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Gender, AI, and Skill Development in Southeast Asia

Case Studies from Thailand, Vietnam, and Cambodia

By Donhathai Sutassanamarlee

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Contents

Executive Summary

This research report explores the impact of technological trends, particularly the advancement of artificial intelligence (AI), on employment and the workforce in Southeast Asia. It aims to explore how Southeast Asian countries could adapt their skilling systems to help women obtain quality employment in light of the evolving labour market landscape and changing skill requirements.

The study involved qualitative primary research in Thailand, Vietnam, and Cambodia, as well as secondary research on the region. Primary data collection took place from March-May 2023. It included interviews with eight key informants and 30 female workers from various occupational backgrounds within the three case study countries.

We found that female and male workers in Southeast Asia are concentrated in different sectors and occupations. Women are concentrated in the services sector, while more men are employed in industry and agriculture. Furthermore, women are overrepresented in low-skilled white-collar roles, whereas blue-collar and managerial positions are overwhelmingly male-dominated. These patterns of gender segregation extend into specific subsectors: in particular, the technology workforce continues to be dominated by men. These imbalances are, in part, perpetuated by deeply ingrained stereotypes and perceptions of economic mobility.

The ripple effects of these gender disparities are seen in labour market shifts, affecting men and women disparately across Southeast Asia. The report identifies significant megatrends that loom large over the employment landscape, encompassing climate change, population aging, supply chain restructuring, and the enduring influence of the COVID-19 pandemic. Simultaneously, the region bears witness to the accelerated and widespread adoption of digital technology, the proliferation of AI being a prominent development.

Considering the gender disparities in labour markets, the impact of AI trends varies significantly for women and men. Notably, as AI adoption has been more advanced in the services sector and among white-collar professions, women, who are disproportionately represented in these areas, are likely to experience more substantial exposure to AI than men. Despite the potential for both positive and negative outcomes stemming from AI exposure, employment statistics suggest that women may disproportionately face adverse effects, while men may enjoy greater benefits. The overrepresentation of women in low-skilled, white-collar positions, especially those in declining clerical support roles, places them at higher risk of displacement. Conversely, women's underrepresentation in managerial roles, which often offer more opportunities to leverage AI exposure, exacerbates gender disparities. Moreover, since fewer women work in technology- and machine-related jobs compared to men, the rapid growth and higher wage premiums associated with these positions are more likely to benefit men disproportionately. These observations serve as a stark reminder of the critical importance of recognising and addressing

gender disparities in the dynamic and ever-evolving landscape of AI and technology adoption within Southeast Asia.

Against this backdrop, the report sheds light on evolving skill demands. This transformation calls for an array of specialised technology skills, encompassing the realms of AI expertise, juxtaposed against an overarching need for basic digital skills, cognitive skills, social skills, learnability, and English language proficiency.

While the existing skill development systems in Cambodia, Thailand, and Vietnam do offer these essential skills, the inclusivity of access remains a formidable challenge. Importantly, gender disparities in skilling commence early in life, evident in gender-biased educational choices that ultimately shape career trajectories. Notably, at the upper secondary education level, boys tend to gravitate toward vocational tracks, while girls are often channelled into arts and social science domains. These initial educational inclinations invariably carry over into higher education decisions, resulting in fewer women enrolling in STEM programs at the tertiary level and pursuing a career in the technology subsector.

Gender-based disparities further inform the types of skills acquired outside the formal education sphere. The report spotlights distinct gender-influenced preferences in training among women, entangled within the web of societal norms and stereotypes. Time constraints, stemming from domestic and caregiving responsibilities, also emerge as barriers to adult learning, exerting a disproportionate impact on women. Additionally, disparities in access to digital technology serve as a further impediment, potentially hampering women's participation in e-learning opportunities. Although initiatives like women-specific training programs and initiatives aim to address these gender disparities in skill development, their reach is often confined to a small fraction of the female workforce.

In light of these findings, the report concludes with a set of recommendations aimed at improving the skill development systems of Southeast Asia to better serve women:

1. **Rethink secondary education:** Transform the secondary education system to provide students with diverse skill exposure, reducing the rigidity of pre-determined course tracks.

2. **Reduce gender bias in skill development systems:** Proactively address unconscious gender bias and stereotypes in skill development to promote equal opportunities for women and men.

3. **Facilitate employer-provided training:** Encourage employers to contribute to workforce skill development and mandate for demographic representation in training.

4. **Promote and strengthen micro-credentials:** Recognise the importance of lifelong learning and quality control for micro-credentials to ensure their credibility and acceptance.

5. **Tackle inequalities and intersectionality:** Address socioeconomic disparities, ensuring equal access to education, technology, and training for all, regardless of income level or geographical location.

6. **Bridge research gaps:** Invest in data collection and research to better understand future skill needs, education, and employment choices.

In essence, this research report serves as both a testament to the need for reshaping skill development systems across Southeast Asia and a call for a future that embraces adaptability, empowers women, and champions inclusivity in a burgeoning era of technological evolution.

Section 1: Introduction

The world is now in the era of the Fourth Industrial Revolution, a time characterised by the extended integration of data exchange technologies, including artificial intelligence (AI), cyber-physical systems, the Internet of Things (IoT), cloud computing, and cognitive computing across all sectors and industries.[1] These technologies can automate and augment worker tasks, and thus have the potential to increase productivity, and both create new jobs and displace workers, with varying effects across sectors, industries, and occupations.[2]

Much of present-day attention on the effects of technology on employment has been focused on AI. Unlike earlier digital technologies that follow programmable rules, AI learns to perform tasks by training on examples,[3] allowing it to "react dynamically to new conditions, invent new solutions on the fly, and perform complex tasks, such as driving vehicles, recognising speech and text, and generating new text and images".[4] In other words, AI is not only capable of performing routine tasks; it can replicate both cognitive and manual skills, with recent advancements being primarily in automating non-routine, cognitive tasks.[5]

The speed of AI adoption has intensified concerns over its impact on work and workers. A global survey of approximately 1,500 respondents across the full range of regions, industries, and company sizes found that the proportion of companies adopting AI more than doubled within a five-year period, surging from 20 percent of survey respondents in 2017 to 50 percent in 2022.[6] Southeast Asia is also expected to see rapid intensification of AI, thanks to the region's high rate of internet penetration combined with megatrends including climate change, population aging, supply chain restructuring, and the COVID-19 pandemic. The main challenge for the region is not the ability to keep up with technological innovation, but rather how to ensure inclusive growth amidst technological changes.[7]

While its net effects on employment remain subject to debate, AI adoption is sure to impact labour markets, job qualities, and skills required for the workforce, with the impact being felt unevenly across nations, industries, and demographics.[8] One of the factors responsible for this uneven impact is gender; there exist disparities in employment and skilling between women and men. To ensure that women can obtain quality employment, it is essential that they have access to the skills required to adapt to these changes.

Skill development in Southeast Asia is a crucial area of focus for governments and organisations aiming to enhance the employability and productivity of the workforce. This report aims to address the question: **How should the skill development systems of Southeast Asian countries adapt to technology-induced changes, particularly the advancement of AI, to help women obtain quality employment?**

The brief is divided into seven sections. Following the introduction, Section 2 briefly describes the methodology of the research. Section 3 offers a labour market analysis for Southeast Asia, discussing the evolving economic landscape and employment dynamics, with an emphasis on gender disparities observed across sectors and occupations. In

Section 4, we explore the impact of megatrends and technological advancements, particularly AI, on employment, while examining their differential effects on women and men. Moving to Section 5, we delve into the changing skill requirements driven by these trends and evaluate the responsiveness of the skill development systems in Southeast Asia, with a focus on three case study countries—namely, Thailand, Vietnam, and Cambodia. Section 6 then looks at the gender disparities within these skill development systems, highlighting barriers women face in accessing skills. Finally, the report concludes with a set of recommendations aimed at enhancing skill development systems to better serve the needs of women in the region.

Section 2: Methodology

This study provides an overview of Southeast Asia—encompassing Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam. It then delves deeper into three case study countries: Thailand, Vietnam, and Cambodia, to provide further insights into changing labour markets and skill gaps; explore whether existing systems are adapting to technological change; and ask if women have the access to technology, skills, and opportunities to enable them to partake in the 'new economy'.

The study relied on a combination of secondary research and qualitative primary research. Three separate teams of researchers—based in Thailand, Vietnam, and Cambodia—were involved in the primary data collection, which took place between March and May 2023. In total, eight key informants and 30 female workers (i.e., 10 from each case study country) participated in the research.

The sampling was purposive. The key informants were chosen for their role and expertise. Each of them was either a government official or an expert working in the fields of skill development, technology, and/or women's empowerment. Female workers were selected based on their occupation and subsectors. It was anticipated that each individual could offer valuable insights into the ramifications of technology trends on female workers, and that their combined insights would capture the heterogeneity across the spectrum of blue collar-white collar jobs, low-end and high-end IT skills, and socioeconomic contexts.

The methods of primary data collection encompassed in-depth interviews and focus group discussions. All eight key informants and 21 workers participated in in-depth interviews, while the remaining nine workers took part in two separate focus group discussions. The first focus group consisted of four participants of the same occupation, while the second group consisted of five participants from different subsectors. Further detail regarding the research participants and methods can be found in the appendices.

Section 3: Gender disparities in the labour markets

Economic structures and labour markets

Despite the diversity of Southeast Asian economies, some common patterns emerge. Notably, there has been a shift away from agriculture towards services and, to some extent, industry. As of 2021, services constitute the largest shares of the national gross domestic product (GDP) in eight of the 11 Southeast Asian countries, while industry accounts for the largest GDP share in the remaining three (see **Table 1**). In countries like Singapore, the Philippines, and Thailand, services contribute as high as 70 percent, 61 percent, and 56 percent of the GDP, respectively.[9] Meanwhile, the economic shares of agriculture have been on a declining trend in most of the region. Even in Myanmar and Cambodia, where agriculture retains

Table 1

Economic structures of Southeast Asian countries

	Agriculture			Industry			Services		
	2011	2021	Change	2011	2021	Change	2011	2021	Change
Brunei Darussalam	0.58	1.26	0.68	73.67	62.70	-10.97	27.36	37.63	10.27
Cambodia	34.56	22.85	-11.71	22.14	36.83	14.69	37.50	34.18	-3.33
Indonesia	13.51	13.28	-0.23	43.91	39.84	-4.07	40.58	42.82	2.24
Lao PDR	20.79	16.07	-4.72	30.82	34.13	3.31	41.77	38.85	-2.93
Malaysia	11.45	9.59	-1.87	39.82	37.76	-2.07	47.77	51.55	3.78
Myanmar	34.51	23.44	-11.07	29.06	35.05	5.98	36.43	41.51	5.09
Philippines	14.10	10.07	-4.03	31.34	28.89	-2.45	54.57	61.04	6.48
Singapore	0.03	0.03	0.00	25.26	24.36	-0.90	69.02	70.28	1.25
Thailand	11.59	8.71	-2.88	37.98	34.99	-2.99	50.43	56.30	5.88
Timor-Leste	22.16	8.64	-13.53	12.98	62.25	49.27	66.97	30.53	-36.45
Vietnam	16.26	12.56	-3.70	34.58	37.48	2.90	38.91	41.21	2.30

Source: World Bank Open Data[11]
Note: orange = largest GDP share in a given country; pink = decrease in GDP share; green = increase in GDP share; blue = unchanged

the highest level of economic significance, the GDP shares of agriculture declined from 35 percent in 2011 to 23 percent in 2021.[10]

The changes in economic structures have resulted in corresponding shifts in employment. In the 10-year period between 2011 and 2021, the shares of employment in services and industry increased by 4.9 and 3.6 percentage points on average, respectively; whereas agriculture's employment share dropped by an average of 8.4 percentage points (see **Table 2**). Notably, services employ the largest shares of workers in most of Southeast Asia. The three exceptions are Cambodia, Lao PDR, and Myanmar, where agriculture still constitutes the largest share of employment even as the agricultural workforces in all three countries are similarly declining.

The shift in employment from agriculture to non-agriculture sectors is understandable, given that job

Table 2

Employment by sector (% of total employment) in Southeast Asia

	Agriculture			Industry			Services		
	2011	2021	Change	2011	2021	Change	2011	2021	Change
Brunei Darussalam	1.37	1.29	-0.08	17.87	24.32	6.45	80.76	74.38	-6.38
Cambodia	56.55	38.85	-17.69	16.47	25.43	8.96	26.98	35.72	8.74
Indonesia	37.19	28.99	-8.21	19.99	21.76	1.77	42.82	49.25	6.43
Lao PDR	70.13	58.09	-12.04	8.57	10.77	2.20	21.30	31.14	9.84
Malaysia	13.39	9.65	-3.74	27.57	28.26	0.69	59.04	62.09	3.05
Myanmar*	52.35	46.47	-5.89	17.40	18.58	1.18	30.25	34.96	4.71
Philippines	32.61	24.27	-8.34	15.36	18.68	3.32	52.03	57.05	5.02
Singapore	0.85	0.32	-0.53	20.60	14.42	-6.19	78.55	85.26	6.71
Thailand	41.01	31.59	-9.42	19.44	22.51	3.07	39.55	45.90	6.35
Timor-Leste	49.30	41.62	-7.67	8.54	14.42	5.88	42.17	43.96	1.80
Vietnam	48.31	29.04	-19.27	21.28	33.13	11.86	30.41	37.82	7.41
Average	**36.64**	**28.20**	**-8.44**	**17.55**	**21.12**	**3.56**	**45.80**	**50.68**	**4.88**

Source: World Bank, Gender Data Portal[12]

Note: orange = largest GDP share in a given country; pink = decrease in GDP share; green = increase in GDP share

*2021 data is not available for Myanmar; data from 2020 is provided in the 2021 column

opportunities in non-agriculture sectors have grown alongside rapid modernisation and industrialisation, and non-farm wage rates have outstripped returns to agricultural work in much of the region.[13] Furthermore, the younger generations of Southeast Asians tend to attain higher levels of education than their older counterparts, affording them more employment options.[14] The younger and often better-educated members of farm households are progressively less involved in farming, as they are enticed by higher-wage opportunities beyond agriculture.[15]

However, it is important to acknowledge that a complete exit from agriculture is unlikely. Most rural households in Southeast Asia hesitate to abandon their farms for various reasons, including the role farming plays as a safety net in light of precarious labour market conditions.[16] These households frequently employ livelihood diversification strategies, with some members taking up non-farm jobs while others continue to tend the farm—allowing them to maintain an economic footing across agriculture and non-agriculture sectors.[17] Furthermore, many individuals employed in non-farm sectors still engage in farming during certain days, seasons, or stages of their lives.[18] This diversification practice was also observed during our primary data collection (see **Box 1**).

Another notable observation is the discrepancy between economic contributions and employment. Considering regional averages, agriculture employs more workers than industry but contributes substantially less value added to the region's GDP (see **Table 3**). This hints at the more labour-intensive nature of the agriculture sector, and the stronger reliance on technology in industry. However, the fact that the shares of employment in industry grew in most Southeast Asian countries from 2011 to 2021 indicates that technology may not necessarily replace human workers in the sector.

Sectoral and occupational gender divides

Like other regions, Southeast Asia witnesses gender disparities in its labour markets. In fact, the female labour force participation rates are lower than the male rates in every country in the region.[21] The largest gender gap in workforce participation is found in Myanmar, with a difference of 31 percentage points, while the smallest gap can be found in Lao PDR, with a difference of 7 percentage points.[22] Among our three case study countries, Thailand has the largest gap of 16 percentage

Table 3

Economic structure vs employment structure, regional average (latest data)

Sector	Share of GDP (%)	Share of total employment (%)
Services	46.0	50.7
Industry	39.5	21.1
Agriculture	11.5	28.2

Sources: World Bank Open Data[19] and World Bank, Gender Data Portal [20]

Box 1

The Livelihood Diversification of Rural Farm Households in Thailand

Our research team in Thailand conducted a focus group discussion with four female farmers in Saraburi Province. All four women grew up in low-income, rural farm households. Their ages ranged from 44 to 67. Two younger participants, in their 40s, had completed secondary education, while the two older participants, in their 60s, had only completed the fourth grade. Barriers such as education fees and travel distance had prevented them from pursuing higher levels of education, while their families' pressing need for money led them to engage in income-generating activities as quickly as they could. One participant noted that she and her older siblings could not afford university education but managed to financially support their youngest brother in obtaining a bachelor's degree, ultimately enabling him to become a civil servant.

Reportedly, members of the four participants' extended families were still supporting each other, with some members continuing to farm and others taking up work in factories or government offices, and a few even working in both farm and non-farm sectors simultaneously. Notably, one participant herself had worked in ceramic and electronic factories for 20 years before returning to help her older sister tend the farm following a mass layoff at her latest place of employment. Her secondary education qualification enabled her to work in factories, whereas her older sister, who only had primary schooling, never sought employment outside of agriculture.

The experiences of these four participants illustrate a significant level of interdependence among extended family members, particularly among siblings, even after they have formed their own nuclear families. Moreover, their stories underscore the pivotal role of education in accessing non-farm employment opportunities. At the same time, the example of the participant who returned to farming after a layoff from employment in industry highlights the enduring importance of rural farming as a safety net in the face of the precariousness of non-farm work.

points, followed by Cambodia at 13 percentage points and Vietnam at 9 percentage points.[23]

Traditional gender norms, which disproportionately burden women with unpaid care and domestic work duties, are primarily responsible for the gender gaps in workforce participation. In Thailand, household work was the most frequently reported barrier to women's labour force participation—cited by 4.8 million out of the 12.0 million Thai women who were not part of the labour force in 2022.[24] In Vietnam, a national survey conducted from 2012-2015 found that more than 20 percent of women did not work because of household chores, compared to 2 percent of men.[25] In Cambodia, women's average and median wages, as well as their average working hours, decline after

the age of 35 because women traditionally leave the labour market to take on care responsibilities, and often receive lower wages when re-entering the market.[26] Worker interviews conducted for this study similarly show that women are more likely to shoulder the majority of care work and household chores, though with some exceptions.

Among those employed, gender disparities can be found across sectors and occupation groups. Although the shares of both female and male employment are largest in the services sector, there is a significantly stronger concentration of women in services. Nearly 60 percent of Southeast Asian women work in the services sector, compared to 45 percent of men. In every Southeast Asian country, the share of female workers in services, as a percentage of total female employment, is larger than the share of male workers in services, as a percentage of total male employment (see **Table 4**). Conversely, the shares of male workers in industry and agriculture are larger than the shares of female workers in these

Table 4

Employment by sector and sex in Southeast Asia (latest data)

	Agriculture		Industry		Services	
	Male	female	Male	female	Male	Female
	% of male employment	% of female employment	% of male employment	% of female employment	% of male employment	% of female employment
Brunei Darussalam	1.76	0.61	34.11	10.16	64.13	89.23
Cambodia	38.55	39.19	27.28	23.35	34.17	37.45
Indonesia	30.96	26.00	25.63	15.91	43.42	58.09
Lao PDR	56.67	59.68	12.80	8.49	30.53	31.83
Malaysia	12.18	5.69	33.57	19.94	54.26	74.37
Myanmar	50.80	39.23	18.92	18.01	30.28	42.76
Philippines	30.33	14.63	24.83	8.90	44.84	76.48
Singapore	0.44	0.16	17.37	10.47	82.19	89.36
Thailand	34.68	27.96	25.50	19.00	39.83	53.04
Timor-Leste	43.31	39.52	17.45	10.63	39.24	49.85
Vietnam	29.31	28.76	36.67	29.35	34.03	41.88
Average	**29.91**	**25.58**	**24.92**	**15.84**	**45.17**	**58.58**

Source: World Bank Gender Data Portal [27]

Note: All data is from 2021, except for Myanmar, where the latest data available is from 2020; coloured cells denote larger shares compared between male and female; shaded cells denote the larger shares of employment, comparing between the shares of male and the shares of female employment, within a given country.

sectors in all countries, except for Cambodia and Lao PDR, where there are slightly larger shares of female employment in agriculture.

Long-term trends show us that women in Southeast Asia have gravitated more toward services over time, while men have shown a stronger inclination toward industry. Between 2011 and 2021, the share of women employed in services has expanded by 7.3 percentage points, while the share of men has grown by just 2.9 percentage points (see **Table 5**). In parallel, the share of men employed in industry has seen a rise of 4.4 percentage points, whereas the share of women has increased by a more modest 2.6 percentage points.

Furthermore, these gender-related patterns at the sectoral level align with those observed at the occupational level. Data from our three case study countries reveal a higher representation of women in white-collar occupations[29], which are found mostly in services, and a greater presence of men in blue-collar occupations,[30] which are primarily concentrated in industry and agriculture (see **Figures 1-3**).[31]

Our primary research indicates that gender stereotypes, social norms, and economic mobility all contribute to these gender imbalances in employment. Our interview results indicated that women often steer away from roles involving intensive physical labour and machine operation as they associate them with masculinity. In addition, the participants tend to link white-collar positions and the services sector with greater potential for upward economic mobility and prestige, whereas blue-collar roles in agriculture and industry are associated with lower socioeconomic status. Hence, women, particularly those with university degrees, usually view white-collar occupations in services as natural career choices (see further discussion on education and career choices in Section 5).

It is worth noting, that although our primary data collection did not include male workers, it is highly plausible that men with university education similarly gravitate toward white-collar roles due to the associated prestige and economic prospects. Men are more likely than women, therefore, to be upwardly mobile and enjoy prestige associated with their jobs.

Despite women's higher representation in white-collar positions, managerial roles remain predominantly

Table 5

Regional average changes in employment patterns, 2011-2021

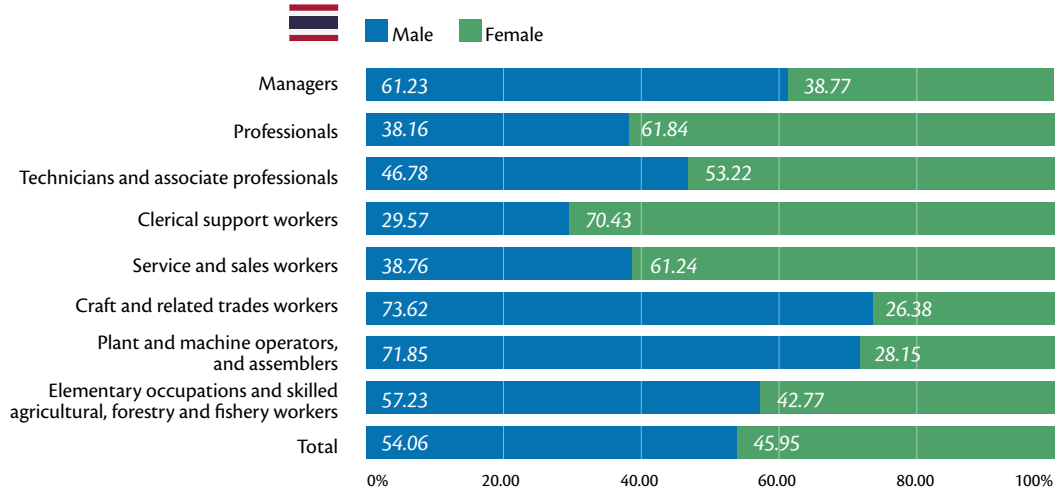
	Agriculture			Industry			Services		
	2011	2021	Change	2011	2021	Change	2011	2021	Change
% of female employment	35.48	25.58	-9.90	13.27	15.84	2.56	51.24	58.58	7.34
% of male employment	37.22	29.91	-7.32	20.53	24.92	4.39	42.24	45.17	2.93
% of total employment	36.64	28.20	-8.44	17.55	21.12	3.56	45.80	50.68	4.88

Source: World Bank Gender Data Portal [28]

Notes: 2021 data is not available for Myanmar, so Myanmar's data from 2020 was used for the regional average calculations. Green cells signify an increase in % of employment, while orange cells signify a decrease.

Figure 1

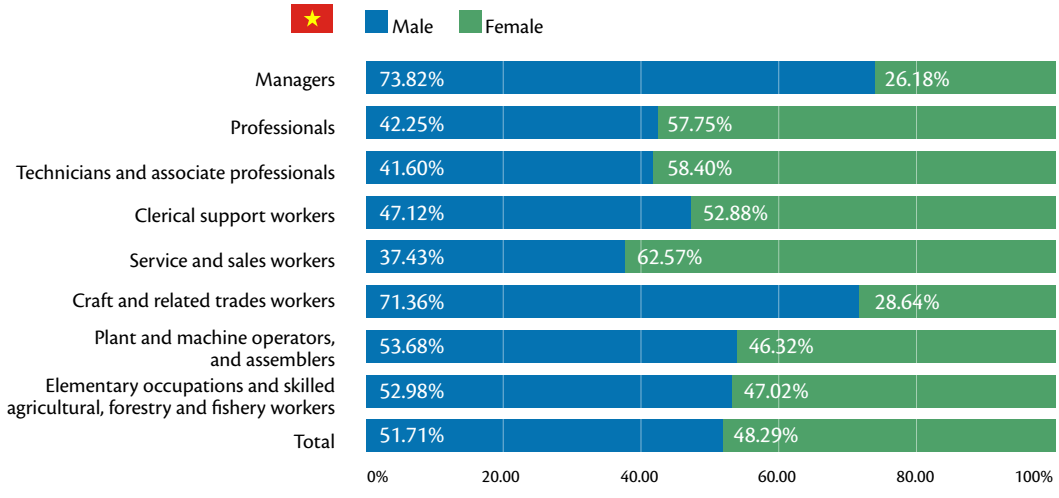
Employment by sex and occupation, Thailand (2021)



Source: International Labour Organization, ILOSTAT database. Data as of 2021.

Figure 2

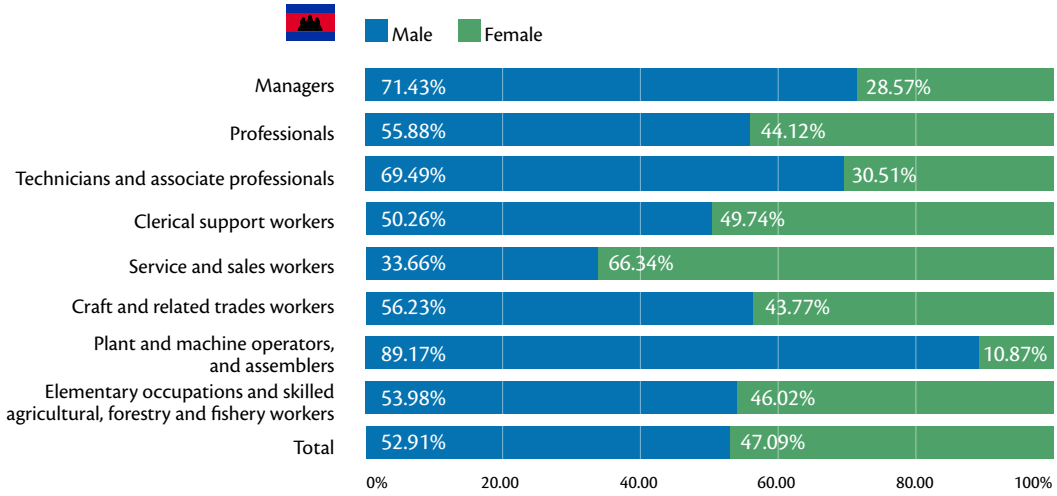
Employment by sex and occupation, Vietnam (2021)



Source: International Labour Organization, ILOSTAT database. Data as of 2021.

Figure 3

Employment by sex and occupation, Cambodia (2021)



Source: International Labour Organization, ILOSTAT database. Data as of 2021.

occupied by men. In our case study countries, men account for 74 percent, 71 percent, and 61 percent, of all managers in Vietnam, Cambodia, and Thailand, respectively (see **Figures 1-3**).[32] Anecdotal evidence from our interviews suggests that this male dominance is at least partially rooted in stereotypical views about gender. These stereotypes tend to associate men more closely with leadership attributes such as assertiveness and decisiveness, which could facilitate their advancement into leadership positions. Several interviewees reported that their company executives were mostly men despite most employees being women. In one instance, a participant disclosed that her employer strictly appointed men as department heads, a decision seemingly influenced by gender-biased perceptions.

On the contrary, women are overrepresented in the low-skilled, white-collar roles of service and sales workers, and clerical support workers. Again, this overrepresentation may be perpetuated by gender stereotypes. Participants discussed the stereotypical image of women as approachable, talkative, and detail-oriented, which are qualities perceived as suitable for service, sale, and clerical support roles.

Gender imbalances across subsectors

Gender stereotypes also play a significant role in gender segregation across subsectors. Notably, within services, technology is among the subsectors where women remain underrepresented, although

Southeast Asia is closer to achieving gender parity in tech than most other world regions. BCG research has found that women make up 32 percent of Southeast Asia's technology workforce, but only 28 percent of the global technology workforce.[33] Thailand leads the region with 42 percent women in tech, while Vietnam also surpasses global and regional averages at 34 percent.[34] In contrast, a separate ILO study found that women accounted for 22 percent of the ICT workforce in Cambodia as of 2018.[35]

Moreover, our interview participants in the technology subsector reported gender segregation within the tech workforce itself. According to them, women tend to gravitate toward 'functionality-oriented' positions, such as system/software testers, business analysts, and user experience/user interface (UX/UI) designers, while men are more inclined toward 'machine-oriented' roles like engineers, developers, programmers, and IT specialists.

These gender disparities can be attributed, at least in part, to the perception that technology and machines are primarily associated with men. Cambodia, in particular, exhibits a pronounced lack of confidence among women in their technology skills, limited support and encouragement from parents, insufficient female role models in tech, and persistent beliefs that men possess a natural aptitude for technology. This contrasted with the interview results from Thailand, where women are generally seen as equally capable as men in technology-related fields, with Thai parents more likely to encourage their daughters to pursue tech careers. Nonetheless, Thai interviewees noted that female tech talent often avoids machine-oriented occupations because such roles are widely perceived as 'hard' work, which may not appeal to women. One participant mentioned interviewing female job candidates with computer engineering degrees for positions of software testers and UX/UI designers (functionality-oriented roles), even though these candidates were qualified for more lucrative and technically demanding engineering positions.

Of course, technology is not the sole subsector marked by gender imbalances. For instance, construction, transportation, and energy tend to see an overrepresentation of men, while family-owned enterprises and food and accommodation often see an overrepresentation of women.[36] Further information about female- and male-dominated subsectors in our case study countries can be found in **Figure 4**.[37]

Moreover, like in the case of technology, gender segregation permeates other subsectors across multiple levels. Notably, in manufacturing, women are overrepresented in the garment, textile, electronics, and agro-processing industries.[38] Our interview results also revealed that specific roles within factories are often gender-segregated. For example, one Vietnamese participant working at a foam and wood pallet manufacturer noted that men handled assembling tasks, while women handled cutting tasks. Similarly, a Thai participant employed at a tire manufacturer mentioned that men staffed the moulding department, while women staffed the forming department. These divisions were reportedly shaped by both employers and workers' biases that women were more suitable for detail-oriented roles, while men were more fitting for physically demanding and machine-oriented positions.

Figure 4

Subsectors with overrepresentation of men and women in Thailand and Cambodia

Male-Dominated subsectors with the largest gender gaps in Thailand and Cambodia

% OF MALE WORKERS	Thailand	Cambodia
Construction	14.4	16.5
Transportation & storage	18.5	6.1
Electricity, gas, steam, and air conditioning supply	21.3	18.0
Mining & quarrying	26.9	25.8
Water supply	35.1	–
Real estate activities	–	37.6
Information & communication	37.9	29.2
Public administration & defence	40.3	18.6

Female-Dominated subsectors with the largest gender gaps in Thailand and Cambodia

% OF FEMALE WORKERS	Thailand	Cambodia
Activities of household as employers	82.2	63.4
Human health & social work	77.2	–
Education	70.7	–
Wholesale & retail trade	–	66.6
Accommodation & food service	66.3	64.4
Other service activities	–	64.1
Manufacturing	–	63.8
Financial & insurance activities	59.2	–

Source: MOL (2022) and NIS (2019)

This data has been designed using images from Flaticon.com

Similarly, gendered divisions of labour are evident in agriculture. According to the female farmers we interviewed, men typically undertake physically demanding or hazardous tasks like digging and pesticide spraying, while women usually handle less physically intensive, albeit demanding, activities such as planting and animal care.

Considering the gender-based employment dynamics across sectors, subsectors, and occupations, it becomes evident that women and men will experience distinct consequences as labour market transformations take place. Additionally, the varying economic structures and employment trends observed across Southeast Asia indicate disparate impacts on different countries within the region.

Section 4: The impact of technology trends on women workers

Megatrends unfolding

Before delving into technology trends, it is useful to briefly examine megatrends that will have major implications for employment and technology adoption in Southeast Asia. These megatrends include climate change, population aging, supply chain restructuring, and the COVID-19 pandemic.

Climate change: Climate change will not only have environmental changes like more extreme and frequent weather events, but also instigate responses to address these changes. These responses include the implementation of new environmental regulations, the adoption of climate change mitigation and environmental management technologies, and increased investments to facilitate the green transition of businesses.[39] Remarkably, within our case study countries, Vietnam and Thailand explicitly state their plan to use AI for sustainability promotion in their national AI strategies and other policy instruments.[40] These climate change-related developments will both create and displace jobs, with impacts being felt most heavily in agriculture and manufacturing.[41] While men dominate these sectors within Southeast Asia, it is also essential to acknowledge the substantial presence of women. For example, as of 2022, 5.1 million women were employed in agriculture and 3.0 million in manufacturing in Thailand alone.[42] Many of these women across Southeast Asia may need skill development opportunities to effectively navigate the green transition.

Population aging: As the working-age population shrinks and the elderly population grows, Southeast Asian countries must proactively promote labour force participation, skill development, migration, and technology deployment, including AI.[43] In addition, the growing number of elderly people will shift consumption patterns from durable goods towards services,[44] and elevate the importance of social jobs in care, education, and healthcare subsectors.[45] As women predominate these areas, they may experience job growth opportunities but could also face displacement risks from increased technology adoption.

Supply chain restructuring: Global supply chains are increasingly shifting to the Southeast Asia region due to several factors, including rising production costs in China, concerns over the US-China tensions, and the motivation to enhance supply chain resilience.[46] This restructuring offers job growth prospects, especially in countries with skilled workforces and robust infrastructure.[47] Despite more men working in manufacturing in Southeast Asia, substantial numbers of women, especially in low-skilled positions, like garment workers, should be equipped with the necessary skills to capitalise on this shift.

COVID-19 pandemic: The pandemic and associated measures have disrupted various subsectors, from healthcare and education to manufacturing and tourism.[48] At the same time, the crisis has ushered in job flexibility, exemplified by remote work, and has accelerated digital technology adoption. Women,

Figure 5

Summary of megatrends and their impact on women workers

OVERALL IMPACT

- Major impact on agriculture, tourism, and manufacturing
- Potential job growth
- Adoption of tech, including AI, for mitigation, adaptation, and sustainability

IMPLICATIONS FOR WOMEN

- Large numbers of women in hard-hit industries
- Need skills to leverage technologies for green transition

OVERALL IMPACT

- More technology to replace human labour
- Shift from durable goods towards services
- Job growth in social, healthcare, and leisure sector

IMPLICATIONS FOR WOMEN

- Require skill development to avoid displacement
- Increased opportunities in women-dominated sectors

OVERALL IMPACT

- Rising production demands
- Potential job growth
- More intense technology deployment

IMPLICATIONS FOR WOMEN

- Increased job opportunities in manufacturing
- Assembly line workers may need to upskill/reskill to avoid displacement

OVERALL IMPACT

- Unemployment and career shifts
- More flexible work arrangements
- Accelerated technology adoption, including digital platforms

IMPLICATIONS FOR WOMEN

- Increased opportunities for labour force participation
- Require basic digital skills

often shouldering more caregiving responsibilities, may benefit from flexible job opportunities and the rising popularity of platform work. However, this transformation underscores the importance of digital skills and raises issues like labour protection and welfare.[49]

Technology and AI

In Southeast Asia, digital adoption has been rapid and widespread. Across six Southeast Asian nations, including Vietnam, Thailand, Malaysia, the Philippines, Singapore, and Indonesia, a study revealed a significant increase of 100 million internet users between 2019 and 2022, rising from 360 million to 460 million in just three years.[50] The region's tech-savvy population, with the highest rate of mobile internet use globally,[51] played a crucial role in driving this swift digital adoption. Our interview results also indicate that the expansion of supportive infrastructure, reduced digital device costs, and user-friendly technology design have made digital technology more accessible.

Amidst these changes, AI is among the technologies that has become more widely commercialised and more readily adopted. Remarkably, AI technology can perform both routine and non-routine tasks, of both cognitive and non-cognitive nature.[52] Its applications are diverse—in machine learning, natural language processing, robotic process automation, intelligent automation, virtual reality, and as virtual assistant.[53] Nonetheless, AI adoption in Southeast Asia remains in a nascent stage.[54]

Due partially to the early stage that AI adoption is in, it is premature to conclusively assess its net impact on aggregate employment and labour productivity.[55] The slow pace of adoption can be attributed to several factors, including cost barriers and skill gaps,[56] as well as a reluctance to replace human workers (see Box 2 for an example of technology adoption reluctance). Even when AI is adopted to save labour costs, firms may gradually reduce their human workforce through natural attrition instead of immediate layoffs.[57] Our primary research also suggests that employers typically strive to retain their workers to the best of their ability. Even in situations where workers had to be furloughed or laid off during the COVID-19 pandemic, many were reportedly rehired once the crisis subsided. Additionally, organisational changes from technology adoption do not materialise quickly. One study conducted in the US and Southeast Asia found that multi-year efforts were often needed to make complementary investments, innovations, and adjustments required to support AI-based systems.[58]

It thus remains unclear whether AI will ultimately create more jobs than it displaces and improve more jobs than it worsens. To understand the ramifications of AI on labour demand, it is essential to examine tasks as the fundamental unit. As AI automates tasks, human workers may be displaced if their jobs predominantly involve automatable tasks; however, the demand for human workers may also rise for other tasks or jobs as a result of the cost savings of automation.[59] Additionally, the application of AI creates new tasks and jobs that require human labour, such as for maintaining, monitoring, improving, or developing the AI system itself.[60] Furthermore, the technology can complement and boost human productivity by making workers' tasks more efficient and/or by removing the need for them to perform tedious or hazardous tasks.[61] At the same time, AI

Box 2

Human Bonds vs. Cost Efficiency: A Human's Choice

In Southeast Asia, manual backpack sprayers have long been used for pesticide application. In many instances, farmers, especially female famers, do not operate these backpack sprayers themselves, but hire others to provide the service due to its physically demanding nature. However, in recent times, the use of agricultural drones for pesticide application has gained popularity.

In a particularly noteworthy case from our primary research, two Thai farmers discussed their reluctance to transition from a backpack spraying service to a drone spraying service, despite being aware of the cost efficiency of the latter. Reportedly, a drone spraying service cost 60 Thai Baht per rai ($1.7 per 0.16 hectare), whereas a backpack spraying service cost 80 Baht per rai ($2.3 per 0.16 hectare) and also more time-consuming.

Even though some of their neighbours have already embraced the drone technology, the two farmers expressed their unwillingness to lay off the individuals providing them with the backpack spraying service: "I want the people to get [the money] …They're actually relatives or people we know well. Like children or grandchildren [of our friends and relatives]."

may devalue certain skills, potentially reducing the wages of workers in possession of these skills.[62]

It should be noted that most national labour force surveys do not collect data at the skill and task levels. Given that technology replicates skills and automates tasks, and does not replicate entire jobs, the data limitations make it difficult to determine who will be impacted by the technological changes.

Although it is too soon to confirm the net effects of technology adoption on jobs, some effects are relatively certain. According to the World Economic Forum's Future of Jobs Survey 2023, the fastest-growing jobs—both globally and in Southeast Asia—are mostly technology-related. For instance, 'AI and machine learning specialists' top the lists of fastest-growing jobs in Singapore, Indonesia, and the Philippines; 'data analysts and scientists' top the list in Thailand; and 'digital transformation specialists' top the list in Vietnam.[63] Apparently, the AI adoption trend demands specialists for AI development and application, resulting in these job growths. Conversely, the fastest-declining jobs in the Southeast Asian region include clerical, secretarial, and administrative roles,[64] as AI and other automation technologies can automate most of the tasks that these workers perform.[65]

It is worth noting that recent AI advancements have been most prominent in automating non-routine cognitive tasks, particularly information ordering, memorisation, perceptual speed, and deductive reasoning.[66] As these tasks are primarily performed by managers and professionals, these high-skilled, white-collar occupational groups have been most exposed to AI.[67] However, it is crucial to emphasise that AI exposure is not inherently detrimental. In fact, studies found that it tends to have positive effects for high-skilled workers, as they typically have low risk of automation and possess sufficient digital skills to leverage the technology.[68] Research has also found that workers involved in the development, training, and maintaining of AI systems earn high wages and enjoy substantial wage premiums, with the highest premiums found in management positions.[69]

In addition to occupational differences, there have been sectoral differences in terms of AI exposure and impact. Thus far, advanced AI adoption[70] is mostly found in the services sector.[71] Nonetheless, there are efforts to intensify AI implementation in agriculture and industry in Southeast Asian countries as well. Interestingly, the target subsectors for Thailand and Vietnam's national AI strategies are very similar. The Thai strategy targets food and agriculture, healthcare and medical, and government services from 2022-2023; and education, security and safety, energy and environment, logistics and transportation, creative economy and tourism, manufacturing, and trade and finance from 2024-2027.[72] Meanwhile, Vietnam's AI adoption strategy until the year 2030 targets defence and national security, education and training, finance and banking, industry, agriculture, transportation and logistics, culture and tourism, natural resources and environment, and healthcare and medical care.[73]

Gendered impacts of technology and AI trends

Considering the gender disparities in labour markets, AI trends will have differential impacts on women and men. The services sector and white-collar professions have witnessed more advanced AI adoptions, and the higher concentration of women in these areas implies that women are likely to experience greater AI exposure compared to men. Our primary data also supports this observation, as white-collar respondents in the services sector reported using and being affected by AI, whereas blue-collar respondents in industry and agriculture seemed unaware of the technology.

Nonetheless, it is important to note that factors other than occupational differences may contribute to exposure and adoption differences. Education and income levels are two such factors, since the blue-collar workers also had lower education and income levels than their white-collar counterparts. Additionally, the lack of awareness about AI does not necessarily indicate a lack of AI exposure. For example, farmers reported exposure to agricultural drones, but they were unfamiliar with the concept of AI and therefore unsure is AI powered these devices.

Furthermore, although services have seen greater AI exposure so far, the national AI strategies of Thailand and Vietnam indicate that governments in the region are actively promoting AI adoption in several subsectors in which men outnumber women. These include security and defence, transport and logistics, energy and natural resource management, manufacturing, and agriculture.

While AI exposure can have both positive and negative outcomes, employment statistics suggest that women may disproportionately face adverse effects, while men may disproportionately enjoy benefits. The overrepresentation of women in low-skilled, white-collar jobs, especially in fast-declining clerical support roles, suggests that women are more susceptible to displacement effects than men. Simultaneously, women's underrepresentation in managerial roles, which often hold greater potential to leverage AI exposure, exacerbates gender disparities. Moreover, since there are fewer women working in technology- and machine-related jobs than men, the rapid growth and higher wage premiums of these jobs are likely to benefit men disproportionately. Further information about the varying exposure and effects of technology can be found in **Box 3**.

Box 3

Insights into Technology Exposure and Impact from Interview Participants

The extent of technology exposure and adoption varied among our research participants. While our primary research was qualitative and its results could not be generalised, the patterns observed within our research sample appeared to mirror broader trends found in larger populations. Among our respondents, white-collar workers, younger individuals, and those with higher levels of education reported more advanced digital skills compared to their blue-collar, older, and less-educated counterparts.

On one end of the spectrum, a 67-year-old farmer with a fourth-grade education mentioned that she only knew how to use her smartphone for personal communication purposes, through either phone calls or a chat application. On the other end, a 39-year-old business development consultant holding two master's degrees (in applied business analytics and computational linguistics) not only exhibited familiarity with various types of technology, but also possessed the ability to code and build websites and applications by herself. Other examples of modern technology applications among our white-collar respondents included the use of software and applications for graphic design, web design, resource planning, and team management; chatbots for customer interaction and text generation; AI and big data for analysing customer needs and behaviour; and virtual reality goggles for selling and presentation purposes.

While our participants agreed that digital technology offers time-saving and convenient solutions, some also reported some adverse effects of technological changes and technology adoption. These included:

- A former content writer and translator expressed her struggle to demand better pay for her work despite honing her writing skills, because AI could now translate and generate English texts deemed

'good enough' for many businesses and individuals, thereby devaluing her skills. This prompted her to develop new skills and transition into a better-paid profession in UX research. She also noted that this displacement would likely affect more women than men, as there were more women in writing and translation professions.

- A hotel sales manager reported displacement risks for clerical and administrative workers in the hotel industry, who are mostly women, because many hotels have deployed AI for booking and price quoting purposes. Nevertheless, she suggested that these workers could potentially transition to new roles like hotel butlers, which overlap somewhat with their current responsibilities but demand more interpersonal and critical thinking skills.

- Some farmers in Thailand began to hire more cost-efficient drone operators for pesticide application instead of workers with backpack sprayers. Interestingly, most workers providing backpack spray services were men, so this technology adoption appeared to affect more men than women.

- One of the farmers, who had previously worked in an electronics factory, reported mass layoffs of the female-majority workers at her latest company due to the obsolescence of the technological device they were manufacturing. She reported having undergone multiple reskilling efforts during her 20 years of factory work prior to the incident. Following the layoffs, most of the workers reportedly returned to their rural hometowns to work in the agriculture sector.

- Workers in the technology subsector identified several technology-related occupations that were likely to disappear. For instance, testers and web developers could be displaced since AI can now create websites within minutes. AI trainers also face potential displacement as AI technology advances. Additionally, participants recounted how job dynamics in technology evolved over time. Most notably, iOS developers had experienced a significant drop in pay rates due to their increased availability in the labour market. Conversely, roles involving cybersecurity, deep coding, and network technology were identified as positions poised for growth with technology advancements. Respondents also noted that men predominantly occupy these roles.

Section 5: Technological Change and Skill Development Ecosystems

Changing skill requirements

Against the backdrop of both megatrends and technology trends, the demand for different types of skills is poised to undergo significant changes. It is useful to first distinguish between specialised and non-specialised skills.

On the one hand, advanced technology skills, including specialised AI skills, will assume growing importance as AI and other technology-related jobs grow. As mentioned previously, the projected fastest-growing jobs in Southeast Asian countries include AI and machine learning specialists, data analysts and scientists, and digital transformation specialists.[74] Furthermore, green jobs are increasing, alongside increased investment in the green transition and the increased adoption of climate change mitigation and environmental management technologies.[75] Hence, the demands for specialised skills in these areas are expected to grow. In addition, the technology experts in our primary study suggested that skills related to cybersecurity, deep coding, and computer networking would likely be in high demand in the future due to evolving technology trends. However, it is essential to note that these technology-related specialist roles constitute a small proportion of the labour markets,[76] meaning that only a small number of workers will require the specialised skills.

On the other hand, the majority of workers will require non-specialised skills. Both prior research and our interview results highlight that five types of skills will become increasingly important across the region. These include basic digital skills, cognitive skills, social skills, learnability, and English language proficiency.

Basic digital skills, including basic AI literacy, will be crucial since the use of digital technology now extends to almost every aspect of life.[77] More specifically, AI advancement and national AI strategies will make it challenging for individuals unable to leverage AI tools to remain competitive. At the very least, AI could save workers time and labour costs by automating tasks, such as generating automatic responses to customers, facilitating booking and price quoting processes, providing translations and editing, and powering agricultural drones for tasks like pesticide spraying, as evident in our interview findings (see Box 3).

Cognitive skills, such as critical thinking, complex problem solving, and creativity, will remain important, as certain bottlenecks in AI automation persist. For example, AI has limitations in discerning what is true or false, or good or bad, and it is subject to biases depending on the training sets used to train its algorithms.[78] Consequently, human critical thinking remains essential. ADB's study in eight selected industries in Cambodia, Indonesia, the Philippines, and Vietnam also found that 'evaluation, judgment, and decision-making' is projected to be the most important skill in most industries.[79] In addition, although AI is now advanced enough to produce novel texts, images, and even art, studies suggest that

AI models in their current form cannot yet replace artists or other professions that require high levels of creative thinking skills.[80] It is more likely that AI tools will complement, rather than replace, these professionals.[81] This sentiment was echoed by key informants and white-collar workers in our research sample, most of whom believed that critical thinking, complex problem solving, and creative thinking cannot be easily replaced by technology, underscoring their significance for maintaining competitiveness in the labour market.

Social skills are similarly deemed critical, with communication, collaboration, and socio-emotional awareness considered to be particularly crucial for the future job market. Again, most of our interview participants perceived these skills as being difficult to replace by technology but essential for most jobs. Consistently, the study of online job listings in Southeast Asia demonstrates that the bulk of jobs require oral and verbal communication, and that relationship-related skills like teamwork and leadership are the most frequently demanded subset of socioemotional skills.[82]

Learnability, along with a growth mindset, was yet another skill/value repeatedly identified as crucial. As emerging technologies continue to reshape labour markets and workplaces, the ability and willingness to learn, unlearn, and relearn have become critical.[83] This also signals the needed shift in focus from 'what to learn' to 'how to learn'.[84] Furthermore, several interview participants spoke of the importance of a growth mindset, wherein intelligence and abilities are viewed as learnable rather than innate and unchangeable. Some noted how their own growth mindset enabled them to thrive on challenges, including the challenges of acquiring new skills.

Finally, English proficiency is important not only for employment but also for learning. It is often required for participation in the technology workforce due to the English-centric nature of most platforms and code bases.[85] Additionally, half of our interview participants noted that most learning resources, including resources for developing technology skills, are more readily available in English than in their local languages. English proficiency is also required to pass certain certification exams that are important for career progression. Moreover, one Vietnamese participant highlighted how companies in her country often preferred job candidates with English proficiency even when the work itself did not require English usage, since fluency in English usually signified that the candidates were well educated.

Education systems

In light of the changing skill requirements, it is vital to explore where the workforce in Southeast Asia could acquire these increasingly important skills. To do so, an examination of the education and skilling systems is necessary. Here, we will focus on our three case study countries of Cambodia, Thailand, and Vietnam.

The formal education systems in all three countries are relatively similar. Students attend three years of pre-primary schooling and complete nine years of basic education (primary and lower secondary education). Once they complete lower secondary education, typically at the age of 15, they may continue to pursue upper secondary education in the academic track (i.e., Grades 10-12), enter a technical and vocational education and training (TVET) track,[86] or opt to enter the labour market early by dropping out of schools. **Table 6** demonstrates that a substantial number of

Table 6

Education completion rates in case study countries, latest data available

Country	Primary (%)	Lower secondary (%)	Upper secondary (%)
Cambodia	82.3	56.0	26.7
Thailand	99.3	88.5	65.4
Vietnam	98.3	87.0	57.9

Source: UNESCO Institute for Statistics, 2023, http://sdg4-data.uis.unesco.org/

students, especially in Cambodia, drop out of schools at the secondary education level.

Those continuing within the formal education system need to make decisions regarding the area of concentration in their studies. Upper secondary schools in Cambodia, Thailand, and Vietnam employ a tracking system, wherein students must choose between a science track and an arts/social science track. Under each track, students further choose an area of concentration, such as mathematics, language, social studies, etc. Each track and concentration come with a pre-determined set of subjects. The available options of concentration areas and subjects differ across schools.

Similarly, students in the TVET track must choose their study program. The programs available in the three case study countries are relatively similar. In Cambodia, the most popular TVET courses are construction, auto mechanic, electricity, ICT, business, and manufacturing.[87] In Thailand, TVET programs are grouped into five categories: industrial, commerce, tourism, agriculture, and home economics.[88] In Vietnam, most TVET courses seek to build skills for employment in construction, manufacturing, ICT, and agriculture.[89]

Although students are not confined to pursuing tertiary education programs that align with their secondary education concentrations, it is clear that their earlier choices shape their decisions. Anecdotal evidence suggests that it is uncommon for those in the academic track at the secondary level to switch to a TVET track at the tertiary level. Within the academic track, students in the arts/social science track are notably less likely to switch to a STEM (science, technology, engineering, and mathematics) major compared to students in the science track who switch to non-STEM majors.[90]

Our primary research indicates that while the governments of Cambodia, Thailand, and Vietnam share the goal of promoting essential skills through their formal education systems, the degree to which students acquire these skills largely hinges on the educational institutions they attend. Most interviewees agreed that disparities in education

quality remain a major concern. Schools with limited resources often lack the necessary infrastructure and equipment to effectively nurture students' digital and technology skills. Furthermore, many schools struggle to deliver competency-based education, relying instead on rote learning, which ultimately restricts the development of cognitive and social skills, learnability, and English proficiency. Moreover, resource limitations can pose barriers to student participation in government-led skill development initiatives. For instance, Thailand has implemented the STEAM4Innovator program, designed to cultivate students' innovative thinking, entrepreneurial skills, and growth mindsets through collaboration with educational institutions. However, a key informant reported that most participating students are concentrated in urban areas, particularly Bangkok, where teachers can better support their students' involvement in the program.

Additionally, disparities between the academic and TVET tracks persist. Notably, enrolment rates in the TVET track are significantly lower than those in the academic track. This is due, at least partially, to the common perception that "TVET [is] 'second-chance' and/or 'second-rank' education for the poor, marginalised groups, and school drop- out youth".[91] Many also view vocational education qualifications as 'dead ends' rather than pathways towards higher education.[92] Hence, individuals from middle- and upper-class backgrounds generally do not consider going to a vocational school, but usually complete high school and proceed to universities. Some respondents also mentioned that universities were generally better at developing cognitive and social skills compared to vocational institutions, since the latter focuses heavily on technical and vocational skills.

Recent efforts to develop AI workforce also appear to focus on building AI skills through the academic education track, especially at the university level. For instance, a key informant in Vietnam estimated that around 40-50 Vietnamese universities had established AI majors in the last two years, often enlisting foreign experts to deliver these courses. An AI training centre has also been established at the National University of Ho Chi Minh City. In Thailand, the national AI strategy has set a target to generate at least 30,000 AI engineers and innovators within six years. It aims to achieve this target by developing AI-related skills and knowledge for all age groups from the pre-primary education level; providing AI education scholarships at the postgraduate levels; and creating cooperation mechanisms with foreign researchers and experts in AI.[93]

Skilling beyond formal education

Outside of formal education, individuals have various avenues to acquire skills. Numerous organisations play a role in the skill development ecosystems of the three case study countries. However, these efforts appear fragmented due to a lack of coordination.

It should be noted that many Southeast Asian countries have national skills development agencies specifically dedicated to overseeing and coordinating skill development efforts. Among our case study countries, Thailand has the Department of Skill Development, under the Ministry of Labour, and Vietnam has the General Directorate of Vocational Training, under the Ministry of Labour, Invalids, and Social Affairs. Meanwhile, Cambodia does not have a dedicated national skills development agency,

although the Ministry of Labour and Vocational Training is the key player in skill-related governance.

Despite the presence of a national skills development agency, several government agencies are often involved in skill development. For example, in Thailand, the Digital Economy Promotion Agency leads the development of the country's digital manpower; the Department of Women's Affairs and Family Development is involved in some forms of training for women; the National Innovation Agency provides training to develop innovative entrepreneurs; the Office of SMEs Promotion plays a role in developing the skills of MSMEs; the Department of Agricultural Extension delivers training for farmers, etc. Relatively similar patterns could be observed in the other two countries—different government agencies deliver skill development initiatives in the areas in which they hold expertise. Nevertheless, our primary research indicates that coordination across these departments remains insufficient despite efforts to promote government integration.

At the same time, government agencies are not the sole organisations involved in skill development. Private companies, education institutions, non-governmental organisations, and international/multilateral organisations all play significant roles, sometimes through partnerships with government agencies. Well-known public-private partnerships involve technology and telecom companies, such as Google, Microsoft, Meta (Facebook), Axiata, True, etc., most of which focus on digital skill development. For example, Google and Vietnam's Ministry of Industry and Trade (MoIT) launched the Accelerate Vietnam Digital 4.0 program in 2018 to provide digital skills training for 500,000 SMEs.

The private sector arguably plays a larger role than the government in developing skills of the workforce. In our primary research, most interviewees reported that their employers provided them with a combination of in-house training and sponsorship for external skill development. These efforts cover a diverse range of skills, depending on company directions and policies. Furthermore, three participants reported that their employers facilitated their reskilling to transition to a new role.

In addition, a majority of the participants expressed a preference for private sector-delivered training. This preference stemmed from the perception that private actors possessed more insights and capacity than government agencies, especially in the context of white-collar occupations. It is also worth noting that the private sector's responsibility in skill development is embedded within the Thai law. Specifically, Thailand's Skill Development Promotion Act (2002) mandates that workplaces employing 100 or more employees must organise skill development programs for at least 50 percent of their total workforce each year.[94]

Meanwhile, individuals without employers often need to proactively seek skill development opportunities. The government has made efforts to extend them such opportunities. Notably, national skill development agencies primarily concentrate on developing the skills of individuals leaving school after lower secondary education to transform them into skilled workers before entering the labour market. Additionally, agricultural extension authorities in the three case study countries are active in their outreach efforts to provide training for farmers.

Finally, online platforms have emerged as prominent tools for skill development. Beyond employer-provided training, most interview participants relied on online learning resources, such as YouTube, Coursera, Udemy, Codeacademy, and local MOOC (massive open online course) platforms. Furthermore, all three case study countries' governments recognise the importance of lifelong learning outside of formal education, with micro-credentials and short-term courses gaining popularity. Given the widespread adoption of digital technology and access to digital devices/infrastructure, these courses could be more widely disseminated.

Section 6: Women's access to skills

Gender disparities in formal education

To assess the effectiveness of workforce development systems in facilitating women's access to quality employment amidst evolving skill demands, we need to examine gender disparities within the education and skilling systems. Our findings reveal that gender disparities in labour markets often stem from educational choices influenced by gender biases that are made at a young age, shaping later education and career prospects.

Gender disparities become apparent as early as the secondary education level in both vocational and academic tracks. First, boys are more inclined to pursue the TVET track compared to girls. In Thailand, there were about 600,000 male and 400,000 female students pursuing either a vocational or a high vocational diploma in 2022.[95] In the same year, Vietnam saw 20 percent of its male youth (15- to 24-year-olds) and 10 percent of its female youth enrolled in vocational education.[96] In Cambodia, there were approximately 4,000 male and 1,350 female students in TVET programs back in 2010.[97] Additionally, although precise statistical data is lacking, interview respondents generally agreed that there were more male students in the science track and more female students in the arts/social science track.

Furthermore, these early educational choices often carry over to higher education decisions. Although students do switch tracks between secondary and tertiary education levels, certain switching patterns are less common than others. As mentioned earlier, relatively few students switch from academic to TVET track, or from the arts/social science track to a STEM major. A previous study in Cambodia found that approximately 81 percent of students who switched did so from a science track in high school to a non-STEM major in university, but only 9 percent switched from a social science track to a STEM major.[98] Female students are also more likely to switch from the science track to a non-STEM major than male students. Among the female students who switched, only 2 percent switched from social science to STEM majors, while 94 percent switched from science to non-STEM majors.[99]

Considering the initial higher representation of boys in the vocational and science tracks at the secondary education level, combined with the higher likelihood of girls switching from the science track to a non-STEM major, it follows that there are more men than women in TVET and STEM programs at the tertiary level. While all three case study countries exhibit higher rates of female tertiary education enrolment compared to males, female students are underrepresented in STEM programs, including ICT (information and communication technology), as illustrated in **Table 7**. The gender gaps also vary across countries. For instance, female students make up 48 percent of all ICT graduates in Thailand but only 8 percent of the ICT graduates in Cambodia.[100]

Consequently, since TVET programs mostly produce blue-collar workers, while members of the technology

Table 7

Tertiary education by sex, 3 case study countries

Country	Tertiary education enrolment (%)		STEM graduates (%)		ICT graduates (%)	
	F	M	F	M	F	M
Cambodia	13.19	12.78	16.68	83.32	8.44	91.56
Thailand	50.96	37.31	30.14	69.86	47.85	52.15
Vietnam	37.57	33.35	36.51	63.49	No data	No data

Source: WEF's Global Gender Gap Report 2023

workforce are mostly products of STEM programs, the gender disparities in blue-collar professions and technology workforce become understandable. Furthermore, it should be highlighted that most university programs seek to produce high-skilled, white-collar workers, primarily within the services sector. Conversely, most blue-collar roles in industry and agriculture do not require university degrees.

For instance, within our research sample of 30 female workers, 22 of them worked in services, five in agriculture, and three in industry. All 22 participants in services had university degrees. Meanwhile, among the eight participants in the other sectors, four had secondary education, two had primary education, one had a high vocational diploma, and one had a university degree. Notably, the sole respondent outside of services who had a university degree acquired the degree (in public administration) after she had already started working in manufacturing as a garment worker. Once she had acquired it, she transitioned into a white-collar role as a union leader albeit still within the garment industry.

Given that education qualifications influence employment opportunities, we must understand what causes the diverging educational choices that led to these disparities in the first place. In our primary study, personal interests and influences from friends and family members were frequently reported as factors driving educational choices. This is consistent with the research in Cambodia, which found that academic performance was not a significant factor influencing the selection of university majors. Instead, the most frequently cited factor was personal interests, followed by perceived labour market demands and family expectations.[101] Moreover, students who switched, whether from science to non-STEM or social science to STEM, were three times more likely than non-switchers to choose their majors based on family expectations.[102]

Interests and expectations, of course, do not develop randomly, but are moulded by personal experiences and prevailing gender-biased norms and expectations. Simply put, one would not become interested in a career in technology without any exposure to it (see for example, **Box 4**). However, as previously

Box 4

Nurturing Tech Enthusiasm: The Impact of Early Exposure

Below, we describe the experiences of two women working in the technology field at the time of their interviews. One of them developed an interest in technology from a young age, while the other was not exposed to it until adulthood.

Case 1: The first case involves a 39-year-old Thai woman who was working as an independent consultant in the technology subsector during the interview. She attributed her passion for digital technology to her father, who introduced her to computers and websites when she was in lower secondary school. Her father even bought her coding books, fuelling her self-taught journey into website and application development. Subsequently, she pursued university degrees in computational linguistics and applied business analytics, combining her technology-related skills with business acumen. She has held various positions within the technology workforce, including executive positions in tech start-ups. At the time of the interview, her role as an independent consultant primarily focused on transforming firms' ideas into profitable products and enhancing their internal workflows through technology. Her income reportedly fell within the highest tax bracket in Thailand.

Case 2: The second case features a 27-year-old Vietnamese woman who was employed as a software tester in an IT company. Unlike in the first case, she did not harbour interests in the technology field until after entering the labour market. Her academic background was in business administration, and she began her career as a human resources and administration officer for a tech company upon completing her studies. It was only during her first job that she was exposed to the technology field and decided to transition into a career as a tester. She acquired the necessary skills through a combination of online learning and on-the-job training. However, even after four years as a tester, she still reported a lack of in-depth IT knowledge and frequently sought support from her colleagues.

Both women noted the gender segregation prevailing in the technology workforce. Roles such as coders and programmers, which are more machine-oriented and offer higher pay, remained male-dominated. Conversely, functionality-oriented roles like testers were predominantly filled by women. Notably, the former type of roles usually requires formal qualifications involving years of studies, while the latter is generally open to anyone with at least a bachelor's degree. This also underscores the significance of early exposure to technology. Between the two examples, the first woman, whose tech interests were nurtured from a young age, evidently enjoyed advantages in terms of career prospects and upward mobility.

Despite this, the first woman acknowledged her lack of 'deep technology' skills, as she did not study engineering. She mentioned that her disinterest in pursuing deep tech-related education stemmed from the fact that most job opportunities in Thailand for individuals with deep tech skills were in automotive factories, a field that did not appeal to her. She suspected that most women shared her sentiment, as these workplaces were typically male dominated.

mentioned, societal stereotypes tend to cast men as more closely associated with blue-collar occupations, the industry sector, technology, and machinery-related fields. Additionally, there is a noticeable lack of female role models in STEM and technology domains, particularly in Cambodia. These factors help explain why fewer women in comparison to men report having 'interests' in these areas.

Another crucial aspect to address is the mismatch between the skills acquired through education and those demanded by the job market. Many individuals do not find themselves in careers that align with their formal qualifications. Within our research sample of women workers, 24 respondents had higher education qualifications (i.e., 23 university degrees and one high vocational diploma), but only 14 possessed qualifications relevant to their current jobs at the time of the interviews. This discrepancy may arise from the fact that these individuals made their educational choices when they lacked adequate insights into the labour market and/or their own interests and capabilities.

Gendered skilling beyond formal education

Unsurprisingly, gender differences also manifest in the realm of skill development outside of formal education. Thailand may be used as an illustrative case: a 2021 national survey revealed distinct preferences in the choice of courses among women who had participated in skill development activities. The most popular courses among women were cooking (40 percent), followed by agriculture (18 percent) and computer (13 percent).[103] In contrast, the same survey found that men had mostly been trained in agriculture (43 percent), industrial mechanics (18 percent), and computers (12 percent). Again, our interview findings indicate that these differences are likely shaped by gender norms and stereotypes.

Additionally, time constraints are major barriers to adult learning, disproportionately affecting women. Multiple participants, especially those in Cambodia, noted challenges with finding time to engage in skill development because of their domestic and care

work obligations, including having to take care of elderly parents. The population aging trend is likely to increase this burden for many women in the future, given their role as primary caretaker. The time constraints are in line with the literature,[104] as well as Thailand's Skill Development Survey 2021, where the lack of time was the primary reason cited for non-participation in skill development—reported by 22.24 million persons, including 1.59 million who were not in the labour force.[105]

Meanwhile, as e-learning has become a prominent means of skill development, the gender gap in access to digital technology becomes a barrier. In all three case study countries, the rates of internet use and mobile phone ownership are slightly higher among the male population than the female population (see **Table 8**). A cross-country comparison further shows that while Thai women have slightly lower access to the internet and mobile phones compared to Thai men, they still enjoy greater access than both women and men in the other two countries.

Several interviewees in our study acknowledged the existence of the digital gender divide and expressed concerns that technological advancements could exacerbate existing gender disparities. For instance, a key informant in Vietnam cited research conducted in disadvantaged communities which revealed that women often lack confidence in using smartphones. Disadvantaged households tend to prioritise purchasing smartphones for male family members, and only 11 percent of women in these communities have searched online for jobs. In Cambodia, some interview participants voiced apprehension about online harassment and internet scams, noting that women are frequently targeted due to their perceived vulnerability and limited digital literacy.

The digital divide was evident even within our small research sample. Participants with limited formal education and low levels of digital literacy reported that they had never considered using e-learning resources for skill development. Although they possessed mobile phones with internet access, their

Table 8

Access to digital technologies and internet use by sex, case study countries

Country	Internet use			Mobile phone ownership		
	Total (% of population)	Female (% of female population)	Male (% of male population)	Total (% of population)	Female (% of female population)	Male (% of male population)
Thailand	85	84	86	87	86	87
Vietnam	74	72	77	77	77	78
Cambodia	52*	52*	53*	72*	71*	72*

Source: ITU; data for Thailand and Vietnam is from 2021; whereas data for Cambodia is from 2019.

usage was primarily restricted to communication purposes.

Moreover, several participants who engaged in e-learning believed they could learn better through in-person training. Their involvement in online training was motivated by its flexibility and convenience. Thus, while digital technology has expanded access to skill development, the quality of online learning deserves attention. This also suggests that we must strive for assisted technology models rather than relying blindly on technology to train our workforce.

Recognising gender disparities, various initiatives aimed at developing women's skills have emerged across Southeast Asia. In Vietnam, the government, in collaboration with private and multilateral organisations, has offered women-specific training, particularly in digital and technology skills. For instance, in 2021, the Institute of Science and Vocational Education, UN Women, and the College of Economics, Technology, and Trade jointly launched an e-commerce training program for women. This program covered various aspects of e-commerce, including legal frameworks, platforms, tools, business models, and personal financial management.[106] Similarly, Cambodia is working to ensure women's equal access to education and training. For example, the Ministry of Posts and Telecommunications developed the Technovation 2023 initiative—a women-only training and competition program that seeks to develop young women into tomorrow's entrepreneurs and leaders in digital technology by building their digital, collaboration, and problem-solving skills. In Thailand, the Department of Skill Development has allocated funds for running courses that are open exclusively for women. However, our key informant highlighted that the budget was small, and only about 3,000 women were trained in these women-only courses each year. The informant further noted that these courses often align with traditional gender stereotypes, covering subjects like bakery, sewing, basket weaving, and barista skills, based on assumptions about women's interests. Nevertheless, efforts are being made to provide women with training in digital and technology-related skills, similar to initiatives in Vietnam and Cambodia. One common challenge across the three countries is that these training initiatives are provided sporadically and reach only a small proportion of the female workforce.

Finally, while many women face gender-related issues, it is crucial to acknowledge variations that arise from intersectionality. Within our interview sample, younger participants and those from higher socioeconomic classes tend to be better educated, more digitally literate, and less burdened by disproportionate caregiving and domestic work responsibilities compared to their older and lower-income counterparts. Additionally, it is worth noting that low-income individuals working in 'survival mode' often lack opportunities for upskilling or acquiring new skills. Geographical location also plays a significant role, as access to technology, education, and skill development opportunities varies between urban and rural areas and across different countries.

Section 7: Recommendations

Given these findings, the following recommendations could be implemented to promote the ability of workers, particularly women workers, to adapt to technology-induced changes in the labour markets of Southeast Asia:

Rethink secondary education system

Southeast Asian countries must reconsider their secondary education systems. Given the rapid transformation of the labour market due to technology and the fact that students often lack comprehensive insights into their future career opportunities during their secondary education years, it is crucial to expose students to a broader spectrum of skills instead of confining them to a single track that may limit their prospects. An essential step is the integration of the traditional academic track with the TVET track. This approach ensures that students receive both transferable skills and vocational training. The exposure to a wide range of skills would also allow students to gain a better understanding of their personal interests and expertise, as opposed to being influenced by prevailing norms and stereotypes. Simultaneously, students should receive information and guidance about potential job opportunities and educational pathways, empowering them to make well-informed decisions about their future.

Reduce gender bias in skill development systems

Unconscious gender bias and deeply ingrained gender stereotypes take root from an early age, influencing the career paths that girls and boys choose. Skill development systems, including formal education, must proactively address and mitigate these biases, ensuring that both women and men perceive equal opportunities in pursuing a wide array of careers. To achieve this, educators/trainers should undergo training to recognise and counteract unconscious bias, while educational materials and curricula should be scrutinised and revised to prevent the perpetuation of gender stereotypes. Students should be exposed to diverse role models of all genders to broaden their horizons and expand their potential. Meanwhile, education and training programs should actively strive for gender balance among participants, fostering an environment where individuals feel empowered to break free from existing stereotypes that may hinder the pursuit of genuine interests and aspirations.

Facilitate employer-provided training

Considering the rapidly evolving labour markets and the shifting skill demands, employers are increasingly prioritising the hiring of trainable rather than trained workers. The private sector should thus lead skill development efforts. To encourage employers to take a more active role in enhancing the skills of the national workforce, Southeast Asian governments may enact legislation mandating employee training, coupled with tax deduction incentives to incentivise compliance. However, to promote more inclusive development and address gender disparities more effectively, these laws could benefit from further refinement. For instance, legislation could mandate firms to ensure that individuals trained each year reflect the demographic composition of their workforce. This approach not only encourages skill development but also helps in achieving a more balanced representation, thereby contributing to a reduction in gender disparities in the labour market.

Promote and strengthen micro-credentials

Most individuals have already finished formal education when the need for reskilling and upskilling arises, underscoring the need for lifelong learning. It is crucial to provide flexible learning solutions that can accommodate the time constraints faced by workers, especially women, when seeking skill development opportunities. Micro-credentials emerge as an ideal option, enabling workers to respond to the evolving demands of the job market in a timely and adaptable manner throughout their lives. However, in an environment saturated with numerous training options, especially on online platforms, individuals may struggle to discern which skilling opportunities are genuinely worthwhile. To address this challenge, governments should play an active role in ensuring the quality and credibility of micro-credentials. This may involve establishing mechanisms for quality control, whereby micro-credentials are endorsed by reputable institutions, and their certifications are widely recognised and accepted. Quality assurance for online learning is particularly important, as individuals typically achieve better learning outcomes through in-person learning experiences.

Tackle inequalities and intersectionality

To cultivate sustainable and inclusive workforce skill development in the long term, it is imperative to address prevailing social disparities across multiple dimensions. Beyond mitigating gender bias within skill development, initiatives aimed at rectifying gender disparities may encompass encouraging businesses to foster gender-balanced workforces within each occupational group, promoting female role models to inspire increased female representation in the technology sector, and implementing family-friendly policies to alleviate the caregiving burden on women. Furthermore, it is crucial to acknowledge the concept of intersectionality, recognising that various forms of disparities endure, such as those related to income levels and geographical locations. To comprehensively combat socioeconomic inequalities, governments must ensure equitable access to quality education, technology, and training opportunities across all demographics and regions.

Bridge research gaps

Current available data is insufficient to identify future skill requirements and understand the factors that shape educational and employment decisions. As previously noted, most national labour force surveys do not collect and analyse data at the skill and task levels, in turn limiting their ability to predict future skill needs. However, a wealth of data currently resides within online skilling and job search platforms. Southeast Asian governments should consider collaborating with prominent platforms in their respective countries to harness this data, offering valuable insights for both skill development providers and learners. Governments can enhance data collection and analysis efforts, placing a greater emphasis on skills and tasks. Additionally, while our primary research has offered anecdotal insights into factors influencing students' educational choices, more robust research into these factors is essential. Such research could aid governments in re-evaluating and reforming the secondary education system to better equip students for the demands of the labour market.

Appendix 1:
Profiles of Women Workers in Primary Research

THAILAND

No.	Industry	Occupation	Age	Education	Method
1	Tech	UX writer & researcher	33	Master's degree	In-depth interview
2	Education	IT assistant professor	43	PhD	In-depth interview
3	Tech	Business development consultant	39	Master's degree	In-depth interview
4	Education	Teacher & secretary	32	Master's degree	In-depth interview
5	Manufacturing	Administrative worker	33	High vocational diploma	In-depth interview
6	Hotel	Sales manager	31	Bachelor's degree	In-depth interview
7	Agriculture	Farmer	46	High school	Focus group discussion
8	Agriculture	Farmer	64	Primary school	Focus group discussion
9	Agriculture	Farmer	44	High school	Focus group discussion
10	Agriculture	Farmer	67	Primary school	Focus group discussion

VIETNAM

No.	Industry	Occupation	Age	Education	Method
1	Agriculture	Farmer	61	High school	In-depth interview
2	Finance	Clerk	24	Bachelor's degree	In-depth interview
3	E-commerce	Retailer	24	Bachelor's degree	In-depth interview
4	Logistics	Warehouse officer	23	Bachelor's degree	In-depth interview
5	Manufacturing	Nailing process leader	39	High school	In-depth interview
6	Healthcare	Nurse	28	Medical college - nursing	In-depth interview
7	IT	Marketing manager	27	Bachelor's degree	In-depth interview
8	IT	Tester	27	Bachelor's degree	In-depth interview
9	IT	Digital transformation consultant	28	Bachelor's degree	In-depth interview
10	Trade	Computer store owner	35	Bachelor's degree	In-depth interview

CAMBODIA

No.	Industry	Occupation	Age	Education	Method
1	Garment	Women's union leader	38	Bachelor's degree	In-depth interview
2	Finance	Accounting assistant	27	Bachelor's degree	In-depth interview
3	Retail	Digital content officer	26	Bachelor's degree	In-depth interview
4	Social work	Gender justice coordinator	35	Bachelor's degree	In-depth interview
5	Social work	Social manager	29	Master's degree	In-depth interview
6	Education	Program coordinator	-	Bachelor's degree	Focus group discussion
7	Social work	Social worker	-	Bachelor's degree	Focus group discussion
8	Social work	Gender justice coordinator	-	Master's degree	Focus group discussion
9	Social work	Employment project coordinator	-	Bachelor's degree	Focus group discussion
10	Retail	Digital marketing officer	-	Bachelor's degree	Focus group discussion

Appendix II: Key Informants

No.	Country / Region	Organisation	Type
1	Thailand	Department of Skill Development	Government official
2	Thailand	National Innovation Agency	Government official
3	Vietnam	Vietnet - ICT	Expert
4	Vietnam	Ministry of Science and Technology	Government official
5	Vietnam	Ministry of Labour, Invalids and Social Affairs	Government official
6	Cambodia	Capacity-building NGO	Expert
7	Cambodia	Ministry of Women's Affairs Kingdom of Cambodia	Government official
8	Southeast Asia	Economic Research Institute for ASEAN and East Asia	Expert

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JustJobs NETWORK

JustJobs Network is an applied research institute finding evidence-based solutions to pressing labour market challenges. We produce research on good job creation and workforce development, focusing our work on the critical knowledge gaps in the employment landscape.

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