULD SEE NET LOSSES

RANGE OF ESTIMATES OF NET JOB IMPACTS DUE TO INTERACTION BETWEEN INCOME AND DISPLACEMENT EFFECTS BY SECTOR IN ASEAN[1] (2018-2028),
PERCENT OF CURRENT JOBS (%)



1. This includes Malaysia, Thailand, Indonesia, the Philippines and Vietnam.
2. Net job impacts were computed by dividing the projected net changes in jobs by the total number of jobs in that sector in 2018. Workforce statistics were derived from national statistics and based on 2018 data where possible to match year of analysis by Oxford Economics and Cisco.
SOURCE: Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs; National statistical offices of above countries; AlphaBeta analysis

65. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132

PERCEPTION:
"THE JOBS AND SKILLS IN HIGHEST DEMAND WILL BE THOSE THAT DIRECTLY SUPPORT AI DEVELOPMENT."

8. JOBS THAT DIRECTLY SUPPORT AI DEVELOPMENT COULD ACCOUNT FOR LESS THAN A FIFTH OF 'IN-DEMAND' POSITIONS, WHILE ALMOST 60 PERCENT COULD BE POSITIONS THAT REQUIRE INTERPERSONAL, CREATIVE OR STRATEGIC DECISION-MAKING TASKS

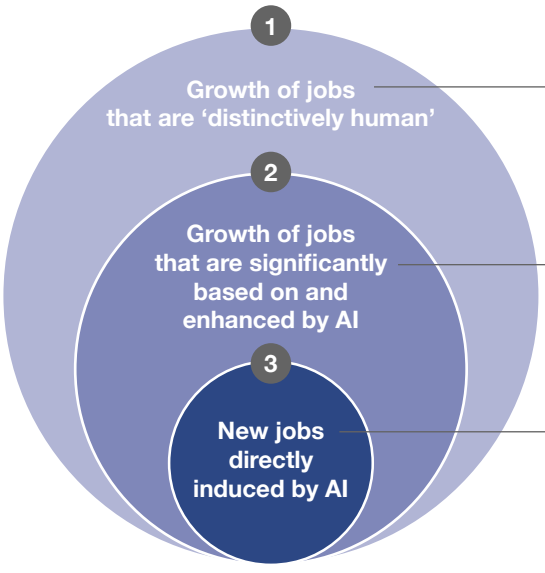
Contrary to widely-circulating narratives that jobs that directly support AI development such as machine learning experts would be in highest demand in future,[66] it was projected that in 2022, such jobs could in fact account for less than a fifth of future 'in-demand' roles, with almost 60 percent of 'in-demand' roles being in 'distinctively human' positions that require interpersonal, creative and strategic decision-making tasks (Exhibit 23).[67]

This finding is qualitatively supported by existing research in the Asian context. For example, a study of the impact of AI on jobs and skills across six ASEAN economies found that the new job opportunities in an AI economy would require them to develop their 'soft' skillsets, with such roles involving managerial, decision-making, customer service and negotiation positions.[68] A study for Australia also found that by 2030, two-thirds of jobs in the country will be soft-skill intensive.[69]

EXHIBIT 23:

JOBS THAT DIRECTLY SUPPORT AI DEVELOPMENT COULD ACCOUNT FOR LESS THAN A FIFTH OF 'IN-DEMAND' POSITIONS, WHILE ALMOST 60% COULD BE POSITIONS THAT REQUIRE INTERPERSONAL, CREATIVE OR STRATEGIC DECISION-MAKING TASKS

PROJECTED DISTRIBUTION OF IN-DEMAND JOB POSITIONS IN AN AI ECONOMY OVER 2018-2022 PERIOD[1] (%)



58% **Interpersonal, creativity or strategic decision-making roles**
e.g., Customer service workers, innovation managers, strategy development officers

25% **Roles that require the use of AI technologies in day-to-day tasks**
e.g., Data analysts and scientists, software and applications developers

17% **Roles that directly support the development of AI technologies**
e.g., AI and machine learning specialists, big data specialists, process automation experts

1. The projected distribution of in-demand job positions in an AI economy was proxied based on the percentage breakdown of job roles that the WEF survey reflected would have "new" and "stable" demand by employers through 2022.
SOURCE: World Economic Forum (2018), Future of jobs 2018 report, AlphaBeta analysis

66. Sources include: Alison Rayome (2019), "Why data scientist is the most promising job of 2019", TechRepublic. Available at: https://www.techrepublic.com/article/why-data-scientist-is-the-most-promizing-job-of-2019/; Alison Rayome (2019), "Why data scientist is the most promising job of 2019", TechRepublic. Available at: https://www.techrepublic.com/article/why-data-scientist-is-the-most-promising-job-of-2019/

67. World Economic Forum (2018), The future of jobs report 2018. Available at: https://www.weforum.org/reports/the-future-of-jobs-report-2018 Note: Owing to significant gaps in the existing literature on the detailed breakdown of new jobs that could be created by AI, this distribution was proxied based on the percentage breakdown of job roles that the WEF 'Future of Jobs 2018' survey reflected would have "new" and "stable" demand by employers to 2022. This approach of estimating the future magnitude of demand based on the type of positions demanded by future employers rather than the number of each type of positions demanded has the limitation of obscuring the extent to which each position could be demanded in future. New original analysis on the breakdown of the different types of new jobs created by AI in the future, and in the Asian context, would thus be useful.

68. The six ASEAN economies covered are: Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. Source: Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs: The impact of AI on workers in ASEAN's six largest economies. Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf

69. Deloitte (2019), The path to prosperity: Why the future of work is human. Available at: https://www2.deloitte.com/au/en/pages/building-lucky-country/articles/path-prosperity-future-work.html

9. WHILE TECHNOLOGICAL SKILLS WILL CONTINUE TO BE IMPORTANT IN THE FUTURE, SOFT SKILLS SUCH AS HIGHER COGNITIVE, SOCIAL AND EMOTIONAL SKILLS WILL BE CRITICAL FOR WORKERS IN ASIA

Similar to the future landscape of jobs, the importance of 'distinctively human' attributes is also reflected in the projections for 'in-demand' skills. Exhibit 24 shows a list of projected top ten demanded skills between 2018 and 2021, based on a survey by Microsoft and IDC of over 1,600 business leaders in Asia.[70] While technological skills such as 'digital skills' (second position) and 'IT skills and programming' (sixth position) will continue to be important in the future, higher cognitive skills such as 'quantitative, analytical and statistical skills' (first position), and social and emotional skills such as 'adaptability and continuous learning' (third position) will be similarly critical for workers in Asia.

Corresponding to these trends will be the projected growth of 'hybrid roles', i.e., technology roles that also require management and communication skills. For example, analysis by LinkedIn of millions of unique, user-input job titles in Singapore in the years 2013 and 2017 found that over this period, such roles grew at the fastest rate as compared to other roles.[71] Examples of job titles for these roles include 'Head of Digital', 'User Experience Designer' and 'Content Specialist'. Similar findings were noted in Malaysia, in which such 'hybrid roles' were increasingly demanded by employers to help their organizations navigate their digital transformation journeys.[72]

"IN THE FUTURE, WHAT MAKES US HUMAN WILL MAKE US EMPLOYABLE. COMPANIES ARE INCREASINGLY PLACING A PREMIUM ON JOB APPLICANTS WHO DEMONSTRATE SKILLS LIKE FLEXIBILITY, SELF-MOTIVATION, EMPATHY, RESILIENCE, CREATIVITY AND COMMUNICATION CAPABILITIES."

– Manish Bahl (2018),
Associate Vice President, Cognizant's Center for the Future of Work

(Source: Channel News Asia 2018). Available at: *https://www.channelnewsasia.com/news/commentary/education-train-singaporeans-for-jobs-not-created-yet-automation-11017258*

70. 1,605 business leaders and 1,585 workers were surveyed across markets in Asia Pacific, which include: Australia, China, Hong Kong, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. Source: Microsoft and IDC (2019), "Microsoft-IDC study: Artificial Intelligence to nearly double the rate of innovation in Asia Pacific by 2021". Available at: *https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/#_ftnref1*
71. Claudia Chong (2018). "Tech jobs with soft skills fastest-growing in Singapore: LinkedIn".
Available at: *https://www.businesstimes.com.sg/government-economy/tech-jobs-with-soft-skills-fastest-growing-in-singapore-linkedin*
72. HR Asia (2019). "Growing demand for hybrid skills". Available at: *https://hrasiamedia.com/top-news/2019/growing-demand-for-hybrid-skills/*

EXHIBIT 24:

WHILE TECHNOLOGICAL SKILLS WILL CONTINUE TO BE IMPORTANT IN FUTURE, SOFT SKILLS SUCH AS HIGHER COGNITIVE, SOCIAL AND EMOTIONAL SKILLS WILL BE CRITICAL

TOP TEN 'IN-DEMAND' SKILLS IDENTIFIED BY BUSINESS LEADERS IN ASIA PACIFIC[1]

Higher cognitive skills | Social & emotional skills | Technological skills

Rank	Future skills in demand (2022)	Percent of surveyed business leaders who believe skill will be important over 2018-2021 (%)[1]
1	Quantitative, analytical and statistical skills	51
2	Digital Skills	51
3	Adaptability and continuous learning	49
4	Critical thinking and decision making	47
5	Creativity	44
6	IT skills and programming	44
7	Entrepreneurship and initiative-taking	42
8	Project management	41
9	Communication and negotiation skills	41
10	Interpersonal skills and empathy	39

1. 1,605 business leaders in the Asia Pacific region were surveyed. They were asked the question, "Which of these skillsets do you see most commonly available in the workforce today, and which do you think is most needed 3 years from now in the AI-enabled workplace?" 15 countries were included in the survey: Australia, China, Hong Kong, India, Indonesia, Japan, New Zealand, the Philippines, Malaysia, Singapore, South Korea, Sri Lanka, Taiwan, Thailand and Vietnam.
SOURCE: Microsoft-IDC survey (2018); AlphaBeta analysis

PERCEPTION:
"AI COULD POTENTIALLY REDUCE WORKFORCE PARTICIPATION BY AUTOMATING JOBS."

10. AI-ENABLED JOB MATCHING PLATFORMS HAVE THE POTENTIAL TO INCREASE WORKFORCE PARTICIPATION, CREATING ADDITIONAL EMPLOYMENT FOR 31.6 MILLION WORKERS AND A GDP BOOST OF ABOUT US$494 BILLION ACROSS TEN ASIAN ECONOMIES IN 2025

A key channel through which AI could increase workforce participation is through AI-enabled job matching platforms. It has been found that, job matching platforms have the potential to increase workforce participation rates, which are estimated to translate into an annual combined additional employment of 31.6 million full-time workers and GDP contribution of US$494 billion across ten Asian economies in 2025 (Exhibit 25).[73] As shown in the Exhibit, in 2025, the projected annual increase in jobs as a share of total employment ranges from 1.3 percent in Thailand to 2.9 percent in the Philippines. Forecast GDP contributions in 2025 arising from improved workforce participation rates due to job matching platforms range from 0.7 percent in Japan to 1.2 percent in India. In addition, the study reflected that increased workforce participation was estimated to be have the largest impact (at over 60 percent of the total estimated GDP impact of job matching platforms) relative to the other impacts from job matching platforms, such as faster job matches and new job matches.[74] It should be noted, however, that the online job matching platforms analyzed in this study relate to all types of online job-matching platforms – including but not limited to those that are AI-enabled.[75] There is therefore room for additional analysis that distinguishes work participation benefits from AI-enabled platforms.

11. AI COULD BRING ABOUT THE GREATER INCLUSION OF UNDERSERVED GROUPS IN THE WORKFORCE THROUGH AI-ENABLED WORK TOOLS AND TECHNOLOGIES, IMPROVED ACCESS TO DIGITAL SKILLS TRAINING, AS WELL AS MORE OPPORTUNITIES FOR FLEXIBLE WORK

In addition to increasing overall workforce participation rates, AI technologies have the potential to improve the employability of underserved groups in Asia. Examples of these underserved groups include:[76]

- **Women, and in particular, mothers.** Research has shown that women are often deterred from pursuing career opportunities in STEM (Science, Technology, Engineering and Management) due to a lack of role models as well as access to education in digital skills.[77] In Asia, it has been found that only three of 18 countries had over 50 percent of STEM researchers who were women.[78] Women seeking to return to the workforce after childbirth also tend to face challenges with simultaneously managing full-time work and domestic responsibilities. The culture of long working hours expected of employees in Japan, for example, has been reported to be the key reason behind why 70 percent of Japanese women quit their jobs after giving birth to their first child, as compared to around one-third of women in the US.[79]

- **Youth at risk.** Youth from disadvantaged backgrounds tend to have poorer access to education, which could preclude them from the workforce or from the jobs that they want. In Vietnam, for example, youth unemployment accounts for about two-thirds of the overall number of people employed.[80] A major factor for this is the rising costs of education, which has excluded youth from lower-income families in accessing the education opportunities required to enter the workforce.

73. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
74. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
75. The platforms studied were defined based on data usage and functionality (i.e., matching individuals with traditional jobs, online marketplaces for contingent work and talent
76. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf
77. Microsoft (2018), Closing the STEM gap: Why STEM classes and careers still lack girls and what we can do about it.
Available at: https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE1UMWz
78. These countries are the Philippines (52 percent), Thailand (51 percent) and Kazakhstan (50 percent). Source: UNESCO (2017), "10 facts about girls and women in STEM in Asia".
Available at: https://bangkok.unesco.org/content/10-facts-about-girls-and-women-stem-asia
79. Rupert Wingfield-Hayes (2013), "Japan: The worst developed country for working mothers?" Available at: https://www.bbc.com/news/magazine-21880124
80. Pham Thi Tanh Tam (2017), "Addressing Vietnam's struggle with youth unemployment". Available at: https://asiasociety.org/blog/asia/addressing-vietnams-struggle-youth-unemployment

EXHIBIT 25:

INCREASED WORKFORCE PARTICIPATION FROM JOB MATCHING PLATFORMS HAVE THE POTENTIAL TO CREATE ADDITIONAL EMPLOYMENT FOR 31.6 MILLION WORKERS AND GDP BOOST OF US$494 BILLION ACROSS TEN ASIAN ECONOMIES IN 2025

PROJECTED ANNUAL GDP AND EMPLOYMENT IMPACTS OF ONLINE JOB MATCHING PLATFORMS IN 10 ASIAN ECONOMIES IN 2025

Country	Estimated impact of job matching platforms on employment in 2025		Estimated GDP impact of increased workforce participation due to job matching platforms in 2025	
	Share of employment (%)	Number of employees (millions)	Share of GDP (%)	GDP impact (US$ billion)
Philippines	2.9	1.4	0.9	7.3
Indonesia	2.7	3.5	0.9	23.3
India	2.2	11.3	1.2	140.2
Australia	2.2	0.27	1.0	14.5
Malaysia	1.9	0.29	1.1	9.3
Singapore	1.8	0.07	1.0	5.3
South Korea	1.7	0.42	0.9	21.9
China	1.6	12.9	0.7	226.3
Japan	1.3	0.91	0.7	36.4
Thailand	1.3	0.51	0.8	8.9
TOTAL		31.6		494

Note: The online job matching platforms analyzed in this study include but are not limited to AI-enabled job matching platforms. Platforms studied were defined based on data usage and functionality (i.e., matching individuals with traditional jobs, online marketplaces for contingent work and talent management). To date, there is no study that isolates the impact of AI-enabled job matching platforms on workforce participation. Also, numbers may not sum due to rounding.
SOURCE: McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age; AlphaBeta analysis

- **People who live in areas with limited job opportunities.** A large fraction of Asia's poor live in rural areas where they are forced to work in the informal economy or in jobs with little stability. In Cambodia, for example, 77 percent of workers who live in rural areas are employed in 'vulnerable jobs', which refer to work in precarious conditions (e.g., unsafe environments such as unregulated construction sites) and/or jobs with uncertain income flows (e.g., unpaid family workers).[81]

- **Long-term unemployed job seekers.** A global study revealed that because employers take into account the length of unemployment when recruiting, the probability of finding a job declines by 50 percent once a person has been unemployed for eight months.[82] This pattern of entrenchment in joblessness could be seen in some economies in the region; for example, in 2017, nearly half of people in New Zealand's jobless households was found to have not worked in more than two years.[83]

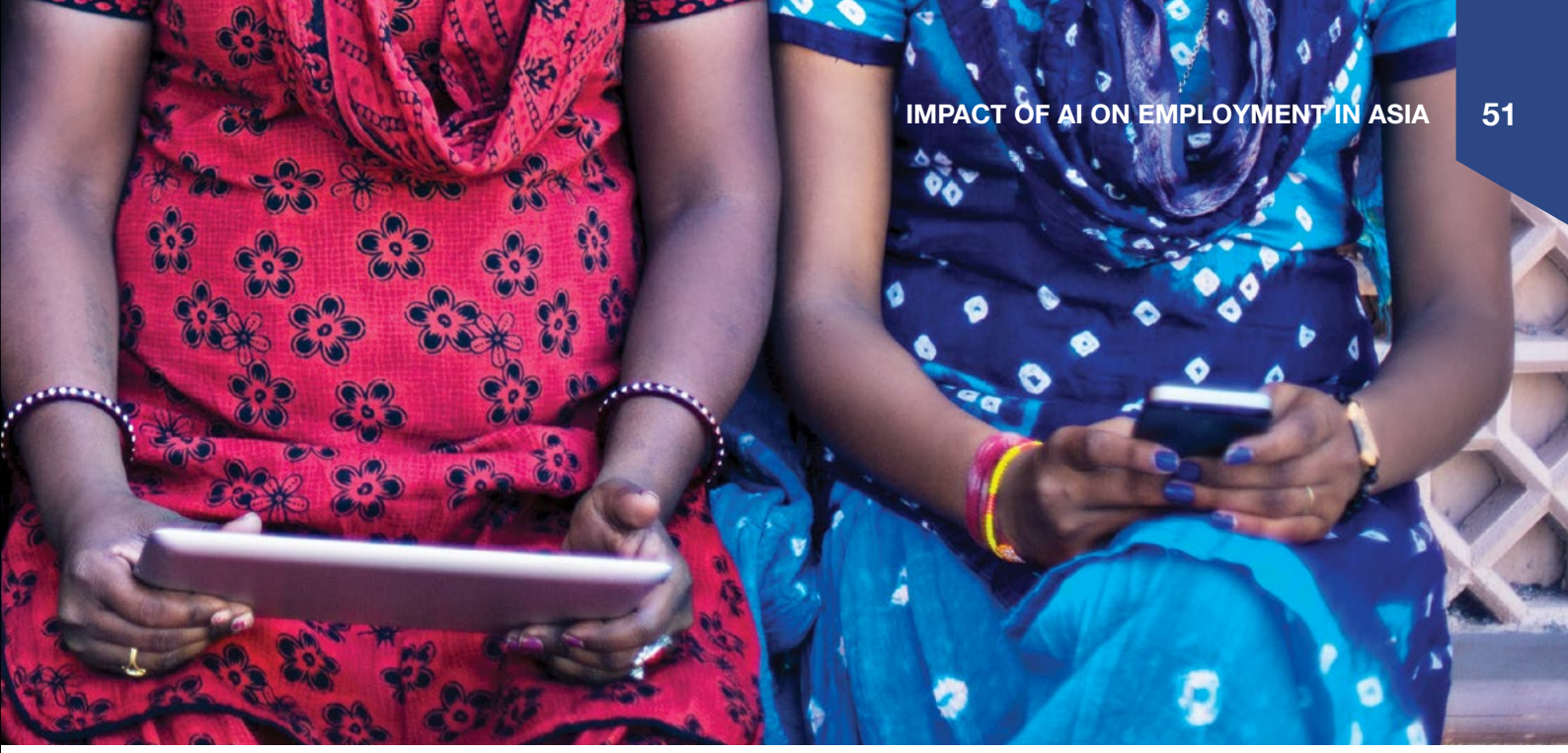
- **People with disabilities.** The barriers to accessing job opportunities for people with disabilities remain relatively high. In 2015, data from UNESCAP reflected that people with disabilities faced on average a 20 percent lower employment rate than the overall population.[84] Even though minimum disability hiring rates – which are typically one percent of positions in both public and private organizations – are imposed in countries such as Japan and Malaysia, reports reflect that these have been far from achieved.[85]

- **Elderly workers.** The desire of elderly workers to work has seen an increase, particularly in Asia's ageing societies. In South Korea, for instance, it was found that 31 percent of people aged 65 or older held low-wage jobs such as cleaners and security guards after their retirement in order to supplement their living costs.[86] It has also been reported that an increasing number of seniors in Singapore are working into their 80s and 90s in order to stay mentally and physically active.[87]

AI could help increase the workforce participation rates of these individuals through three channels:

1. **AI technologies allow free or affordable access to digital skills education, regardless of where they are located, their language abilities and current competency levels.** Youth with poor access to education, people living in areas with limited job opportunities, as well as women and long-term unemployed job seekers seeking to upgrade their skillsets could benefit from AI natural language processing programs that allow them to access free or affordable online digital skills courses from across

81. International Labour Organization (2015), "Rural development and employment opportunities in Cambodia; How can a national employment policy contribute toward realization of decent work in rural areas?" Available at: https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_228280.pdf
82. World Economic Forum (2016), "The longer you're unemployed, the less likely you are to find a job. Why?"
Available at: https://www.weforum.org/agenda/2016/08/the-longer-youre-unemployed-the-less-likely-you-are-to-find-a-job-why
83. Stats NZ (2017), Jobless households in New Zealand.
Available at: https://www.stats.govt.nz/assets/Reports/Jobless-households-in-New-Zealand-June-2017-quarter/jobless-households-in-new-zealand-june-2017-quarter.pdf
84. UNESCAP (2015). Disability at a glance 2015. Available at: https://www.unescap.org/sites/default/files/SDD%20Disability%20Glance%202015_Final.pdf
85. Sources include: Ivan Loh (2018), "Help the disabled find employment", The Star Online. Available at: https://www.thestar.com.my/metro/metro-news/2018/07/10/help-the-disabled-find-employment-experts-say-community-should-receive-equal-opportunities/; Japan Times (2018), "Ministries check disability employment rates as government investigates allegations they were miscalculated for over 40 years". Available at: https://www.japantimes.co.jp/news/2018/08/17/national/japan-probing-ministries-padded-employment-rates-disabled/#.XO0r3IgzaUm
86. Korea Herald (2018), "31% of elderly people land low-wage jobs after retirement." Available at: http://www.koreaherald.com/view.php?ud=20181203000671
87. Benson Ang (2017), "Age of golden workers: Many seniors working into 80s and 90s to stay active". Available at: https://www.straitstimes.com/lifestyle/age-of-golden-workers



the world in any language (Exhibit 26).[88] AI-enabled coding programs could help these individuals pick up coding skills on their own.[89]

2. **AI-enabled work tools and applications could eliminate the barriers to workplace access that are currently faced by some of these groups.** AI-enabled universal access tools such as speech recognition typing tools could help make the workplace more accessible to people with disabilities, lowering their barriers to employment (Exhibit 26).[90] AI-enabled assistive devices could also allow such people as well as elderly individuals to compensate for their physical limitations in undertaking work tasks.

3. **The AI economy will offer more opportunities to work on more flexible terms as compared to traditional forms of labor, benefiting groups that are currently excluded from the workforce because they require such terms.** Also termed as 'on-demand' or 'gig economy' workers, examples of flexible forms of labor include short term contractors and freelance workers.[91] These individuals typically find work through online talent platforms or staffing agencies, and perform tasks for a wide variety of customers.[92] The AI economy offers more opportunities for flexible forms of labor through two key channels:

   - **By increasing the demand for such labor.** To meet in-house skill shortages for specific competencies required to adopt and deploy AI, surveys have shown that, on average, 60 percent of employers in Asia are 'very likely' to hire freelancers to address skill gaps in an AI economy (Exhibit 27).[93] Moreover, such forms of labor could be particularly helpful to small businesses that cannot afford a large full-time workforce but can get work done through targeted on-demand engagements.[94]

   - **By increasing the supply of such labor.** With the emergence of AI-enabled tools that enhance the ease with which flexible work can be conducted, the supply of such labor could increase. For example, the 'Microsoft 365' freelance toolkit leverages AI and related technologies to ease the friction points that freelancers often encounter in their businesses, such as data analytics and workflow automation.[95]

These flexible work opportunities would be beneficial to currently underserved groups, such as mothers seeking employment on flexible terms that allow them to have a work-life balance, and people who live in areas with limited job opportunities.

88. ITU News (2018), "How can young people seize the opportunities of artificial intelligence?" Available at: https://news.itu.int/empowering-youth-redress-inequalities-seize-opportunities-ai/; Hilary Scharton (2018), "AI, Personalized Learning are a dynamic duo for K-12 classrooms". Available at: https://www.siliconrepublic.com/advice/workplace-accessibility-ai
89. Jade Boyd-Rice (2018), "New AI application can write its own code", Futurity. Available at: https://www.futurity.org/artificial-intelligence-bayou-coding-1740702/
90. Sources include: Microsoft (2019), "AI for Accessibility". Available at: https://www.microsoft.com/en-us/ai/ai-for-accessibility; Silicon Republic (2018), "What AI can do to improve workplace accessibility for employees with disabilities". Available at: https://www.siliconrepublic.com/advice/workplace-accessibility-ai
91. OECD (2017), Future of work and skills. Available at: https://www.oecd.org/els/emp/wcms_556984.pdf
92. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf
93. World Economic Forum (2018), The future of jobs report 2018. Available at: https://www.weforum.org/reports/the-future-of-jobs-report-2018 Note: The top ten list of skills in demand and in decline in 2022 were derived from this report. The categorization of these skills based on digital and non-digital (and for non-digital, further into the different types of skills) was done by AlphaBeta.
94. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf
95. Paul Estes (2018), "Introducing Microsoft 365 freelance toolkit – a solution to launch and scale your freelance workforce".
Available at: https://www.microsoft.com/en-us/microsoft-365/blog/2018/12/06/introducing-microsoft-365-freelance-toolkit-a-solution-to-launch-and-scale-your-freelance-workforce/

EXHIBIT 26:

AI-ENABLED WORK TOOLS AND APPLICATIONS COULD BRING ABOUT THE GREATER INCLUSION OF UNDERSERVED GROUPS IN THE WORKFORCE

GROUP	HOW AI COULD IMPROVE WORKFORCE PARTICIPATION
YOUTH AT RISK PEOPLE LIVING IN AREAS WITH LIMITED JOB OPPORTUNITIES WOMEN LONG-TERM UNEMPLOYED JOB SEEKERS	**By improving access to digital skills training:** • **AI-enabled personalized learning assistants** can simplify learning by making tutoring services and learning materials accessible to all students, regardless of where they are located • **Natural language processing** AI technology can allow access to free or affordable online digital skills courses from anywhere in the world, and in any language • **AI-enabled coding programs** enable budding programmers to collaborate on software projects and augment their abilities in coding, error-spotting and troubleshooting
PEOPLE WITH DISABILITIES ELDERLY WORKERS	**By reducing the barriers to employment:** • **AI-enabled universal access tools** can help make the workplace more accessible for persons with disabilities (e.g., speech recognition typing tools, real-time subtitles) • **AI-enabled assistive devices** can compensate for physical limitations in undertaking voluntary work tasks

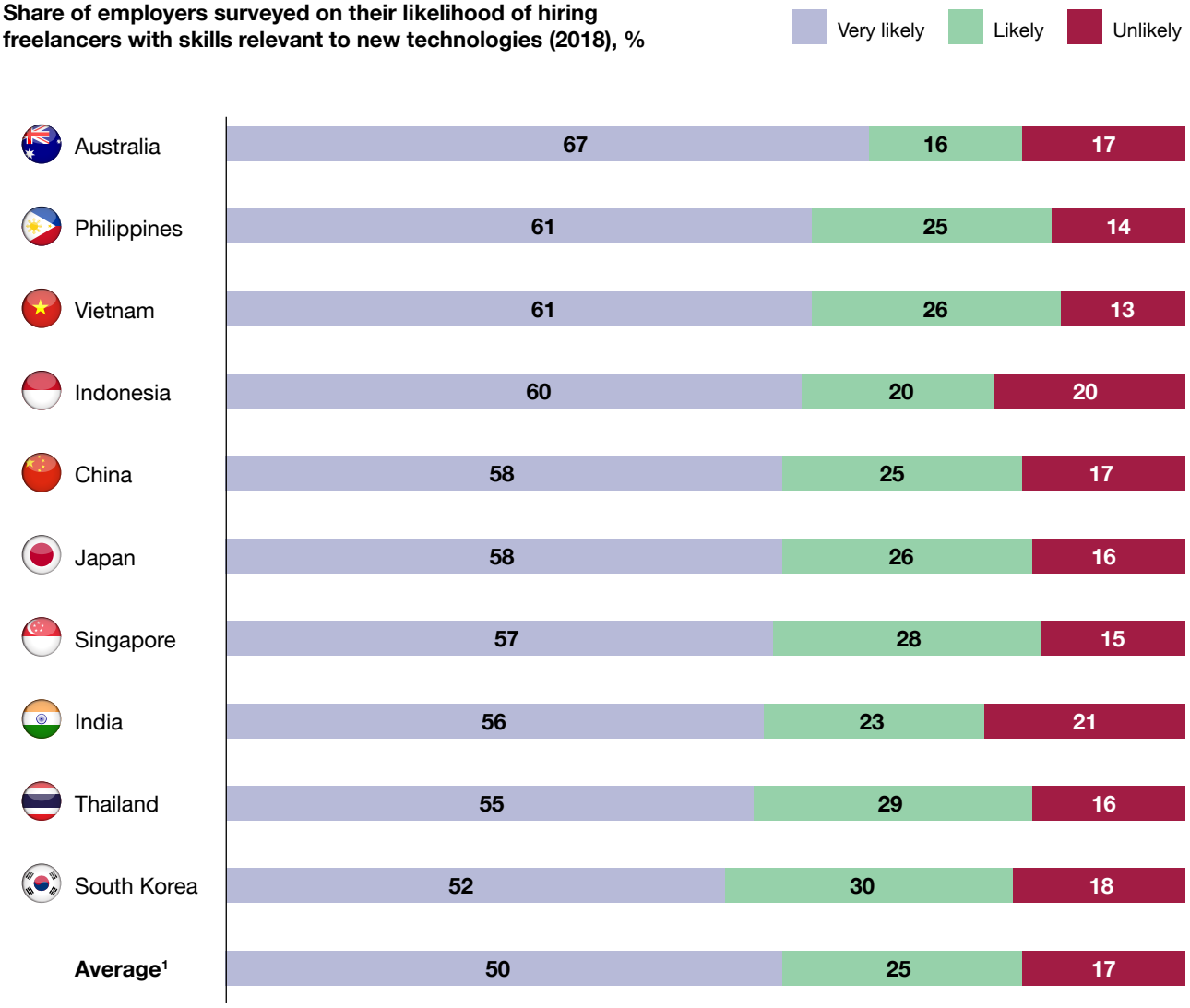
SOURCE: Literature review, AlphaBeta analysis

EXHIBIT 27:

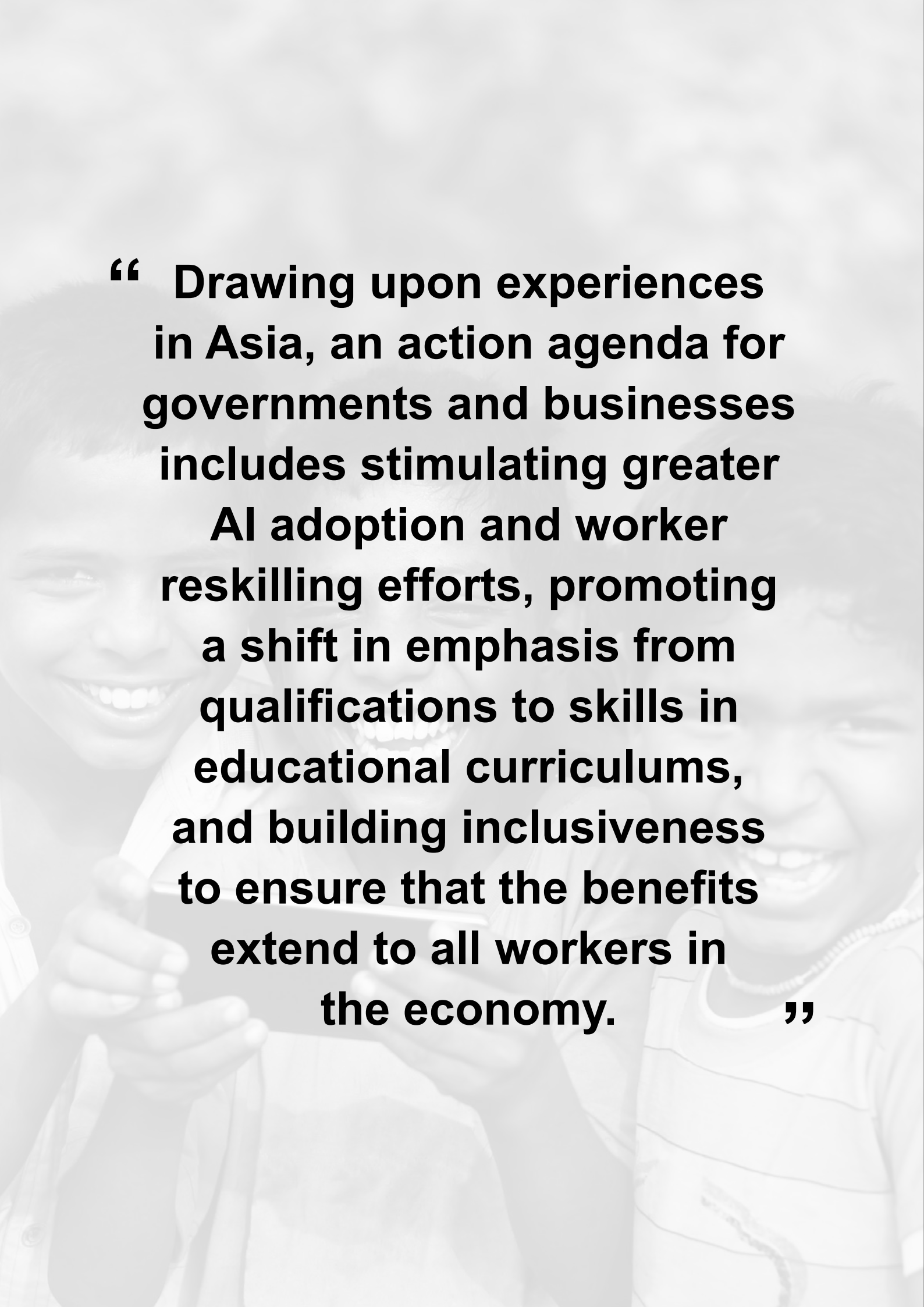
THE AI ECONOMY OFFERS MORE OPPORTUNITIES FOR NEW FLEXIBLE FORMS OF LABOR, WHICH COULD HELP INCREASE OVERALL WORKFORCE PARTICIPATION RATES

ON AVERAGE, 60% OF EMPLOYERS IN ASIA ARE "VERY LIKELY" TO HIRE FREELANCERS TO ADDRESS SKILL GAPS IN AN AI ECONOMY

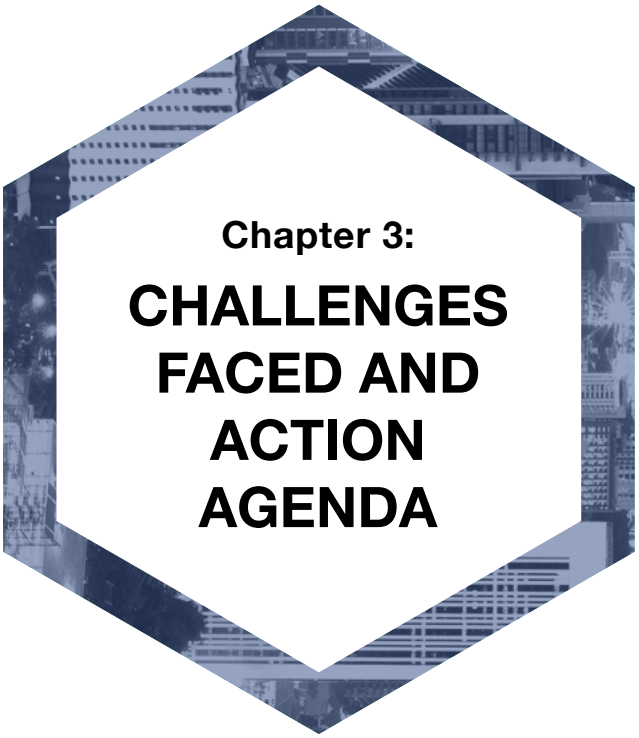
Share of employers surveyed on their likelihood of hiring freelancers with skills relevant to new technologies (2018), %



1. Based on a simple average of the findings for the above countries.
SOURCE: World Economic Forum (2018), Future of jobs report 2018; Microsoft (2018), The future computed; AlphaBeta analysis



“ Drawing upon experiences in Asia, an action agenda for governments and businesses includes stimulating greater AI adoption and worker reskilling efforts, promoting a shift in emphasis from qualifications to skills in educational curriculums, and building inclusiveness to ensure that the benefits extend to all workers in the economy. ”



Chapter 3:

CHALLENGES FACED AND ACTION AGENDA

To fully harness the potential benefits of AI for jobs and work in Asia, an appropriate action agenda must address the unique challenges the region faces. These challenges include a highly varied AI adoption landscape across firms and workers, inadequate awareness of the benefits of and opportunities for reskilling, the inability or reluctance of some governments and employers to implement worker retraining programs, the exclusion of underserved groups from AI benefits, a lack of effective lifelong learning models, the inability of educational curriculums to keep pace with the evolving skill needs of an AI economy, and a lack of social protection measures for flexible workers. Drawing upon experiences in Asia, an action agenda for governments and businesses includes stimulating greater AI adoption and worker reskilling efforts, promoting a shift in emphasis from qualifications to skills in educational curriculums, and building inclusiveness to ensure that the benefits extend to all workers in the economy. In short, Asian economies have a lot to learn from each other in terms of how they could manage the evolving technology landscape of AI. It should also be noted that although this study focuses on AI, the impacts, lessons and priorities identified are likely to be relevant for automation as well.

CHALLENGES FACED

There are seven key challenges that could limit the benefits of AI to employment and the nature of work in Asia (Exhibit 28).

These challenges are:

1. **Relatively low and uneven adoption of AI across firms and workers.** The adoption of AI across firms in Asia is relatively low as compared to international benchmarks. A 2018 survey of over 3,000 business representatives in the Asia Pacific revealed that only six percent of organizations had incorporated AI into their core business strategy.[96] This is relatively low as compared with North America and Europe, where between 18 and 38 percent of companies surveyed were already actively implementing AI.[97]

The picture of AI adoption across sectors also appears highly uneven. A 2017 study on ASEAN economies reflected that while sectors such as technology, financial and healthcare services appeared to have relatively high adoption rates, the resources, utilities and construction sectors registered low or no adoption at all (Exhibit 29).[98] The study also illustrated a great divergence in AI adoption levels between higher-income countries such as Singapore, and lower-income countries such as Lao PDR. Adoption potential also appears differs by firm size. A survey in Singapore reflected that 56 percent of MSMEs (micro, small and medium sized companies) stated that they had strategies in place for digital transformation including AI technologies, as compared to 98 percent for larger enterprises.[99]

EXHIBIT 28:

THERE ARE SEVEN KEY CHALLENGES THAT COULD LIMIT THE BENEFITS OF AI IN ASIA

CHALLENGES FACED IN ASIA THAT IMPACT…	BENEFITS TO THE NATURE OF WORK	BENEFITS TO OVERALL EMPLOYMENT
1 Relatively low and uneven adoption of AI across firms and workers	✓	✓
2 Lack of awareness by workers about the benefits of reskilling, what skills to learn, and reskilling opportunities	✓	✓
3 Inability or reluctance of governments and employers to implement and/or fund worker retraining programs	✓	✓
4 Risk of underserved groups not participating in the benefits	✓	✓
5 Lack of effective and/or scalable lifelong learning models		✓
6 Educational curriculums struggle to keep pace with the evolving skill needs of an AI economy		✓
7 Social protection exists for jobs, not people		✓

SOURCE: Literature review, AlphaBeta analysis

96. 1,605 business leaders and 1,585 workers were surveyed across markets in Asia Pacific, which include: Australia, China, Hong Kong, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. Source: Microsoft and IDC (2019), "Microsoft-IDC study: Artificial Intelligence to nearly double the rate of innovation in Asia Pacific by 2021". Available at: https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/#_ftnref1

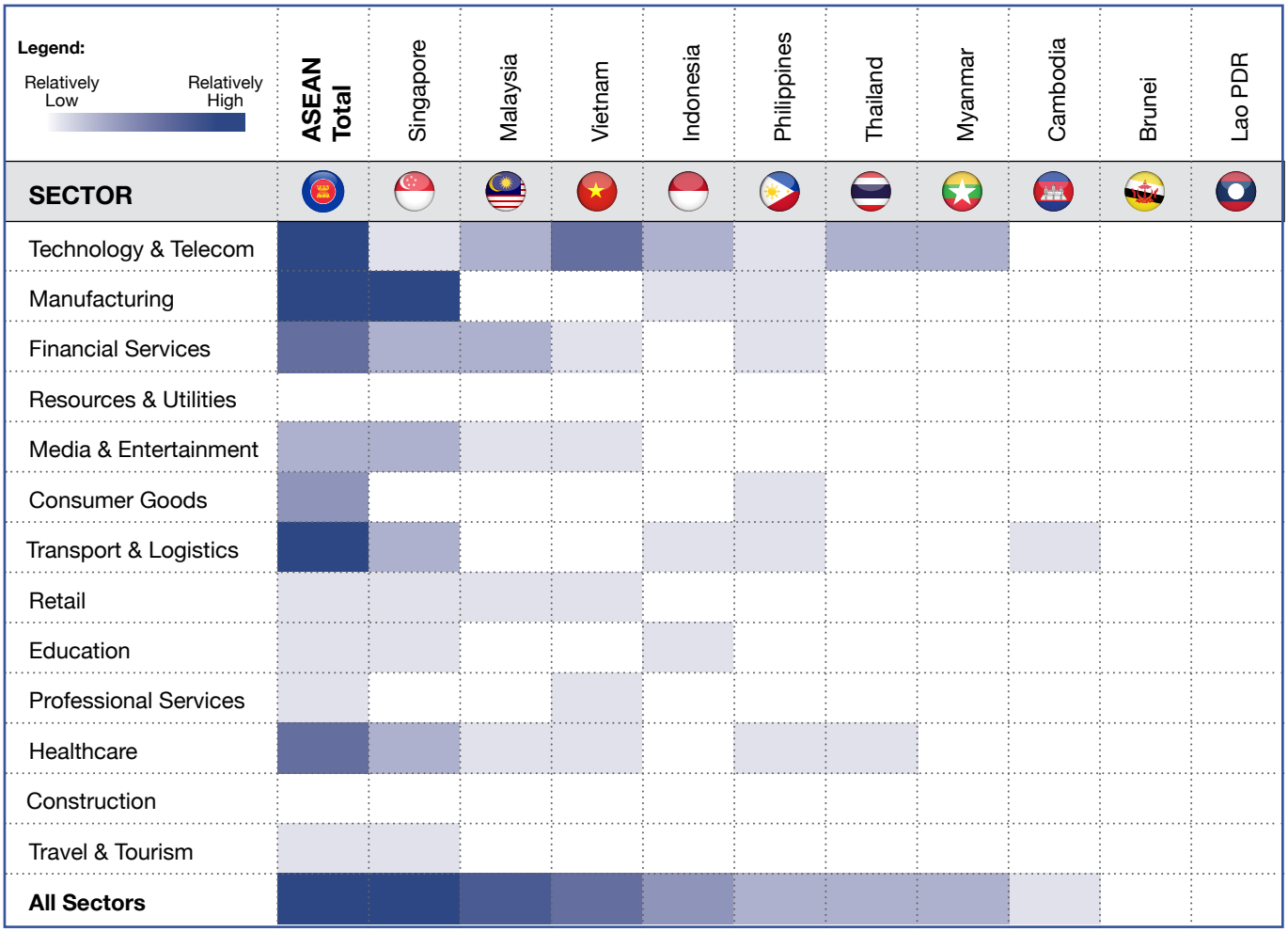
97. 18 percent refers to companies with 'lower growth' and 38 percent refers to companies with 'higher growth'. Based on another survey conducted by Microsoft in 2018. 1,150 business leaders were surveyed across markets in Europe and the US, which include: Czech Republic, France, Germany, Hungary, Italy, Netherlands, Poland, Russia, Switzerland, the United Kingdom and the United States. Source: Microsoft (2019), "Leaders look to embrace AI, and high-growth companies are seeing the benefits." Available at: https://news.microsoft.com/europe/features/leaders-look-to-embrace-ai-and-high-growth-companies-are-seeing-the-benefits/

98. McKinsey Global Institute (2017), Artificial Intelligence and Southeast Asia's Future. Available at: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20SE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.ashx; Cisco and Oxford Economics (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132

99. Microsoft Singapore News Center (2018), "Singapore SMEs who embrace digital transformation expect to see average revenue gains of 26%: ASME-Microsoft study". Available at: https://news.microsoft.com/en-sg/2018/10/23/singapore-smes-who-embrace-digital-transformation-expect-to-see-average-revenue-gains-of-26-asme-microsoft-study/

EXHIBIT 29:

AI ADOPTION LEVELS ARE HIGHLY VARIED ACROSS SECTORS AND COUNTRIES IN ASEAN



SOURCE: McKinsey Global Institute (2017), Artificial intelligence and Southeast Asia's future; AlphaBeta analysis

2. **Lack of awareness by workers about the benefits of reskilling, what skills to learn, and reskilling opportunities.** There appears to be a lack of awareness about why reskilling is important, what skills to learn, and where the opportunities for reskilling are. A survey by the Economist Intelligence Unit (EIU) of executives in four Asian countries – Australia, India, Japan and Singapore – found that 86 percent of workers believed that their education was sufficient for them to stay employed, and a fifth were not willing to undertake any training outside of working hours.[100] Another survey by Microsoft and IDC of over 1,500 workers in the Asia Pacific region reflected that the most commonly-cited challenge workers faced in reskilling themselves was not knowing what courses to take, with 40 percent of workers indicating this concern.[101] The same survey showed that 37 percent of workers felt that there were "no suitable training programs to take".[102]

3. **Inability or reluctance of governments and employers to implement and/or fund worker retraining programs.** The literature review reveals that existing government efforts to develop retraining programs in some Asian countries have been relatively weak. For example, a 2016 study found that only a fifth of government-managed vocational training schools for workers in Indonesia were deemed to be have the requisite teaching resources and quality.[103] In another study, India's technical and

100. The Economist Intelligence Unit and Microsoft Philanthropies Asia (2018), Learning to work, working to learn.
Available at: https://eiuperspectives.economist.com/sites/default/files/learning_to_work_working_to_learn.pdf
101. Microsoft and IDC (2019), "Microsoft-IDC study: Artificial Intelligence to nearly double the rate of innovation in Asia Pacific by 2021".
Available at: https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/#_ftnref1
102. Microsoft and IDC (2019), "Microsoft-IDC study: Artificial Intelligence to nearly double the rate of innovation in Asia Pacific by 2021".
Available at: https://news.microsoft.com/apac/2019/02/20/microsoft-idc-study-artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-asia-pacific-by-2021/#_ftnref1
103. The Jakarta Post (2016), "Five plans to upgrade Indonesia's workforce". Available at: https://www.thejakartapost.com/adv/2016/05/04/five-plans-to-upskill-indonesias-workforce.html

vocational education and training (TVET) system was assessed to have only enough capacity to train less than one-quarter of the 13 million people entering the labor market each year.[104] Efforts by employers have also been limited. A survey showed 7 percent more employers in Asia would hire new staff with the relevant skillsets, as compared to the share that was willing to retrain existing employees.[105] In lower-income countries such as Bangladesh, Indonesia and Sri Lanka, it was found than less than one-quarter of companies conducted formal in-house training for their workers.[106]

4. **Risk of underserved groups not participating in the benefits.** These include youth at risk, mothers returning to the workforce, long-term unemployed individuals and people with disabilities. Currently, the workforce inclusion of these groups is relatively low in Asia. For example, people with disabilities in Asia experience a 20 percent lower employment rate on average in comparison to the overall population.[107] A concerning survey found that over half of employers in Hong Kong stated that they prefer not to hire women with children.[108]

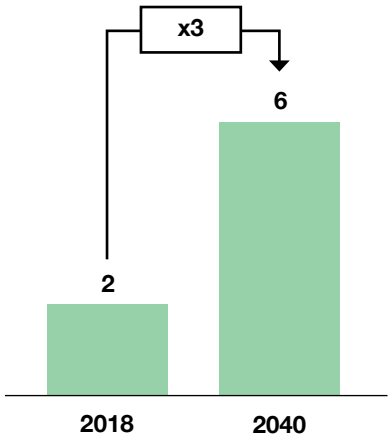
5. **Lack of effective and/or scalable lifelong learning models.** Research shows that lifelong learning is essential in an AI economy. A study showed the average Australian would likely need to triple the amount of time spent on learning new skills after the age of 21 by 2040, with most of this taking place on the job (Exhibit 30). In addition, a 2018 survey by the WEF reflected that employers in Asian countries believe that their workers would require an average of 103 days of retraining (almost 40 percent of working days in a year) between 2018 and 2022 in order to

EXHIBIT 30:

LIFELONG LEARNING IS ESSENTIAL, WITH THE AMOUNT OF LEARNING AFTER THE AGE OF 21 EXPECTED TO TRIPLE BY 2040

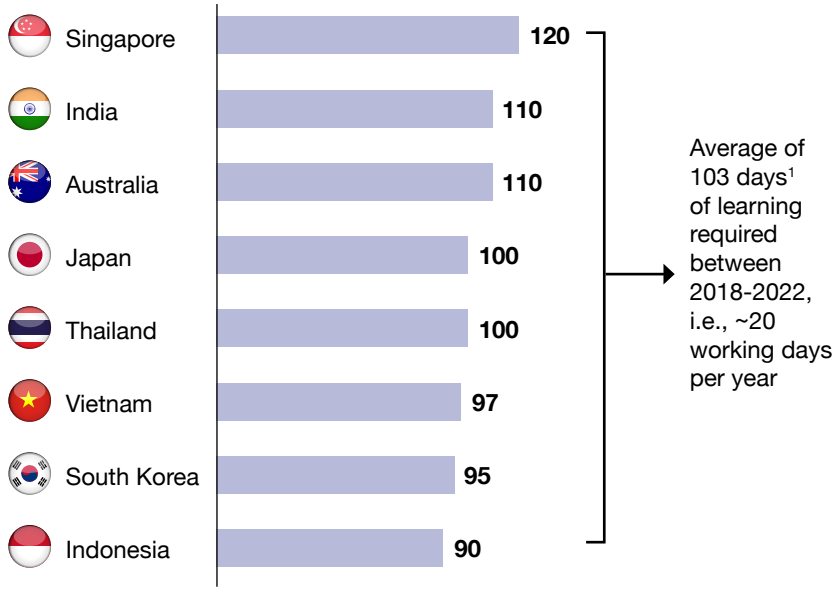
THE AVERAGE AUSTRALIAN WILL LIKELY NEED TO TRIPLE THE AMOUNT OF TIME SPENT ON LEARNING NEW SKILLS AFTER THE AGE OF 21 BY 2040…

Skill acquisition over a working life for Australians above age of 21, average weekly hours per person



… EMPLOYERS IN ASIAN ECONOMIES EXPECT THAT BY 2022, THE AVERAGE WORKER WILL NEED 103 DAYS OF RETRAINING AND UPSKILLING

Average reskilling needs in days over 2018-2022 period cited by employers by country, days



1. Average computed based on simple (not weighted) average of reskilling days for countries shown in exhibit
SOURCE: AlphaBeta (2019), Future skills; World Economic Forum (2018), Future of jobs 2018; AlphaBeta analysis

104. Lee Jong-Wha (2016), "How can Asia close its emerging skills gap?" Available at: http://www.moe.go.kr/web/100085/site/contents/ko/ko_0120.jsp?selectId=1085
105. The Economist Intelligence Unit and Microsoft Philanthropies Asia (2018), Learning to work, working to learn.
Available at: https://eiuperspectives.economist.com/sites/default/files/learning_to_work_working_to_learn.pdf
106. Lee Jong-Wha (2016), "How can Asia close its emerging skills gap?" Available at: http://www.moe.go.kr/web/100085/site/contents/ko/ko_0120.jsp?selectId=1085
107. United Nations Economic and Social Commission for Asia and the Pacific (2015), Disability at a glance 2015: Strengthening employment prospects for persons with disabilities in Asia and the Pacific. Available at: https://www.unescap.org/sites/default/files/SDD%20Disability%20Glance%202015_Final.pdf
108. Mandy Zheng (2018), "Half of Hong Kong employers do not want to hire women with children, study finds". South China Morning Post.
Available at: https://www.scmp.com/news/hong-kong/community/article/2160912/half-hong-kong-employers-do-not-want-hire-women-children

keep up with the anticipated pace of AI adoption. However, lifelong learning models in many Asian countries appear to be limited in their reach and impact. While recent years have seen the emergence of more initiatives to reach youth and adults excluded from the formal education system through informal vocational skills training particularly in lower-income Asian economies, they are often locally based, short-lived, underfunded and not part of a comprehensive national strategy for lifelong learning.[109]

6. **Educational curriculums struggle to keep pace with the evolving skill needs of an AI economy.** As skill needs emerge with new technology developments, educational curriculums need to stay nimble and allow students to develop future-ready skillsets. A study of Indonesia's education system found that 20 percent of students in Indonesia's upper secondary schools dropped out in 2017 due to curriculums that did not reflect 'in-demand' skills and uncertainty over job opportunities provided by their education.[110] In Thailand, 27 percent of the 270,000 students who graduated in 2015 could not find a job; it was found that 70 to 80 percent of Thai graduates were not skilled enough to meet industry demands.[111] Even in higher-income countries, educational curriculums do not seem to have adapted sufficiently to cater to emerging skill needs. A policy report by the Mitchell Institute in 2018 found that the education system in Australia needed to go beyond literacy, numeracy and core subject knowledge to provide young people with the full range of capabilities young people require for a successful future.[112] An Asia Pacific survey revealed that 73 percent of respondents felt that there was a mismatch between educational training and needs in the economy.[113]

7. **Social protection exists for jobs, not people.** Health insurance and other benefits are typically designed for employees who remain with a single employer for many years. This is ineffective for individuals in an AI economy who take on flexible forms of labor, such as short-term contractors

who work for multiple companies simultaneously, self-employed individuals (freelancers) or part-time workers. Scant literature on the presence of social protection measures for such forms of labor in Asia suggests limited social safety nets available. Indeed, the overall coverage of social protection programs in Asia is low; in 2015, less than half of Asia's population was fully covered by at least one social protection scheme.[114]

109. Colin Power and Rupert Maclean (2012), Lifelong learning: Meaning, challenges and opportunities. Available at: https://link.springer.com/chapter/10.1007/978-94-007-5937-4_2
110. Asia Philanthropy Circle and AlphaBeta (2017), Catalysing productive livelihood: A guide to education interventions with an accelerated path to scale and impact. Available at: http://www.edumap-indonesia.asiaphilanthropycircle.org/wp-content/uploads/2017/11/APC-Giving-Guide-Book-Final-Report-17112017.pdf
111. HR in Asia (2016), "Increasing unemployment in Thailand owing to lack of new investments in the country". Available at: http://www.hrinasia.com/news/increasing-unemployment-in-thailand-owing-to-lack-of-new-investments-in-the-country/
112. The Educator (2018), "Students not prepared for future – report". Available at: https://www.theeducatoronline.com/k12/news/students-not-prepared-for-future--report/252961
113. Pacific Economic Cooperation Council (2018), State of the region 2018. Available at: https://pecc.org/resources/regional-cooperation/2584-state-of-the-region-2018-2019/file
114. Sri Wening Handayani (2018), "4 ways to rethink social protection for future work in Asia", Eco-business. Available at: https://www.eco-business.com/opinion/4-ways-to-rethink-social-protection-for-future-work-in-asia/

ACTION AGENDA

To address these challenges, best practices and lessons learnt in the region as well as outside of Asia (where outstanding examples were observed) were identified to develop an action agenda for AI in the region. This action agenda involves three broad areas: stimulating greater AI adoption and worker reskilling efforts; promoting a shift in emphasis from qualifications to skills; and building inclusiveness in the labor market to extend the benefits of AI to all workers. Exhibit 31 presents an overview of these actions, and examples of countries in Asia where governments, industry and/or civil society actors have implemented these actions.

EXHIBIT 31:

BEST PRACTICE APPROACHES AND LESSONS LEARNT WERE IDENTIFIED TO DEVELOP AN ACTION AGENDA FOR AI IN ASIA

ACTION AGENDA	KEY ACTION	EXAMPLES OF COUNTRIES IN ASIA WHERE GOVERNMENTS, INDUSTRY AND/OR CIVIL SOCIETY ACTORS HAVE IMPLEMENTED ACTION
Stimulate greater AI adoption and worker reskilling efforts	1 Ensure strong and even adoption of AI across firms and workers	
	2 Build awareness of reskilling benefits, critical skills and training opportunities	
	3 Incentivize and encourage employers to retrain their workers	
	4 Foster close collaboration between governments, industry and civil society to create relevant and effective nation-wide retraining frameworks	
Promote a shift in emphasis from qualifications to skills	5 Establish effective and skills-focused lifelong learning models	
	6 Ensure relevance of educational curriculums to emerging skill needs	
	7 Encourage focus on skills rather than just qualifications in both recruitment and national labor market strategies	
Build inclusiveness to extend AI benefits to all workers	8 Build inclusive models that allow underserved groups to benefit from AI	
	9 Create social protection mechanisms for flexible workers	

SOURCE: Literature review, AlphaBeta analysis

KEY AREA OF ACTION: STIMULATE GREATER AI ADOPTION AND WORKER RESKILLING EFFORTS

ACTION 1: ENSURE STRONG AND EVEN ADOPTION OF AI ACROSS FIRMS AND WORKERS

To facilitate the benefits of AI to work, it is critical to ensure the strong and even adoption of AI across firms and workers through the following actions:

- **Focus development of AI applications in core industries.** Australia, for instance, is building up AI competencies in a key production and export sector – agriculture. Its 'Agriculture 4.0' initiative examines how new technologies can be adopted in the sector, connecting farmers with startups and research institutions.[115] To date, the country has seen over 300 start-ups produce AI-driven solutions to problems such as drought, plant disease and livestock management.[116]

- **Invest in talents and tools to develop and deploy AI at the firm level.** Talent development in two broad areas is encouraged: technical skills for AI development and deployment, and greater awareness of AI applications for non-digital professionals. On technical skills for AI development, the South Korean government, for example, aims to set up at least six new AI graduate schools in order to meet the goal of training 5,000 AI specialists by 2022.[117] In terms of 'tools', governments are investing heavily in robotics and de-regulating the industry - for instance, the Japanese government, which aims to triple its robotics market to US$22 billion by 2020.[118]

- **Foster industry-research partnerships.** To ensure that companies have access to the latest AI technologies, the Japanese government seeks to build AI capabilities by catalyzing extensive partnerships between firms and research institutions. Comprising an 11-member council with representatives from academia, industry and government, the 'Strategic Council for AI Technology' was established to develop 'research and development goals and a roadmap for the industrialization of AI'.[119]

- **Address barriers faced by firms preventing adoption of AI.** The Singapore government's 'SMEs Go Digital' program helps SMEs address such barriers through grants covering up to 70 percent of the cost of AI solutions, the roll-out of 'Industry Digital Plans' for adopting AI solutions in sectors lagging in digital transformation (e.g., construction), and the provision of basic technology advice to SME leaders.[120]

ACTION 2: BUILD AWARENESS OF RESKILLING BENEFITS, CRITICAL SKILLS AND TRAINING OPPORTUNITIES

Besides the benefits of reskilling, it is also important that workers and employers are informed about the requisite skills and opportunities to be trained in those skills. The following actions are key:

- **Educate workers and employers about 'in-demand' skills.** The New Zealand government developed a mobile app called 'Occupation Outlook', which allows the country's residents to explore study and career options based on extensive information on labor supply and demand in over 100 occupations in New Zealand.[121] By outlining the qualifications required for each role, average incomes as well as job prospects upon completion of the required qualifications, it allows New Zealanders to make informed decisions about their education and career.[122]

- **Convene dialogue between industries, government and civil society to identify AI-related skill needs.** An example for this is the International Transport Workers' Federation (ITF), an association of about 700 transport unions representing more than 16 million transport workers from 150

115. Ellen Daniel (2019), "Agriculture 4.0: Australia invests in future of farming", Verdict. Available at: https://www.verdict.co.uk/agriculture-4-0-in-australia/
116. Ellen Daniel (2019), "Agriculture 4.0: Australia invests in future of farming", Verdict. Available at: https://www.verdict.co.uk/agriculture-4-0-in-australia/
117. Kathleen Walch (2018), "Is South Korea poised to be a leader in AI?" Forbes.
Available at: https://www.forbes.com/sites/cognitiveworld/2018/09/07/is-south-korea-poised-to-be-a-leader-in-ai/#60c2b0d7fa2f
118. Frank Tobe (2014), "Japan's new robotics push: funding and deregulation". Available at: https://www.therobotreport.com/japans-new-robotics-push-funding-and-deregulation/
119. Prime Minister of Japan and his Cabinet (2016), "Public-private dialogue towards investment for the future". Available at: https://japan.kantei.go.jp/97_abe/actions/201604/12article6.html
120. Irene Tham (2019), "SMEs to get more help to adopt technology". The Straits Times. Available at: https://www.straitstimes.com/singapore/smes-to-get-more-help-to-adopt-technology
121. Ministry of Business, Innovation and Employment, New Zealand (2019). "Occupation Outlook". Available at: http://occupationoutlook.mbie.govt.nz/
122. Ministry of Business, Innovation and Employment, New Zealand (2019). "Occupation Outlook". Available at: http://occupationoutlook.mbie.govt.nz/

countries.[123] The ITF developed a program to engage governments, unions and business leaders in the transport sector around the world to identify the reskilling needs of transport workers in an AI economy.

- **Inform workers and employers about the avenues to access training in such skills.** The Singapore government set up a dedicated unit to reach out to firms and educate them about worker reskilling needs and opportunities under the government's skills training courses.[124] Training courses structured based on specific job roles could also make it easier for workers to understand the courses relevant to them. For example, the 'Microsoft Learn' platform offers online digital skills courses organized based on nine different job roles, such as 'AI engineer' and 'business analyst'.[125]

- **Map skills to job opportunities.** This could help stimulate greater awareness around reskilling needs. LinkedIn, for example, partnered with the World Bank to establish an interactive online skill-to-industry mapping database, which was recently launched in April 2019.[126] This is a comprehensive, free-for-all online tool that leverages LinkedIn data covering over 100 countries with at least 100,000 LinkedIn members each, and distributed across 148 industries and 50,000 skills categories.[127] This tool allows both policymakers and workers to understand global shifts in skill requirements by industry, the portability of skills across sectors, as well as country-level trends in sectoral employment and talent migration.[128] Employers have also leveraged skill-to-job mapping methods to encourage reskilling. The professional services firm, Accenture, developed the 'Job Buddy' software which uses an algorithm to indicate to individual employees the percentage of their job that is likely to be lost to automation and how their existing skills could be improved to be 'automation-proof'.[129] This has led to nearly 300,000 employees in the company being retrained between 2014 and 2018.[130]

ACTION 3: INCENTIVIZE AND ENCOURAGE EMPLOYERS TO RETRAIN THEIR WORKERS

To stimulate more training efforts on the part of employers to retrain their workers, the following actions are key:

- **Provide training subsidies and incentives to employers.** The Singapore government, for example, provides government subsidies that cover up to 95 percent of course fees and absentee payroll salary costs, with higher incentives being awarded for courses with professional qualifications.[131] The Malaysian government's 'Skills Upgrading Program' also provides grants covering 70 percent of training fees for SMEs for technical and soft skills.[132] In Japan, the 'Jinzai Kaihatsu Shien Joseikin' ('Subsidy to Support Human Resource Development') program subsidizes firms for their reimbursement of employees' wages during training, with the amount of subsidy being tailored to the type of training and size of the firm.[133]

- **Establish retraining programs that directly address critical skill gaps faced by employers.** For example, due to a shortage of cybersecurity talent particularly in women, employers in South Korean businesses face challenges in complying with recent government regulations that mandate the hiring of cybersecurity specialists. To address this, Microsoft is establishing a 10-month Microsoft Professional Program (MPP) on data science and cybersecurity targeted at women, with the aim to have 140 apprentices placed within Microsoft's partner and customer firms by 2020.[134]

123. Gwyneth Teo (2018), "NTUC to support reskilling of transport workers worldwide with research and training". Channel News Asia.
Available at: https://www.channelnewsasia.com/news/singapore/ntuc-to-support-reskilling-of-transport-workers-worldwide-10825876
124. Faris Mokhtar (2018), "SkillsFuture Singapore to deepen skills of training and adult education providers". Today.
Available at: https://www.todayonline.com/singapore/skillsfuture-singapore-deepen-skills-training-and-adult-education-providers
125. Microsoft (2019), "Microsoft Learn". Available at: https://docs.microsoft.com/en-us/learn/
126. World Bank Group and LinkedIn Corporation, "World Bank LinkedIn Digital Data for Development", licensed under CC BY 3.0. Available at: https://linkedindata.worldbank.org/
127. World Bank Group and LinkedIn Corporation, Data insights: Jobs, skills and migration trends methodology & validation results.
Available at: https://datacatalog.worldbank.org/dataset/world-bank-group-linkedin-dashboard-dataset#tab2
128. World Bank Group and LinkedIn Corporation, "World Bank LinkedIn Digital Data for Development", licensed under CC BY 3.0. Available at: https://linkedindata.worldbank.org/
129. Business Insider Singapore (2019), "Accenture's HR chief shares what the company has learned from retraining nearly 300,000 employees".
Available at: https://www.businessinsider.sg/training-employees-on-new-skills-and-technology-what-accenture-learned-2019-1/?r=US&IR=T
130. Business Insider Singapore (2019), "Accenture's HR chief shares what the company has learned from retraining nearly 300,000 employees".
Available at: https://www.businessinsider.sg/training-employees-on-new-skills-and-technology-what-accenture-learned-2019-1/?r=US&IR=T
131. Skillsfuture SG (2019). "Funding support for employers". Available at: https://www.ssg.gov.sg/programmes-and-initiatives/funding/funding-for-employer-based-training.html
132. SME Corp Malaysia (2019), "Skills upgrading programme". Available at: http://www.smecorp.gov.my/index.php/en/slides/86-program-sme/103-skills-upgrading-programme
133. OECD (2018). "Getting skills right: future-ready adult learning systems".
Available at: https://read.oecd-ilibrary.org/education/getting-skills-right-future-ready-adult-learning-systems_9789264311756-en#page1
134. Information shared by Microsoft on the company's 'Careers Pathways' program.

- **Offer affordable, high-impact short-term courses for 'in-demand' skills.** These courses, which could be spearheaded by both government and industry, render it feasible for workers to pursue training even as they work, minimizing the costs employers face due to lost working hours. For example, the Singapore government offers tailored AI-relevant courses for workers of different competencies and experience levels. This includes a three-month 'AI for Industry' program for IT professionals, as well as 'AI for Everyone', a short course which aims to give 10,000 non-technical Singaporean workers basic familiarity with how AI could apply to their jobs.[135] In India, a local start-up, UpGrad, offers online courses spanning between six and 11 months that aim to 'cross-skill' individuals exploring jobs in different sectors.[136]

- **Develop holistic cost-benefit analysis frameworks for firms to assess worker retraining programs.** As outlined under the 'Challenges' section, a key stumbling block for employers has often been the cost of retraining programs. It is crucial that when making these investment decisions, employers take a holistic approach in assessing the costs and benefits of worker retraining. Exhibit 32 outlines the costs and benefits to employers pertaining to worker retraining, while Box 2 explains these in more detail.

EXHIBIT 32:

Cost-benefit analysis for **Employers**

A HOLISTIC UNDERSTANDING OF THE COSTS AND BENEFITS TO WORKER RETRAINING COULD INCENTIVIZE MORE INVESTMENT BY EMPLOYERS IN THIS AREA

	COMPONENT	DESCRIPTION
− COSTS OF WORKER RETRAINING	RESKILLING EXPENDITURES	Reskilling costs covered by the company, including payments to course providers and salaries to in-house trainers
	MISSED PRODUCTIVITY DURING TRAINING	During the reskilling, the company continues to pay wages to the employee undergoing the course, but does not receive their full productivity
+ BENEFITS OF WORKER RETRAINING	AVOIDED SEVERANCE AND HIRING COSTS	Reskilling instead of hiring and firing allows employers to avoid the costs of severance and hiring, which could be significant
	PRODUCTIVITY GAINS FROM RESKILLING	Skills learnt from the training course could be applied by the employees to improve their productivity at work, which would translate into overall productivity gains for employers as well
	AVOIDED REDUCED PRODUCTIVITY OF NEW EMPLOYEES	Studies have shown that employees who are new to the company or industry have reduced productivity compared to reskilled internal employees

SOURCE: World Economic Forum (2019), Towards a Reskilling Revolution, and other sources, AlphaBeta analysis

135. Infocomm Media Development Authority (2019), "Artificial Intelligence". Available at: https://www.imda.gov.sg/sgdigital/tech-pillars/artificial-intelligence
136. Startup India (2019), "Startup India Learning Program". Available at: https://www.startupindia.gov.in/content/sih/en/learning-and-development_v2.html

BOX 2:
DEVELOPING A HOLISTIC COST-BENEFIT ANALYSIS FRAMEWORK FOR EMPLOYERS TO ASSESS THE VIABILITY OF WORKER RETRAINING PROGRAMS

The costs of worker retraining to firms include:

- **Reskilling expenditures.** This relates to the costs of reskilling undertaken by the firm, including payments to course providers and salaries to in-house trainers.

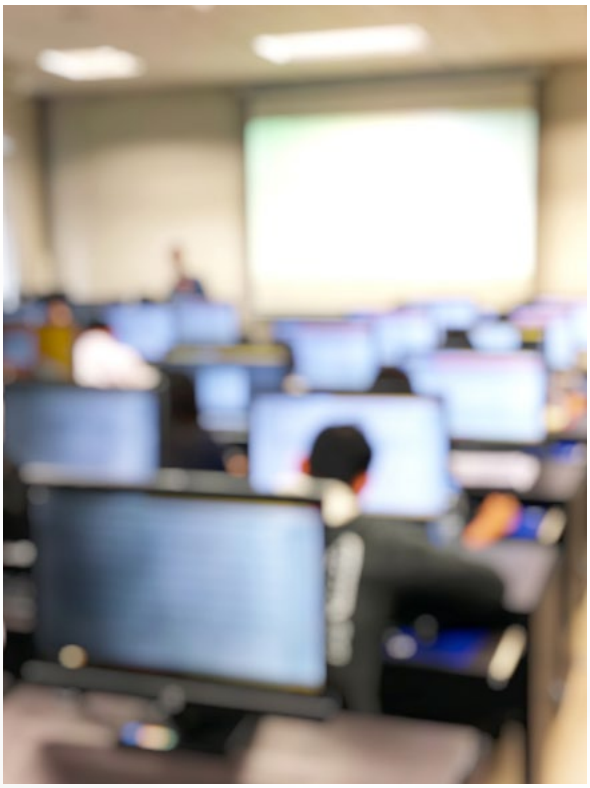
- **Missed productivity during training.** This refers to the wages that employers continue to pay to employees without receiving their full productivity as they undergo the training course.

It has been found that Japanese businesses spend an average of around 280,000 yen (US$2,536) a year per employee on both direct spending on training courses as well as wages equivalent to the hours that employees spend at these sessions.[137]

On the other hand, the benefits of worker retraining to firms include:

- **Avoided severance and hiring costs.** These refer to the costs of firing and hiring avoided by employers when they retrain their workers. A study in Australia estimated that when taking into account incurred costs such as advertising fees and recruitment fees as well as time costs, rehiring a new worker in the Australian economy costs over 50 percent of the job's salary.[138]

- **Productivity gains from reskilling.** The skills learnt at retraining programs could be applied by employees to improve their productivity at work, translating into overall productivity gains for their employers. It was estimated in Japan that on average, a 1 percent increase in talent development spending by employers lifted the company's productivity by 0.68 percent.[139]



- **Avoided reduced productivity of new employees.** Studies have shown that employees who are new to the company have reduced productivity as compared to reskilled internal employees. 75 percent of employers surveyed in the US indicated that the average time for new hires to achieve 'full productivity' was between one and two years, which translates into a substantial 150 to 250 percent of the job's annual compensation.[140]

137. HR in Asia (2018). "Japan urges business leaders to invest more in employees training and development".
Available at: http://www.hrinasia.com/retention/japan-urges-business-leaders-to-invest-more-in-employees-training-and-development/
138. Rosie Cairnes (2018), "Here's why you're better off retraining employees than hiring new staff". Business Insider Australia.
Available at: https://www.businessinsider.com.au/heres-why-youre-better-off-retraining-employees-than-hiring-new-staff-2018-6
139. HR in Asia (2018). "Japan urges business leaders to invest more in employees training and development".
Available at: http://www.hrinasia.com/retention/japan-urges-business-leaders-to-invest-more-in-employees-training-and-development/
140. Training Industry Quarterly (2012), "Identifying roadblocks to productivity adds value to the business".
Available at: http://www.nxtbook.com/nxtbooks/trainingindustry/tiq_2012winter/index.php?startid=40#/40

ACTION 4: FOSTER CLOSE COLLABORATION BETWEEN GOVERNMENTS, INDUSTRY AND CIVIL SOCIETY TO CREATE RELEVANT AND EFFECTIVE NATION-WIDE RETRAINING FRAMEWORKS

To form relevant and effective nation-wide worker training frameworks, governments must consult and engage extensively with industry and civil society actors.

- **Develop a national training framework based on collaboration between industries, government and civil society to identify AI-related skill needs.** For example, the 'Skills Framework' under Singapore's 'Industry Transformation Maps' (ITMs) that was created based on a consultation involving these parties provides information on career pathways, the skills required for different occupations and reskilling options for different sectors.[141] In formulating Australia's 'National Foundation Skills Strategy for Adults', the government undertook an extensive one-year consultation process involving industry bodies, employers, training practitioners, research organizations and service providers – with over 400 stakeholders involved and 70 submissions received.[142]

- **Establish private-public partnerships.** Corporate-led retraining programs could act as testbeds to prove the effectiveness of such programs before governments scale them up. An example is Microsoft's 'Empowered Women', a basic IT training program for women in Japan. Aimed at providing 200 returning mothers the opportunity to upskill and obtain job experience in the IT sector through industry apprenticeships, the training program included technical and soft skills training.[143] With an 86 percent conversion rate from internship to full-time employment achieved in one of the pilot locations, the program's success prompted the Japanese government to expand the program to five cities based on a public-private co-investment model.[144]

- **Develop holistic cost-benefit analysis frameworks for governments to assess nation-wide retraining programs.** As with employers, it is also important for governments to undertake holistic cost-benefit analyses to ensure that any positive economic returns from nation-wide worker retraining schemes are not disregarded when making relevant investment decisions. Exhibit 33 summarizes the list of costs and benefits to governments of nation-wide worker retraining schemes, while Box 3 explains these in more detail.

EXHIBIT 33:

Cost-benefit analysis for **Governments**

A HOLISTIC UNDERSTANDING OF THE COSTS AND BENEFITS TO NATION-WIDE WORKER RETRAINING SCHEMES COULD INCENTIVIZE MORE PUBLIC INVESTMENT IN THIS AREA

	COMPONENT	DESCRIPTION
− COSTS OF WORKER RETRAINING	RESKILLING EXPENDITURES	Costs of state-provided training programs as well as subsidies provided to firms
+ BENEFITS OF WORKER RETRAINING	AVOIDED WELFARE PAYMENTS	Reskilling aids job transitions which allows governments to avoid welfare costs incurred on the unemployed
	INCREASED TAX REVENUE	Reskilling aids job transitions, likely to higher-paying jobs, which allows the government to collect more taxes on the employee's future wage
	INCREASED PRODUCTIVITY FROM TRAINING	Skills learnt in these programs could be applied by to improve productivity at work, translating into overall productivity gains for the economy
	POSITIVE EXTERNALITIES FROM TRAINING	Social benefits tend to increase with the level of education and training a person receives, as these people tend to bring greater economic value to their community

SOURCE: World Economic Forum (2019), Towards a Reskilling Revolution, and other sources, AlphaBeta analysis

141. SkillsFuture (2019). "Skills framework". Available at: https://www.skillsfuture.sg/skills-framework
142. Australian Government: Department of Education and Training (2013), National Foundation Skills Strategy for Adults. Available at: https://docs.education.gov.au/system/files/doc/other/national-foundation-skills-strategy-for-adults_0.pdf
143. Based on information provided by Microsoft.
144. Based on information provided by Microsoft.

BOX 3:
DEVELOPING A HOLISTIC COST-BENEFIT ANALYSIS FRAMEWORK FOR GOVERNMENTS TO ASSESS THE VIABILITY OF NATIONAL WORKER RETRAINING PROGRAMS

The costs of such schemes include:

- **Reskilling expenditures.** This refers to the costs of state-provided training programs, which includes payments to the engaged training providers and subsidies provided to firms to encourage firm-sponsored training for their employees. Singapore, for example, increased its spending over the past decade by 40 percent – from S$600 million (US$440 million) per year over the period 2010-2015, to over S$1 billion (US$730 million) per year over the period 2015-2020.[145]

On the other hand, the benefits of such schemes include:

- **Avoided welfare payments.** As reskilling aids job transitions for displaced workers, governments could avoid welfare costs incurred on the unemployed. In countries where governments provide unemployment benefits, such avoided costs could be significant. For example, in New Zealand, where unemployment benefits are on average about NZ$200 (US$133) a week, a period of long-term unemployment could result in welfare payments of over NZ$10,000 (US$6,600) per person per year.[146]

- **Increased tax revenue.** This relates to the increased taxes that governments could collect from displaced workers who manage to secure new jobs upon reskilling. While there have been few estimates of the impact of worker retraining on tax revenue, strong impacts have been found for higher education. On average across the OECD countries, the extra tax revenue gained from educating a typical student at the tertiary level has been estimated to offset government education cost by a substantial 20 percent.[147]

- **Increased productivity from training.** The Japanese government reported in 2018 that a one percent increase in talent development raised labor productivity by 0.6 percent.[148]

- **Positive externalities from increased training.** Social benefits tend to increase with the level of education and training a person receives, as these people tend to bring economic value to their community. While estimates of the impact of worker retraining are limited, proxies could be derived from research on the impact of higher education. A 2016 estimate for Australia showed that for every 1,000 university graduates, 120 new jobs were created for people without a university degree.[149] This effect was also reflected in wages: the wages of workers without a university degree rose as a higher number of university graduates entered the workforce.[150]

145. Singapore Budget 2019, "Look back at recent budgets". Available at: https://www.singaporebudget.gov.sg/budget_2019/about-budget/look-back-at-recent-budgets
146. Social Security Administration, Office of Retirement and Disability Policy (2019). "New Zealand".
Available at: https://www.ssa.gov/policy/docs/progdesc/ssptw/2010-2011/asia/newzealand.html
147. OECD (2018), Taxation and skills: How tax systems impact skills development in OECD countries.
Available at: https://www.oecd.org/tax/tax-policy/taxation-and-skills-brochure.pdf
148. HR in Asia (2018). "Japan urges business leaders to invest more in employees training and development".
Available at: http://www.hrinasia.com/retention/japan-urges-business-leaders-to-invest-more-in-employees-training-and-development/
149. Universities Australia (2016), "'The graduate effect': having more graduates grows jobs and wages".
Available at: https://www.universitiesaustralia.edu.au/Media-and-Events/media-releases/-The-graduate-effect---having-more-graduates-grows-jobs-and-wages
150. Universities Australia (2016), "'The graduate effect': having more graduates grows jobs and wages".
Available at: https://www.universitiesaustralia.edu.au/Media-and-Events/media-releases/-The-graduate-effect---having-more-graduates-grows-jobs-and-wages

KEY AREA OF ACTION: PROMOTE SHIFT IN EMPHASIS FROM 'QUALIFICATIONS' TO 'SKILLS'

ACTION 5: ESTABLISH EFFECTIVE AND SKILLS-FOCUSED LIFELONG LEARNING MODELS

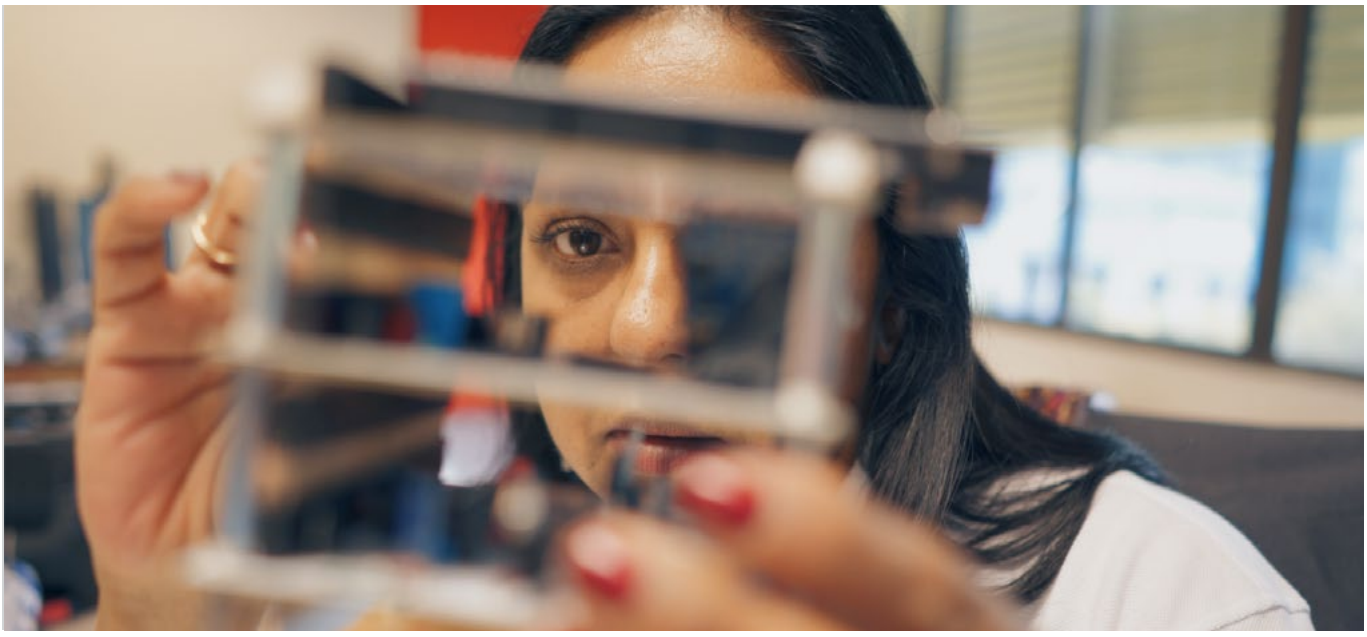
To ensure continual training in key skills, it is important that lifelong learning models that are scalable and effective. Key actions include:

- **Issue lifetime learning credits.** These refer to monetary credits issued to citizens that allow them to spend on training courses. The Singapore government issues credits worth S$500 (US$370) to each citizen above the age of 25, which allows them to select from a wide list of approved courses.[151]

- **Establish inclusive, age-agnostic courses in AI-relevant skills.** Such courses could help stimulate the learning of AI-relevant skills across different age groups and levels of experience. For example, Microsoft is establishing an AI school in India that will impart AI-relevant skills to eager learners across the age and experience spectrum. This aims to place young learners in good stead for future job opportunities, while also facilitating successful career transitions for adults of working age.[152]

- **Leverage community and informal resources.** A possible way of addressing fiscal constraints to implementing lifelong learning models is to leverage existing informal learning resources. Community learning centers, for instance, offer an important and affordable channel of education.[153] Over 70 such centers have been established across Vietnam to offer alternative educational support to both youth and adults that have been excluded from the formal system, and about 10 percent of Thailand's workforce currently participate in activities at such centers.[154]

- **Ensure high quality of training providers.** In Japan and South Korea, training quality guidelines were developed by government, and workshops were organized to familiarize training providers with these guidelines.[155] Formal certifications – which are also visible to employers and workers choosing from these programs – are issued to training providers who comply with these guidelines. In South Korea, training programs are certified by the Korean Skills Quality Authority based on their content, teaching methods and teacher quality.[156]



151. SkillsFuture Singapore (2019). Available at: https://www.myskillsfuture.sg/content/portal/en/index.html
152. Information shared by Microsoft on the company's 'Digital Skills' program.
153. UNESCO (2017), Lifelong learning in transformation: promising practices in Southeast Asia. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000253603
154. UNESCO (2017), Lifelong learning in transformation: promising practices in Southeast Asia. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000253603
155. OECD (2018). "Getting skills right: future-ready adult learning systems".
Available at: https://read.oecd-ilibrary.org/education/getting-skills-right-future-ready-adult-learning-systems_9789264311756-en#page1
156. OECD (2018). "Getting skills right: future-ready adult learning systems".
Available at: https://read.oecd-ilibrary.org/education/getting-skills-right-future-ready-adult-learning-systems_9789264311756-en#page1

ACTION 6: ENSURE RELEVANCE OF EDUCATIONAL CURRICULUMS TO EMERGING SKILL NEEDS

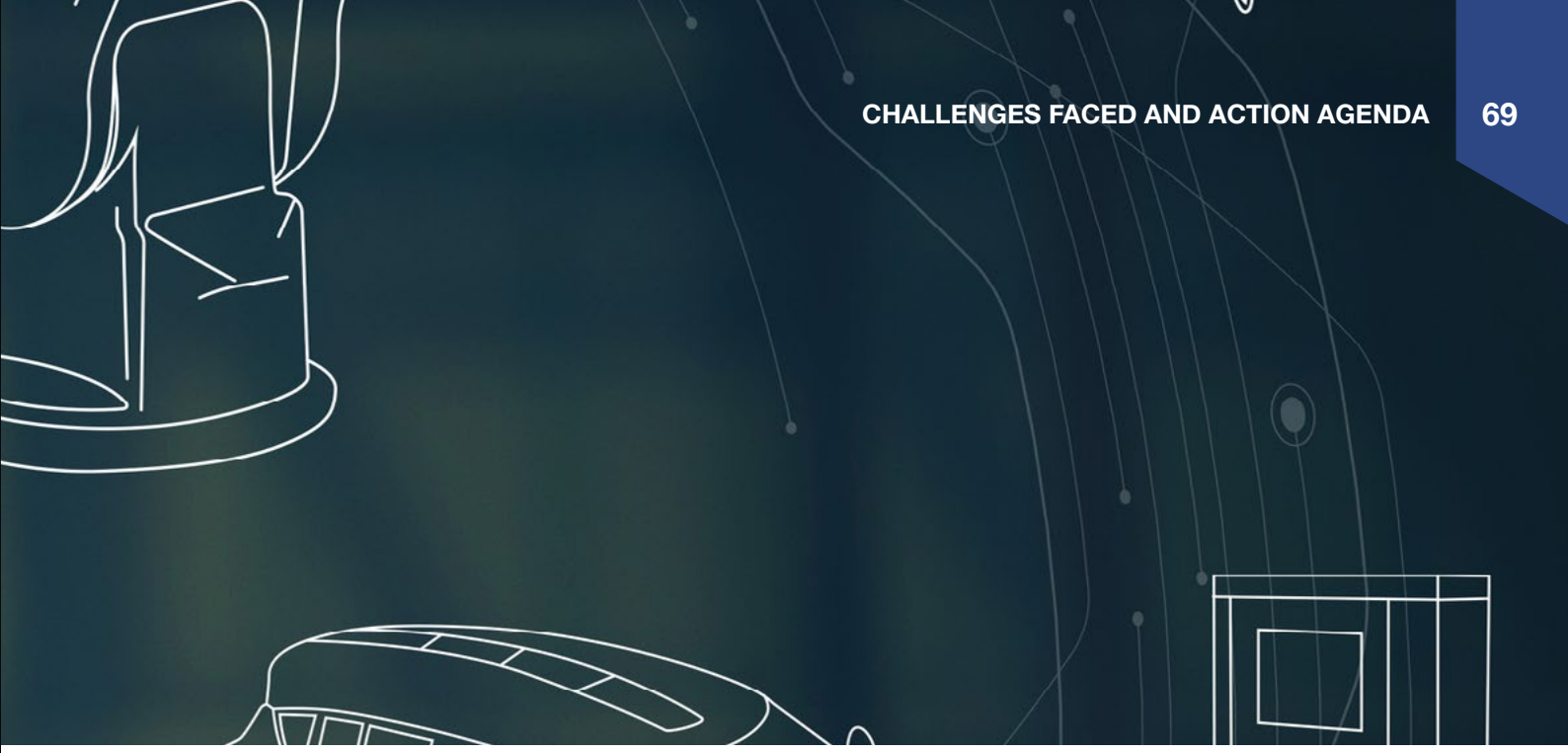
Educational curriculums spanning primary to tertiary levels need to be relevant to the emerging skill needs of an AI economy. As established in Chapter 2, such skills include both technological skills and soft skills like creativity and problem-solving. The following actions are crucial:

- **Review and update existing curriculums and teaching resources to emerging skill needs.** An example of an education system that has continually adapted to the evolving skill needs of the economy over the past two decades is Singapore's, which halved its curriculum to allocate more time to honing soft skills such as creative and critical thinking.[157] Partnerships between educators and employers are also beneficial. For example, Microsoft is partnering local organizations in Japan and South Korea to develop the national computer science education curriculums in both countries.[158]

- **Expand provision of vocational education.** To better respond to increased demand for technological skills in the labor market, China and Indonesia are increasing the number of polytechnics to offer targeted courses for these skills.[159] In particular, China is currently transiting from a largely academic-focused educational system toward a 'dual track higher education system', with equal weightage given to both institutions of applied learning and academic-focused universities. Under this plan, 600 of the country's universities would be converted into polytechnics.[160]

- **Augment existing curriculums through industry apprenticeships.** The relevance of existing education curriculums could also be enhanced through industry apprenticeships. For example, Microsoft is seeking to augment the IT education of university students in Thailand through instructor-led training on data science and AI followed by a six-month industry project with Microsoft's partners and customers.[161]

157. Ong Ye Kung (2018), "Helping Singapore's students to learn for life". Available at: https://www.todayonline.com/commentary/helping-singaporean-students-learn-life
158. Information shared by Microsoft on the company's 'Digital Skills' program.
159. Sources include: Ivany Arbi (2019), "Indonesia focuses on polytechnics amid staggering skills gap", The Jakarta Post. Available at: https://www.thejakartapost.com/news/2019/01/04/indonesia-focuses-on-polytechnics-amid-staggering-skills-gap.html; Yojana Sharma (2014), "Major reform as 600 universities become polytechnics". University World News. Available at: https://www.universityworldnews.com/post.php?story=20140612080509913
160. Yojana Sharma (2014), "Major reform as 600 universities become polytechnics". University World News.
Available at: https://www.universityworldnews.com/post.php?story=20140612080509913
161. Information shared by Microsoft on the company's 'Digital Skills' program.



ACTION 7: ENCOURAGE FOCUS ON SKILLS RATHER THAN JUST QUALIFICATIONS IN BOTH RECRUITMENT AND NATIONAL LABOR MARKET STRATEGIES

Inculcating a focus on skills rather than paper qualifications is essential to ensuring the readiness of workers for the AI economy.[162] This mindset shift would need to be reflected in recruitment practices as well as national labor market strategies:

- **Recruit based on skills instead of educational qualifications alone.** The UK branch of the professional services company Ernst and Young, for example, has removed qualifications as a hiring criteria, stating that they "found screening candidates based on academic performance alone too blunt an approach to recruitment".[163] Within Asia, a 2018 survey by the Ministry of Manpower in Singapore found that for four in 10 vacancies for professionals, managers, executives and technicians (PMETs), academic qualifications were not the main consideration in hiring, with soft skills such as tenacity and problem-solving abilities considered more critical.[164] A series of interviews with employers in Singapore found that such skills were increasingly being assessed through recruitment strategies such as compulsory work stints before hiring decisions are made, and assessment centers where candidates are reviewed based on their behavior under simulated scenarios.[165]

- **Increase focus on skill competency rather than just educational qualifications in national labor market strategies.** Under Malaysia's 'Recognition of Prior Learning' program, 'Malaysian Skills Certificates' are granted to workers who do not have any formal educational qualifications but who have obtained relevant knowledge, experience and skills in the workplace to enhance their career prospects.[166] With these certificates being accredited as officially-recognized qualifications under the 'Malaysian Qualifications Framework', Malaysian companies are able to take guidance from this framework when assessing the suitability of job candidates without formal education but who possess the relevant skills to excel at the job.[167] Since 1994, China has also established a similar skill-based qualification system in order to improve the quality of its workforce and strengthen workers' chances of finding jobs and performing them well.[168] Within 15 years, a total of 18.4 million professionals throughout the country had obtained the required qualifications for their desired roles, and over 100 million qualification certificates for workers of different skill levels were issued.[169]

162. Ng Jun Sen (2018), "Focus on skills, not paper qualifications, to embrace technological change: Lawrence Wong".
Available at: *https://www.straitstimes.com/world/lawrence-wong-focus-on-skills-not-paper-qualifications-to-embrace-technological-change*
163. Statement made in 2015 by Maggie Stillwell, EY's managing partner for talent. Source: Richard Garner (2015), "EY: Firm says it will no longer consider degrees or A-level results when assessing employees". The Independent. Available at: *https://www.independent.co.uk/news/education/education-news/ey-firm-says-it-will-not-longer-consider-degrees-or-a-level-results-when-assessing-employees-10436355.html*
164. Joanna Seow (2018), "Firms looking beyond paper qualifications in hiring PMETs". The Straits Times.
Available at: *https://www.straitstimes.com/singapore/manpower/firms-looking-beyond-paper-qualifications-in-hiring-pmets*
165. Workforce Singapore (2019), "Key things Singapore employers look out for when hiring". Available at: *https://content.mycareersfuture.sg/key-things-singapore-employers-look-hiring/*
166. OECD (2012), Skills development pathways in Asia. Available at: *https://www.oecd.org/cfe/leed/Skills%20Development%20Pathways%20in%20Asia_FINAL%20VERSION.pdf*
167. Malaysian Qualifications Industry, Ministry of Higher Education (2011), "Malaysian Qualifications Framework". Available at: *http://www2.mqa.gov.my/mobile/mqf.html*
168. OECD (2012), Skills development pathways in Asia. Available at: *https://www.oecd.org/cfe/leed/Skills%20Development%20Pathways%20in%20Asia_FINAL%20VERSION.pdf*
169. OECD (2012), Skills development pathways in Asia. Available at: *https://www.oecd.org/cfe/leed/Skills%20Development%20Pathways%20in%20Asia_FINAL%20VERSION.pdf*

KEY AREA OF ACTION: BUILD INCLUSIVENESS IN LABOR MARKET TO EXTEND AI BENEFITS TO ALL WORKERS

ACTION 8: BUILD INCLUSIVE MODELS THAT ALLOW UNDERSERVED GROUPS TO BENEFIT FROM AI

This involves the following action:

- **Develop targeted programs tailored to the needs of specified underserved groups to enhance their employability and ability to benefit from AI.** Microsoft has established a number of targeted programs that address the relative disadvantage faced by youth at risk, women, long-term unemployed individuals, and people with disabilities. Box 4 illustrates examples of such programs implemented by Microsoft, as well as learning points gleaned from the company's experiences. Other companies such as JP Morgan, Facebook and Accenture have also been active in developing skills training programs and job intermediation schemes for these communities.[170]

ACTION 9: CREATE SOCIAL PROTECTION MECHANISMS FOR WORKERS TAKING ON FLEXIBLE FORMS OF LABOR

Such mechanisms are currently rare in Asia, but the following actions could be good starting points:

- **Government-mandated social protection policies that increase income security.** In Australia, workers on short-term contracts are entitled to an increment of 25 percent for each hour worked compared to a worker doing the same job on an ongoing basis.[171] Such workers also benefit from minimum-hour guarantees – employers have to pay them for at least three hours of work each time they engage their services.
- **Private sector to lead by example through internal policies.** For example, Microsoft's policy for on-demand workers includes minimum pay requirements and stipulates that all such workers be paid within one week of completion of the work.[172]
- **Provide avenues for customers to contribute toward social security.** Care.com, a platform for caregivers to seek work, enables families seeking such services (the customers) to contribute to their caregiver's benefits in a way that is similar to how traditional corporate employers fund employee benefits.[173] A similar model could be adopted for on-demand workers in other sectors.

170. Sources include: JP Morgan Chase & Co (2019). Available at: https://www.jpmorganchase.com/corporate/Corporate-Responsibility/new-skills-stories.htm; Facebook (2019), "#SheMeansBusiness". Available at: https://shemeansbusiness.fb.com/sg/; Accenture (2019), "Skills to Succeed Academy". Available at: https://www.accenture.com/au-en/company-skills-succeed-academy-online-learning

171. OECD (2018), The future of social protection: What works for non-standard workers? OECD Publishing, Paris. Available at: https://doi.org/10.1787/9789264306943-en

172. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf

173. Sources include: Giuliano Bonoli (2019), "Ensuring economic security in the gig economy". The Business Times. Available at: https://www.businesstimes.com.sg/opinion/ensuring-economic-security-in-the-gig-economy; Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf

BOX 4:
INSIGHTS FROM MICROSOFT'S SKILLS PROGRAMS FOR UNDERSERVED GROUPS IN ASIA[174]

The company has developed a range of programs to enhance the employability of youth at risk in Asia. For example, in Cambodia, Vietnam and the Philippines, Microsoft's 'Career Pathways' pilot with the NGO, Passerelles Numeriques, delivers computer science courses to disadvantaged youth over a period of 24 to 36 months; these courses are followed up with industry apprenticeships of over five to 10 months. 90 percent of its students have been recruited within two months of graduating.

Microsoft's programs targeted at women have also sought to address current gender biases in the access to digital skills education as well as jobs. The company also organizes an annual 'Digigirlz' event which provides young women aged 14 to 16 the opportunity to meet Microsoft employees, get hands-on training workshops and access to career coaching, with over 20,000 girls engaged across 12 countries in Asia.

Microsoft has also developed a range of programs to address the challenges faced by people with disabilities. In a partnership with the National Institute of Special Education in South Korea, Microsoft developed an introduction to computer science curricula for visually impaired and deaf youth which will be piloted in selected special education schools, with the goal of scaling the adoption of this curriculum nationwide.[175]

Finally, Microsoft has also developed programs that cater to the needs of rural and indigenous communities. In partnership with Acer, the Center for Marinelife Conservation and Community Development and Vietnet ICT, Microsoft's 'Enabling Boat' program taught computer science courses to communities in Vietnam's rural coastal areas.[176] Such courses included applications to the environmental protection of these coastal regions. Indigenous Australians were taught computer science skills under Microsoft's 'Digital Custodians'

program, and how to leverage these skills to celebrate their culture.[177]

These programs have informed the following insights for developing skills and employability schemes for underserved groups:

- **Programs with industry-recognized qualifications and job-matching opportunities help beneficiaries secure jobs.** Such schemes enable beneficiaries to secure jobs based on the skills they learn at these courses.

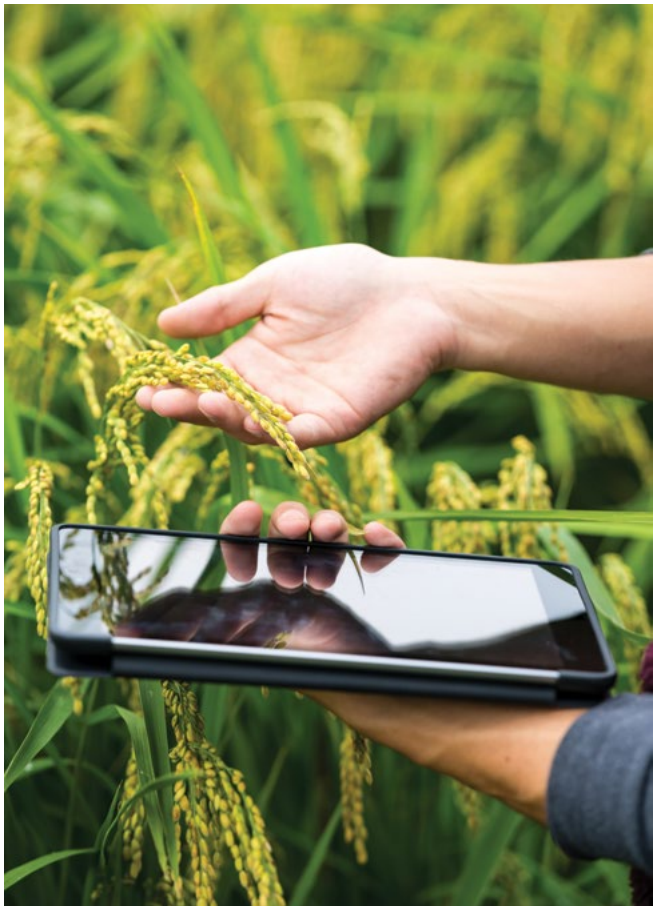
- **Tailoring programs to the unique needs of the group enhances their effectiveness.** The programs targeted at women were highly successful as they had incorporated gender-responsive principles such as the showcasing of female STEM role models and the demonstration of positive social impact from applying the taught skills.[178]

- **Employing an iterative process that takes into account feedback from the intended beneficiaries.** Numerous feedback-based iterations were conducted to ensure that the courses for individuals with disabilities were effective for them.

174. Information shared by Microsoft on the company's 'Careers Pathways' and 'Digital Skills' programs.
175. JA Korea (2019). Available at: http://www.nise.go.kr/sedu/pt/home.html
176. Microsoft (2019). "The Enabling Boat connects youth in coastal Vietnam". Available at: https://www.microsoft.com/inculture/enabling-boat-connects-youth-coastal-vietnam/
177. Microsoft (2019). "When dreams become (augmented) reality: preserving Australia's Indigenous cultures". Available at: https://news.microsoft.com/life/indigenous-cultures/
178. Microsoft (2018), Closing the STEM gap: Why STEM classes and careers still lack girls and what we can do about it.
Available at: https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE1UMWz

Appendix:

REVIEW OF EXISTING LITERATURE ON AI IN ASIA



This section summarizes existing studies in the AI domain focusing on Asia and the eleven markets of interest – Australia, India, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea, Thailand and Vietnam. It includes three main sections:

1. **Macroeconomic benefits** of AI to different economies in Asia, including to GDP, productivity, and in social areas

2. The likely impacts of AI on **the labor market** in Asia, including a) Jobs lost; b) Jobs gained; c) workforce participation; d) productivity; e) incomes; f) worker well-being.

3. The **action agenda** for governments, the private sector and civil society in preparing for AI.

SUMMARY INSIGHTS

MACROECONOMIC BENEFITS

- **Economic benefits.** There are several Asia-focused studies on the economic benefits of AI technologies. Such benefits are typically quantified in the form of improved labor productivity and their impact for projected GDP growth increments. For example, the McKinsey Global Institute (MGI) estimated that AI technologies could bring about increased year-on-year growth of between 0.6 percent (in India) to 1.6 percent (in South Korea) between 2017 and 2030.[179] A number of studies also seek to develop indices to measure the extent to which different economies could benefit from AI, based on a range of factors including workforce skill profile, labor costs, sectoral split and level of digital infrastructure.[180] However, three gaps emerge from the literature review: one, some studies tend to focus on the broader topic of automation, without separating out the benefits that accrue specifically to AI; two, there is a lack of detailed country-level analyses particularly for smaller but emerging Asian economies such as Vietnam and Thailand; three, there is a lack of analysis of economic impacts at the sectoral level, which is critical since different sectors have different AI applications and adoption potential.

- **Social impact.** Analysis of the social impacts of AI in the context of Asian economies has been more limited, and lack the robustness of AI research for the rest of the world. Asia-focused studies that do include analysis of social impacts tend to focus either on 'consumer benefits' from a business angle (e.g. greater product customization leading to greater demand and profits), or specific social challenges faced by certain economies (e.g. Japan's ageing workforce). Such analyses are also rarely backed by robust research and are often based on anecdotal evidence. The wider AI literature offers a variety of interesting insights on the potential application of AI technologies across social domains such as healthcare, hunger, inclusiveness, environment, education and disaster response.[181] Given the range of social challenges faced in rapidly urbanizing Asia, there is much room for deeper analysis in this area.

179. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: *https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning*
180. Sources include: IBA Global Employment Institute (2017), Artificial intelligence and robotics and their impact on the workplace. Available at: *https://www.ibanet.org/Document/Default.aspx?DocumentUid=c06aa1a3-d355-4866-beda-9a3a8779ba6e;* McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy. Available at: *https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning;* PricewaterhouseCoopers (2017), Sizing the prize: What's the real value of AI for your business and how can you capitalise? Available at: *https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf*
181. McKinsey Global Institute (2018), Notes from the AI frontier: Applying AI for social good.
Available at: *https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good*

LABOR MARKET IMPACT

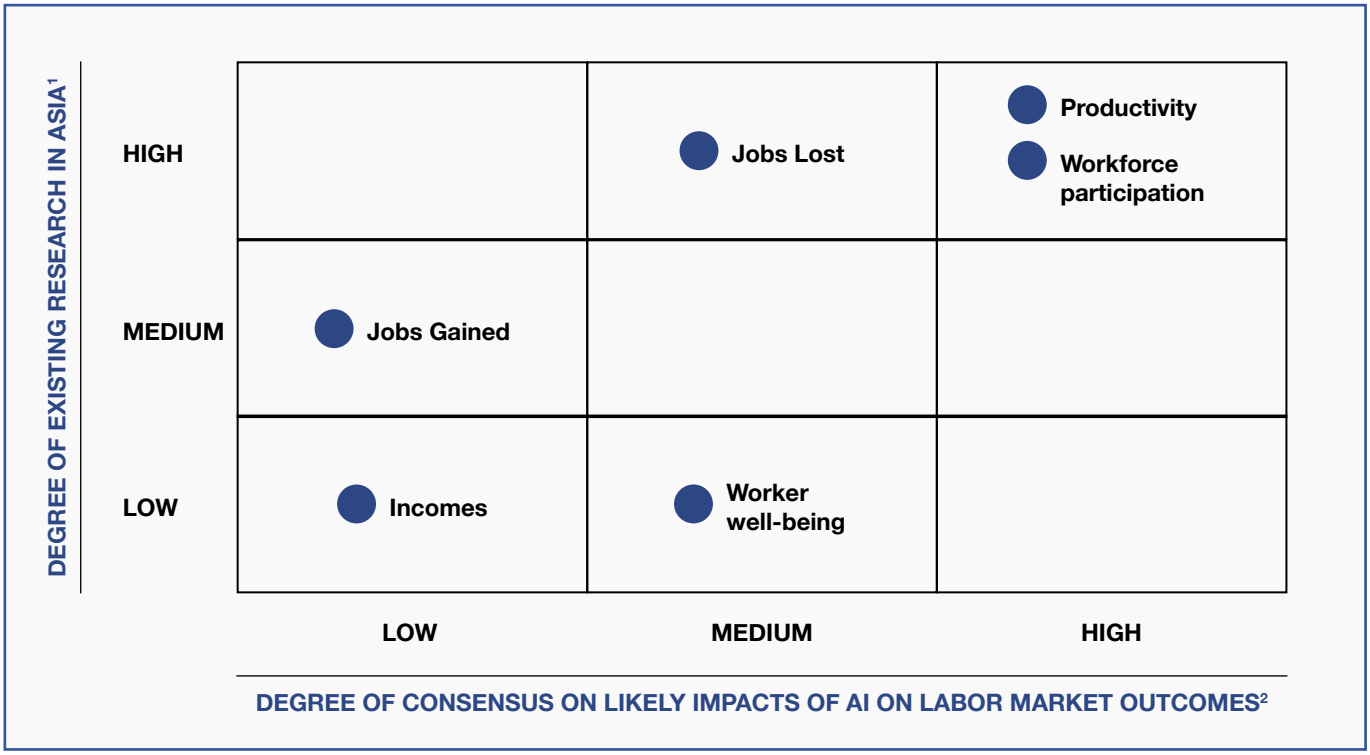
The degree of focus and consensus on labor market impact varies significantly by topic (Exhibit A1):

- **Jobs lost:** There are several reports on how digital transformation and AI technologies could affect work activities in Asia. These focus mainly on job displacement projections and identifying which work activities have the potential to be automated. For instance, in the context of major ASEAN economies, studies by MGI and Oxford Economics have estimated that AI has the potential to automate roughly half of the work activities and displace these jobs.[182] Such job displacement analyses, however, tend to be simplistic in their treatment of labor market impacts as they do not address the dynamic implications of re-skilling responses, as well as the creation of new jobs from AI. Furthermore, studies, thus far, have not measured the impact of specific AI technologies (e.g. chatbots, speech recognition tools) on labor markets; many have also tended to focus on broader automation concerns rather than AI-specific implications.

- **Jobs gained:** Few studies have been conducted on the positive job creation impacts of AI exclusively in Asia. One study in China projects the number of jobs that could be gained due to the income effect of AI, alongside those that could potentially become displaced.[183] Another study on the six economies in ASEAN does project future job gains across sectors and occupations to 2028, but was based on a general equilibrium model that assumed stable long-term employment levels.[184] As a result, it did not attempt to forecast changes in employment,

EXHIBIT A1:

THE DEGREE OF EXISTING RESEARCH AND THE CONSENSUS OF THE LIKELY IMPACTS OF AI ON VARIOUS LABOR MARKET OUTCOMES VARIES IN ASIA



1 Refers to existing academic research on each topic for regions within Asia. "Low" reflects less than one-third of the focus countries in Asia having existing research on the topic; "Medium" reflects between one-third and two-thirds of focus countries in Asia having existing research on the topic; and "High" reflects more than two-thirds of focus countries in Asia having research on the topic.
2 Refers to the degree of consensus of the impacts of AI on the labor market aspect. "Low" reflects fundamental differences in predictions of the likely impact by country or by different researchers; "Medium" reflects a large degree of consensus, but differences in a limited number of countries or researchers; "High" reflects large consensus across countries and researchers.

SOURCE: AlphaBeta analysis

182. Sources include: McKinsey Global Institute (2017), Artificial Intelligence and Southeast Asia's Future. Available at: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20SE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.ashx; Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
183. PricewaterhouseCoopers (2018), What will be the net impact of AI and related technologies on jobs in China? Available at: https://www.pwc.com/gx/en/issues/artificial-intelligence/impact-of-ai-on-jobs-in-china.pdf
184. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132

which prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI. Other studies that examine the job creation impacts of AI tend to focus on economies outside of Asia (e.g., PricewaterhouseCooper's analysis for the UK[185]), are global in scale (e.g., WEF's study on jobs lost and gained due to AI[186]), or do not isolate the impacts that come directly from AI as other labor demand catalysts which are not necessarily related to AI are also taken into account (e.g., MGI's analysis of future job losses and gains to 2030 across 46 economies[187]).

- **Workforce participation:** The implications of AI-enabled job matching platforms and tools for workforce participation rates have largely only been qualitatively examined using case studies. With regards to AI-enabled job platforms, existing quantitative estimates of economic benefits relate broadly to all types of job platforms, including those that are not AI-enabled.[188] Further analysis could be done to quantify the socio-economic implications of AI-enabled job matching platforms for each country.

- **Productivity:** Several studies discuss AI-enabled impacts to labor productivity. For example, a study by Oxford Economics estimated that for the six largest ASEAN economies, by 2028, 28 million fewer workers (which is equivalent to more than 10 percent of the region's current workforce) would be required to produce the same level as output currently.[189] Beyond economy-wide GDP impacts, such studies, however, do not investigate the further implications of such productivity benefits, for instance, the time savings accrued to different job classes.

- **Incomes:** Research on AI impacts to worker incomes has been limited, with few studies going beyond anecdotal and generalizing analyses of implications to existing income inequalities between workers of different skill classes. Such studies often fail to address two issues: 1, explain the detailed shifts in income based on the specific employment and skill profiles of individual economies; 2, quantify the income improvements that come from transitioning workers to higher order thinking jobs.

- **Worker well-being:** Three aspects of worker well-being were examined in the literature – workplace safety, job satisfaction and leisure. A number of studies anecdotally discuss the benefits of AI for workplace safety using case studies, but, except in Australia, none have attempted to quantify such benefits. There is also a lack of analysis on how such benefits differ across sectors and job profiles. With regards to job satisfaction, while the AI-enabled transition from manual and repetitive tasks to creative and higher-order thinking roles are widely discussed in the literature, direct allusions to how such shifts could potentially drive greater job satisfaction are weak. On leisure, the literature contains analyses of AI-driven labor productivity benefits in different economies, but no explicit references have been made to impacts on the amount of leisure time of workers.

ACTION AGENDA

There are existing high-level recommendations, across separate publications, to guide stakeholders on the next steps.[190] There are also various national strategies on AI, outlining the focus of the governments.[191] However, a comprehensive benchmarking of 'best practice' lessons that address the unique challenges Asia faces in maximizing the benefits and minimizing the costs of AI has not been conducted.

185. PricewaterhouseCoopers (2018), "AI will create as many jobs as it displaces by boosting economic growth".
Available at: *https://www.pwc.co.uk/services/economics-policy/insights/the-impact-of-automation-on-jobs.html*
186. World Economic Forum (2018), The future of jobs report 2018. Available at: *https://www.weforum.org/reports/the-future-of-jobs-report-2018*
187. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*
188. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age. Available at: *https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age.* The online job matching platforms analyzed in this study are defined based on data usage and functionality. Functionality can take three forms: matching individuals with traditional jobs, online marketplaces for contingent work and talent management. The trouble with mapping the impact of such platforms directly to the benefits of AI for the economy is that not all the platforms analyzed make use of AI technologies.
189. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf*
190. Sources include: McKinsey Global Institute (2017), Artificial Intelligence and Southeast Asia's Future. Available at: *https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/AI%20and%20SE%20ASIA%20future/Artificial-intelligence-and-Southeast-Asias-future.ashx;Cognizant* (2018), Humans + Intelligent Machines: Mastering the Future of Work Economy in Asia Pacific. Available at: *https://www.cognizant.com/whitepapers/humans-plus-intelligent-machines-mastering-the-future-of-work-economy-in-asia-pacific-codex3873.pdf;* Pacific Economic Cooperation Council (2018), State of the region 2018. Available at: *https://pecc.org/resources/regional-cooperation/2584-state-of-the-region-2018-2019/file*
191. An example is CIFAR (2018), Building an AI World: Report on National and Regional AI Strategies.
Available at: *https://www.cifar.ca/cifarnews/2018/12/06/building-an-ai-world-report-on-national-and-regional-ai-strategies*

COUNTRY-SPECIFIC INSIGHTS

The degree of focus on topics varies by country, particularly when it comes to labor market outcomes (refer to Exhibit 3 under 'Project Approach'):

AUSTRALIA

- **Macroeconomic benefits:** There are several Australia-focused studies on the macroeconomic impacts of automation and AI technologies. For example, AlphaBeta in Australia[192] found that automation could deliver a A$2.2 trillion (US$1.6 trillion) boost to Australia's GDP between 2015 and 2030 from productivity gains, while MGI estimated this value to be between A$1.1 to A$4 trillion (US$0.8 to US$2.8 trillion), and that AI could bring about a productivity-fueled year-on-year increase of 1.2 percent in GDP growth to 2030.[193]

- **Jobs lost:** There are several studies that discuss the detailed impact of AI on Australia's labor market, particularly with respect to shifts within the type of tasks workers will perform, and implications for reskilling. AlphaBeta's work in Australia, for example, found that automation had caused a significant shift from 'manual' and 'routine' tasks to 'interpersonal' and 'creative' tasks over the last 15 years, and MGI found that 23 percent of work activities in Australia could be potentially displaced due to automation.[194] Implications for reskilling in the labor market across different sectors and job functions have also been well elaborated.[195]

- **Jobs gained:** Existing analysis on this has been more limited than for 'jobs lost', though several studies have sought to illustrate the future job gains.[196] However, few isolate the different job creation effects of AI. The study by MGI, for example, projects that by 2030, four million jobs could be created to offset the estimated 3.5 million jobs at high risk of AI-related displacement in Australia.[197] However, these four million jobs are a result of both AI-relevant and irrelevant labor demand catalysts, such as investment in energy and infrastructure.

- **Productivity:** The literature contains detailed estimates of productivity from AI and automation in Australia's context. MGI, for example, found that automation could boost productivity growth by 50 to 155 percent (depending on pace of adoption).[198]

- **Incomes:** There are also estimates of worker income improvements due to AI adoption in Australia available in the literature. AlphaBeta's study found that by allowing the average worker to spend two less hours per week on manual and routine tasks, and reallocate this time towards non-automatable tasks such as 'interpersonal' and 'creative' tasks, AI could increase real wages for low-skilled workers by 10 percent in 2030, which is equivalent to an annual income gain of approximately A$6,000 (US$4,280) per worker.[199]

- **Workforce participation:** There is a scarcity of analysis on the impact of AI-enabled job matching applications. While there is literature on the impact of online job matching platforms on Australia's employment and economy,[200] the trouble with such approaches is that they are not confined to AI-enabled platforms alone, but relate broadly to all job matching platforms, including non-AI-enabled ones (e.g. online job directories).

- **Worker well-being:** AlphaBeta's study in Australia found that workplace safety could improve significantly as more hazardous elements of jobs become automated, with potential for the total

192. AlphaBeta (2017), The Automation Advantage. Available at: http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
193. Sources include McKinsey Global Institute (2019), Australia's automation opportunity: Re-igniting productivity and inclusive income growth. Available at: https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth; McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
194. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
195. AlphaBeta (2018), Future skills: The rise of machines will drive a need for more lifelong learning in Australia. Available at: https://www.alphabeta.com/our-research/future-skills-report/
196. Deloitte (2019), The path to prosperity: Why the future of work is human. Available at: https://www2.deloitte.com/au/en/pages/building-lucky-country/articles/path-prosperity-future-work.html
197. McKinsey Global Institute (2019), Australia's automation opportunity: Reigniting productivity and inclusive income growth.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth
198. McKinsey Global Institute (2019), Australia's automation opportunity: Reigniting productivity and inclusive income growth.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth
199. AlphaBeta (2017), The Automation Advantage. Available at: http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
200. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age. Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age. The online job matching platforms analyzed in this study are defined based on data usage and functionality. Functionality can take three forms: matching individuals with traditional jobs, online marketplaces for contingent work and talent management. The trouble with mapping the impact of such platforms directly to the benefits of AI for the economy is that not all the platforms analyzed make use of AI technologies.

number of work days lost to injuries sustained from physical work in the Australian economy to fall by 11 percent in 2030.[201] The study also found that job satisfaction could increase significantly particularly for low-skilled workers as automation and AI remove the more manual and less enjoyable aspects of jobs.[202] With regards to worker leisure, the literature discusses how timeshares allocated to different types of tasks will be re-allocated from automatable to non-automatable work but shed little light on whether the absolute amount of time spent on work could reduce as a result of automation.[203]

- **Action agenda:** The Australian government has a comprehensive strategy to leverage AI for economic growth. The federal government earmarked A$29.9 million (US$20.9 million) over four years to enhance the country's efforts in AI technology development in the 2018-19 budget, part of which would include the development of a national AI Ethics Framework, technology roadmap and a set of standards.[204] Much focus has been placed on developing applications for the country's key export sector, agriculture. The government agency responsible for scientific research, CSIRO (Commonwealth Scientific and Industrial Research Organization), for example, launched a new AI-powered platform to bring together a trove of land use data for agribusinesses to better predict performance.[205]

INDIA

- **Macroeconomic benefits:** There are several studies on AI-enabled GDP impact in India. For example, MGI estimates AI-led growth in India to be 0.6 percent year-on-year between 2017 and 2030, acknowledging this to be comparatively lower than developed economies due to the country's low automation potential and labor costs.[206]

- **Jobs lost:** Several organizations (MGI, IBA Global Employment Institute, World Bank, PwC, and Citibank) have estimated the extent of work that could be potentially automated. Projections range from 9 to 20 percent of work hours (depending on the sector).[207] Many reports support the notion that automation could put a substantial number of jobs at risk – estimates vary from 6 percent of India's workforce to 70 percent of jobs.[208] It should be noted that the majority of this research examined the broader theme of automation, rather than AI alone. There were, however, surveys conducted to understand how AI is reshaping jobs and whether India is ready for AI-driven changes.[209]

- **Jobs gained:** There are no existing studies that investigate potential job creation impacts directly due to AI adoption in India. A study by MGI does seek to illustrate future job gains in India that could offset potential AI-related displacement losses, but does not isolate the impact of AI alone as it takes into account other labor demand catalysts that are not related to AI.[210]

- **Workforce participation:** Beyond anecdotal evidence of how AI improves the productivity of job matching tasks in India's recruitment industry, there is little literature quantifying economy-wide impacts on jobs and GDP.[211] Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without isolating those derived from AI-enabled ones.[212]

- **Productivity:** Productivity impact of AI for India are available in the literature. Accenture estimates that AI could lead to a year-on-year productivity

201. AlphaBeta (2017), The Automation Advantage. Available at: http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
202. AlphaBeta (2017), The Automation Advantage. Available at: http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
203. AlphaBeta (2017), The Automation Advantage. Available at: http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
204. Future of Life Institute (2018), "AI policy - Australia". Available at: https://futureoflife.org/ai-policy-australia/
205. Kate Langford (2019), "New analytics platform to help future-proof farms", CSIRO. Available at: https://www.csiro.au/en/News/News-releases/2019/analytics-platform-to-help-future-proof-farms
206. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
207. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
208. The estimate of 6 percent of workforce was derived from: McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages. The estimate of 70 percent of jobs was derived from: World Bank (2016), World Development Report 2016. Available at: http://www.worldbank.org/en/publication/wdr2016
209. All India Management Association and PricewaterhouseCoopers (2018), How AI is reshaping jobs in India.
Available at: https://www.pwc.in/assets/pdfs/publications/2018/how-ai-is-reshaping-jobs-in-india.pdf
210. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
211. Malini Goyal (2017), "How artificial intelligence is reshaping recruitment, and what it means for the future of jobs", The Economic Times. Available at: https://economictimes.indiatimes.com/jobs/how-artificial-intelligence-is-reshaping-recruitment-and-what-it-means-for-the-future-of-jobs/articleshow/60985946.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
212. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age

improvement of 1.3 percent between 2017 and 2035 – equivalent to US$957 million in economic impact.[213] Other studies suggest that India's limited digital infrastructure (e.g. low access to high-quality Internet) could threaten its ability to enjoy the full extent of productivity benefits that AI has to offer.[214]

- **Incomes:** There are few reports discussing the impact of AI on incomes; a PwC survey suggests a strong belief by business representatives in the potential of AI to improve income equality in India, but this stems from improved consumer benefits rather than impacts to worker wages.[215]

- **Worker well-being:** A number of studies anecdotally discuss the benefits of AI for workplace safety using case studies, but none have attempted to quantify this impact and at an economy-wide level.[216] With regards to job satisfaction, while the AI-enabled transition from manual and repetitive tasks to creative and higher-order thinking roles in India's context is discussed in the literature, direct allusions to how such shifts help drive greater job satisfaction are weak.[217] While labor productivity benefits of AI in India have been discussed at length, no explicit references have been made to impacts on the amount of leisure time of workers.

- **Action agenda:** There are both high-level and specific key considerations, for instance, by the Centre for Internet and Society, for Indian stakeholders.[218] The national think-tank, Niti Aayog, also released the 'National Strategy for Artificial Intelligence' that provides over 30 policy recommendations.[219] Again, however, consistent with the Asia-wide evidence, there is a lack of comprehensive best practice insights from across Asia and what it could mean in India.

INDONESIA

- **Macroeconomic benefits:** AI impact studies for Indonesia appear to be limited to analyses of the job market and the level of adoption, without any estimates of implications at a broader macroeconomic level (e.g. GDP growth impacts). Any AI-linked economic impacts are examined as part of broader studies on Indonesia's digital economy, and often at the technology application or sectoral level.

- **Jobs lost:** There have been detailed studies on the impact of AI on jobs in Indonesia, both economy-wide and by sector. MGI, for example, estimated that such technologies have the potential to automate 52 percent work activities in the country.[220] Oxford Economics undertake a detailed sectoral analysis of the potential number of jobs that would be displaced and created, estimating that a total of two million existing roles will 'disappear' from the labor market, pushing these workers into other industries and occupations.[221]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Indonesian economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with that of jobs gained due to AI.[222]

- **Workforce participation:** Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without a breakdown into AI-enabled ones.[223]

213. Accenture (2017), Accelerating India's economic growth with artificial intelligence.
Available at: https://www.accenture.com/_acnmedia/PDF-68/Accenture-ReWire-For-Growth-POV-19-12-Final.pdf#zoom=50
214. Sources include: Brookings Institute (2018), Harnessing the future of AI in India. Available at: https://www.brookings.edu/research/harnessing-the-future-of-ai-in-india/; McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
215. In this PwC survey, 47 percent of respondents believed that AI was important to improving income equality in India. Source: PricewaterhouseCoopers (2018), Artificial intelligence in India – hype or reality: Impact of artificial intelligence across industries and user groups. Available at: https://www.pwc.in/assets/pdfs/consulting/technology/data-and-analytics/artificial-intelligence-in-india-hype-or-reality/artificial-intelligence-in-india-hype-or-reality.pdf
216. Sources include: PricewaterhouseCoopers (2018), Artificial Intelligence in India – hype or reality: Impact of artificial intelligence across industries and user groups. Available at: https://www.pwc.in/assets/pdfs/consulting/technology/data-and-analytics/artificial-intelligence-in-india-hype-or-reality/artificial-intelligence-in-india-hype-or-reality.pdf; NITI Aayog (2018), National strategy for Artificial Intelligence: #AIFORALL. Available at: http://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf
217. NASSCOM, FICCI, EY (2018), Future of jobs in India: A 2022 perspective. Available at: https://www.ey.com/in/en/services/advisory/people-advisory-services/ey-future-of-jobs-in-india
218. The Centre for Internet & Society (2018), "AI in India: A Policy Agenda". Available at: https://cis-india.org/internet-governance/blog/ai-in-india-a-policy-agenda
219. Niti Aayog (2018), National Strategy for Artificial Intelligence: #AIFORALL. Available at: http://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf
220. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
221. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
222. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
223. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age

- **Productivity:** A survey on AI by Microsoft and IDC found that AI could improve employee productivity gains in Indonesia by 46 percent by 2021, as compared to a business-as-usual scenario of no AI adoption.[224]

- **Incomes:** There is also little analysis of the direct impact of AI on workers' incomes; existing income-related analysis appears to be confined to the indirect 'income effect' posed by AI technologies.[225]

- **Worker well-being:** There is limited analysis of AI impacts on workplace safety in Indonesia. With regards to job satisfaction, the study by Oxford Economics estimate the displacement effects of automatable jobs such as 'routine administration' by non-automatable jobs such as 'critical and creative thinking'; however, direct allusions to how such shifts help drive greater job satisfaction are weak.[226] Finally, on leisure, while the literature contains AI-induced productivity benefits in Indonesia, no explicit references have been made to impacts on the amount of leisure time of workers.

- **Action agenda:** While there is limited literature on a policy by the Indonesian government to develop AI for the economy, several sources point toward a number of private sector-led initiatives. For example, e-commerce platform Tokopedia sought to tackle the country's shortage of digital talent by launching an AI center in collaboration with the University of Indonesia.[227] A 2018 study by Forrester Consulting on behalf of technology company Appier also shows that Indonesia ranked first in the Asia-Pacific region in implementing AI, with 65 percent of respondents stating that they had either implemented AI in their business or were expanding or upgrading current AI capabilities.[228]

JAPAN

- **Macroeconomic benefits:** There is substantial literature on the macroeconomic benefits of AI to Japan's economy, particularly in relation to the potential productivity impact for its ageing population.[229] For example, Accenture and Frontier Economics found that AI adoption could more than triple the projected annual growth rate of Japan's Gross Value Added (GVA) in 2035 from the estimated baseline growth rate of 0.8 percent, to become 2.7 percent under a steady-state scenario of AI adoption.[230] This translates into an additional US$2 trillion in total GVA till 2035.

- **Jobs lost:** There is a significant volume of detailed research from organizations such as the OECD and Nomura Research Institute covering the potential automation of work activities, individuals' and firms' perceptions of AI-related impact, and the country's reskilling needs. Owing to Japan's high level of AI adoption, job displacement impacts have been widely discussed. Estimates of the potential extent of automated work include 26 to 52 percent of work hours, and nine to 49 percent of jobs.[231] Some studies further investigate the variation in impacts due to geography, workers' gender and age, and occupational risk profiles.[232] Others have also taken into account the potential magnitude of new job profiles induced by AI.[233] However, some of these studies focus broadly on automation, rather than AI.

224. Microsoft and IDC Asia Pacific (2019), Future Ready Business: Assessing Asia Pacific's Growth Potential Through AI.
Available at: https://news.microsoft.com/en-my/2019/04/02/artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-malaysia-by-2021-microsoft-study/
225. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
226. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
227. The Jakarta Post (2019), "Tokopedia, University of Indonesia launch AI research center".
Available at: https://www.thejakartapost.com/news/2019/04/05/tokopedia-university-of-indonesia-launch-ai-research-center.html
228. The Jakarta Post (2018), "Indonesia leads Asia-Pacific in AI implementation, study shows".
Available at: https://www.thejakartapost.com/news/2018/09/05/indonesia-leads-asia-pacific-in-ai-implementation-study-shows.html
229. IMF (2018), Land of the Rising Robots. Available at: https://www.imf.org/external/pubs/ft/fandd/2018/06/japan-labor-force-artificial-intelligence-and-robots/schneider.htm
230. Accenture and Frontier Economics (2017), AI is the future of growth. Available at: https://www.accenture.com/_acnmedia/PDF-57/Accenture-AI-Economic-Growth-Infographic.pdf#zoom=50
231. Sources include: McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages; OECD (2016), The risk of automation for jobs in OECD countries. Available at: https://www.oecd-ilibrary.org/docserver/5jlz9h56dvq7-en.pdf?expires=1551857686&id=id&accname=guest&checksum=2E68D0CEBAC2FCA6E832213C4CC33232; Dave Gershgorn (2017), "Worried about AI taking your job? It's already happening in Japan", World Economic Forum. Available at: https://www.weforum.org/agenda/2017/01/worried-about-ai-taking-your-job-its-already-happening-in-japan; PwC (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf
232. There are some studies that tried to understand the impact of automation and technologies on the job safety of older workers in Japan. An example is CSIRO (2018), Workplace Safety Futures: The impact of emerging technologies and platforms on work health and safety and workers' compensation over the next 20 years. Available at: https://www.data61.csiro.au/~/media/D61/Files/WorkPlaceSafety_Accessible.html?la=en&hash=C7BE47479D0F4D160BBAC19A991190CA82616E363
233. Sources include: Hamaguchi Nobuaki and Kondo Keisuke (2018), Regional employment and artificial intelligence in Japan, RIETI. Available at: https://www.rieti.go.jp/jp/publications/dp/18e032.pdf; David, B (2017), "Computer Technology and Probable Job Destructions in Japan: An Evaluation", Journal of the Japanese and International Economies 43: 77-87; McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages; Nomura Research Institute and University of Oxford (2017), NRI's future timeline: 2017-2020. Available at: https://www.nri.com/en/journal/2017/0123

- **Jobs gained:** There are no existing studies that investigate potential job creation impacts due to AI in Japan. A study by MGI does seek to illustrate future job gains in India that could offset potential AI-related displacement losses, but does not isolate the impact of AI alone as it takes into account other labor demand catalysts that are not relevant to AI.[234]

- **Workforce participation:** Consistent with the other countries, economy-wide estimates of job matching platforms do not relate directly to AI-specific benefits, but to all types of digital job matching platforms.[235]

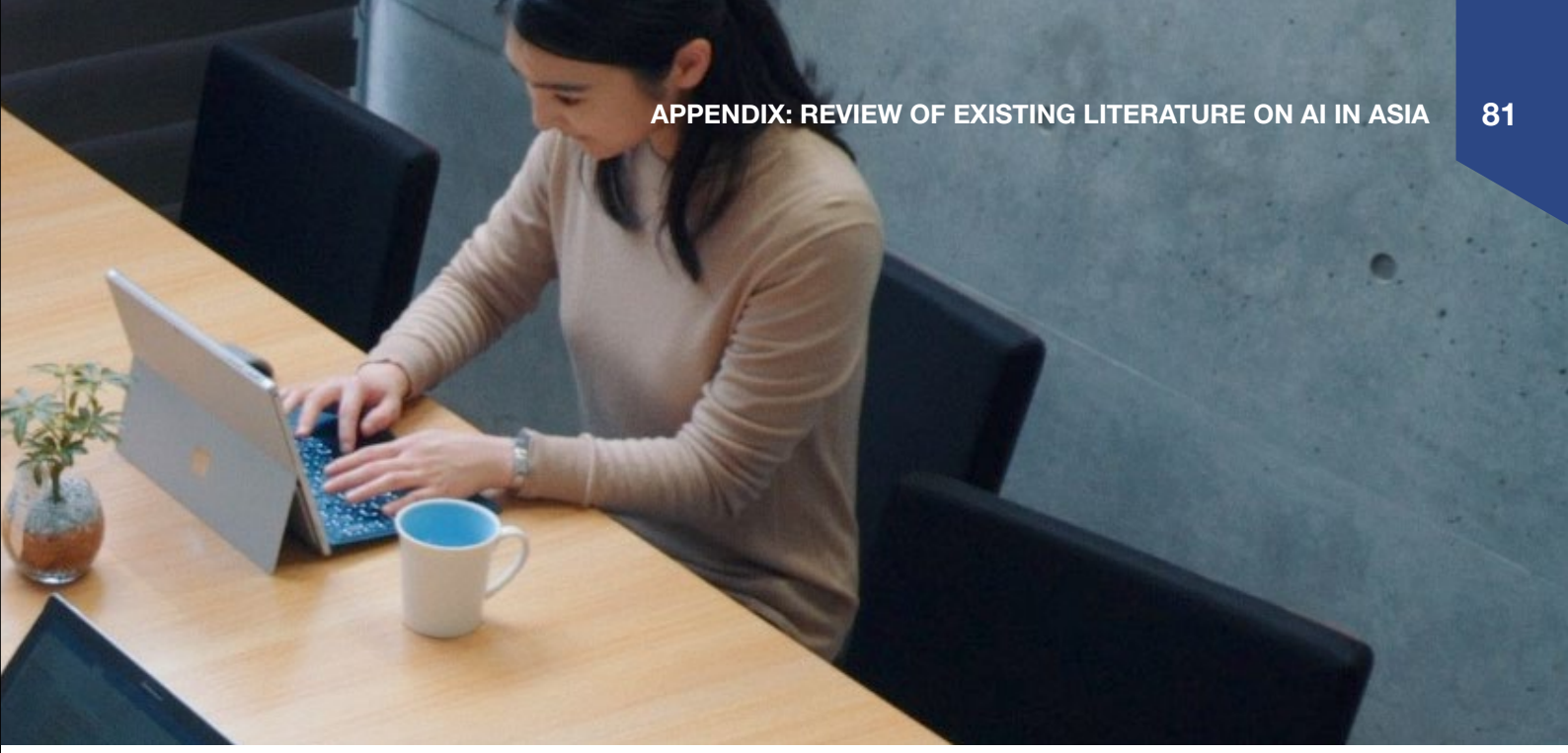
- **Productivity:** There are several estimates of AI-enabled labor productivity in Japan available. Accenture and Frontier Economics, for example, projects an increase of 34 percent in 2035, as compared to a baseline scenario without AI.[236] The survey on AI by Microsoft and IDC found that AI could improve employee productivity gains in Japan by 26 percent by 2021, as compared to a business-as-usual scenario of no AI adoption.[237]

- **Incomes:** Few studies analyze the impact of AI to incomes in Japan. Those that do investigate the impact on income inequality arising from the disproportionate impact of AI on different job classes, but their analyses do not go beyond theoretical generalizations.[238]

- **Worker well-being:** Several studies have been done on the improvements that AI technologies bring to workplace safety, particularly with regard to older workers who are more susceptible to health and safety risks.[239] Studies and surveys have also explored job satisfaction impacts of AI, reflecting that while this does increase with AI adoption, so does worker stress from having to learn more new skills at a faster rate.[240] With regards to leisure, no explicit references have been made to impacts of AI on the amount of leisure time of workers.

- **Action agenda:** Other than the 'Artificial Intelligence Technology Strategy' released in 2017, there are limited studies that explore the specific 'next steps' or focus areas for the various stakeholders, or incorporate relevant insights from other countries.[241]

234. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*
235. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: *https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age*
236. Accenture and Frontier Economics (2019), "Artificial intelligence is the future of growth". Available at: *https://www.accenture.com/sg-en/insight-artificial-intelligence-future-growth*
237. Microsoft and IDC Asia Pacific (2019), Future Ready Business: Assessing Asia Pacific's Growth Potential Through AI.
Available at: *https://news.microsoft.com/en-my/2019/04/02/artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-malaysia-by-2021-microsoft-study/*
238. Mizuho (2017), Will AI take away our jobs? Our concern should not be the loss of jobs but the mismatch. Available at: *https://www.mizuho-ri.co.jp/publication/research/pdf/eo/MEA170828.pdf*
239. CSIRO and Data 61 (2018), Workplace safety futures. Available at: *https://www.data61.csiro.au/en/Our-Work/Future-Cities/Planning-sustainable-infrastructure/workplacesafety*
240. Sources include: *https://voxeu.org/article/impact-ai-and-information-technologies-worker-stress* ; Kuroda, S, and I Yamamoto (2016), "Workers' mental health, long work hours, and workplace management: Evidence from workers' longitudinal data in Japan", RIETI Discussion Paper Series 16-E-017; Kuroda, S, and I Yamamoto (2018b), "Good boss, bad boss, workers' mental health and productivity: Evidence from Japan", Japan and the World Economy 48: 106-118.
241. Future of Life Institute (2019), "AI policy – Japan". Available at: *https://futureoflife.org/ai-policy-japan/*



MALAYSIA

- **Macroeconomic benefits:** There are several studies on projected AI-driven macroeconomic impacts for Malaysia. For example, MGI estimates AI-led growth in Malaysia to be 1.2 percent year-on-year between 2017 and 2030.[242] A recent study by Microsoft and IDC reflected that AI technologies will allow the rate of innovation in Malaysia's economy to almost double by 2021.[243]

- **Jobs lost:** There are a number of studies that demonstrate the impact of AI on jobs in Malaysia, both economy-wide and by sector. MGI, for example, estimates that such technologies have the potential to automate 51 percent of work activities in the country.[244] Oxford Economics undertake a detailed sectoral analysis of the potential number of jobs that would be displaced and created, estimating that a total of 250,000 existing roles will 'disappear' from the labor market, pushing these workers into other industries and occupations.[245]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Malaysian economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI.[246]

- **Workforce participation:** Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without isolating those from AI-enabled ones.[247]

- **Productivity:** AI labor productivity impacts have been examined in a few studies and surveys. The survey by Microsoft and IDC, for example, found that AI would increase employee productivity by 46 percent in Malaysia by 2021.[248]

- **Incomes:** No analysis has been done on AI-driven wage impacts for Malaysian workers, however.

- **Worker well-being:** Though limited, there is some literature on the importance of using AI to improve workplace safety in Malaysia's context.[249] These

242. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: *https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning*
243. Microsoft and IDC Asia Pacific (2019), Future Ready Business: Assessing Asia Pacific's Growth Potential Through AI. A
vailable at: *https://news.microsoft.com/en-my/2019/04/02/artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-malaysia-by-2021-microsoft-study/*
244. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: *https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages*
245. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: *https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf*
246. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: *https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132*
247. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: *https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age*
248. Microsoft and IDC Asia Pacific (2019), Future Ready Business: Assessing Asia Pacific's Growth Potential Through AI.
Available at: *https://news.microsoft.com/en-my/2019/04/02/artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-malaysia-by-2021-microsoft-study/*
249. Tan Sri Lee Tham Thye (2018), "Boost automation to boost safety", New Straits Times. Available at: *https://www.nst.com.my/opinion/letters/2018/12/436476/boost-automation-boost-safety*

studies, however, fail to quantify such benefits and assess their variation across different sectors. No surveys or studies have been done to understand the potential impact of AI on job satisfaction nor on leisure.

- **Action agenda:** There is comprehensive literature on Malaysia's action agenda for AI. This includes plans by the government to develop a 'National Artificial Intelligence Framework' as an expansion of its existing 'National Big Data Analytics Framework' in October 2017.[250] To accelerate AI deployment by firms, the government will also establish a 'Digital Transformation Acceleration Program' for medium and large companies, as well as 'Digital Transformation Labs' to assist in the creation of new digital products and services.

NEW ZEALAND

- **Macroeconomic benefits:** There are several studies on the AI-enabled GDP impacts in New Zealand. For example, the AI Forum for New Zealand estimates that AI has the potential to increase New Zealand's GDP by up NZ$54 billion (US$35.8 billion) by 2035.[251]

- **Jobs lost:** Several organizations (NZ Institute of Economic Research, PricewaterhouseCoopers, Hays) have estimated the extent of work that could be potentially automated. Projections range from 16 to 46 percent of work hours, depending on the estimation approach taken.[252]

- **Jobs gained:** The study by the AI Forum for New Zealand illustrates two different channels through which AI could create jobs in the country – directly in the technology sector, and indirectly in other relevant sectors. It examines the potential job creation impact based on historical trends.[253]

- **Workforce participation:** Beyond anecdotal evidence of how AI improves the productivity of job matching tasks in New Zealand's recruitment industry, there is little literature quantifying economy-wide impacts of AI on workforce participation rates.[254] Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without isolating those derived from AI-enabled ones.[255]

- **Productivity:** Productivity impacts of AI for New Zealand are available in the literature, both at the broad economy level and across all sectors. In particular, the AI Forum for New Zealand estimates the range of enhanced labor productivity benefits in the professional, scientific and technical services sector to be between NZ$2.2 and NZ$5 billion (US$1.5 and US$3.3 billion).[256]

- **Incomes:** There is more limited literature on the impact of AI on wages in New Zealand.

- **Worker well-being:** Few studies discuss the impact of AI on worker well-being.

- **Action agenda:** Policy recommendations are available from the AI Forum for New Zealand, and a recent inquiry by the New Zealand government also discusses key policy stances for the country.[257]

250. AI Forum for New Zealand (2018), Artificial Intelligence: Shaping a future New Zealand. Available at: https://aiforum.org.nz/wp-content/uploads/2018/07/AI-Report-2018_web-version.pdf
251. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
252. Sources include: NZ Institute of Economic Research (2015), Disruptive technologies, risks, opportunities – Can New Zealand make the most of them? Available at: https://nzier.org.nz/static/media/filer_public/6d/6e/6d6ecf8b-032c-4551-b0a7-8cd0f39e2004/disruptive_technologies_for_caanz.pdf; PricewaterhouseCoopers (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf; CIO (2019), "Half of Kiwi workers say automation has altered their jobs or made them redundant: survey". Available at: https://www.cio.co.nz/article/658064/half-kiwi-workers-say-automation-has-altered-their-jobs-made-them-redundant-survey/
253. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
254. Malini Goyal (2017), "How artificial intelligence is reshaping recruitment, and what it means for the future of jobs", The Economic Times. Available at: https://economictimes.indiatimes.com/jobs/how-artificial-intelligence-is-reshaping-recruitment-and-what-it-means-for-the-future-of-jobs/articleshow/60985946.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
255. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
256. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
257. New Zealand Productivity Commission (2019), Technology and the Future of work: Issues paper. Available at: https://www.productivity.govt.nz/inquiry-content/3960?stage=2

PHILIPPINES

- **Macroeconomic benefits:** There are several studies of the impact of AI on the Philippine economy. A study by Microsoft and IDC found that by 2021, AI could add an estimated US$8 billion to the Philippines's GDP, and increase the country's growth rate by 0.4 percent annually.[258]

- **Jobs lost:** There have been several estimates on the impact of AI and automation on jobs and tasks in the Philippines. A study by Oxford Economics found that AI could displace 10 percent of current jobs and force 1.1 million existing workers into other industries and occupations by 2028.[259] Another study by MGI estimates that automation could displace 48 percent of employee tasks, which is assessed to be equivalent to 18.2 million jobs.[260] Both studies agree that the country's most affected sectors would be agriculture, wholesale and retail, and manufacturing. In terms of reskilling, some studies have found that 65 percent of jobs in the market today could be redeployed through reskilling to take higher value roles by 2021.[261] There are also some studies that focus on job displacements within specific sectors, such as IT-BPO.[262]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Philippine economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI.[263]

- **Workforce participation:** Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without isolating those from AI-enabled ones.[264]

- **Productivity:** Although few, studies of the impact of AI on productivity in the Philippine economy appear to be limited to the country's prominent and labor-intensive IT-BPO (Information Technology-Business Processing and Outsourcing) sector. These studies discuss how AI could significantly improve the productivity of back-office work through cutting-edge algorithms that significantly improve the productivity of back-office work.[265] For instance, an estimate by a digital marketing firm found that AI could reduce labor cost and operation expenses by more than 50 percent in the IT-BPO sector.[266]

- **Incomes:** There are no existing studies on the impact of productivity on incomes in the country.

- **Worker well-being:** There is limited analysis of AI impacts on workplace safety, job satisfaction nor leisure in the Philippines.

- **Action agenda:** There is some literature on the national agenda for AI in the Philippines. This includes AI's inclusion in a list of emerging technologies prioritized in the 'Philippine Development Plan 2017-2022'.[267] Under this plan, the government committed to participate in collaborative AI R&D and infrastructure building activities, as well as to reskill the workforce in analytics, mobile applications and cloud computing.

258. Microsoft Philippines Communications Team (2018), "Digital transformation to contribute US$8 billion to the Philippines GDP by 2021". Microsoft News Center Philippines.
Available at: https://news.microsoft.com/en-ph/2018/02/14/digital-transformation-contribute-us8-billion-philippines-gdp-2021/
259. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
260. McKinsey Global Institute (2017), Seizing the automation opportunity in the Philippines.
Available at: https://www.mckinsey.com/featured-insights/asia-pacific/seizing-the-automation-opportunity-in-the-philippines
261. Microsoft Philippines Communications Team (2018), "Digital transformation to contribute US$8 billion to the Philippines GDP by 2021". Microsoft News Center Philippines.
Available at: https://news.microsoft.com/en-ph/2018/02/14/digital-transformation-contribute-us8-billion-philippines-gdp-2021/
262. Hong Kong University of Science and Technology and the Association of Pacific Rim Universities (2019), Transformation of work in Asia Pacific in the 21st century.
Available at: http://www.bm.ust.hk/en-us/media-resources/overview/publications/reports
263. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
264. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
265. International Labor Organization (2019), Changing business and opportunities for employer and business organizations.
Available at: https://www.ilo.org/actemp/areas-of-work/WCMS_679582/lang--en/index.htm
266. iMark International (2018), "Artificial Intelligence 2017: AI age has begun in the Philippines". Available at: https://www.imarkintl.com/artificial-intelligence-philippines/
267. Richa Bhatia (2017), "Is Philippines ready to gear up for the impact of AI?" Analytics India. Available at: https://www.analyticsindiamag.com/philippines-ready-gear-impact-ai/

SINGAPORE

- **Macroeconomic benefits:** There are several studies on the AI-enabled GDP impacts in Singapore. For example, MGI estimated AI-led growth in Singapore to be 1.4 percent year-on-year between 2017 and 2030.[268] Accenture and Frontier Economics found that AI could nearly double Singapore's GDP growth rate by 2035, translating to an additional S$295 billion (US$215 billion) in gross value added.[269]

- **Jobs lost:** There are a number of studies that demonstrate the impact of AI on jobs in Singapore, both economy-wide and by sector, as well as reskilling and job restructuring responses to these impacts. Estimates of the potential of AI to automate jobs range from 24 to 29 percent.[270] Oxford Economics undertook a detailed sectoral analysis of the potential number of jobs that would be displaced and created, estimating that a total of 85,000 existing roles (21 percent of jobs) will 'disappear' from the labor market, pushing these workers into other industries and occupations.[271] Such job displacement analyses, however, tend to be simplistic in their treatment of labor market impacts as they do not address the dynamic implications of re-skilling responses, as well as the creation of new jobs from AI. In this regard, the literature on Singaporean firms' efforts to re-skill workers and redesign job roles in response to AI is comprehensive.[272]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Singaporean economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI.[273]

- **Workforce participation:** Beyond qualitative analysis of how AI has and could further improve the productivity of job matching tasks in Singapore's recruitment industry, there is little literature quantifying economy-wide impacts on jobs and GDP.[274] Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without a breakdown into AI-enabled ones.[275]

- **Productivity:** Some research has been conducted on AI-enabled impacts on worker productivity and incomes in Singapore. A study by Accenture, for example, found that AI could raise Singapore's labor productivity by 41 percent by 2035.[276] The survey by Microsoft and IDC, for example, found that AI would increase employee productivity by 38 percent in Singapore by 2021.[277]

- **Incomes:** There is a lack of research quantifying potential wage changes arising from AI adoption, though a survey of Singaporean businesses reflected that 57 percent of Singaporean companies expect to pay higher salaries for employees with 'AI-ready' skills (e.g., data mining, digital marketing and cloud computing).[278]

- **Worker well-being:** Though limited and largely anecdotal, there is some literature on the importance of using AI to improve workplace safety in Singapore's context.[279] On job satisfaction and leisure, short of a quantitative analysis of the amount of time freed up from work, a few reports acknowledge the potential of AI for improving work-life balance in Singapore's context.[280] Other literature tend to focus on impacts on the distribution of time across different work tasks, without any suggestion

268. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
269. Accenture and Frontier Economics (2017), AI is the future of growth. Available at: https://www.accenture.com/_acnmedia/PDF-57/Accenture-AI-Economic-Growth-Infographic.pdf#zoom=50
270. Sources include: Willis Towers Watson (2018), The global future of work survey. Available at: https://www.willistowerswatson.com/en-SG/insights/2018/02/reimagining-our-future-workspace-future-of-work-survey-results; McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages; PwC (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf
271. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs. A
vailable at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
272. Willis Towers Watson (2018), The global future of work survey – Singapore.
Available at: https://www.willistowerswatson.com/en-SG/insights/2018/02/reimagining-our-future-workspace-future-of-work-survey-results
273. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
274. Ben Chew (2017), "Impact of AI on talent acquisition and recruitment in the future".
Available at: https://sbr.com.sg/hr-education/commentary/impact-ai-talent-acquisition-and-recruitment-in-future
275. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
276. Accenture and Frontier Economics (2017), AI is the future of growth. Available at: https://www.accenture.com/_acnmedia/PDF-57/Accenture-AI-Economic-Growth-Infographic.pdf#zoom=50
277. Microsoft and IDC Asia Pacific (2019), Future Ready Business: Assessing Asia Pacific's Growth Potential Through AI.
Available at: https://news.microsoft.com/en-my/2019/04/02/artificial-intelligence-to-nearly-double-the-rate-of-innovation-in-malaysia-by-2021-microsoft-study/
278. Willis Towers Watson (2018), The global future of work survey – Singapore.
Available at: https://www.willistowerswatson.com/en-SG/insights/2018/02/reimagining-our-future-workspace-future-of-work-survey-results
279. Fann Sim (2018), "Workplace safety and health scorecard could be made more transparent under proposal", Channel News Asia. Available at: https://www.channelnewsasia.com/news/singapore/workplace-safety-and-health-scorecard-could-be-made-more-10662778; Loke Kok Fai (2017), "Health and safety critical for workplaces of the future: Sam Tan", Channel News Asia.
Available at: https://www.channelnewsasia.com/news/singapore/health-and-safety-critical-for-workplaces-of-the-future-sam-tan-9181070
280. Lydia Lim (2017), "What to do about robots and artificial intelligence", The Straits Times. Available at: https://www.straitstimes.com/opinion/what-to-do-about-robots-and-artificial-intelligence

of a possible reduction in the total amount of time required for work due to AI.[281]

- **Action agenda:** One of the most comprehensive national-level agendas across the countries studied, there is comprehensive literature on a national AI agenda for Singapore. Backed by an investment of up to S$150 million (US$110 million) in AI over 5 years to 2022, 'AI Singapore' is a national program which focuses on stimulating AI deployment at the firm level, particularly for three key sectors: finance, urban solutions and healthcare.[282] It also includes reskilling and awareness courses, 'AI for Everyone (AI4E)' and 'AI for Industry (AI4I)'.

SOUTH KOREA

- **Macroeconomic benefits:** There is a lack of country-specific study on AI impacts. Nevertheless, global studies typically include and feature South Korea as an archetype of a developed Asian economy that is well-positioned to capture AI benefits. MGI, for example, estimated AI to contribute 1.7 percent year-on-year to South Korea's GDP growth, as well as aggregate economic impacts of KRW 460 trillion (US$404 billion) by 2030.[283]

- **Jobs lost:** A number of studies have explored the impact of automation (AI being a subset) on jobs in South Korea. Estimates include 25.5 percent of work hours and six to 22 percent of jobs.[284] However, these studies tend to focus broadly on automation and do not relate only to AI. There are hence opportunities to separate the effects of AI and analyze the skills which would be relevant for an AI-driven economy.

- **Jobs gained:** There are no existing analyses on the impacts of AI for future job creation in South Korea.

- **Workforce participation:** Consistent with the other countries, economy-wide estimates of job matching platforms do not relate directly to AI-specific benefits, but to all types of digital job matching platforms.[285]

- **Productivity:** In these global studies, extensive research has been done to project the labor productivity impacts of AI-enabled technologies in South Korea.[286] MGI estimates a 16 percent increase in GDP by 2030.

- **Incomes:** There is no existing analysis on the impacts to worker incomes of AI in South Korea.

- **Worker well-being:** Few studies discuss the impact of AI on workplace safety, job satisfaction nor leisure in the context of South Korea.

- **Action agenda:** Other than the 'Mid-to Long-term Master Plan in Preparation for the Intelligent Information Society: Managing the Fourth Industrial Revolution' introduced in 2016, there are limited studies exploring the specific 'next steps' or focus areas for the various stakeholders.[287]

281. Tristan Chan (2018), "What Industry 4.0 means to Singapore and why its workers must upskill and lose their sense of entitlement".
Available at: https://www.scmp.com/lifestyle/article/2143239/what-industry-40-means-singapore-and-why-its-workers-must-upskill-and-lose
282. Future of Life Institute (2019), "AI policy – Singapore". Available at: https://futureoflife.org/ai-policy-singapore/
283. McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy.
Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
284. Sources include: McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation. Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages; OECD (2016), The risk of automation for jobs in OECD countries. Available at: https://www.oecd-ilibrary.org/docserver/5jlz9h56dvq7-en.pdf?expires=1551857686&id=id&accname=guest&checksum=2E68D0CEBAC2FCA6E832213C4CC33232; PwC (2018), Will robots really steal our jobs? An international analysis of the potential long term impact of automation. Available at: https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf
285. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
286. Sources include: PricewaterhouseCoopers (2018), The macroeconomic impact of artificial intelligence. Available at: https://www.pwc.co.uk/economic-services/assets/macroeconomic-impact-of-ai-technical-report-feb-18.pdf; McKinsey Global Institute (2018), Notes from the AI frontier: Modeling the impact of AI on the world economy. Available at: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning
287. Future of Life Institute (2019), "AI policy – South Korea". Available at: https://futureoflife.org/ai-policy-south-korea/

THAILAND

- **Macroeconomic benefits:** AI impact studies for Thailand appear to be limited to analyses of the job market and the level of adoption, without any estimates of implications at a broader macroeconomic level such as forecast GDP impacts. AI-linked impacts on macroeconomic indicators are examined as part of broader studies on Thailand's digital economy, and often at the technology application or sectoral level.

- **Jobs lost:** There are a number of studies that project the impact of AI on jobs in Thailand, both economy-wide and by sector, as well as analyses of resulting shifts in the labor market. MGI, for example, estimates that such technologies have the potential to automate 55 percent of work activities in the country.[288] Oxford Economics undertook a detailed sectoral analysis of the potential number of jobs that would be displaced and created, estimating that a total of 1.3 million existing roles (12 percent of jobs) will 'disappear' from the labor market, pushing these workers into other industries and occupations.[289] Some of these studies acknowledge that the actual impacts could be limited by the country's low labor costs and large low-skilled workforce.[290]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Thai economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI.[291]

- **Workforce participation:** Beyond qualitative analysis of how AI has and could further improve the productivity of job matching tasks in Thailand's recruitment industry, there is little literature quantifying economy-wide impacts on jobs and GDP.[292] Consistent with the other countries, estimates of the economic impacts of job matching platforms broadly relate to all types of job platforms, without a breakdown into AI-enabled ones.[293]

- **Productivity:** Beyond anecdotal evidence and surveys reflecting sector- and firm-specific productivity benefits from AI, there is no economy-wide analysis of AI impacts for Thailand's productivity.[294]

- **Incomes:** With regard to incomes, there are suggestions of how AI could potentially mitigate Thailand's 'middle income trap', but these are not backed by robust research.[295]

288. McKinsey Global Institute (2017), Jobs lost, jobs gained: Workforce transitions in a time of automation.
Available at: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
289. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
290. IBA Global Employment Institute (2017), Artificial intelligence and robotics and their impact on the workplace.
Available at: https://www.ibanet.org/Document/Default.aspx?DocumentUid=c06aa1a3-d355-4866-beda-9a3a8779ba6e
291. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
292. Julian Meissner (2018), "Recruiting the help of AI", Bangkok Post. Available at: https://www.bangkokpost.com/tech/local-news/1542058/recruiting-the-help-of-ai
293. McKinsey Global Institute (2015), Connecting talent with opportunity in the digital age.
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age
294. Sources include: Bangkok Post (2017), "Labor risks going under amid AI wave". Available at: https://www.bangkokpost.com/tech/local-news/1367471/labor-risks-going-under-amid-ai-wave; Bangkok Post (2017), "AI will have biggest impact on us, say youths". Available at: https://www.bangkokpost.com/tech/local-news/1272739/ai-will-have-biggest-impact-on-us-say-youths; Alita Sharon (2019), "Thailand govt to use AI to help lower HIV infection rate", Open Gov Asia. Available at: https://www.opengovasia.com/thailand-govt-to-use-ai-to-help-lower-hiv-infection-rate/
295. The World Bank, "Artificial intelligence, big data: Opportunities for enhancing human development in Thailand and beyond".
Available at: http://blogs.worldbank.org/eastasiapacific/artificial-intelligence-big-data-opportunities-enhancing-human-development-thailand-and-beyond

- **Worker well-being:** There are no known studies of AI impacts on workplace safety, worker job satisfaction nor leisure in Thailand.

- **Action agenda:** There are few sources discussing government policies or directives on AI, suggesting current government focus on this to be weak.

Nonetheless, there appears to be some government support for AI deployment by firms. Private sector deployment, on the other hand, appears to be stronger, with companies across a number of sectors (e.g., oil and gas, financial services) planning to adopt AI.[296]

VIETNAM

- **Macroeconomic benefits:** Beyond several ASEAN-wide analyses of AI impacts, there are few studies analyzing the implications in Vietnam's context. These studies also tend to focus only on job displacement effects, without analysis of macroeconomic impacts such as on GDP and productivity.

- **Jobs lost:** Several studies demonstrate the impact of AI on jobs in Vietnam. Oxford Economics, for example, undertake a detailed sectoral analysis of the potential number of jobs that would be displaced and created, estimating that a total of 1.8 million existing roles (14 percent of jobs) will 'disappear' from the labor market, pushing these workers into other industries and occupations.[297]

- **Jobs gained:** There is a study projecting where future job gains due to AI could be in the Vietnamese economy in 2028. However, this study was based on a general equilibrium model that assumed stable long-term employment levels, and as a result, prevents any comparisons of the expected magnitude of jobs displaced with jobs gained due to AI.[298]

- **Workforce participation:** There are no known studies assessing the impact of AI-enabled job matching applications on Vietnam's labor market.

- **Productivity:** There are no country-specific studies for Vietnam.

- **Incomes:** There are no country-specific studies for Vietnam.

- **Worker well-being:** There are no known studies of AI impacts on workplace safety, leisure and job satisfaction in Vietnam.

- **Action agenda:** Vietnam has a comprehensive AI strategy. With a clear aspiration to leverage AI for economic growth, the country aims to become an 'advanced country in the AI age' and 'an AI leader in Southeast Asia'.[299] To achieve this goal, the government is developing a number of strategies including building AI universities and schools, as well as deploying AI across multiple sectors including healthcare, legal services and public services.

296. Alita Sharon (2019), "The future and adoption strategies of AI in Thailand." Open Gov Asia. Available at: https://www.opengovasia.com/the-future-and-adoption-strategies-of-ai-in-thailand/
297. Oxford Economics and Cisco (2018), Technology and the future of ASEAN jobs.
Available at: https://www.cisco.com/c/dam/global/en_sg/assets/csr/pdf/technology-and-the-future-of-asean-jobs.pdf
298. Oxford Economics and Cisco (2018), Technology and the future of ASEAN Jobs. Available at: https://www.oxfordeconomics.com/recent-releases/dd577680-7297-4677-aa8f-450da197e132
299. Jason Furman et al (2018), "Vietnam's breakthrough strategy for AI economy". Michael Dukakis Institute for Leadership and Innovation, Boston Global Forum.
Available at: https://bostonglobalforum.org/wp-content/uploads/Vietnam%E2%80%99s-breakthrough-strategy-for-AI-economy_Full-Report.pdf

αlphaβeta
strategy x economics

This report was prepared by
AlphaBeta on behalf of Microsoft.