



ASEAN Regional Study

on the Impacts of
the Fourth Industrial Revolution (4IR)
on Marginalised and Vulnerable Groups



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**The ASEAN Secretariat
Jakarta**

Foreword

ASEAN recognises the limitless opportunities arising from the 4th Industrial Revolution, from intensifying connectivity and growing economies, to empowering ASEAN's citizens to tap technological advances and innovations to improve their livelihoods, enhance access to basic social services, and improve overall wellbeing. As enunciated in the Consolidated Strategy on the 4IR for ASEAN, the region endeavors to build the ASEAN Digital Community across the ASEAN Community pillars through technological governance and cybersecurity, digital economy, and digital transformation.

Digitalisation and technological advances become imperative in improving leadership and governance and in delivering services for education, health, social welfare, among others, as well as in leveraging trade and commerce for economic growth and social progress.

The ASEAN digital economy is growing significantly and is estimated to add \$1 trillion to regional GDP over the next ten years.* There are around 125,000 new internet users in the region entering the Internet every day and e-commerce is booming with the increasing use of electronic modes of financial transactions.**

The 2021 ASEAN Digital Integration Index reveals that the ASEAN Member States fare well against other Asia Pacific countries in terms of digital integration, and noted some challenges and gaps for capacity building and the promotion of innovation and entrepreneurship in accelerating digital transformation in the region.

With promising projections in the economy of ASEAN in the digital era, ASEAN is equally mindful of several challenges that may hinder the region's digital transformation. Addressing emerging risks on cybersecurity, safety, protection of data and privacy, among others are crucial in the digital integration efforts of ASEAN across sectors.

ASEAN recognises that vulnerable and marginalised groups are at a higher risk of not having access to digital technologies leaving them unable to optimise the benefits of digitalisation, particularly in education, health, labour market, and social welfare and social protection. There is also a widening space in the online world exposing such groups to potential harms and risks, especially those with multiple vulnerabilities, including children, women, persons with disabilities and older persons.

* Digital ASEAN, World Economic Forum, <https://www.weforum.org/projects/digital-asean/>

** Ibid.

In the face of rapidly advancing technological changes brought about by the 4th Industrial Revolution (4IR), ASEAN continues to promote digital access, digital literacy and cyberwellness and safety. ASEAN's collective efforts and commitments are laid out in ASEAN frameworks such as the Consolidated Strategy on the Fourth Industrial Revolution for ASEAN, ASEAN Economic Community (AEC) Blueprint 2025, Masterplan on ASEAN Connectivity 2025, and the e-ASEAN Framework Agreement.

The **ASEAN Regional Study on the Impacts of the Fourth Industrial Revolution (4IR) on Marginalised and Vulnerable Groups** was developed by the Senior Officials Meeting on Social Welfare and Development (SOMSWD) together with the ASEAN Secretariat and with the support from The Asia Foundation (TAF) and the International Development Research Centre (IDRC).

The study presents evidence on the compounding issues arising from 4IR affecting vulnerable groups in the region, and how resolving these issues matter to ASEAN in fulfilling the promise of leaving no one behind. It demonstrates how the digital age provides opportunities for connectivity, empowerment, and economic growth in the region while identifying the points of vulnerability associated with challenges due to 4IR. The study highlights ASEAN's efforts, good practices, policies and programmes to mitigate the impact and address the challenges arising from 4IR.

I commend the leadership of the Ministry of Social Development and Human Security (MSDHS), as Thailand's focal point to SOMSWD, for leading the development of this report.

I am confident that this report will provide valuable insights into current and future efforts of ASEAN and ASEAN Member States in advancing an inclusive approach to digitalisation in the three ASEAN Community pillars towards ensuring that the benefits from 4IR improve and sustain the quality of life of all peoples of ASEAN

A handwritten signature in black ink, appearing to read "San Lwin", with a stylized flourish at the end.

H.E. SAN LWIN
Deputy-Secretary General of ASEAN
for ASEAN Socio-Cultural Community

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This regional study on the impacts of the Fourth Industrial Revolution (4IR) on marginalized and vulnerable groups in ASEAN has been made possible through the invaluable contributions of multiple institutions and individuals.

As the Leader of the Senior Officials Meeting on Social Welfare and Development (SOMSWD) Thailand and the country lead for this project, I would like to convey my sincere appreciation to the International Development Research Centre (IDRC) and the Asia Foundation whose generous support has been instrumental in enabling the conduct of this study. I would like to express our heartfelt gratitude to the Regional Researchers Team, including Assistant Professor Dr. Prapaporn Tivayanond Mongkhonvanit, Dr. Victor Karunan, and Mr. Yannik Mieruch, as well as all National Consultants from each ASEAN member state. Their expertise and commitment have been crucial in advancing inclusive, evidence-based research on the Fourth Industrial Revolution (4IR) in the ASEAN region. Their contributions have played an essential role in shaping this study and ensuring a thorough analysis of the opportunities and challenges presented by emerging technologies.

I would like to acknowledge all contributions of the technical advisory team, which includes the Asia Foundation, the ASEAN Secretariat, along with our staff at the SOMSWD Thailand Focal Point. Their guidance, coordination and management have been instrumental in facilitating this regional study.

Their support aligning this research with ASEAN's broader policy frameworks and regional initiatives has significantly enhanced the study's relevance and impact.

Finally, a special appreciation is extended to the ASEAN Member States, all stakeholders, and contributors who played a role in the development of this report for their invaluable contributions. Their collective efforts and dedication have helped create a resource that will inform policies and strategies to foster inclusive digital transformation in ASEAN.

With profound appreciation.



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Their contributions have been instrumental in highlighting the unique challenges and opportunities faced by marginalised and vulnerable groups across ASEAN. Through the dedicated efforts of the regional research team and national consultants, this study stands as a testament to the power of collaboration in advancing inclusive policies in the 4IR era while strengthening social and economic resilience across ASEAN.

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Abbreviations and Acronyms

4IR	Fourth Industrial Revolution
AEC	ASEAN Economic Community
AI	Artificial Intelligence
AMS	ASEAN Member States
APSC	ASEAN Political-Security Community
ASSC	ASEAN Socio-Cultural Community
AV	Autonomous vehicle
DEC	Digital Economy Council
DEPA	Digital Economy Promotion Agency
DepEd	Department of Education
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICT	Information and Communication Technology
IoT	Internet of Things
LDC	Least developed country
MECG	The Mother and Early Child Grant
MEF	Ministry of Economy and Finance
MISTI	Ministry of Industry, Science, Technology and Innovation
MoCI	Ministry of Communication and Informatics
MOE	Ministry of Education
MoEYS	Ministry of Education, Youth and Sport
MOFE	Ministry of Finance and Economy
MOSTI	Ministry of Science, Technology, and Innovation
MSMEs	Micro-, Small and Medium-sized Enterprises
NEDA	National Economic Development Authority
NIC	National Innovation Center
PSA	Philippine Statistics Authority
PwD	Persons with disabilities
R&D	Research and development

SDGs	Sustainable Development Goals
SOMSWD	Senior Officials Meeting on Social Welfare and Development
TESDA	Technical Education and Skills Development Authority
TVET	Technical and Vocational Education and Training
UN	United Nations

Executive Summary

The Fourth Industrial Revolution (4IR) is transforming ASEAN Member States (AMS). Its rapid technological advancements are influencing political, economic, and social spheres at all levels. While the 4IR embraces technologies such as artificial intelligence (AI), robotics, Internet of Things (IoT), and blockchain, this study examines the 4IR as an impetus to significant societal changes and focuses on the effects and impacts it and its technologies will have on marginalised and vulnerable groups.

In the past, AMS have predominantly skewed support for 4IR technology adoption towards economic purposes. However, the 4IR is not only a technological shift: it is a social transformation that reshapes how citizens live and work. To understand this transformation and how to harness it for social as well as economic benefit, it is important for policymakers to look at the broader socio-economic aspects of each AMS and the ASEAN region to see how policy can address the socio-economic challenges of 4IR technologies and ensure that no one is left behind.

While 4IR technologies promise economic growth and efficiency improvements, they pose significant challenges, particularly for marginalised and vulnerable groups. The juxtaposition of 4IR opportunities and challenges amongst AMS raises speculation that more can be done within the region to harness and optimise 4IR technologies and mitigate their negative impacts in order to advance social welfare and development at national and regional levels.

This regional study on the impacts of the 4IR on marginalised and vulnerable groups identifies the points of vulnerability that may lead to reduced livelihoods and greater disadvantages. It also identifies practices or programmes that will mitigate these negative challenges and foster better opportunities, particularly for three main groups of ASEAN citizens – children and youth, persons with disabilities (PwD), and older persons. Cultural variability and context lead to many other complex vulnerabilities for other disadvantaged groups that are also mentioned in this report because this study aims to highlight key vulnerabilities and recognise that inclusivity is required to support the vulnerable without exclusion.

The study begins with a regional overview and synthesis that covers the context of the 4IR and its potential impacts on vulnerable groups in the ASEAN region. It then draws a profile of each AMS and provides an overview and assessment of each country's key 4IR policies, actors, and programmes for vulnerable groups (Annex 1). It discusses the policy and programme implications of these assessments and makes national-, regional-, and sub-regional-level recommendations to create or improve policies and programmes that are aligned with relevant ASEAN mandates. It concludes with key insights and suggestions for the future.

Regional Context and Socio-Economic Trends

Various socio-economic trends affect AMS, including wealth and other inequalities, demographic shifts, urbanisation, and new technology adoption. These trends vary significantly between AMS and influence each country's readiness to adopt 4IR technologies on a broad scale.

Poverty reduction has seen great progress across the region, but inequality remains a concern, as do inequalities in people's access to employment, modernised education, and physical infrastructure, particularly by vulnerable groups.

Demographic shifts also variably affect the region. Some AMS, such as Thailand and Singapore, are experiencing a rapid ageing of their populations, which necessitates technological innovations in healthcare and social services. Other countries, like Cambodia, the Philippines and Indonesia, have a large youth population, which increases the need for digital education and unemployment programmes.

Furthermore, AMS have tended to focus investment in digital infrastructure and ecosystems on their rapidly growing urban areas. These also vary in size and structure and tend to drain resources away from rural areas.

Increasingly, ASEAN and AMS promote new technology adoption and focus on building digital economies through initiatives like the *ASEAN ICT Masterplan 2020* and the *ASEAN Digital Integration Framework*, which aim to enhance digital connectivity, promote e-commerce, and foster innovation across the region. However, AMS economies vary significantly in size and structure. For instance, Indonesia has the largest economy in the region, one dominated by the service sector, while Brunei Darussalam relies heavily on primary sector oil production and Cambodia strives to develop. Thus, economic diversity influences each country's ability to invest in and benefit from 4IR technologies and its ability to bridge the substantial digital divide that exists across the region. For example, wealthier countries, such as Singapore and Brunei Darussalam, experience higher internet penetration rates than other AMS. Additional investments in digital infrastructure will be critical to bridging this divide, particularly in rural and underserved areas.

Overall, the varied socio-economic trends and contexts of AMS require understanding and a nuanced approach when developing inclusive and effective 4IR strategies to harness the benefits of the 4IR while mitigating its challenges. By addressing the unique challenges and opportunities presented by these trends, AMS can ensure that the benefits of the 4IR are equitably distributed and contribute to sustainable, inclusive development.

Impact on Marginalised and Vulnerable Groups

The 4IR has multifaceted impacts on marginalised and vulnerable groups, such as children and youth, older persons, and PwD. These groups face the risk of digital exclusion, job displacement, and negative online experiences. Conversely, the 4IR also offers them opportunities for empowerment through improved access to education, healthcare, social welfare, and economic and livelihood opportunities.

Looking at the risks specific to each vulnerable group, children and youth are at greater risk of online exploitation and privacy breaches but can benefit from digital skills and education initiatives. Efforts across AMS focus on integrating information and communication technologies (ICT) into education by providing the necessary hardware and promoting digital literacy to equip students with essential skills for the digital age. However, education systems across AMS remain at different stages in the integration of ICT and digital literacy into curricula. Countries like Brunei Darussalam and Malaysia have advanced programmes to equip students with digital skills, while other AMS are focused on developing digital education frameworks to reach disadvantaged groups.

Older persons confront digital exclusion and societal isolation but stand to benefit from 4IR technological innovations in healthcare, caregiving services, and independent living. For example, programmes in Brunei Darussalam and Malaysia focus on enhancing digital literacy among older persons, while policies in the Philippines aim to create an inclusive, age-friendly society. Meanwhile, targeted initiatives are still much needed in other AMS to reduce the risk of digital exclusion for older persons.

For PwD, 4IR technologies hold significant potential to improve their lives through assistive technologies and better and more accessible services but access remains limited and uneven due to infrastructural and societal barriers. While some countries have implemented policies and programmes to support PwD, other AMS face significant gaps in infrastructure and societal support. Initiatives across AMS aim to bridge these gaps, but more focused efforts are needed to ensure that PwD are not left behind in the digital transformation.

Policy and Programme Implications

AMS are at varying levels of readiness for the 4IR, particularly for vulnerable and marginalised groups, depending on each country's economic capacity and existing digital infrastructure. Region-wide policies that target digital inclusion and skills development are crucial, like the *ASEAN Consolidated Strategy on 4IR*, which emphasises inclusivity and provides guidance for national initiatives.

While regional and AMS 4IR policies often aim to address broad societal and economic goals, they do not specifically target marginalised and vulnerable groups. Major

national and sectoral 4IR digital and technology roadmaps have been directed towards mainstream groups of educated, upper-middle- and high-income populations in cities and urban centres, with less focus on the needs of marginalised and vulnerable groups in the ASEAN region.

To ensure inclusivity in the 4IR, it is essential to integrate specific measures that address the unique challenges faced by marginalised and vulnerable groups and to ensure that the benefits of 4IR are equitably distributed across all segments of society. To harness the 4IR technologies' potential and mitigate their challenges, this study makes five key recommendations that focus on the need to: (1) ensure access to digital technologies in rural and remote areas, (2) provide learning opportunities for the workforce to adapt to changing job requirements, (3) provide training and resources for marginalised and vulnerable groups to engage in digital entrepreneurship, (4) customise digital content and applications to be linguistically and culturally appropriate, and (5) deploy a holistic approach that integrates efforts to grow economies with efforts to increase social well-being. Doing so will promote a 4IR that fosters sustainable growth, further inclusivity, and an improved quality of life.

Further inclusivity means that an understanding and accommodation of local contexts effectively integrates 4IR technologies into societies through solutions tailored to local needs, capabilities, and cultural nuances. The AMS can do more to involve local stakeholders in the policy-making process to ensure that 4IR strategies are inclusive and contextually relevant. The development of a more inclusive approach to economic growth, governance, social well-being, and social harmony using 4IR technologies would require a more democratised framework, one that can facilitate and support public participation and engagement in the 4IR and optimise its benefits while mitigating its challenges.

Recommendations

This study offers recommendations to foster cooperation and collaboration in recognition of the need for an integrated and multi-sectoral approach to the 4IR. It highly recognizes the key role of the *Senior Officials Meeting on Social Welfare and Development (SOMSWD)* and other relevant ASEAN Sectoral Bodies, and the roles of key AMS line ministries and agencies, including from the health, education, social welfare and labour sectors, to implement its recommendations and advocate on behalf of marginalised and vulnerable groups. Through SOMSWD, ASEAN could accelerate collective efforts in and between governments, the private sector, and development partners at national and regional levels to develop strategies and programmes to increase awareness and training on the 4IR and its technologies, with a special focus on the marginalised and vulnerable groups that do not presently benefit from the 4IR. SOMSWD can also promote inclusive development and harness the potential of 4IR technologies to facilitate and support the participation of marginalised and vulnerable groups in social entrepreneurship.

Education, technology, and technical and vocational education and training (TVET) policymakers and professionals in AMS will have to re-think the learning outcomes and skills required for the job market in this current digital era, particularly for youth. They will also need to introduce strategic interventions to upskill the current workforce of all ages and to enhance competencies required for the future.

The AMS have formulated and implemented sectoral 4IR strategies that could have cross-sectoral dimensions. In Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, and Thailand, a high-level central coordinating agency or body provides direction, oversight, and coordination of 4IR policies and programmes across various government agencies. Other AMS have no formally established national coordination mechanism, so they should consider establishing one to facilitate and strengthen inter-sectoral coordination and cooperation. Where establishing such a central coordinating body is not feasible, a national Special Task Force on 4IR and marginalised and vulnerable groups could bolster a more targeted and meaningful approach that aims to mitigate the risks of 4IR technologies and harness their benefits for the economic and social well-being of marginalised and vulnerable groups.

Conclusion

Clearly, it is imperative that AMS make changes and focus attention on the 4IR, its technologies, and their positive and negative impacts on marginalised and vulnerable citizens. The unprecedented pace of change demands that AMS exhibit adaptive flexibility and agile regulatory approaches that allow for experimentation, policy adjustment, and cross-sector collaboration to ensure resilient and comprehensive policy responses that can thrive in the face of ongoing technological disruption and evolution. By proactively embracing the advancements that the 4IR offers, ASEAN societies can harness its potential for positive impacts while mitigating its risks and ensuring a sustainable, inclusive future.

As the 4IR transforms industries and labour markets, social protection can serve as an important entry point for an integrative approach to leveraging 4IR technologies for the benefit of disadvantaged groups. It is also important to underpin the 4IR with ASEAN's high political commitment and SOMSWD's mandate to promote and protect the rights of the marginalised and vulnerable groups and improve their quality of life through more extensive and efficient social assistance programmes, as enshrined in ASEAN Regional Frameworks, such as the *ASEAN Declaration on Strengthening Social Protection*. By adopting an integrative approach that leverages digital technologies, enhances inclusivity, and fosters collaboration, social protection can serve as a powerful tool for ensuring that 4IR benefits are widely and equitably distributed.

Finally, the 4IR presents both opportunities and challenges for AMS. To harness its full potential, the promotion of regional cooperation amongst AMS and across the three ASEAN Community pillars is essential to ensure that the benefits are equitably distributed and the rights of the most vulnerable upheld. Continuous dialogue, shared resources, and a commitment to inclusivity will be crucial in achieving these goals. By focusing on inclusive policies and targeted interventions, AMS can ensure that marginalised and vulnerable groups benefit from technological advancements, leading to a more equitable, inclusive and prosperous ASEAN region.



Part I: Introduction

The Fourth Industrial Revolution (4IR) is transforming societies in ASEAN Member States (AMS) at an unprecedented scope and pace¹ even as significant social and economic transformations are affecting most ASEAN nations through dynamics such as demographic shifts, urbanisation, greater economic inequality, and increased social exclusion, the latter two intensified by the COVID-19 crisis.

The 4IR refers to the drastic changes in the political, economic and social spheres in AMS and elsewhere that are driven by rapid technological advancements and innovations in various fields.² While there is no common definition of the 4IR, it may be understood as “the blurring of boundaries between the physical, digital, and biological worlds” due to advancement in various fields of technology.³ According to a World Economic Forum (WEF) and Asia Development Bank (ADB) report,⁴ these technologies commonly include:

- Artificial Intelligence (AI) and machine learning
- Advanced robotics and new forms of automation
- Ubiquitous mobile internet
- Sensors and the internet of things (IoT)
- Blockchain and distributed ledgers
- 3D printing
- Autonomous vehicles, such as cars and drones
- New materials, such as graphene
- Genetic advances, bioengineering, personalised and precision medicine
- New energy sources and storage technologies
- Quantum computing

The speed and the scope of systemic changes throughout all sectors of society without regard for the adoption of a specific technology sets the 4IR apart from previous periods of technological advancements.⁵ The 4IR is expected to provide huge benefits to AMS and the entire region. These opportunities include the potential for economic growth and improvements to environmental management, government transparency and efficiency, and the healthcare sector.⁶ However, the 4IR may also bring tremendous challenges, such as heavier demands on education systems, deep disruptions to jobs as semi-skilled and unskilled manufacturing and service sector workers may be replaced by AI

¹ WEF and ADB, ‘ASEAN 4.0’.

² WEF and ADB, ‘ASEAN 4.0’

³ Mhlanga, D. (2021). ‘Artificial Intelligence in the Industry 4.0, and Its Impact on Poverty, Innovation, Infrastructure Development, and the Sustainable Development Goals’. *Sustainability*, 13(11), 5788; <https://doi.org/10.3390/su13115788>.

⁴ WEF and ADB, ‘ASEAN 4.0’.

⁵ Schwab, K. *The Fourth Industrial Revolution*.

⁶ Menon and Fink, ‘The Fourth Industrial Revolution and Its Implications for Regional Economic Integration in ASEAN’; WEF and ADB, ‘ASEAN 4.0’.

and advanced robotics, and greater inequality between and within countries, depending on their readiness, and that of their populations, to adopt emerging technologies.⁷

In other words, reaping the benefits of such technologies is not automatic: the COVID-19 pandemic demonstrated the negative impact of a greater reliance on digital technologies for vulnerable and marginalised groups⁸ who have long had a higher risk of being unable to access digital technologies.⁹ Vulnerability generally refers to the exposure of an individual, household, or group to the risk of suffering an undesirable outcome due to adverse events.¹⁰ Following this logic, the United Nations (UN) Economic and Social Commission for Western Asia defines vulnerable groups as “a population that has some specific characteristics that make it at higher risk of falling into poverty than others”.¹¹ While there is no agreed definition of marginalised groups across the ASEAN region, marginalisation is often described as a process of social exclusion rooted in unequal power dynamics.¹² Marginalised and vulnerable groups commonly include “children and youth, persons with disabilities (PwD) (of whom more than 80 per cent live in poverty); people living with HIV/AIDS; older persons; ethnic minorities; indigenous peoples; refugees; and internally displaced persons and migrants” as listed in the UN Agenda 2030.¹³

Overall, this definition of marginalised and vulnerable groups implies that disadvantaged groups might vary depending on the national and local socio-cultural, political, and economic contexts. Furthermore, recent literature on vulnerability highlights the complexity of vulnerabilities and stresses the importance of an approach that goes beyond categorising vulnerability by homogenous groups. Therefore, this study adopts a framework that understands vulnerability as a broad concept, one that encompasses a variety of groups based on their experience of social exclusion within the context of the 4IR and that acknowledges the importance of intersectional vulnerabilities, which take into account the differences that may co-exist within the same group. Following the literature on digital inclusion, this study highlights how mechanisms of social exclusion and inclusion influence the impact of digital technologies on three particular marginalised groups: children and youth, older persons, and PwD.¹⁴ In this report, a child is defined as any person under the age of 18 unless under law applicable to the child majority is

⁷ Enzmann and Moesli, ‘Seizing Opportunities’; Smith, ‘How Can the Least Developed Member Countries of ASEAN Benefit from the 4th Industrial Revolution?’; The Asia Foundation, ‘The Future of Work Across ASEAN: Policy Prerequisites for the Fourth Industrial Revolution’; Zervoudi, ‘Fourth Industrial Revolution’.

⁸ Asian Development Bank, ‘COVID-19 and Labor Markets in Southeast Asia’; Lai and Widmar, ‘Revisiting the Digital Divide in the COVID-19 Era’.

⁹ Park, ‘Multidimensional Digital Exclusion and Its Relation to Social Exclusion’; Robinson et al., ‘Digital Inequalities and Why They Matter’.

¹⁰ Alwang et al., ‘Vulnerability: A View from Different Disciplines’.

¹¹ UN Economic and Social Commission for Western Asia, ‘Vulnerable Groups’.

¹² UNDP, ‘Marginalised Minorities in Development Programming’.

¹³ UN, ‘Transforming Our World: The 2030 Agenda for Sustainable Development’, 6.

¹⁴ Tsatsou, *Vulnerable People and Digital Inclusion*.

attained earlier. A youth is a young person aged 15 to 35 years old, the range used by the *ASEAN Youth Development Index*.¹⁵ An older person is aged 60 or more, and a person with disabilities may have a physical or mental disability, or both.

The increasing need to adopt the use of digital technologies in all spheres of life under the 4IR thus threatens to leave these groups even further behind, even as the technologies may have other negative effects on people's lives, ranging from systemic bias and discrimination in government or healthcare systems to online scams or sexual exploitation.¹⁶ Even before the emergence of 4IR technologies, individuals, households, and communities have been exposed to multiple risks and have had multidimensional vulnerabilities. These often originate in conditions of economic disadvantage and social exclusion that do not fall neatly under one category, making it necessary to consider how these risks and vulnerabilities interact and reinforce each other.¹⁷

Despite the challenges posed by the 4IR, opportunities abound to decrease inequalities and empower vulnerable and marginalised groups. For instance, introducing emerging technologies into the agricultural sector could improve the livelihoods of large parts of the rural population in ASEAN or empower migrant workers to pursue better opportunities.¹⁸ For such technologies to be practical and empowering, AMS must have a detailed understanding of the impact and the opportunities of the 4IR on various disadvantaged groups, and the impacts it will have on regional, national, and local development objectives and plans, particularly where these objectives are intertwined and aligned with the UN Sustainable Development Goals (SDGs).

This regional study explores the positive and negative impacts, and opportunities and challenges, presented by the 4IR for people living in marginalised and vulnerable situations in the AMS, focusing on the provision of social welfare and development assistance. This research maps current public policies and programmes and proposes long-term strategies that can address the social externalities of 4IR technology adoption. While acknowledging that the private sector has an important role to play in this context, this study focuses on regional, national, and local government policies in the ASEAN region to guide policymakers in ways to harness and optimise 4IR technologies and mitigate their negative impacts and challenges. This report focuses on three priority vulnerable groups while also recognising the importance of the multidimensionality and

¹⁵ ASEAN, 'ASEAN Youth Development Index 2022'.

¹⁶ Equals Global Partnership, 'I'd Blush If I Could: Closing Gender Divides in Digital Skills through Education'; Heeks, 'Digital Inequality beyond the Digital Divide'; Kamaruddin et al., 'When Love Is Jeopardized'; Machimbarrena et al., 'Internet Risks'; UNDP, 'Development 4.0 Opportunities and Challenges for Accelerating Progress towards the Sustainable Development Goals in Asia and the Pacific'.

¹⁷ ASEAN Secretariat, 'Senior Officials Meeting on Social Welfare and Development (SOMSWD) Work Plan 2021-2025 and Its Results Framework'.

¹⁸ ILO, 'Digitalization to Promote Decent Work for Migrant Workers in ASEAN'; Menon and Fink, 'The Fourth Industrial Revolution and Its Implications for Regional Economic Integration in ASEAN'.

intersectionality of vulnerabilities, in line with the SOMSWD Work Plan 2021-2025 and its Framework.¹⁹

This study builds on country-level data collected primarily through desk research, complemented by expert interviews where necessary. National consultants²⁰ conducted the interviews and wrote the ten ASEAN Country Profiles. The ASEAN regional research team then synthesised the country profiles to write this report.

This report has five parts. Part I provides an overview of the 4IR and a synthesis of its potential impacts on vulnerable groups in the ASEAN region. Part II summarizes each of the ten individual ASEAN country profiles, including their key 4IR policies, actors, general programmes, and programmes specifically for marginalised and vulnerable groups. Part III discusses the implications of these policies and programmes. Part IV showcases good practices across AMS that leverage 4IR technologies to address challenges faced by marginalised and vulnerable groups. The section emphasizes innovative applications of technology that not only improve service delivery but also promote social inclusion and protection. Part V concludes with strategic recommendations for regional and national policymakers so that they can maximize the benefits of 4IR technologies while mitigating their risks for marginalised and vulnerable groups.

Limitations of this study: This regional report primarily draws on the highly variable and often limited information presented in the ten AMS Country Profiles. The Regional Research Team conducted additional desk research when needed to fill gaps, explain the context, and perform a comparative analysis across AMS. The scope of the study, aligned with the SOMSWD mandate, focuses on three priority groups—children, older persons, and PwD. As a result, the needs of other vulnerable groups, such as ethnic minorities, informal workers, and low-income households, were not addressed in depth. This limited scope, while necessary for actionable recommendations, does not fully capture the intersectional and diverse vulnerabilities faced by other marginalised populations across the ASEAN region. Additionally, the study offers a broad regional overview but does not explore in detail the specific sectoral impacts of 4IR, such as its effects on agriculture, manufacturing, or the gig economy. Future research should aim to address these gaps by expanding the scope to include a wider range of vulnerable groups and conducting deeper sectoral and country-specific analyses. Such efforts would ensure a more comprehensive understanding of how the 4IR affects all segments of society.

¹⁹ ASEAN Secretariat, 'Senior Officials Meeting on Social Welfare and Development (SOMSWD) Work Plan 2021-2025 and Its Results Framework'.

²⁰ The national consultant for each AMS is identified in the Acknowledgements section of this report.



Part II:

Regional Synthesis and Overview

2.1. Background and Regional Context of the 4IR

2.1.1. Macro-trends Impacting the 4IR in ASEAN

The 4IR in ASEAN is happening in the context of other large socio-economic trends such as demographic shifts, urbanisation, migration, economic inequality, and social exclusion. While some of these trends affect all AMS, their effects and dynamics vary significantly between different countries. The 4IR is providing great advances in technology and transforming existing relations in production processes, consequently causing systemic changes through all sectors of society.²¹ The 4IR thus intersects with general developmental trends: it is crucial to have a clear understanding of these trends within AMS to be able to analyse the potential opportunities and challenges of the 4IR in the ASEAN region.

The ability of each AMS to exploit 4IR opportunities depends, in part, on the size of their economy. Obviously, more prosperous states can more easily afford to build out digital infrastructure and seize opportunities. AMS with lower economic output will find it more difficult to invest in the infrastructure and development necessary to benefit from the technologies associated with the 4IR. For this reason, ASEAN policymakers need to remain mindful of capabilities differences between large economies and smaller ones across the region, and especially urban versus rural areas, to reduce opportunity gaps for smaller AMS and their populations.

In this context, in 2021, Indonesia ranked as the largest economy in the ASEAN region, accounting for 35.4 percent of the region's total GDP. Thailand followed with a 15.1 percent share, and the Philippines and Singapore contributed 11.8 percent each. Malaysia and Viet Nam followed with 11.1 percent and 10.8 percent, respectively. The smallest economies, Myanmar, Cambodia, Lao PDR, and Brunei Darussalam together contributed only 4 percent.²² Of this last group, only Brunei Darussalam ranks as a high-income economy according to the World Bank; the others are lower middle-income economies.²³

The composition of AMS economies also differs across the region. The service sector dominates all AMS except for Brunei Darussalam; its economy is driven by the primary sector, which includes agriculture, fishing, forestry, mining, and oil production, and

²¹ Mhlanga, 'Artificial Intelligence in the Industry 4.0, and Its Impact on Poverty, Innovation, Infrastructure Development, and the Sustainable Development Goals'.

²² ASEAN, 'ASEAN Key Figures 2022', 45.

²³ For the current 2025 fiscal year, lower middle-income economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, between \$1,146 and \$4,515 and high-income economies are those with more than a GNI per capita of \$14,005. See <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

accounts for 42.0 percent of GDP. By contrast, the service sector drives the economy of the Philippines (61.1 percent of GDP), Singapore (59.3 percent), Thailand (56.7 percent), and Indonesia (42.8 percent). The primary sector also plays a significant but less dominant role in Myanmar (26.4 percent of GDP), Cambodia (26.1 percent), Indonesia (22.3 percent), Lao PDR (20.4 percent), Malaysia (17.6 percent), and Viet Nam (14.8 percent).²⁴ The different compositions of AMS economies means that they will face different challenges in the wake of the 4IR. For instance, an AMS with an economy heavily reliant on manual labour will be more susceptible to job displacement than an already highly automated one because of an introduction of robotics and automation.

These incipient job losses and displacements could exacerbate poverty levels in countries already subject to high or growing levels of poverty, or reverse recent positive trends. Over the past five years, some AMS have shown significant success in reducing poverty and income inequality. By 2023, the Philippines and Lao PDR saw significant decreases in their poverty rates, to 15.5 percent from 23.5 percent in 2016 and 18.3 percent from 24 percent in 2016, respectively. Over the same period Viet Nam, Thailand, Indonesia, and Malaysia also saw declines of 5.8 percent, 1.8 percent, 1.5 percent, and 1.4 percent, respectively. Cambodia, meanwhile, saw its poverty rate increase 8 percent during the same period, and Myanmar recorded the highest rate among AMS (24.8 percent) in 2023.²⁵

AMS also see varying degrees of income inequality, with some improvement across the region. On one hand, Cambodia significantly lowered its Gini Index from 0.42 in 2005 to 0.29 in 2017, and Viet Nam reduced its from 0.42 in 2005 to 0.375 in 2023.²⁶ Thailand, Malaysia, and Singapore also recorded reductions in income inequality. On the other hand, Singapore and the Philippines had the highest levels of income inequality in the region, with a 2023 Gini index of 0.437 and 0.44 in 2021, respectively.²⁷ The 4IR could increase the levels of inequality within countries, leaving disadvantaged groups of people in the more unequal societies even further behind.

Just as economies and inequalities vary across the ASEAN region, some AMS are facing the major challenge of demographic ageing, a global phenomenon associated with lower fertility rates and higher life expectancies. In 2022, the Asia and the Pacific region was home to 670 million older individuals aged 60 and over, which constituted approximately one out of seven people. Forecasts suggest that by 2050, the number of older persons

²⁴ ASEAN, 'ASEAN Key Figures 2024'.

²⁵ ASEAN, 'ASEAN Key Figures 2022', 37.

²⁶ The Gini Index measures income inequality, ranging from 0 (perfect equality) to 1 (perfect inequality), based on the dispersion of income.

²⁷ ASEAN, 'ASEAN Statistical Yearbook 2023', 303.

will reach 1.3 billion, or one in four people.²⁸ In the ASEAN region specifically, number of older persons similarly increased from 5.3 percent of the population in 2000 to 7.5 percent in 2022,²⁹ while the productive working-age population increased only 41.5 percent compared to a 83.7 percent increase of older persons.³⁰

In the context of the 4IR, the ageing of the population is an important trend since older persons are less likely to have the skills necessary to interact with emerging technologies. This trend impacts each AMS in very different ways. For example, Singapore and Thailand lead the trend of ageing populations, with a share of persons aged over 65 of 16.6 percent and 12.9 percent in 2022, respectively, and only 19.4 percent and 22.6 percent under 19-years-old, respectively.³¹ By 2030, nearly 25 percent of Singapore's population will be aged 65 and over.³² Other AMS, such as Cambodia, the Philippines, Indonesia, and Malaysia, have much larger shares of people under the age of 19, ranging from 30 percent to over 40 percent, with less than 10 percent aged 65 and over.³³ Thus, while all AMS are on track to become aged societies by 2050, Singapore and Thailand are expected to become super-aged societies by then. This demographic dynamic should further shape policymakers' response to the 4IR given the need for ageing societies to provide for their older populations and younger ones to provide for their youth according to each group's unique needs.

As indicated earlier, the availability of digital infrastructure is key condition for countries to be able to reap the benefits of the 4IR. However, throughout ASEAN, a digital divide persists since all people do not have the ability to access 4IR and other digital technologies. While physical access to the internet has consistently expanded in the ASEAN region, gaps between and within countries remain, with people in rural and remote regions more likely to be disconnected.³⁴ Within AMS, 72 percent of people could access the internet on average in 2022. Brunei Darussalam leads in access to internet services with 98.1 percent of its population online, closely followed by Malaysia (97.4 percent) and Singapore (96.0 percent). On the other end of the spectrum, the Philippines and Myanmar had the lowest percentage of internet users at 52.7 percent and 44.0 percent, respectively.³⁵

²⁸ ESCAP, 'Asia-Pacific Report on Population Ageing 2022: Trends, Policies and Good Practices Regarding Older Persons and Population Ageing (ST/ESCAP/3041)'.

²⁹ ASEAN, 'Ageing ASEAN: Shifting Demographic Structure', 1.

³⁰ ASEAN (2023). Ageing ASEAN: Shifting Demographic Structure (No. Volume III; ASEAN Statistical Brief, p. 1). <https://www.aseanstats.org/wp-content/uploads/2023/12/ASB-202312-5.pdf>.

³¹ ASEAN. (2023). *Ageing ASEAN: Shifting Demographic Structure* (No. Volume III; ASEAN Statistical Brief, p. 1). <https://www.aseanstats.org/wp-content/uploads/2023/12/ASB-202312-5.pdf>.

³² NPTD, 'Population Trends: Overview'.

³³ ASEAN. (2023). *Ageing ASEAN: Shifting Demographic Structure* (No. Volume III; ASEAN Statistical Brief, p. 1). <https://www.aseanstats.org/wp-content/uploads/2023/12/ASB-202312-5.pdf>.

³⁴ Chen, 'Digital Connectivity'; ITU, 'Digital Trends in Asia and the Pacific 2021'.

³⁵ ASEAN, 'ASEAN Statistical Yearbook 2023', 319.

This variation in internet access is echoed in the percentage of ASEAN citizens who adopt 4IR technologies such as AI. While rigorous data on AI adoption in AMS is lacking, estimates based on a survey of entrepreneurs suggest that Indonesia leads with 24.6 percent having integrated the technology. Thailand comes next (17.1 percent), followed by Singapore (9.9 percent), and Malaysia (8.1 percent).³⁶ A large digital divide within a country is an important indicator of its population's lack of both internet access and digital skills, and therefore people's vulnerability to being left behind in the 4IR, particularly marginalised and disadvantaged groups. For all AMS and their populations to benefit from the 4IR, it is crucial to have widely accessible digital infrastructure in place for all people to effectively employ 4IR technologies.

2.1.2. Key Region-wide Challenges and Responses

Some experts have argued that the greatest impact of the 4IR in the ASEAN region will not play out at the national level, but at the regional level. A closer look at key 4IR technology adoption trends in the ASEAN region shows large differences between the majority population and marginalised and vulnerable groups in each AMS. These differences make it clear that AMS are at different levels of readiness

to benefit from the 4IR. Research shows that, in addition to adequate strength, an economy must have four attributes to be successful in the 4IR: resiliency, agility, innovativeness, and a human-centric in development approach. Some authors argue that human capital is key in facilitating technology adoption and enabling countries to benefit from the 4IR. They further recommend that ASEAN could play a crucial role in overseeing “various activities and initiatives related to the 4IR, ensuring they are well executed and that stakeholders are fully informed”.³⁷

This would imply dramatic changes in cross-border relations and economic integration across AMS. As Menon and Fink point out:

“[I]t will not be enough to think only about a national response. In the years ahead, regional organisations like ASEAN will be called upon ever more heavily to help steer and sharpen these historic transformations. [...] It means that ASEAN and organisations like it will need to re-imagine and re-design the way they manage regional governance”.³⁸

³⁶ Vora-Sittha and Chinprateep, ‘Readiness of the ASEAN Community for the 4th Industrial Revolution’.

³⁷ Enzmann and Moesli, ‘Seizing Opportunities’, 11.

³⁸ Menon and Fink, ‘The Fourth Industrial Revolution and Its Implications for Regional Economic Integration in ASEAN’, 2.

Managing regional governance and ensuring the adoption of 4IR technologies will ensure that AMS economies and businesses can keep pace with global trends and engage in global trade and commerce. Therefore, the regional approach needs to ensure that each AMS undertakes necessary policy reforms and sets up institutional capacities required for 4IR technology adoption and integration, especially in the highly uneven regional context.

Another major challenge for the ASEAN region in relation to the 4IR is on the issue of inclusion and equity. All AMS have adopted the SDGs as their framework for economic and social development policies and programmes, but the achievement of SDG goals has been mixed and the principle of Leave No One Behind remains a challenge. This principle becomes even more important in relation to 4IR technologies, as seen earlier. Nearly all AMS reported very little policy focus on the impact of 4IR technologies on marginalised and vulnerable communities – especially children and youth, older persons, women, PwD, or ethnic minorities and others. Instead, they reported that the main purpose for or attention to 4IR technology adoption centred on mainstream populations and applications, such as business, e-commerce, banking, and so forth. Apart from this study, no major research has been undertaken in the region to assess the positive and negative impacts of 4IR technologies on marginalised and vulnerable groups in AMS.

2.1.3. LDCs in ASEAN

Another major concern is the impact of the 4IR and its technologies on Cambodia, Lao PDR and Myanmar, the least developed countries (LDCs)³⁹ in the ASEAN region, which the World Bank classifies as lower middle-income countries, as discussed earlier. Several bottlenecks prevent these three economies from taking full advantage of 4IR technologies and reaching a higher middle-, upper-middle, or high-income status. Among other barriers, Lao PDR has the lowest internet connectivity in the ASEAN region, and none of the manufactured exports from Cambodia and Myanmar include high technology products. Furthermore, all three countries score badly in all three dimensions of the Human Development Index: a long and healthy life, being knowledgeable, and having a decent standard of living.^{40 41}

Therefore, ASEAN policymakers should pay particular attention to these LDCs, for example by developing approaches and strategies that could facilitate inter-country technical exchanges and provide financial support so that these countries, too, can benefit from the opportunities that the 4IR could provide for their national development and well-being of their peoples.

³⁹ UNCTAD, 'UN List of Least Developed Countries'.

⁴⁰ Smith, 'How Can the Least Developed Member Countries of ASEAN Benefit from the 4th Industrial Revolution?'

⁴¹ United Nations, 'Human Development Index and Its Components'.

2.2. 4IR and Marginalised and Vulnerable Groups in ASEAN

When exploring the impact of 4IR on vulnerable and marginalised groups, it is important to keep in mind the specific context of their risks and vulnerabilities in the ASEAN region.

Under the *SOMSWD Work Plan 2021-2025 and Its Results Framework*, AMS list children, PwD, and older persons as priority vulnerable groups while acknowledging the existence of other vulnerable groups.⁴² In recognition of these priority areas, this section highlights the impact of 4IR technologies on these groups in the ASEAN region.

2.2.1. Negative and Positive Impacts of the 4ir Technologies on Marginalised and Vulnerable Groups

As discussed earlier, the 4IR will affect all sections of the population in AMS, with positive and negative consequences. The increasing need for people to engage with digital technologies in all areas of life, particularly in the economic sphere, exacerbates the already precarious situation of marginalised and vulnerable groups who lack the necessary digital skills or cannot access 4IR technologies and their benefits.⁴³ Such groups risk not only being left behind, but in a process of ‘adverse digital incorporation’, power inequalities that already exist in the offline world translate into the digital world, where they and other disadvantaged groups may face exploitation or other negative impacts.⁴⁴ Examples discussed earlier include the increasing prevalence of online scams to which older persons and children are at higher risk,⁴⁵ or the exploitation of women from disadvantaged economic backgrounds on online sex platforms.⁴⁶

The proliferation of digital technologies also provides opportunities to address existing inequalities and problems through innovative 4IR and other technological solutions. For example, digital technology has been successfully employed to combat human trafficking and improve the agency of migrant workers in the region;⁴⁷ telemedicine and other digital solutions within the health sector have the potential to reduce inequalities in access to healthcare;⁴⁸ connecting disadvantaged communities to the internet can bring economic opportunities while empowering marginalised groups such as women and

⁴² ASEAN Secretariat, ‘Senior Officials Meeting on Social Welfare and Development (SOMSWD) Work Plan 2021-2025 and Its Results Framework’.

⁴³ Robinson et al., ‘Digital Inequalities and Why They Matter’.

⁴⁴ Heeks, ‘Digital Inequality beyond the Digital Divide’.

⁴⁵ Kamaruddin et al., ‘When Love Is Jeopardized’.

⁴⁶ Heeks, ‘Digital Inequality beyond the Digital Divide’.

⁴⁷ ILO, ‘Digitalization to Promote Decent Work for Migrant Workers in ASEAN’.

⁴⁸ Garg et al., ‘Mobile Health App for Self-Learning on HIV Prevention Knowledge and Services Among a Young Indonesian Key Population: Cohort Study’.

PwD; and access to the internet and other digital technologies can empower indigenous communities to gain recognition and protect their ancestral lands.⁴⁹

2.2.2. Impact of the 4IR on Priority Marginalised and Vulnerable Groups

Risk and vulnerabilities are not only multi-dimensional, but the way different groups of people experience them is better understood using an intersectionality framework. However, for the purpose of policy making, it is important to identify specific groups that might be most vulnerable and most at risk. Thus, the *Consolidated Strategy on the Fourth Industrial Revolution for ASEAN (ACS4IR)* identifies women, children and youth, older persons, and PwD as those most likely to be affected by the 4IR.⁵⁰ This report highlights some specific challenges facing the latter three groups, as indicated earlier.

2.2.2.1. Children and Youth

The 4IR presents challenges and benefits to children and youth in AMS, which count more than 218 million people aged 0 to 19-years-old. They represent 32.5 percent of the overall population,⁵¹ of which youths aged 15 to 35 account for an estimated 224.2 million, with 53 percent being Gen Z (15- to 25-year-olds) and 47 percent being Millennials (26- to 35-year-olds).⁵² The AMS with the highest percentages of youth are Lao PDR (40.3 percent) and the Philippines (39 percent) (Table 1).

Table 1. Children and Youth Populations by AMS

Country	Estimated number of people aged 0-19	Percentage of youth relative to total population
Brunei Darussalam	0.124 million	27.8 percent
Cambodia	6.345 million	37.7 percent
Indonesia	88.630 million	32.1 percent
Lao PDR	3.003 million	40.3 percent
Malaysia	10.362 million	31.7 percent
Myanmar	19.771 million	35.4 percent
Philippines	43.456 million	39.0 percent
Singapore	0.789 million	19.4 percent
Thailand	14.926 million	22.6 percent
Viet Nam	30.701 million	30.9 percent

Source: ASEAN, 'ASEAN Statistical Yearbook 2023', 8.

⁴⁹ Bala and Tan, 'Digital Inclusion of the Orang Asli of Peninsular Malaysia'.

⁵⁰ ASEAN, 'Consolidated Strategy on the Fourth Industrial Revolution for ASEAN'.

⁵¹ ASEAN, 'ASEAN Statistical Yearbook 2023', 8.

⁵² ASEAN, 13.

The major challenge facing children and youth in AMS is the acquisition of skills needed to compete in the drastically changing labour market and the ability to use digital services in all sectors of society. It is thus crucial to build education systems that can prepare children adequately. However, many AMS experience difficulties in imparting the necessary skills because their education systems are already struggling with inequalities and a lack of resources.⁵³ This became especially apparent during the COVID-19 pandemic. Studies show that most AMS did not have infrastructure for remote learning: device and internet access was not universal.⁵⁴ This lack especially impacted households and children already at risk of being left behind since technology access is highly unequal in the region: only 53 percent of rural children and adolescents have internet access at home compared to 72 percent of their urban peers.⁵⁵ There are also variations between AMS: only a small percentage of households in Cambodia, Lao PDR, and Myanmar have access to broadband internet, whereas 80 percent or more of children could attend online classes in countries such as Brunei Darussalam, Indonesia, Viet Nam, and Singapore.⁵⁶ While today's youngest children may be challenged by a lack of digital skills when they enter the labour market, many youth already face this barrier. Therefore, AMS research and policies on the 4IR and young people mainly need to focus on restructuring and transforming education to fit with the future of work and its employability requirements.

Within the digital realm, 4IR technologies and advancements affect children in various other ways. Among the 4IR technologies and tools currently proliferating across the internet, the one that has great impact on boys and girls less than 18-years-old is AI. ASEAN policymakers need to pay urgent attention to the negative and detrimental impacts of AI on children and young people who risk exposure to cyber-bullying, online sexual exploitation, misuse of personal information, and other harms. Furthermore, excessive screen time and reliance on digital devices also impacts on children's social and emotional development.⁵⁷ In 2023, for example, a staggering 36.2 million reports documented suspected instances of online child sexual abuse materials worldwide. Moreover, a recent, comprehensive, global study conducted by Economist Impact on behalf of the WeProtect Global Alliance revealed that 54 percent of 18 to 20-year-old respondents had encountered online sexual harms during childhood.⁵⁸

⁵³ Zervoudi, 'Fourth Industrial Revolution'; Enzmann and Moesli, 'Seizing Opportunities'.

⁵⁴ ASEAN, 'ASEAN Policy Brief on Safe School Reopening_ '.

⁵⁵ ASEAN, 12.

⁵⁶ ASEAN, 12.

⁵⁷ ASEAN, 'Regional Plan of Action for the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN'; ASEAN and UNICEF, 'Ending Violence against Children in ASEAN Member States'; ASEAN and UNICEF, 'Children in ASEAN'.

⁵⁸ Protect Children, 'Tech Platforms Used by Online Child Sexual Abuse Offenders', 4.

Furthermore, emerging technologies, including generative AI, a subfield of AI that uses generative models to produce text, images, videos, or other forms of data, are introducing new dimensions to the landscape of online harms. The rise of AI-generated online child-related materials, which can range from altered images of real children to entirely synthetic yet realistic-looking content, exacerbates the already pervasive challenges in identifying and combating child sexual abuse materials.⁵⁹ For this reason, UNICEF has called for the urgent need for governments, private companies, and other stakeholders work together to map the potential positive and negative uses of AI on children's lives, and to develop a child rights-based framework for AI that delineates rights and corresponding duties for developers, corporations, parents, and children around the world.⁶⁰

Therefore, there is an urgent need for AMS to focus attention on engaging with internet and technology companies to design and use AI platforms with a child rights-based approach⁶¹ and to ensure that proper policies, protocols, and safeguards are in place to ensure privacy and personal data protection, and to prevent the abuse and sexual exploitation of children on the internet. Child safety needs to be a top priority, and more efforts are needed to provide accessible, child-friendly and effective monitoring and to facilitate the reporting and prosecution of violations of children's rights. With globalisation and a rapidly developing digital environment, technology companies, often under competitive pressure, subordinate children's best interests to their own business and commercial interests. Despite some companies promising to respect children's rights in the digital environment, many have failed to comply with policies and regulations that directly or indirectly safeguard children online.⁶²

That said, on the positive side, AI could improve teaching and learning and enhance social and career skills for children and young people if designed and deployed for those purposes. For this reason, one of the key areas where AI is becoming very popular is in education, where its proponents promise that its use will improve learning outcomes by enabling individualised learning, immersive learning environments, and data-driven teaching.⁶³ AI technology companies are producing new teaching and learning tools that some AMS education ministries have already adopted. The education market for AI-enabled tools and solutions is projected to grow due to increasing demand for intelligent tutoring systems that use computers and algorithms to imitate human tutors.⁶⁴ The Brookings Institute claims that "[w]ith AI, every aspect of the traditional learning

⁵⁹ Protect Children, 'Tech Platforms Used by Online Child Sexual Abuse Offenders'.

⁶⁰ Human Rights Center, 'Memorandum on Artificial Intelligence and Child Rights', 14.

⁶¹ Such an approach is based on the four general principles of the UN Convention on the Rights of the Child: (1) best interests; (2) life, survival and development; (3) non-discrimination; and (4) participation).

⁶² Livingstone et al., 'The Best Interests of the Child in the Digital Environment'.

⁶³ Holmes and Tuomi, 'State of the Art and Practice in AI in Education'.

⁶⁴ Human Rights Center, 'Memorandum on Artificial Intelligence and Child Rights', 13.

environment is up for reimagining”.⁶⁵ Education technology companies have increased their investments in digital content development and e-learning services for students, fostering demand for AI in the educational market.⁶⁶

The challenges and opportunities presented by AI and other 4IR technologies may be understood as two sides of the same coin. At one and the same time, digital technologies may provide multiple channels of connectivity for young people while increasing social isolation. Digital worlds may serve as a playground for important developmental tasks of childhood and adolescence, such as exploring sexuality and identity, but children and adolescents must also deal with the darker and more unsavoury aspects of technology during a stage of special psychological vulnerability. More specifically, these environments increase risks often associated with the sexual exploitation and trafficking of young people.⁶⁷ Furthermore, because marginalised youth are less likely to have digital skills than advantaged youth, they are generally unable to prevent themselves and their communities from being tracked online, so digital privacy has become a major concern. This fosters a new form of haves and have-nots—between “the privacy rich [those whose lives and thoughts can remain private] and the privacy poor [those who have no control over their privacy]”.⁶⁸

As ASEAN-region children grow up to working-age young adults, their have-or-have-not status often follows them, particularly if they come from a vulnerable group, when they arrive on the labour market seeking access to good-paying jobs. Persistent youth unemployment precedes the 4IR and affects all AMS, although conditions vary. The usual contributing factors for youth unemployment include job–skills mismatches in the labour market, a lack of labour market information available to young people, and insufficient employment services for at-risk youth, many of whom come from low-income households with limited social networks.⁶⁹ Changes in the content and organisation of work and structure of employed and unemployed populations, and dynamic changes according to employees’ professional, sexual, regional, national and gender aspects, also have a direct effect on youth employment and unemployment.⁷⁰ A key challenge for youth employment is the acquisition of ITC-related skills.⁷¹ The 4IR has led industries to create jobs that require technology use and higher levels of education, while only a few jobs include manual labour or routine tasks. This kind of job creation particularly hampers employment opportunities for youth who lack digital and advanced technology educations and skills.

⁶⁵ John R Allen, ‘Why We Need to Rethink Education in the Artificial Intelligence Age’.

⁶⁶ Human Rights Center, ‘Memorandum on Artificial Intelligence and Child Rights’.

⁶⁷ Machimbarrena et al., ‘Internet Risks’.

⁶⁸ Arora, *The Next Billion Users*.

⁶⁹ Asian Development Bank, ‘Reducing Youth Not in Employment, Education, or Training through JobStart Philippines’.

⁷⁰ Tyutyunnikova and Romanika, ‘Youth Employment and Unemployment in the Digital Economy Epoch’.

⁷¹ Alao A and Brink R, ‘Impact of ICTs for Sustainable Development of Youth Employability’.

Furthermore, AMS that have significant rural populations find it particularly difficult to meet the need for youth employment and education. Rural youth face numerous constraints to employment compared to adults, because they have fewer technology skills, smaller social networks, and less work experience. They also have fewer economic resources to continue their educations and build other skills that can translate into improved employment outcomes in agricultural and non-agricultural sectors.⁷² In addition, some rural youth may face additional constraints based on their gender, ethnicity, race, and physical or mental abilities. Even if 4IR technology addresses some of these challenges, rural youth still need access to other public goods, such as reliable digital infrastructure and finance. For example, the limited availability of timely and affordable credit remains a major constraint that can realistically limit farmers' and small businesses' capacity to meaningfully use information if they are unable to make investments needed to, for example, shift crop production to more profitable patterns.⁷³

2.2.2.2. Older persons

The ASEAN region is home to more than 50 million people aged 65 years or older, which constitutes 7.5 percent of the total population. With their large and growing populations of older persons, most AMS are becoming increasingly aware of the need to adapt rapidly to accommodate them. The 4IR has the potential to provide effective solutions to challenges that come with age. Such solutions will be particularly important for AMS like Singapore, which has the highest share of people aged 65 and over (16.6 percent), and Indonesia, which has the highest number of older persons (18.457 million) (Table 2).

Table 2. Older Persons Populations by AMS

Country	Estimated number of people aged 65 and over	Percentage of older people relative to total population
Brunei Darussalam	0.030 million	6.7 percent
Cambodia	1.068 million	6.3 percent
Indonesia	18.457 million	6.7 percent
Lao PDR	-.348 million	4.7 percent
Malaysia	2.364 million	7.2 percent
Myanmar	3.916 million	7.0 percent
Philippines	6.666 million	6.0 percent
Singapore	0.678 million	16.6 percent

⁷² Aker, 'Information and Communication Technologies and Rural Youth'.

⁷³ Casaburi and Reed, 'Incomplete Pass-Through and Interlinked Transactions'; Srinivasan and Burrell, 'Revisiting the Fishers of Kerala, India'.

Country	Estimated number of people aged 65 and over	Percentage of older people relative to total population
Thailand	8.530 million	12.9 percent
Viet Nam	8.230 million	8.3 percent

Source: ASEAN, 'ASEAN Statistical Yearbook 2023', 8.

For older persons in the ASEAN region, some of the potential benefits of 4IR technologies may not be realised because of policymakers' and societies' preconceived notions about elders. Older persons frequently face isolation and societal exclusion in their everyday lives.⁷⁴ And, despite the promotion of protocols and strategies related to 'active aging', most policies remain formulated exclusively in terms of families taking care of their elders and older persons' dependency on their families.

Although some AMS implement lifelong-learning policies, they focus on conventional skills training for working-age job seekers and access to education for individuals who missed out in their youth.⁷⁵ Thus, older persons are highly vulnerable to digital exclusion because they are left out of such policies and may be unable to keep up with the fast pace of technological change. Their plight worsens if their technological knowledge is lower than younger people's since they did not grow up with advanced technologies and therefore are not 'digital natives'. In addition, older persons may find 4IR technologies physically difficult to use.⁷⁶ As a result, many older persons may not be able to fully access essential services, including information, social stimulation, and opportunities to overcome their isolation because online and other systems have been designed without consideration of older persons' specific needs and conditions. For these reasons, older persons might also be socially excluded from our internet-dominated society.⁷⁷ Technological advancements can sometimes lead to even more cultural and social disconnection, as older individuals may feel a widening generation gap as values, communication styles, and social norms evolve.

Policymakers also need to consider the evolving 4IR technological landscape in relation to people as they age; the diversity of motives for older persons' engagement with everyday technologies for information, communication, and entertainment; the changing opportunities and barriers that need to be considered regarding older person's access to

⁷⁴ Tsetoura, 'Technological Inequality and Social Exclusion of Older People during the COVID-19 Pandemic'.

⁷⁵ Jagannathan and Geronimo, 'Reaping the Benefits of Industry 4.0 through Skills Development in High-Growth Industries in Southeast Asia'.

⁷⁶ NIC, 'Digital Technology and Older People'.

⁷⁷ Seifert, Hofer, and Rössel, 'Older Adults' Perceived Sense of Social Exclusion from the Digital World'.

and use of technology; and how forms of assistive technology can support older people, including those with complex needs, to age well within their community.⁷⁸

It is important to note that inequities among older persons themselves also exists, mirroring many of the same inequities demonstrated among the entire population, including differences because of disparities in gender, income, education level and geography.⁷⁹ Furthermore, although internet privacy applies to all populations, older internet users are particularly vulnerable because they generally have lower internet skills.⁸⁰ Coupled with older persons' high concern for privacy, they may be dissuaded from fully engaging in a variety of internet uses and taking advantage of the rapid development of 4IR technologies.

Emerging healthcare-related 4IR technologies could greatly benefit older persons in AMS. These technologies can enhance old-age care through various mechanisms, including digital management systems for efficient data handling, long-distance healthcare via virtual communications systems, decision support systems that facilitate evidence-based decision-making, and online information systems that provide health-related information to older persons and healthcare professionals, such as facts about how to age healthfully and where to find specialised services.⁸¹ These and other kinds of improved and streamlined information management systems can reduce inefficiencies and improve older persons' access to healthcare information.⁸² Telehealth initiatives can allow remote monitoring of a patient's symptoms and vital signs, enabling older persons to remain at home longer and reducing barriers to care for individuals in rural areas. Robots that can provide care, companionship, and entertainment to older persons, alleviating loneliness and social isolation, are another promising application of 4IR technologies for older persons.⁸³ Overall, such innovations have important implications for social welfare systems and social work and can alleviate some of the pressures ageing populations puts on these systems.

2.2.2.3. Persons with disabilities

While the number of PwD living in the ASEAN region remains uncertain, an estimated 700 million PwD live in the Asia Pacific region.⁸⁴ Estimates of PwD populations in each

⁷⁸ Lovarini, O'Loughlin, and Clemson, 'Older Adults and Digital Technologies'.

⁷⁹ Hunsaker and Hargittai, 'A Review of Internet Use among Older Adults'.

⁸⁰ Bartol et al., 'The Roles of Perceived Privacy Control, Internet Privacy Concerns and Internet Skills in the Direct and Indirect Internet Uses of Older Adults'.

⁸¹ ESCAP, 'Using Information and Communication Technologies to Address the Health-Care Needs of Older Persons Managing Chronic Disease: A Guidebook and Good Practices from Asia and the Pacific.'

⁸² Mubarak and Suomi, 'Elderly Forgotten?'; Strong, Guillot, and Badeau, 'Senior CHAT: A Model for Health Literacy Instruction'.

⁸³ ESCAP, 'Using Information and Communication Technologies to Address the Health-Care Needs of Older Persons Managing Chronic Disease: A Guidebook and Good Practices from Asia and the Pacific.'

⁸⁴ WFP, 'Disability Inclusion in Asia and the Pacific, A Regional Overview', 1.

AMS range from as low as 1.6 percent of the total population in Brunei Darussalam to as high as 12 percent in the Philippines (Table 3).

Table 3. Percentage of Persons with Disability in AMS Populations

Country	Person with disabilities as a percentage of total population (%)	Year
Brunei Darussalam ⁸⁵	1.6	2021
Cambodia ⁸⁶	9.4	2022
Indonesia ⁸⁷	9	2020
Lao PDR ⁸⁸	2.77*	2020
Malaysia ⁸⁹	1.9	2023
Myanmar ⁹⁰	12.8	2019
Philippines ⁹¹	12**	2016
Singapore ⁹²	3.4	2017
Thailand ⁹³	3.23	2022
Viet Nam ⁹⁴	7***	2016

* 5 years and older
 ** 15 years and older
 *** 2 years and older

Source: WFP, 'Disability Inclusion in Asia and the Pacific, A Regional Overview'.

Despite being quite numerous, PwD are being left behind in the ability to access information in many AMS. The digital divide continues to greatly impact PwD. Deficient access to written materials is one of the factors that excludes PwD from education and economic opportunities. It is estimated that less than 1 percent of the books published in the region are available in formats accessible to persons with visual, intellectual, and learning disabilities.⁹⁵ The situation is only marginally better with social media and news outlets.

⁸⁵ MFE, 'Insights into the Population and Housing Census (BPP) 2021 - Persons with Disability'.

⁸⁶ Development Pathways, 'Social Protection: A Situational Analysis of Persons with Disabilities in Cambodia'.

⁸⁷ TNP2K, 'Disability Situation Analysis Challenges and Barriers for People with Disability in Indonesia'.

⁸⁸ UNFPA, 'Towards Better Inclusion of People with Disability Rights in Lao PDR'.

⁸⁹ Department of Social Welfare, 'Statistik Pendaftaran OKU'.

⁹⁰ MCERP and Ebead, 'Inclusion for Persons with Disabilities in Federal Democratic Myanmar'.

⁹¹ Philippine Statistics Authority, 'National Disability Prevalence Survey'.

⁹² MSF, '3rd Enabling Masterplan 2017-2021'.

⁹³ Department of Empowerment of Persons with Disabilities, 'Right Promotion and Welfare for Persons with Disabilities'.

⁹⁴ UNICEF, 'Launch of Key Findings of Viet Nam's First Large-Scale National Survey on People with Disabilities (2016)'.

⁹⁵ UNESCAP, *Building Disability-Inclusive Societies in Asia and the Pacific*.

PwD also experience discrimination in the workplace. Studies show that PwD are systematically excluded from jobs throughout the region,⁹⁶ creating problems for these individuals and preventing AMS economies reaching their full potential. Research shows that PwD perform on par or better than regular employees, stay on the job longer, and that hiring PwD can boost workplace morale.⁹⁷

The 4IR has the potential to radically transform the lives of PwD. Amongst others, assistive technologies such as screen readers, voice recognition software, braille displays, and customizable user interfaces and adaptive devices could enhance accessibility and connectivity. Smart mobility devices, including electric wheelchairs and exoskeletons that use sensors and AI, could allow greater mobility and independence for individuals with mobility impairments. Augmentative and alternative communication devices, which use speech synthesis or eye-tracking technology, and speech-to-text and text-to-speech applications facilitate communication for individuals with hearing impairments or speech impediments. The use of these devices and technologies by PwD could help them to achieve improved education and employment opportunities, higher self-esteem, and social inclusion through independent living and isolation reduction.

However, while the potential of 4IR technologies for inclusive development is evident, its realisation will require active efforts to realign and shape the societal, legislative, personal, and infrastructural factors within the ICT ecosystem.⁹⁸ There is a significant need in the ASEAN region, especially in low- and middle-income AMS, to build stakeholder capacity and knowledge about how ICT can benefit PwD and about the large number of affordable and inexpensive accessibility solutions available.

There is also a need to shift perspectives away from conceptual uniformity in policy and research that focuses on the medical and socially-constructed features of disability, such as perceptions of PwD as helpless or a burden, because focusing on these features determines and limits the extent to which PwD can access and benefit from digital technologies.⁹⁹ Furthermore, when applied to a disability, the functional narrowness and inadequacy of the technology industry's 'default user and settings' approach in the design, production, and deployment of most 4IR technologies becomes evident. The technology industry and policymakers need a greater awareness of the variety of digital experiences of and choices for PwD, and both parties need to acknowledge the diversity that exists within groups of PwD and in their experiences with digital technology. To this end, the ASEAN cultural environment must incorporate the voices and cultural

⁹⁶ Crosta and Sanders, 'Overview: Disability in the ASEAN Region'; Khoo, Tiun, and Lee, 'Workplace Discrimination against Malaysians with Disabilities: Living with It or Fighting against It?'; UNDP, 'Fostering Disability Inclusion & Business Integrity in ASEAN'.

⁹⁷ UNDP, 'Fostering Disability Inclusion & Business Integrity in ASEAN'.

⁹⁸ Raja, 'Bridging the Disability Divide through Digital Technologies'.

⁹⁹ Tsatsou, 'Digital Inclusion of People with Disabilities'.

productions of PwD.¹⁰⁰ A move away from a discourse that highlights the deficits of PwD and other vulnerable groups is particularly urgent, as these groups are often studied with an emphasis on their deficits, unlike studies on dominant (able-bodied) people in the Global North. Such new perspectives should adopt ‘asset-based models’ that highlight the resilience and strengths of PwD, rather than their perceived deficits.¹⁰¹

Utilising new perspectives and 4IR technologies, such as AI assistants for voice control of technology, smart prosthetics and hearing aids, or exoskeletons, would facilitate PwD integration into mainstream societies and workforces, simultaneously empowering a marginalised group and fostering economic growth.

2.2.3. Cross-cutting Impact of 4IR on Marginalised and Vulnerable Groups – Development Goals, Policies and Strategies

The previous discussion focused on the direct impacts 4IR technologies may have on risks, vulnerabilities, and opportunities for specific marginalised and vulnerable groups. These groups may also be affected by changes in policy formulation, implementation, and everyday government operation as 4IR technologies are adopted in the AMS.

The use of AI and automation have significant public sector implications, from reducing government bureaucracy to optimising service design and delivery. But there are also risks, including the embedding of racial, ethnic, and gender biases in algorithm-based public services decisions, like those that use biometric data for policing and justice. Research shows that biased policing is aggravated by data feedback loops that predict more crime in neighbourhoods populated by a larger number of racial minorities.¹⁰²

Furthermore, by reaching distant places and enabling remotely distributed forms of action, 4IR technologies offer unprecedented opportunities to rural areas and migrants, but present unexpected new constraints that lead to controversial situations. Monitoring and remote control of smart home devices such as smart TVs or smart home sensors, whether it be by family members or through operational practices of monitoring by the state or marketing platforms, are facilitated and increased by the always-on availability and traceability of digital connectedness.¹⁰³

Notably, the formulation and implementation of development strategies in many AMS have often been unisectoral with relatively few cross-sectoral dimensions. This is particularly the case with 4IR policies or official white papers that rarely go beyond

¹⁰⁰ Ellcessor, *Restricted Access*; Tsatsou, ‘Digital Inclusion of People with Disabilities’.

¹⁰¹ Leurs, ‘Resilience and Digital Inclusion’.

¹⁰² UNDP, ‘Development 4.0 Opportunities and Challenges for Accelerating Progress towards the Sustainable Development Goals in Asia and the Pacific’.

¹⁰³ Diminescu, ‘Researching the Connected Migrant’.

technological dimensions and impacts on people and society. Given the multidimensional nature of vulnerability, it is important for ASEAN and AMS policymakers to adopt a more interdisciplinary and multisectoral approach and lens when assessing the impact of 4IR technologies, especially on marginalised and vulnerable groups.

As noted earlier, AMS have made much progress in strengthening local development policies and deploying 4IR technologies, predominantly in urban and semi-urban areas, but much work remains to be done in rural areas. Thus, an increased and specific focus on rural and remote areas is justified on the grounds that their ICT infrastructure provision is often weaker, and the benefits of online communication in rural areas relatively greater, than in urban areas. In addition, social and digital exclusion take on different forms in disadvantaged rural communities, where there is less peer-to-peer support than may be found in urban areas.¹⁰⁴

2.3. Key Challenges

The AMS need ASEAN region-wide support as they face common socio-demographic, geographic, economic, technological, and cross-border challenges and aim for inclusive adoption of 4IR technologies by their populations. Differences in socio-economic characteristics, such as rich vs. poor, women vs. men, majority vs. minority, little vs. highly educated, contribute to the digital divide and the vulnerabilities of disadvantaged groups. Urban-rural inequality in infrastructure and connectivity risks leaving marginalised and vulnerable groups in rural areas even further behind. However, the risks and vulnerabilities associated with the 4IR and technology adoption for marginalised and vulnerable groups have not been sufficiently examined or stated in government policies and programmes, and most of the technologies identified in AMS national and sectoral digital and technology roadmaps are geared toward the mainstream sectors and not targeted at children, older persons, PwD, the poor, and ethnic minorities.

2.3.1. Socio-demographic

- **Gender disparities:** The generalisation of digital technologies has resulted in gender disparities in many AMS because women's access and use are rather limited compared to men's. Social norms, attitudes, and cultural barriers also limit women's participation in digital spaces, hindering their access to its opportunities.
- **Demographic divide:** youth-elders: As discussed in detail earlier, most AMS are facing a demographic transition towards aged societies. While most young people

¹⁰⁴ Warren, 'The Digital Vicious Cycle'.

are growing up with 4IR technologies and thus becoming digital natives, barriers to use and a lack of digital skills among older persons remain key challenges for the universal adoption of 4IR technologies across AMS.

- **Geographical divide: Urban-rural-remote regions:** With AMS primarily focussing on cities and urban centres in the application of cutting-edge 4IR technologies, people in rural areas, hill regions, and remote areas are being left behind and often ignored in the design and implementation of 4IR policies and programmes. For example, many AMS are rapidly adopting ‘Smart City’ initiatives. Smart cities are urban population centres with a high infusion of modern technology. In these high-tech conurbations, cutting-edge technologies, such as AI, IoT, and automated vehicles, are used extensively to tackle a wide array of urban ills, including traffic congestion, overcrowding, and pollution. Novel 4IR technologies help cities to improve citizens’ quality of life, so governments worldwide and in the ASEAN region eagerly embrace them. Such initiatives have brought significant benefits to people in the urban centres and cities, but the geographical divide between urban, rural, and remote regions has grown wider.

2.3.2. Economic

- **Labour market disruptions:** The automation and digitalisation of industry and business is expected to result in severe job losses and other impacts, especially among the more vulnerable sectors of formal and informal workers as their skills become obsolete or inconsistent with emerging 4IR systems and technologies. For example, AI and robotics will have several detrimental impacts on low and middle-skilled assembly line workers, such as job losses, lower salaries, and less fulfilling or more boring work. The ILO estimates that 56 percent of jobs in five AMS (Cambodia, Indonesia, Viet Nam, Thailand and the Philippines) are at high risk of disappearing due to automation in the next few decades.¹⁰⁵
- **Wider inequalities between and within countries.** Economic and social disparities that have existed in AMS for many decades despite rapid economic growth are being aggravated by 4IR systems and technologies that are beyond the reach of many disadvantaged groups.
- **Concentrated market power:** While ASEAN’s digital economy is growing rapidly, large international corporations account for much of this growth, leading to an increasingly concentrated market that threatens to leave small and medium-sized enterprises (SMSEs) behind. For example, the largest sector of the digital economy,

¹⁰⁵ ILO, ‘Digitalization to Promote Decent Work for Migrant Workers in ASEAN’.

e-commerce is dominated by a few regional players: the largest company, Shopee, holds a 48 percent market share.¹⁰⁶ Similarly, the two leading players in two other major sectors, food delivery and ride hailing, dominate more than 80 percent of those markets in most countries.¹⁰⁷ While these international companies argue that they empower SMSEs and workers, their real impact on society and SMSEs remains unclear.

2.3.3. Technological

- **Digital divide:** As described earlier, access to the internet and digital technologies is very limited in rural and remote areas of most AMS. Where they are available, services remain relatively expensive and of weak quality. The digital divide between those with and without internet access leads to unequal access to emerging economic and technological opportunities that can be provided by online platforms and applications, especially for social services.
- **Algorithmic bias and systemic disadvantage:** Algorithms used by 4IR technologies can reflect and amplify existing societal biases. This may lead to discrimination based on race, religion, sexual preference, gender, ability, or other personal traits for access to credit, employment opportunities, or even healthcare, further disadvantaging groups already experiencing systemic marginalisation and discrimination in society.
- **Vulnerability to cyber-attack:** As more and more data, devices, and machines are connected to the internet, cyber-attacks become more likely and more damaging. Therefore, ASEAN and AMS policymakers need to enforce existing laws and develop more comprehensive new cyber-security measures, policies, and laws for government and personal computers, cloud data storage, and networks at the regional and national levels to counter this trend.
- **Discrimination using facial recognition systems and biometrics:** Many countries in AMS are rapidly adopting facial recognition systems for national civil registration, road traffic management, air travel, and social protection programmes, aiming to identify legal or illegal citizens and beneficiaries. When linked to the biometric system used for national citizenship identification, this widespread technology threatens to disclose and discriminate against the personal identity of citizens and non-citizens in society.

¹⁰⁶ Momentum Works, 'Ecommerce in Southeast Asia 2024'.

¹⁰⁷ Fabrigar, 'Southeast Asia's Food Delivery Spend Reaches US\$19.3B with Vietnam and Indonesia Leading Growth: Momentum Works'.

- **Cybercrime:** Some AMS have seen a rise in online scams, fraud, trafficking in child pornography, intellectual property theft, illegal online gambling and lotteries, and identity theft, among other cybercrimes. The World Economic Forum in 2023 predicted that technology-related cybercrime and cyber insecurity will be one of the top ten global risks over the next ten years, inflicting billions of dollars of damages to individuals and countries.¹⁰⁸

2.3.4. Cross-border

- **The 4IR does not recognise national borders.** Much of the technology that underlies the 4IR is developed and operated by international companies, which leads to ever greater cross-border flows of AMS populations' personal and sensitive information and other data. However, across ASEAN, data protection, privacy, and intellectual property policies and legislation often remain at the national level, which prompts concern over states' effectiveness in safeguarding data, privacy, and intellectual property rights.

¹⁰⁸ WEF, 'Global Cybersecurity Outlook 2023'.



Part III:

4IR Policies Targeting Marginalised and Vulnerable Groups

The first section of Part III reviews regional policies by various ASEAN sectoral bodies and committees that impact vulnerable and marginalised groups in the context of the 4IR, including the *Consolidated Strategy on the Fourth Industrial Revolution for ASEAN*, the *ASEAN Data Management Framework*, the *ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) Statement on Artificial Intelligence (AI)*, the *Declaration on the Protection of Children from all Forms of Online Exploitation and Abuse in ASEAN*, and the *Regional Plan of Action for the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN*.

The second section reviews national 4IR policies, relatively few of which specifically target children and youth, PwD, and older persons. However, most AMS implement policies that address some of the challenges these groups face, including digital literacy and general education interventions, economic inclusion programmes, and healthcare interventions. Part III does not include general 4IR policies and programmes in AMS, which can be found in Annex.

3.1 Regional Policies

The main ASEAN 4IR policy document is the *Consolidated Strategy on the Fourth Industrial Revolution for ASEAN* adopted in 2021.¹⁰⁹ The policy presents comprehensive strategies to leverage the potential benefits of the 4IR in the ASEAN region across all sectors of society. The Strategy further urges AMS to capitalise on the 4IR to address socio-economic challenges that persist in the region and ensure that no one is left behind. Overall, the policy aims to build an ASEAN Digital Community across ASEAN's three pillars: the ASEAN Political-Security Community (APSC), ASEAN Economic Community (AEC), and ASEAN Socio-Cultural Community (ASSC). In doing so, the policy seeks to leverage 4IR technological advantages across the region and fully address the risks that might arise.¹¹⁰

The overall vision of the regional strategy has three key elements:

- a) *A digital ASEAN that is open, secure, transparent, and connected while respecting privacy and ethics, in line with international best practices.*
- b) *A digital ASEAN that harnesses technologies to build a resilient, inclusive, integrated, and globally competitive economy.*
- c) *A digital ASEAN that embraces innovation in transforming society and contributes to social progress and sustainable development.*¹¹¹

¹⁰⁹ ASEAN, 'Consolidated Strategy on the Fourth Industrial Revolution for ASEAN'.

¹¹⁰ ASEAN, 6.

¹¹¹ ASEAN, 'Consolidated Strategy on the Fourth Industrial Revolution for ASEAN'.p. 16.

To help AMS achieve this vision, the *Consolidated Strategy on the Fourth Industrial Revolution for ASEAN* aims to provide policy guidance in three focus areas: technological governance and cyber-security, digital economy, and the digital transformation of society. To this end, the policy leverages six enablers: digital infrastructure, capacity building, institutions and governance, cooperation and collaboration, resource mobilisation, and effective monitoring.¹¹²

The Strategy further recognises the impacts on vulnerable groups and indicates that their inclusion is critical to developing policies and programmes that will help them gain access to basic connectivity, skills development, resources, and protection.¹¹³ To this end, the Strategy highlights potential policies for specific groups:

- **Children:** Strengthening regional cooperation for initiatives focused on online education, digital literacy, and online safety for children.
- **Youth:** Creating lifelong learning programmes and online education courses and increasing regional cooperation within the ASEAN higher education system, such as by allowing credit transfers.
- **Women:** Increasing investment in women's 'technopreneurship', increasing access to continuous learning, and creating accessible remote-work platforms.
- **Older persons:** Teaching basic digital literacy to older persons and their caregivers.
- **Persons with disabilities:** Mainstreaming the labour rights of PwD and assessing tools, machinery, and technologies that could address their challenges; promoting their welfare and livelihoods; and giving them access to lifelong education, training programmes, and finance.

In addition to this Strategy, which explicitly addresses the 4IR, several ASEAN policies address cross-cutting themes within the context of the 4IR. For instance, recognising the importance of secure and streamlined data management, ASEAN implemented the *ASEAN Data Management Framework* in 2021.¹¹⁴ Data underlies most emerging 4IR technologies, so AMS must manage data to benefit from these technologies. The Data Management Framework aims to promote sound data governance practices that will "instil trust in data sharing both between organisations and between countries, which will then promote the growth of trade and the flow of data among AMS and their partners in the digital economy".¹¹⁵ Another policy that only indirectly concerns marginalised and vulnerable groups is the *Framework for Developing Digital Readiness Among ASEAN Citizens*, which, without explicitly mentioning vulnerable groups, contains provisions to

¹¹² ASEAN.

¹¹³ ASEAN.

¹¹⁴ ADGSOM, 'ASEAN Data Management Framework: Data Governance and Protection throughout the Data Lifecycle'.

¹¹⁵ ADGSOM, 4.

increase the digital readiness of all ASEAN citizens through digital access, literacy and participation.¹¹⁶

Other policies, frameworks, and studies address specific technologies and trends associated with the 4IR, such as blockchain, autonomous vehicles, smart cities, and AI. While some studies commissioned by ASEAN evaluate the potential of blockchain¹¹⁷ and autonomous vehicle technologies,¹¹⁸ and consider how they overlap with existing ASEAN policy frameworks, no policies directly govern such technologies. More progress has been made towards policies for the governance and promotion of AI and Smart Cities. ASEAN is actively promoting the development of Smart Cities that leverage 4IR technologies for more sustainable urban development through Smart City Networks and several policies, plans, and guidebooks.¹¹⁹

Artificial intelligence has the most potential to contribute to and disrupt societies in the ASEAN region. The ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) has issued a Statement on AI that highlights the significance of “leveraging AI technologies to foster inclusive and equitable economic growth; improved access to education, healthcare, and essential services; and mitigate socio-economic disparities within our societies, with a commitment to ensuring the equitable distribution of AI benefits across all segments of society”.¹²⁰ This focus is also reflected in the *ASEAN Guide on AI Governance and Ethics*, which serves as a practical guide for the development and deployment of AI technologies in AMS.¹²¹ Recognising the potential benefits of AI for marginalised and vulnerable groups, the Guide includes the commitment to develop human-centred AI technology as a key component, which “should respect human-centred values and pursue benefits for human society, including human beings’ well-being, nutrition, happiness, etc.”¹²²

Another area of policy intervention is child online protection. As stated earlier, children are especially vulnerable to exploitation online, including sexual exploitation. To safeguard children in the region, ASEAN enacted the *Declaration on the Protection of Children from all Forms of Online Exploitation and Abuse in ASEAN* in 2019 and the *Regional Plan of Action for the Protection of Children from All Forms of Online Exploitation and*

¹¹⁶ ASEAN, ‘Framework for Developing Digital Readiness Among ASEAN Citizens’.

¹¹⁷ ADGSOM, ‘Blockchain for Digital Government – the ASEAN Way.’

¹¹⁸ ASEAN, KOMINFO, and Universitas Gadjah Mada, ‘ASEAN Autonomous Vehicle Landscape Report on Regulatory Pilot Space (RPS) to Facilitate Cross-Border Digital Data Flows to Enabling Self-Driving Car in ASEAN’.

¹¹⁹ ASEAN, ‘ASEAN Smart Cities Network’; ASCN, ‘ASEAN Smart Cities Network Monitoring & Evaluation Report 2023’; ASCN, ‘Smart Cities Action Plans’; MLIT, ASCN, and ASEC, ‘ASEAN Smart City Planning Guidebook’.

¹²⁰ AMMSTI, ‘ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) Statement on Artificial Intelligence (AI)’, 2.

¹²¹ ASEAN, ‘ASEAN Guide on AI Governance and Ethics’.

¹²² ASEAN, 14.

Abuse in ASEAN in 2021.¹²³ The Plan sets out specific and practical guidance on the implementation of the commitments outlined in the *Declaration on the Protection of Children from all Forms of Online Exploitation and Abuse in ASEAN*.

While no ASEAN policy documents directly target PwD in the 4IR context, the *ASEAN Enabling Masterplan 2025: Mainstreaming the Rights of Persons of Disabilities* adopted in 2018 covers key action points. The Masterplan has several goals that target digital technologies, including various provisions that aim to develop more universally accessible technology, provide digital literacy training for PwD, leverage technology to increase the efficiency of existing social protection mechanisms, and develop programmes to increase the engagement of PwD in the science and technology sector.¹²⁴

The highest level of political commitment to the care and support older persons in ASEAN is found in the *Brunei Darussalam Declaration on Strengthening Family Institution: Caring for the Elderly* adopted in 2010, *Kuala Lumpur Declaration on Ageing: Empowerment of Older Persons in ASEAN* adopted in 2015, and the latter's *Regional Plan of Action (RPA)*, which was adopted in 2021. All three documents translate ASEAN's commitments into concrete strategies and actions to advance the rights of older persons as a regional agenda across the three ASEAN Community Pillars under the stewardship of the SOMSWD. The Kuala Lumpur Action Plan prioritises the promotion of age-friendly communities and cities in the region through the provision of sustainable and accessible infrastructure, and by promoting and supporting the use and application of IoT and other technologies to ease age-related difficulties.

3.2. National Level Policies in AMS

3.2.1. Children and Youth

3.2.1.1. Education

The AMS 4IR policies mainly cover children and youth needs through interventions in the education system. As discussed earlier, learning digital skills is crucial for children to be able to participate in the 4IR labour market and gain other skills, such as problem solving, critical thinking, and information navigating. Digital skills are also crucial for children to stay safe and well when engaging with digital and 4IR technologies.

¹²³ ASEAN, 'Declaration on the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN'; ASEAN, 'Regional Plan of Action for the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN'.

¹²⁴ ASEAN, 'ASEAN Enabling Masterplan 2025: Mainstreaming the Rights of Persons with Disabilities'.

For these reasons, **Brunei Darussalam** has focused on enhancing digital literacy and skills development through its education and training programmes.¹²⁵ It has made efforts to integrate ICT into the education system through initiatives like the Smart School Project, which aims to equip students with digital skills from an early age.¹²⁶

In **Cambodia**, the government launched the Cambodia Skills Development Roadmap (2023-2035), with a goal to “develop curriculum and competency standards for jobs and occupations related to 4IR, future skills, and the green economy”.¹²⁷ Another roadmap, EduTech, identifies key technologies that can be adapted to achieve four policy pillars: the essentials, management system, courseware, and capacity building. Some key skills development and EduTech technologies include programming languages like Python, Moodle learning management system, blockchain, intranet, cloud technology, big data, AI, immersive technology, virtual and augmented reality, and Web 3.0, which refers to a proposed next generation of the internet that emphasises decentralisation and blockchain technology.

The Cambodian Ministry of Education, Youth and Sport (MoEYS) has also launched an electronic learning centre (eLearning) that caters to students in general education. Students can manage and customise learning modules at their own pace. Online training courses on information technology and soft skills, like motivation, persistence, self-control, and a growth mindset, are also available. Students can register at any time and from any location of their choosing. MoEYS has also been working with development partners to extend digital education to disadvantaged groups and students in remote areas. For instance, Plan International Cambodia, in collaboration with the Ratanakiri provincial department of education, youth, and sport, rolled out a digital learning platform for the 2023–2024 school year. UNESCO and Conserve Indigenous Peoples Languages have collaborated to enhance access to media, information, and digital literacy among ethnic minority youth in Preah Vihear, Monduliri, and Ratanakiri provinces. In a broader effort to increase digital literacy and awareness, MoEYS and partner organisations launched a project in September 2023 to provide basic computer skills, digital literacy, and online safety to teachers and students at schools in Phnom Penh, Kandal, and Kompong Thom provinces. The project’s main objective is to increase digital capacity and narrow digital gaps between various populations.¹²⁸

In **Malaysia**, the Ministry of Education (MOE) has developed the Digital Education Policy (DEP) which focuses on key matters relating to digital literacy among pupils,

¹²⁵ Brunei Darussalam Digital Economy Council, Digital Economy Masterplan 2025.

¹²⁶ Goh, ‘Reimagining and Revitalizing Lifelong Learning in Brunei for a Digital Age’; Brunei Darussalam Digital Economy Council, Digital Economy Masterplan 2025.

¹²⁷ Roth, ‘Country Profile: Cambodia’, 12.

¹²⁸ Roth, 18.

educators, and school leaders; quality of digital education content; and digital infrastructure and strategic partnerships in schools. The MOE is working with the Ministry of Communications and the Ministry of Digital (MCD) to improve schools' infrastructure and digital ecosystems. About 3,600 schools have already benefited from the MCD's Point of Presence project, a fibre optic hub that expands the broadband infrastructure network and coverage around schools and populated areas.¹²⁹

These efforts are mirrored in other countries, such as **Viet Nam**, which has implemented digital literacy programmes to enhance digital skills among marginalised and vulnerable groups, including ethnic minorities, rural populations, and disadvantaged youth. These programmes, such as the open online learning platform One Touch, aim to bridge the digital divide and empower these groups to participate in the digital economy. Since April 2022, skills training courses on digital literacy have been provided to the public, including vulnerable groups, achieving 19 million access visits. The Ministry of Information and Communications collaborates with the People's Committees of centrally governed provinces and cities to coordinate community digital technology teams and implement guidelines for basic digital skills training for citizens through online and offline formats.¹³⁰

Another area of intervention has seen efforts to provide hardware and software to schools and provide capacity training for teachers. In **the Philippines**, the Department of Education (DepEd) adopted in 2020 a Public Schools of the Future Framework to support the roll out of educational and ICT technologies to better equip public schools for the 4IR.¹³¹ The Digital Rise Program, a major component of this framework, provides hardware, software, and capacity building to learners and teachers in public schools. It has three major components: 1) the inclusion of digital literacy in the K-to-12 curriculum; 2) ICT-assisted teaching, which includes the provision of laptops, smart TVs, and lapel speakers, software content, and ICT skills-training for teachers to use in the classroom; and 3) ICT-assisted learning, including the DepEd Learning Management System (DLMS), for synchronous blended learning, which combines traditional face-to-face teaching with online modes of instruction. In addition to the DLMS, the DepEd set up an online learning resources portal, DepEd Commons, where learners and teachers can access self-learning modules, DepEd TV, and DepEd Radio episodes, among other content. Laptops and tablets are also provided to learners through the DepEd Computerization Program. Under the Digital Rise Program, public schools are mandated to have computer laboratories and learning centres, and Innovation Hubs (iHubs), to introduce learners to emerging technologies such as 3D printing; makerspaces, which refers to collaborative workspaces for innovation and hands-on learning; robotics engineering; drone technology; AI; and mobile app development. The DepEd reported that as of

¹²⁹ Hamid, 'Country Profile: Malaysia', 9.

¹³⁰ Quynh, 'Country Profile: Viet Nam', 12.

¹³¹ Lleo, 'DepEd Public Schools of the Future'.

2021, it has provided more than 42,000 schools (93 percent of public schools) with ICT equipment and trained more than 3,400 teachers in using e-Learning resources.¹³²

In addition to interventions in general education, some countries have implemented upskilling initiatives that target working-age people from specific vulnerable groups. For instance, in **Cambodia**, such initiatives for women, youth, and PwD include the 'Women in Tech Awards', funded and implemented by the Cambodia Academy of Digital Technology (CADT), the 'Aus4ASEAN Digital Transformation and Future Skills Initiative' courtesy of the Australian government, and the SmartStart Young Innovator Program funded and produced by Impact HUB and Smart Axiata, a telecommunications company. A range of other projects target women-led micro-, small-, and medium-size enterprises (MSMEs) to raise awareness of the importance of digital technology that can help boost productivity and lower costs.¹³³

3.2.1.2. Career development and employment opportunities

In many AMS, youth unemployment, as discussed earlier, is poised to increase due to technology-propelled job displacement, particularly in labour intensive industries. Some AMS have developed programmes that offer skills- and career-development opportunities to support youth so that they might thrive in the coming digital economy. For example, the **Philippines'** JobStart Program, offered by public employment services offices (PESOs), addresses the needs of at-risk youth: 18- to 24-year-olds not in education, employment, or training (NEET) and having no work experience or less than one year's worth of work experience. JobStart provides career coaching and guidance, life skills training to prepare youth for the workplace, referrals to partner employers for job interviews, placements, and internships. JobStart fully funds a 10-day life-skills training programme, provides trainees with a daily stipend of PhP300, and gives grants to partner-employers to cover training and administrative costs. It also pays for the trainee's medical clearance before the internship, and accident insurance for 12 months starting from the first day of life skills training. A Certification from The Department of Labor and Employment awards graduates a certification when they complete the programme.¹³⁴

3.2.1.3. Digitalisation of social protection

The AMS aim to leverage digital technology to streamline social policies for children and youth. For example, the **Lao PDR** government implemented a pilot project to make electronic payments for its Mother and Early Child Grants (MECG) Program. It

¹³² DepEd, 'An Introduction to DepEd's Digital Rise Program: ICT in the Department of Education'; Santos, 'Country Profile: The Philippines', 19.

¹³³ Roth, 'Country Profile: Cambodia', 17.

¹³⁴ JobStart, 'JobStart Philippines Program'; Santos, 'Country Profile: The Philippines', 20.

provides unconditional bi-monthly cash assistance to pregnant women and lactating mothers with babies aged 0-12 months to enable mothers to access adequate nutrition and healthcare services in the first 1000 days of their child's life. Beneficiaries receive the assistance via U-Money, an electronic payment app, or through a cash-to-door approach provided by Star Fintech. The pilot project includes the development of a web-based software application for programme administrators. It includes a dashboard and mobile application so that administrators can run the programme; track service delivery; manage operations such as registration, enrolment, termination, and MECCG payroll generation; and track health checkups, complaints, and grievances.¹³⁵

3.2.2. Older Persons

Out of the three priority vulnerable groups focussed on in this report, AMS 4IR policies and programmes directly target only older persons. **Brunei Darussalam** has successfully implemented 4IR technologies for marginalised older populations, such as motion sensors, fall detection systems, and emergency call buttons for prompt assistance in case of accidents or emergencies, but needs to expand the technologies' use in healthcare and home settings. Officials in the Palliative and Geriatric Department of the Ministry of Health of Brunei Darussalam are currently discussing how to improve their services by creating a fall-risk assessment and using 4IR technologies.¹³⁶

The Government of **Malaysia** has spent more than RM50 million to train and develop digitally literate communities that include older persons across the country through the Klik Dengan Bijak Program, Malaysian ICT Volunteers, Malaysian Family Digital Economy Centres (PEDI), and Cybersecurity Malaysia. In addition, PEDI, National Digital Interconnection Plan (JENDELA), and Malaysian Digital Family Economic Landmark (MEDi) have long-term plans to create a competitive, creative, and connected society. Telecommunications companies in Malaysia have also initiated several programmes to improve the lives of older and disadvantaged persons through telecom services. For example, ALTEL contributed free ALTEL SIM packs along with mobile phones sponsored by local authorities to select underprivileged students in various locations in Malaysia. The equipment was also distributed to the 'B40 community', which represents the 40 percent of households nationwide that have a net monthly income under RM4,850 and includes many older Malaysians. Three other Malaysian telecommunications companies also make commercial gestures toward older persons. Digi brings connectivity to all levels of society, including older persons, while building skills for a safe and smooth digital future with a lifetime RM10 rebate offer for all its postpaid plans. REDtone has

¹³⁵ Soukhathammavong, 'Country Profile: Lao PDR', 12; UNICEF, *User Manual for Management Information System (MIS) to Support Implementation of Mother and Early Childhood Grant Pilot Programme for Lao PDR*.

¹³⁶ Bungsu and Teo, 'Risk of Pressure Injuries in Fully Dependent Older People during the COVID-19 Pandemic in Brunei'.

organised digital literacy training sessions for older persons. Unifi has launched five #unificares initiatives to proactively support various conveniences for older persons.¹³⁷

Similarly, **the Philippines** government launched in October 2023 the Philippine Plan of Action for Senior Citizens (PPASC) 2023-2028 to address the needs and challenges of older Filipinos. It aims to create a more inclusive and age-friendly society by promoting financial and digital literacy among older persons, advocating for the passage of an Anti-Elder Abuse bill, and proposing amendments to the Republic Act 9994, an expanded Senior Citizens Act that would provide older Filipinos with discounts on medications, water and electricity, among other necessities.¹³⁸

3.2.3. Persons with Disabilities

The *ASEAN Enabling Masterplan 2025: Draft Mid-Term Review Report*¹³⁹ shows that several AMS have made progress in implementing steps to address challenges for PwD in the wake of the 4IR and to leverage opportunities to create more inclusive economies. These actions include policies that aim to increase the availability of innovative technologies that can increase PwD mobility and productivity. **Singapore** leads by encouraging reasonable tax exemptions on the sale of assistive and adaptive devices and technologies.¹⁴⁰ **Cambodia** and **the Philippines** have made major efforts to encourage the proliferation of technology that is efficient, has low environmental impact, and increases PwD mobility. Additionally, **Indonesia**, **Myanmar**, and **Malaysia** have significantly improved the accessibility and usability of ICT for PwD. **Singapore** leads **Cambodia**, **Indonesia**, and **Myanmar** in using an integrative approach to create Smart Cities that feature PwD-inclusive infrastructure and technologies.¹⁴¹

To improve inclusive economic regional integration in the e-commerce sector, **Myanmar** and **Malaysia** have made efforts to harmonise consumer rights and protection laws for consumers and entrepreneurs with disabilities. Outside the economic sector, **the Philippines** and **Myanmar** have largely completed actions set out in the *ASEAN Enabling Masterplan 2025: Mainstreaming the Rights of Persons with Disabilities*, which aims to create incentive systems and support mechanisms that increase the engagement of women and youth with disabilities in the science, technology, and innovation sectors. Although some countries have made notable progress, more work is needed to enhance the availability and accessibility of public and private websites, particularly for online banking, and the use of new, ICT, assistive, and adaptive technologies.¹⁴²

¹³⁷ Hamid, 'Country Profile: Malaysia', 15.

¹³⁸ Santos, 'Country Profile: The Philippines', 20.

¹³⁹ ASEAN, 'ASEAN Enabling Masterplan 2025: DRAFT MIDTERM REVIEW REPORT'.

¹⁴⁰ ASEAN.

¹⁴¹ ASEAN.

¹⁴² ASEAN.



Part IV:

Policy and Programme Implications – Good Practices

The 4IR is a new trend in global economic development and although its main champions originate in the more advanced, high-income countries of the Global North, all countries that are an integral part of the global economy need to come to terms with it and assess the benefits and rewards of adopting the 4IR technologies for their own national development plans and strategies.

As discussed earlier, many AMS have already deployed 4IR technologies. Some have experienced impressive benefits and persistent challenges when adapting and improvising on global 4IR trends. Some AMS have developed innovative and exemplary initiatives that could be replicated elsewhere in the ASEAN region. Part IV presents some 'good practices' in using 4IR technologies drawn from AMS.

Good Practice # 1: **4IR Technologies to Enhance Skills, Learning and Digital Literacy**

Thailand: In July 2023, the Office of Academic Affairs of Chulalongkorn University in Bangkok developed principles and guidelines for using AI tools in education that included understanding and being able to use them appropriately; modifying work tasks, teaching, and assessment processes for them; using AI tools creatively and ethically, with the utmost emphasis on academic integrity.¹⁴³

The Philippines: The Technical Education and Skills Development Authority (TESDA) is mandated to provide quality technical vocational education for the labour market, so its services must evolve as job skill requirements change and as it strengthens its relationships with private sector employers. For these reasons, TESDA is collaborating with the Information Technology and Business Process Association of the Philippines (IBPAP) to conduct a workplace skills survey to determine which skills companies and their employees will need for the 4IR.¹⁴⁴

Cambodia: The MoEYS has been working with development partners to extend digital education to disadvantaged groups and students in remote areas. For instance, as discussed earlier, Plan International Cambodia, in collaboration with the Ratanakiri provincial department of education, youth, and sport, created a digital learning platform for the 2023–2024 school year. UNESCO and Conserve Indigenous Peoples Languages have collaborated to enhance access to media, information, and digital literacy among ethnic minority youth in Preah Vihear, Mondulhiri, and Ratanakiri provinces. In a broader effort to increase digital literacy and awareness, MoEYS and partner organisations launched a project in September 2023 to provide basic computer skills, digital literacy,

¹⁴³ Somboon, 'Chulalongkorn University Principles and Guidelines for Using AI Tools'.

¹⁴⁴ Santos, 'Country Profile: The Philippines'.

and online safety to teachers and students at target schools in Phnom Penh, Kandal, and Kompong Thom provinces. The main objective of these initiatives is to increase digital capacity and narrow digital gaps.¹⁴⁵

Indonesia: “Siberkreasi” is a nationwide digital literacy programme involving the Ministry of Communications and Innovation (MOCI), civil society organisations, private sector, and others that focuses on digital rights and youth empowerment. “Siberkreasi” uses an innovative digital literacy training methodology that sets it apart from other approaches. The programme encompasses a range of activities, from using comprehensive learning modules,¹⁴⁶ to creating songs and music videos,¹⁴⁷ making podcasts,¹⁴⁸ and combining offline and online training sessions. This multifaceted approach ensures a dynamic and engaging learning experience for participants. In collaboration with the Ministry of Education, the programme has also conducted a series of digital-literacy webinars for teachers and trainings for children and PwD.¹⁴⁹

Good Practice # 2: Reaching Beneficiaries and Poor Households for Social Protection With 4IR Technologies

The Philippines: A partnership between the Philippine Statistics Authority (PSA) and the Department of Social Welfare and Development (DSWD) for DSWD’s adoption of the digital Philippine Identification System (PhilSys) is a milestone for the Philippines’ social protection and digital transformation efforts.¹⁵⁰ The DSWD will be the first agency to use secure biometric and SMS-based identity authentication to uniquely identify and verify beneficiaries of the Pantawid Pamilyang Pilipino Program (4Ps) and Assistance to Individuals in Crisis Situations (AICS) Program. The DSWD is using PhilSys to develop a unified beneficiary database that will contain up-to-date and consistent beneficiary information across all programmes.¹⁵¹ By automating verification and business processes for its social protection programmes and services, the DSWD will reduce costs and improve impacts.

Cambodia: The Ministry of Planning, with support from Australian Aid, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the United Nations Development Programme (UNDP), maintains the IDPoor system, an identification registry of poor households that was set up after the government issued Sub-Decree

¹⁴⁵ Roth, ‘Country Profile: Cambodia’.

¹⁴⁶ SIBERKREASI, ‘Modul 4 Pilar Literasi Digital – CABE (Cakap Aman Budaya Etika)’.

¹⁴⁷ *Jangan Diklik! (Official Music Video)*.

¹⁴⁸ *Podcast Alun-Alun Bersama Manggazali: Ber cerita Untuk Negeri Yang Lebih Bersih*.

¹⁴⁹ Karunian, ‘Country Profile: Indonesia’.

¹⁵⁰ Diop, ‘Transforming Social Protection Delivery in the Philippines through PhilSys’.

¹⁵¹ Santos, ‘Country Profile: The Philippines’.

291 in 2011 to regulate their identification. An eligible poor household is entitled to an IDPoor equity card and can access several programmes, such as free health care under the Health Equity Fund, financial assistance via the Cash Transfer Program for Poor Pregnant Women and Children (0–2-year-olds), and the Scholarship Program for Children in Primary and Secondary Schools. The IDPoor system was also used for the COVID-19 Relief Cash Transfer Program.¹⁵² The IDPoor database indicates that almost 3 million Cambodians are poor, which represents 19.7 percent of the country's 15.2 million population.¹⁵³

Lao PDR: Under its National Social Protection Strategy (2021-2025), the Government of Lao PDR and UNICEF, International Labour Organization (ILO), and United Nations Capital Development Fund (UNCDF) agreed to pilot a programme, the Mother and Early Childhood Grant (MECG), to provide unconditional cash assistance and enhance the impact of the country's nascent social protection services for child and family well-being in Lao PDR. The programme will deploy several innovations to adapt to the socio-economic context of Lao PDR and pandemic-related restrictions. Financial inclusion in Lao PDR is low, few rural dwellers have bank accounts, and banking and ICT infrastructure are weak in rural areas. The MECG cash benefit is delivered to beneficiaries through U-Money, a digital payment app that requires only a mobile phone number to register. For the few beneficiaries who do not register a phone number, a payment service provider will do home visits and provide cash-to-door services. Digital payment mechanisms have been gaining popularity recently and lessons from this experience will help to facilitate other social welfare payments and social insurance payments. The MECG programme uses a multi-stakeholder approach to establish the system and inform rural communities about its benefits. Before a cash transfer is implemented, basic digital literacy training and systems and infrastructure need to be put in place. UNICEF is supporting the Ministry of Labour and Social Welfare to work on implementation with village chiefs, district officials, and healthcare workers in the pilot areas.

Because most Lao people live in rural areas and are unfamiliar with the idea of social protection, one of the pillars of the MECG pilot is Behaviour Change Communication, which aims to induce changes in perspectives and actions that will increase the uptake of social protection. Given the many challenges of deploying the programme in remote rural areas that have weak ICT infrastructure, highly concentrated poverty, and low digital literacy, the programme could serve as a model for transitioning from traditional cash payments to homes and cash transfers to digital payments to an app like U-Money for marginalised and vulnerable groups to receive benefits, eventually reducing their vulnerabilities and poverty.¹⁵⁴

¹⁵² World Bank, 'Cambodia Poverty Assessment: Toward a More Inclusive and Resilient Cambodia'.

¹⁵³ MoP, 'IDPoor Data'; Roth, 'Country Profile: Cambodia'.

¹⁵⁴ Soukhathammavong, 'Country Profile: Lao PDR'.

Good Practice # 3: 4IR for Online Child Protection

Viet Nam: In August 2023, Viet Nam established the Viet Nam Cyber Safety for Children Club (VCSC). The list of initial members include businesses and organisations operating in the field of child support and protection in Viet Nam: Cyradar Information Security Joint Stock Company; Information Security Center, VNPT Group; SCS Cyber Security Joint Stock Company; BKAX Joint Stock Company; FPT Telecommunications Joint Stock Company; Viet Nam National Cyber Security Technology Joint Stock Company (NCS); Lancs Viet Nam Network Technology Joint Stock Company; Connect Viet Nam Technology and Services Investment Company; World Vision Viet Nam Organization; Plan International Viet Nam Organization; and Childfund Viet Nam Organization.

The VCSC conducts research and proposes ideas to develop policies and legal documents in the field of online child protection. It also coordinates with state agencies to widely propagate and raise awareness and skills to protect children in cyberspace and promotes the creation of content that supports children's healthy cyberspace interactions. In addition, the VCSC helps the Viet Nam Information Security Association (VNISA) develop basic criteria and standards for healthy interactive child protection products and services, contributing to the healthy-and-safe-child ecosystem and building and expanding markets for Vietnamese businesses to develop child cyberspace protection products, services.¹⁵⁵

Good Practice # 4: AVs to Tackle Traffic Congestion, Land Scarcity, and Pollution

Singapore: Singapore is making a big push into autonomous vehicles (AV), a 4IR technology. These self-driving automobiles began road tests in a few parts of the country in 2015.¹⁵⁶ In 2019, the Land Transport Authority of Singapore (LTA) announced that the entire western part of Singapore would be used to test AVs to ensure that they are safe when operating in a real-world setting.¹⁵⁷ Once that is established, AVs will likely be deployed across the island and become an important part of the country's next-generation transportation system. Ultimately, the long-term plan is to operate a fleet of shared AVs to help tackle traffic congestion, land scarcity, and pollution. A fleet of AVs operating around the clock and shared by Singaporeans is expected to reduce the number of vehicles on the road by up to two-thirds. About one-third of Singaporean households

¹⁵⁵ Quynh, 'Country Profile: Viet Nam'.

¹⁵⁶ SNDGO, 'Driving Into the Future'.

¹⁵⁷ Land Transport Authority, 'Autonomous Vehicle Testbed to Be Expanded to Western Singapore – Continued Emphasis on Public Safety'.

owns a car, the number of which has been rising steadily since 2016.¹⁵⁸ A smaller car population means that the government will not have to build more roads and parking spaces. The precious land can instead be used to build more housing and parks for Singaporeans. Although AVs have gotten into accidents, they are generally much safer than vehicles driven by people since their accident rate is significantly lower.¹⁵⁹ So when AVs take over Singapore's roads, fewer people will be killed in traffic accidents. Thus, on the upside, AVs offer a comprehensive and effective solution to traffic congestion, land scarcity, and pollution. However, the downside is that drivers of taxis, buses, delivery trucks, and private-hire vehicles (PHVs) risk losing their livelihoods because AVs are not only safer, but more also efficient and cheaper to operate. They do not get tired, fall asleep behind the wheel, or need to take breaks. They can operate 24/7 and only stop briefly for fuel. No human driver can compete with an AV on these points, which raises job-loss concerns. Drivers that lose out to AVs may find it very difficult to transition to other jobs because they may not have the kind of new skill sets and qualifications that the 4IR requires, and they tend to be older workers who are unable to make radical career changes.¹⁶⁰

Good Practice # 5: Digitalisation of Disabled Persons Cards to Access Social Services

Malaysia: To facilitate disability-inclusive digitalisation, the Ministry of Women, Family and Community Development (MWFCD) has implemented a programme for the digitalisation of identification cards for PwD, the OKU Card, which carries a QR code. As of 1 December 2023, 47,667 registered OKU Cards had been printed, an increase in the registration rate of PwD, who can use the card countrywide for easy access to various facilities and privileges.¹⁶¹ As PwD often have difficulties accessing jobs in the

production sector or using transportation facilities, information and communications devices, and other services, the OKU Cards are a great asset for PwD in Malaysia.¹⁶²

Good Practice # 6: Digital Platform for Case Management of Social Welfare

Myanmar: The Department of Social Welfare (DSW) in the Ministry of Social Welfare, Relief and Resettlement has been implementing a case management system since 2015.

¹⁵⁸ Loi, 'One-Third of S'pore Resident Households Own Cars, down from 40 per Cent a Decade Ago'.

¹⁵⁹ Osborne, 'Google's Autonomous Car Injuries: Blame the Human'.

¹⁶⁰ Tan, 'Country Profile: Singapore'.

¹⁶¹ Unit Komunikasi Awam Sarawak (UKAS), 'Sebanyak 47,667 Kad OKU Diketuk Menerusi Program Pendigitalan Kad OKU'.

¹⁶² Hamid, 'Country Profile: Malaysia'.

Under it, cash transfer programmes have more functions, so the DSW decided to develop a digital case management platform to replace the manual one. The DSW launched its social management information system (SMIS) in 2021, with technical support from the Department of Information and Technology in the Office of the Commander-in-Chief of Defence (Army, Navy, Air Force). The SMIS digital platform supports four social welfare operations: Maternal and Child Cash Transfer Program (MCCT), Social Pension (SP), Case Management Information Management System (CMIMS), and the Disabled Management Information System (DMIS). At present, only the DIMS can connect to the national electronic identification system. The other three operations, MCCT, SP, and CMIS, will be connected in the future. When that happens, the DSW list of social services beneficiaries will be more systematic and consistent in connecting with the national identification data portal.¹⁶³

Good Practice # 7: Online Delivery Platform for Community Solidarity Economy

Thailand: A cooperative community-based on-demand food and goods delivery platform, Tamsang-Tamsong originated from a research project conducted by a nongovernmental organisation that sought to mitigate the risk of infection in Bangkok during the COVID-19 pandemic under the principle of social solidarity. By having restaurants, food-delivery drivers, and consumers in the community co-own and operate the platform, the Tamsang-Tamsong team aims to provide jobs, boost the community's economy,¹⁶⁴ and make the system accessible to everyone since the delivery service runs on a popular messenger app, LINE, and a chatbot that do not require considerable technology skills.¹⁶⁵ In addition, the Tamsang-Tamsong team holds workshops to help restaurant owners and motorcycle taxi drivers, many of whom are older persons, become acquainted with the technology. The team, aided by student volunteers from Chulalongkorn University, also works with local banks to assist restaurant owners and food-delivery drivers in setting up bank accounts and using mobile banking services. The Tamsang-Tamsong delivery service, first introduced in 2020 in one Bangkok district, has expanded to over ten districts and regions in the capital city. Similar online-platform business models based on worker cooperatives have been launched elsewhere in Thailand, such as in Surat Thani Province.¹⁶⁶

¹⁶³ Sein, 'Country Profile: Myanmar'.

¹⁶⁴ Wantanasombut, 'A Thai Multi-Stakeholder Platform Co-Op for Plastic-Free Food Delivery.'

¹⁶⁵ Chulalongkorn University, 'Chula Researcher Pushes "Tamsang-Tamsong On-Demand-Delivery" Platform to Foster Social Solidarity Economy.'

¹⁶⁶ Wantanasombut, 'Country Profile: Thailand'.

Good Practice # 8: AI and Digital Platform for Health Information Management

Brunei Darussalam: A common electronic medical records (EMR) and hospital information management system (HIMS) known as Bru-HIMS was established in 2012. Approximately 85 percent of public hospital records of procedures have transitioned to the digital platform, which has records for nearly 99 percent of Brunei Darussalam's population, including, without any segregation, older and PwD populations. Bru-HIMS seamlessly integrates patient data on the principle of One Patient One Record, encompassing medical history, previous prescriptions, diagnostic test results, and more information from all visits to public healthcare facilities. The system also consolidates various hospital information modules within the unified application, ranging from laboratory and radiology systems to picture archiving and communication systems (PACS), inpatient and outpatient management, and clinical care and nursing systems. Bru-HIMS administrators plan to upgrade the system by using AI to include the latest interoperability and data standards, such as Fast Healthcare Interoperability Resources (FHIR), the industry standard for passing healthcare data between systems developed by Health Level Seven International (HL7), a nonprofit standards developing organisation.¹⁶⁷

¹⁶⁷ Ibrahim, Gulihana, and Susanto, 'An Explanatory Study of User Satisfaction'.



Part V:

Key Recommendations at Regional and Country Levels

Based on the information and analysis included in this regional study, the authors make the following recommendations to the Senior Officials Meeting on Social Welfare and Development (SOMSWD), key AMS line ministries, and AMS governments for their review and consideration to enhance policy and practice on the adoption and use of 4IR technologies in the ASEAN region and to ensure that the technologies' relevance and benefits are in line with 'the ASEAN Way'.

We note that many of our regional and national recommendations are framed and linked to various 4IR-related ASEAN policies and guidelines and reference the regional- and country-level mandate of SOMSWD. This is to ensure that the suggested recommendations are actionable for SOMSWD and other ASEAN bodies to address the opportunities and challenges that the 4IR presents to people in AMS, especially marginalised and vulnerable groups. However, noting that the operating context differs in each AMS, we suggest that SOMSWD, in consultation and collaboration with the ASEAN Secretariat and other ASEAN entities, reviews and prioritises these recommendations as per its mandate and annual workplan to facilitate and support implementation by AMS at regional and national levels.

5.1. Recommendations at the Regional Level

At the regional level, the following areas are proposed for consideration by SOMSWD, relevant ASEAN Sectoral Bodies, key entities in ASEAN, and its development partners.

5.1.1. Recommendations to Senior Officials Meeting on Social Welfare and Development (SOMSWD)

Given its mandate, SOMSWD is well-placed as a key regional body to advocate on behalf of marginalised and vulnerable groups in the ASEAN region and to ensure that the benefits of 4IR technologies are equity-based and inclusive, and that 4IR technology deployments provide opportunities for enhanced livelihoods and social well-being of children and youth, PwD, older persons, and other marginalised and vulnerable groups.

RECOMMENDATION 1:

SOMSWD needs to develop an Advocacy Strategy on 4IR technologies based on the Consolidated Strategy on the Fourth Industrial Revolution for ASEAN (2021) and to engage with line ministries and other ASEAN sectoral bodies – especially the ASEAN Economic Community - to ensure that the rights and well-being of children and youth, persons with disabilities, and older persons are protected against the negative impacts of 4IR technologies and empowered by the opportunities and benefits they present.

5.1.1.1. 4IR Awareness and Capacity Development Among Marginalised and Vulnerable Groups

Most AMS have much scope to increase awareness and understanding of the 4IR, its technologies, and their impact on marginalised and vulnerable groups. Many 4IR technologies are being adopted primarily in cities and urban areas and deployed for the mainstream population to use in mainstream areas of economic and commercial development in many sectors: public, private, industry, commerce, innovation, and services. As a result, the technologies and their benefits have not reached disadvantaged populations in urban, rural, and remote areas or marginalised and vulnerable groups such as children and youth, older persons, and PwD. Moreover, the public's general awareness and understanding of the pros and cons of 4IR technologies also needs attention, as does services provider capacity development, to address the challenges of 4IR technology adoption in the home, school, community, and society at large.

RECOMMENDATION 2:

SOMSWD, in collaboration with other government agencies, the private sector, and civil society organisations, should develop and disseminate public information and social media messaging to children and youth, persons with disabilities, older persons, and other stakeholders – especially in rural and remote areas - on the benefits and threats of 4IR technologies. SOMSWD should also provide opportunities for the capacity development of users and services providers, such as education authorities, teachers, parents, and social workers for this purpose. Digital literacy should constitute an integral element of education under Article 31 of the ASEAN Human Rights Declaration.

5.1.1.2. 4IR and Child Protection

There is widespread concern in ASEAN about the impact of digital technology and the internet on children and youth in the region. AMS have made many efforts to develop policies and strategies to prepare children and youth for the rapidly changing digital landscape while ensuring their access to opportunities, protection, and effective safety. The *ASEAN Declaration on the Protection of Children from all Forms of Online Exploitation and Abuse*¹⁶⁸ and its *Regional Plan of Action* are important frameworks for promoting safe use of the internet and its technology and also ensuring personal data security and

¹⁶⁸ ASEAN, 'Declaration on the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN'.

privacy for children and youth.¹⁶⁹ SOMSWD could facilitate and support the effective application and monitoring of, and reporting on, these child protection standards and policies to confront all forms of online exploitation and abuse from 4IR technologies.

RECOMMENDATION 3:

SOMSWD should work with relevant ASEAN sectoral bodies, especially the ASEAN Commission on Women and Children (ACWC), and other ASEAN entities including regional-level private sector and development partners to develop strategies and programmes to support AMS efforts to strengthen and improve child protection mechanisms and enforce relevant laws and regulations to protect privacy and data security and to mitigate the use of 4IR technology to exploit and abuse children and youth.

5.1.1.3. Social Protection for Marginalised and Vulnerable Groups

The *ASEAN Declaration on Strengthening Social Protection* was adopted at the 23rd ASEAN Summit in 2013, and its *Regional Framework and Action Plan* at the 27th ASEAN Summit in 2015. The *SOMSWD Work Plan 2021-2025* includes measures to promote the coverage, availability, comprehensiveness, quality, equitability, affordability, and sustainability of various social protection services, including strengthening social assistance programmes for PwD, older persons, children, and other vulnerable groups.¹⁷⁰ To achieve these goals, we make a fourth recommendation:

RECOMMENDATION 4:

SOMSWD should leverage its relationships with relevant ASEAN sectoral bodies, ASEAN entities, and the private sector to advocate for expanded use and application of 4IR technologies to more effectively target and reach marginalised and vulnerable groups and families as part of national social protection programme initiatives. SOMSWD should also facilitate and support inter-country exchanges and collaboration among AMS to share good practices and lessons learnt in 4IR technology adoption and use in the social protection sector.

¹⁶⁹ ASEAN, 'Regional Plan of Action for the Protection of Children from All Forms of Online Exploitation and Abuse in ASEAN'.

¹⁷⁰ ASEAN Secretariat, 'Senior Officials Meeting on Social Welfare and Development (SOMSWD) Work Plan 2021-2025 and Its Results Framework'.

5.1.1.4. Leveraging 4IR Technologies for Inclusive Entrepreneurship for Persons with Disabilities

The ASEAN Socio-Cultural (ASCC) Blueprint Action Line A.6.iii calls for the establishment of an ASEAN network of experts on entrepreneurship to conduct skills training for out-of-school youth, older persons, and PwD who are facing poverty and marginalisation from mainstream society.¹⁷¹ Towards this end, SOMSWD established the Network of Experts on Inclusive Entrepreneurship for ASEAN. This network could become a catalyst for inclusive development, promoting and increasing the participation of PwD and other vulnerable groups and supporting the growth of social entrepreneurship.

RECOMMENDATION 5:

SOMSWD should utilise this regional study to support the Network of Experts on Inclusive Entrepreneurship for ASEAN, strengthen engagements with private sector and civil society organisations to increase access to 4IR technologies for persons with disabilities and other vulnerable groups and to enhance their skills technology use in social entrepreneurship programmes and initiatives at national and local levels.

5.1.1.5. Adopting 4IR Technologies to Promote Inclusive and Equitable Economic and Social Development that Protects Marginalised and Vulnerable Groups in ASEAN

The *Statement of the ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) on Artificial Intelligence (AI)*, dated 7 June 2024, recognises the significant transformative potential of AI, the importance of harnessing its benefits, and the need to proactively address its multi-faceted social, economic and ethnic implications on ASEAN societies. It acknowledges “the potential of leveraging AI technologies to foster inclusive and equitable economic growth and improved access to education, healthcare, and essential services, and to mitigate socio-economic disparities within our societies, with a commitment to ensuring the equitable distribution of AI benefits across all segments of society”.¹⁷² A more inclusive approach to economic and social development using 4IR technologies requires a more democratised framework that can facilitate and support public participation and engagement in the 4IR and optimise its benefits while mitigating its challenges.

¹⁷¹ ASEAN Secretariat.

¹⁷² AMMSTI, ‘ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) Statement on Artificial Intelligence (AI)’, 2.

RECOMMENDATION 6:

SOMSWD should consider engaging the science, technology, and innovation sectors and other relevant sectors by providing technical advice and support for operationalising the action points noted in the AMMSTI Statement on AI about required social, ethical, and human rights safeguards and regulations for the deployment of AI systems and services. SOMSWD also has a key advocacy role to play with relevant government agencies about the importance of ensuring transparency, accountability, fairness, and inclusivity in the use of 4IR technologies in the social sector, and to respect and protect human dignity and rights, especially for marginalised and vulnerable groups in AMS.

5.1.1.6. Integrating the Social Impact of the 4IR Agenda in SOMSWD's Workplan 2021-2025 and Its Results Framework

The *SOMSWD Work Plan for 2021-2025* is a comprehensive framework and strategy that supports the implementation of the *ASEAN Social-Cultural Community Blueprint 2025* and seeks to address the well-being of marginalised and vulnerable groups, with a particular focus on children, PwD, and older persons, among others. The Work Plan covers a range of initiatives at regional and national levels to address the main challenges faced in the social sector through inter-pillar and cross-sectoral coordination and technical support, setting out key outcomes in relation to the various ASEAN and non-ASEAN frameworks and declarations that are relevant to the work of SOMSWD.

While the Work Plan integrates a 4IR agenda in its goals, objectives, projects, and initiatives, it makes no explicit reference to or consideration of the adoption of 4IR technologies other than spearheading the present report. Acknowledging that 4IR technology adoption and use is a relatively more recent phenomenon in many AMS, it would still be timely for SOMSWD to consider the 4IR as they perform a critical review of the 2025 plan in order to integrate recommendations in the formulation of the next Workplan for 2026 and beyond.

RECOMMENDATION 7:

SOMSWD should undertake a review of the key outcomes and proposed outputs and activities in its current Workplan for the period up to 2025 and beyond to identify relevant entry points for harnessing the potential of the 4IR and its technologies to enhance the livelihoods and economic and social well-being of children, persons with disabilities, older persons, and other marginalised and vulnerable groups in AMS.

5.1.2. Recommendations for Key Line Ministries of ASEAN Member States

5.1.2.1. *Ensure that ASEAN 4IR Leading Sectors (Industry, Science, Technology, Communications, Innovation, etc.) Consider Marginalised and Vulnerable Groups.*

Many AMS have established a lead ministry or agency to develop, coordinate, and oversee policies, strategies, and programmes that will optimise the use of digital and 4IR technologies in their economies and businesses. Lead ministries and agencies, such as the Digital Economy Council in Brunei Darussalam; Ministry of Industry, Science, Technology and Innovation (MISTI) in Cambodia; Ministry of Technology and Communications (MTC) in Lao PDR, and others have a mandate to foster a vibrant digital ecosystem, enhance technological innovation, and ensure economic advancement. It is of the utmost importance that they exercise leadership in effectively ensuring that the benefits of 4IR technologies are maximised for their societies, including marginalised and vulnerable groups.

RECOMMENDATION 8:

Lead AMS ministries and agencies on 4IR should ensure that the various policies and guidelines adopted by ASEAN on the 4IR in recent years are effectively implemented with safeguards and regulations to mitigate negative impacts on marginalised and vulnerable groups. Furthermore, these lead ministries and agencies also need to adopt specific strategies and programmes that target ‘those left behind’ and advocate for them among key government agencies and the private sector to design and expand the use of digital technologies to benefit these groups.

5.1.2.2. *Prepare Education Sector to Meet Children and Youths’ Needs in the 4IR*

The education systems in AMS need to continue retooling themselves to meet the challenges of the 4IR. While AMS have begun to focus more attention on soft skills and skills for the digital era in recent years, the rapid development and deployment pace of 4IR technologies calls for more speed in the transformation of ASEAN education systems since these new competencies are much needed to enhance the ASEAN workforce’s capabilities for innovation and creativity in the digital era. Non-cognitive soft skills include things like motivation, persistence, grit, curiosity, self-control, and a growth mindset; they reinforce cognitive skills that students commonly gain in school. As Robert Brian Smith points out in an article on the 4IR and LDCs in ASEAN:

“In 2016, it was predicted that the top 10 skills required in 2020 to thrive in the 4IR would be, in descending order: complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgement and decision making, service orientation, negotiation, and cognitive flexibility”.¹⁷³

His prediction for 2020 remains even more true for this year 2025 and beyond. To adopt and promote these 21st century skills in their education systems, AMS education ministries need to make fundamental changes in national and local curriculums and pedagogies at the primary, secondary and tertiary levels to enable children and youth across demographic and social divides to enhance their skills and thus benefit from the 4IR. There is an urgent need to integrate soft, non-cognitive skills training and assessment into basic, middle, and higher education and vocational programmes, and to develop metrics and certifications pathways for new skills to complement current educative teachings and certifications.

RECOMMENDATION 9:

Ministries of Education, Technology and TVET in AMS should undertake a critical re-thinking of the learning outcomes and skills required in the 4IR era and introduce strategic policies and interventions at all levels to upskill the workforce and to teach students at all levels the new competencies required for the 4IR job market.

5.1.2.3. Leverage 4IR Technologies in the Social Sector to Safeguard Marginalised and Vulnerable Groups

The AMS social sector ministries – Health, Labour, Education and Social Welfare – have a very important role to play in executing their mandates to safeguard the rights of vulnerable and marginalised groups and promoting health, education, labour, and social protection programmes that ensure that 4IR technologies effectively benefit these groups’ livelihoods and socio-economic well-being during the 4IR.

¹⁷³ Smith, ‘How Can the Least Developed Member Countries of ASEAN Benefit from the 4th Industrial Revolution?’, 2.

RECOMMENDATION 10:

The social sector ministries of AMS should work in close coordination with the lead ministry or agency on 4IR, other relevant government agencies, and the private sector to harness 4IR technologies for social sector programmes and to monitor their applications and uses, mitigate bottlenecks and challenges, and ensure governance and accountability on behalf of marginalised and vulnerable groups.

5.1.3. Recommendations to Governments of ASEAN Member States

5.1.3.1. Include Marginalised and Vulnerable Groups in the ASEAN Regional 4IR Vision and Strategy

Several key regional frameworks, policies, and forward-looking strategies on 4IR have been adopted by ASEAN leaders and governments, including the *Consolidated Strategy on the Fourth Industrial Revolution for ASEAN (2021)*, *ASEAN Leaders' Statement on Advancing Digital Transformation in ASEAN (2021)*, *ASEAN Comprehensive Recovery Framework (2020)*, *ASEAN Declaration on Industrial Transformation to Industry 4.0 (2019)*, and *ASEAN Digital Masterplan 2021-2025*, among others. However, ASEAN's regional vision and strategy for 4IR technologies is primarily geared towards economic sectors such as agriculture, industry, business, small enterprises, services, and others. Governments and the private sector give less attention and prioritisation to the relevance and benefit of 4IR technologies in the social sector, including the ability of technology to help AMS develop much-needed social capital to drive economic growth and social development, and to enhance social and cultural well-being citizens, especially the most marginalised and vulnerable.

As a recent Australian National University study pointed out:

"If ASEAN is truly to benefit from the widespread expertise in its societies, it should consider increasing its openness to direct engagement in policy creation. As internet and smartphone penetration deepens across ASEAN, there is substantial opportunity to make ASEAN policy formulation more inclusive by embracing new 4IR tools for public engagement. A more democratised and de-centralised vision for the ASEAN organisation could emerge".¹⁷⁴

¹⁷⁴ Menon and Fink, 'The Fourth Industrial Revolution and Its Implications for Regional Economic Integration in ASEAN', 18.

RECOMMENDATION 11:

AMS governments should seriously consider developing more decentralised approaches and strategies for the use of 4IR technologies related to governance, social well-being, and social harmony. This would require a more democratised and decentralised framework that facilitates and supports public participation and engagement in the 4IR.

5.1.3.2. Include Marginalised and Vulnerable Groups in ASEAN Governments' Approaches and Strategies

In nearly all AMS, the risks and vulnerabilities of the 4IR presented earlier have not been sufficiently examined, made explicit in government policies and strategies, or clearly integrated in initiatives and programmes at national and sub-national levels. Furthermore, implementation of governance and enforcement of regulatory policies remains fragmented and weak at both levels.

RECOMMENDATION 12:

ASEAN governments should ensure that the risks to marginalised and vulnerable groups from 4IR and digital technologies are explicitly stated in national government and private sector policies and strategies. AMS should also develop roadmaps to promote assistive and supportive technologies for marginalised and vulnerable groups along with legal and regulatory frameworks to monitor and protect their privacy and data security.

5.1.3.3. Inter-Agency and Multi-Sectoral Coordination Mechanisms to Safeguard the Rights of Marginalised and Vulnerable Groups

While some AMS, such as Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia and Thailand have a high-level central coordinating ministry, agency or body to provide direction, oversight and coordination of 4IR policies and programmes across various government agencies and private sector actors, others lack a formally established national coordination mechanism for the 4IR.

RECOMMENDATION 13:

AMS that do not already have one should consider establishing a central national-level coordination mechanism for 4IR technologies to facilitate and strengthen inter-ministerial coordination and cooperation. This would also help eliminate overlaps, improve coordination with development partners and the private sector, and ensure the effective use of 4IR-related human and financial resources.

5.1.3.4. Cyber-safety for Children and Youth, Older Persons, and Other Marginalised and Vulnerable Groups

The marginalised and vulnerable groups in AMS are prone to being victims of cybercrime, misinformation, and online bullying, given their low levels of education and limited access to information. Furthermore, cyber criminals mainly target children and youth, women, older persons and people with mental challenges for fraud and other illegal online activities, which underscores the need for stronger online safety measures.

RECOMMENDATION 14:

AMS should take urgent measures to prevent, detect, and combat cyber-crimes and to ensure that laws and policies are effectively implemented and enforced by law enforcement agencies. AMS should also ensure that the public – especially marginalised and vulnerable people – are informed and supported so that they can protect their rights, personal identities, and assets against online scams, fraud, and theft. To bolster such measures' effectiveness, AMS governments need to work closely with each other and the private sector to facilitate cross-border access to electronic intelligence and evidence in order to adhere to the global protection standards and guidelines for online safety, and to use 4IR technologies to setup safeguards and firewalls to combat cyber-crime.

5.1.3.5. Governance and Accountability on 4IR

This year ASEAN developed a practical *ASEAN Guide on AI Governance and Ethics*,¹⁷⁵ or governments, organisations, and private companies that are involved in the design, development, and deployment of AI technologies in business and commerce to ensure that systems that use AI are used in a manner that safeguards ethical standards and increases users' trust in them. This guide follows other recent frameworks and guidelines, including the *European Union's Ethics Guidelines for Trustworthy AI* (2019), *UNESCO Recommendation on the Ethics of Artificial Intelligence* (2021), and the European Parliament's *Artificial Intelligence Act* (2024), a binding treaty that seeks to ensure safety and compliance with fundamental rights while boosting innovation.¹⁷⁶

RECOMMENDATION 15:

AMS should apply recommendations from the ASEAN Guide on AI Governance and Ethics to manage and mitigate harmful and negative impacts on the social well-being of their citizens and ensure that government agencies and the private sector are transparent and accountable in the adoption and use of AI technologies. It is hoped that the ASEAN Secretariat will set in motion a process for the establishment of an "ASEAN Working Group on AI Governance" as recommended in the guide. It is also recommended that AMS governments refer to the UN Guiding Principles on Business and Human Rights standards and provisions when monitoring and regulating the private sector on AI governance and accountability.

5.2. Recommendations at the Country Level

Since the 4IR is a global phenomenon led and championed by multinational corporations, AMS should carefully assess how the 4IR impacts on national and local contexts. AMS should develop national frameworks, principles, and guidelines to assess and adopt 4IR technologies that are relevant and replicable in their contexts and that would contribute to sustainable national and local development for the benefit and well-being of their citizens, including vulnerable groups.

¹⁷⁵ ASEAN, 'ASEAN Guide on AI Governance and Ethics'.

¹⁷⁶ European Parliament, 'Artificial Intelligence Act'.

5.2.1. Localising the 4IR in National and Local Contexts

Many AMS are challenged when adopting 4IR technologies because English is the dominant language and medium of 4IR technologies. Therefore, non-English readers or speakers, a large majority of Southeast Asians, are inevitably unable to adopt and use such technologies. Some AMS, such as Cambodia and Thailand, have invested in local language systems, translations, and 4IR applications to reach a wider participation of people in society.

RECOMMENDATION 16:

ASEAN and AMS should undertake a careful assessment of the potential and limitations of 4IR technologies in each country and develop appropriate policies and guidelines for their localisation, including investing in the use of local languages for technological applications to reach more of their populations, especially marginalised and vulnerable communities.

5.2.2. Addressing Social Vulnerabilities of the 4IR at Sub-national Levels

Social vulnerabilities may manifest differently in each AMS because of local disparities, unequal economic conditions, and varying degrees of infrastructure availability, which creates variations in access to education, healthcare, and economic opportunities. Such local variations can exacerbate vulnerabilities for marginalised and vulnerable groups. For instance, limited access to advanced technologies, the internet, and education can hinder participation in the 4IR in rural and low-income communities that have less money to pay for digital infrastructure, 4IR technologies, and upskilling or reskilling training sessions. Older populations, ethnic minority groups, migrant workers, indigenous peoples, and women may face unique challenges, depending on their own or their locations' demographics and socio-economic conditions.

RECOMMENDATION 17:

AMS should develop location-specific 4IR initiatives and programmes for implementation at the sub-national and local levels to benefit marginalised and vulnerable groups, such as programmes that present customised digital literacy and skills development courses and workshops. AMS should also facilitate and support grassroots initiatives, local entrepreneurship in economically disadvantaged areas, and collaboration local communities and civil society organisations.

5.2.3. Establish a Special Task Force at National Levels to Assess the 4IR Impacts on Marginalised and Vulnerable Groups and Develop Policies and Strategies to Mitigate Vulnerabilities and Risks

Since AMS do not explicitly address the needs and vulnerabilities of marginalised and vulnerable groups in their 4IR policies and initiatives, oversight and monitoring mechanisms should be established at local and national levels to track the impact of 4IR technologies on such groups in each country and develop standards and safeguards to mitigate their risks. Such mechanisms can only be effective if located at the local and national level in each AMS because of the diversity of contexts. AMS should also consider using existing local or national mechanisms and structures wherever appropriate, rather than creating additional ones.

RECOMMENDATION 18:

ASEAN should consider establishing a Special Task Force on 4IR and Marginalised and Vulnerable groups in each country. Such a Task Force can make recommendations to government agencies and the private sector when AMS are developing national and sub-national policies and guidelines to mitigate the risks of 4IR technologies and to harness their benefits for economic and social development. The Task Force would need to identify key vulnerable groups in each country, coordinate with relevant authorities, and suggest proactive measures to support these vulnerable groups to aspire and share in a more inclusive and equitable 4IR.



Part VI:

Conclusion

The Fourth Industrial Revolution (4IR), with its rapid advances in technology and innovation, is transforming the AMS in unprecedented ways in both scope and scale. In the ASEAN region, the 4IR accompanies other larger socio-economic trends, such as ageing, urbanisation, migration, economic inequality, and social exclusion. The transformations are uneven across AMS, depending on each country's economic and social context and its capacity to harness 4IR technologies for economic and social development. Technological advances come with many challenges and bottlenecks, which, as this study shows, particularly impacts on marginalised and vulnerable groups.

The 4IR and its technologies have delivered AMS many benefits, including economic growth and improvements to healthcare, education, and public sector efficiency, among others. At the same time, 4IR technologies have disrupted labour markets, particularly for the semi-skilled and unskilled workforce. They have also contributed to inequality in education and health care, widening digital and urban-rural divides and increasing social exclusion. This study has focused on the risks and vulnerabilities experienced by marginalised and vulnerable groups in AMS, including women and especially children and youth, older persons, and PwD, by the adoption of 4IR technologies. These multi-dimensional and inter-sectoral vulnerabilities cut across economic, social, cultural, ethnic, and other lines. This study is one of the first to attempt an assessment of the positive and negative impacts of 4IR technologies on these vulnerabilities to determine how ASEAN and AMS might harness such technologies to benefit and improve the economic and social well-being of disadvantaged and vulnerable groups.

While the overall policy and legal framework for 4IR technology was put in place in ASEAN in 2021 at the regional level, and in many AMS since then, this study shows that across the ten Member States, 4IR policies and programmes range from what we would call “advanced” (Singapore, Thailand, Malaysia, Viet Nam) to “mid-level” (The Philippines, Brunei Darussalam, Indonesia) to “very early stages” (Lao PDR, Myanmar and Cambodia) in terms of scope, development, and implementation. Notable, few AMS have specific national or sub-national 4IR policies or guidelines for marginalised and vulnerable groups.

Most AMS have a dedicated ministry or government agency that serves as the coordinating body for the 4IR and its technologies. In some AMS, the 4IR coordinating body is a cross-ministerial or sectoral committee. These focal agencies provide oversight and technical support in key areas such as ICT, telecommunications, cyber-security, digital government, and innovation, among others. They closely collaborate and partner with the national and international private sector and development partners such as UN agencies, The World Bank, Asian Development Bank, and bilateral donors. Some AMS also work with academics, universities, and nongovernmental or civil society organisations. These strategic partnerships have helped AMS roll-out a range of national, regional, and local 4IR programmes and initiatives in the past few years, but there is little inter-country or region-wide collaboration to share best practices, lessons learned, and joint initiatives. Greater collaboration on 4IR subjects that have a regional scope is needed because it

would enhance the comprehensiveness and effectiveness of key AMS 4IR strategies and increase security across the region.

As noted earlier, AMS governments have primarily focused on the deployment of AI technologies and infrastructure for mainstream populations and mainstream economic sectors, with less attention and investment in social sectors. Their approach to 4IR technologies has had an urban, elitist, and capital-city bias that overlooks or underserves marginalised and vulnerable groups. The advent of the 4IR thus reinforces the importance of the Leave No One Behind principle enshrined in the SDGs. To honour their pledge to achieve the SDGs, ASEAN policymakers should review how well 4IR adaptation measures for the benefit of all ASEAN citizens are integrated in and across each AMS, and within its own policies and plans, and then use those findings and its regional mandate to build what we call an “ASEAN Digital Community” across the three pillars: APSC, AEC, and ASSC.

Looking beyond the ASEAN region, AMS are essential members of a globalised world and therefore need to keep pace with the 4IR’s global trends and advances in technology and innovation. Therefore, AMS need comprehensive regional policy and legal frameworks to help them adopt and manage 4IR technologies in this global context. They also need to strengthen institutional and human capacities, and would benefit from having a regional 4IR governance mechanism to help them manage 4IR technologies and more easily share learnings about 4IR policies and programmes across sectors and countries.

In conclusion, ASEAN policymakers need to strengthen their regional vision and strategy for the governance, monitoring, and accountability of 4IR technologies to promote social well-being and harmony among the ASEAN community. This would entail increasing government transparency and public participation to result in a more democratic and decentralised framework of policy formulation and programme implementation. ASEAN policymakers should also incorporate policies to eliminate or mitigate the key risks and vulnerabilities posed by 4IR technologies and establish a Special Task Force on 4IR to develop a roadmap for the deployment of useful and supportive 4IR technologies that would benefit marginalised and vulnerable groups. ASEAN policymakers should also consider developing regulatory, monitoring, and governance mechanisms for the use of 4IR technologies by the public and private sectors to mitigate detrimental and negative impacts on people and society. ASEAN policymakers should also take steps to localise 4IR technologies, and embed them deeply within the unique social, cultural, ethnic, and linguistic customs of each Member State. Investing significantly in 4IR technology adoption, tailored to the needs of each AMS and its citizens, is crucial for harnessing its transformative potential across diverse contexts and ensuring that progress and development resonate meaningfully with the lives of all ASEAN citizens.

Finally, we hope this study and its findings and recommendations are helpful to ASEAN policymakers in achieving the vision and purpose of the 4IR as laid out in the 2021 Consolidated Strategy:

“The 4IR offers people the opportunity to grow better connected, helps economies grow and become more competitive, empowers ASEAN’s citizens and improves their livelihoods through digitalising the provision of basic social services, and helps society decarbonise to meet sustainable development challenges confronting the region...”

**Consolidated Strategy on the Fourth Industrial
Revolution for ASEAN
ASEAN Secretariat, Jakarta, 2021**



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Annex:

Overview of 4IR: Policies, Programmes and Actors

1. Policies

1.1. 4IR Master Plans

ASEAN Member States (AMS) have recognised and reacted to the importance of the 4IR. Thailand, Malaysia, and Viet Nam have established policies, strategies and directives that are explicitly concerned with the 4IR while the other AMS have addressed 4IR opportunities and challenges through wider digitalisation policies.

That said, while not explicitly labelled a 4IR masterplan, **Brunei Darussalam's AITI Strategic Plan 2020-2025** comprehensively addresses the changes accompanying the 4IR to ensure that the country is able to benefit from it. The AITI plan “paints the future state of Brunei Darussalam in the context of the Digital Revolution era in realising the Fourth Industrial Revolution”.¹⁷⁷ It includes three strategic goals for a connected nation, digitally enriched society, and thriving digital industry to enhance the quality of life and social and business values.¹⁷⁸ These strategic goals make the policy compatible with other high level policy documents, such as the country's *Digital Economy Masterplan 2025*.¹⁷⁹

In **Indonesia**, the use of 4IR technologies generally falls under the ‘electronic system’ category and its laws and regulations. The Ministry of Communication and Informatics (MoCI) is the main regulator for the electronic system.¹⁸⁰ For this reason, the MoCI's Strategic Plan 2020-2024, which is based on the Medium-Term National Development Plan (RPJMN), is highly influential in shaping Indonesia's 4IR technology landscape. The Strategic Plan reveals three strategic aims that target (1) infrastructure, (2) digital transformation for business, people, and government, and (3) transparency of public information and public communications management.¹⁸¹ Several laws and regulations support both the MoCI's strategic plan and RPJMN's.¹⁸²

The most comprehensive 4IR policy framework is found in **Malaysia**. Its National 4IR Policy outlines four policy thrusts, 16 strategies, and 32 national initiatives that set the direction for all ministries and agencies so that they can align their 4IR and emerging technologies plans. Of the 16 strategies, six aim to equip citizens with the skills needed to fully benefit from digitalisation, six aim to benefit the industries and businesses, and four involve elevating the public sector and its services. These strategies are subdivided

¹⁷⁷ AITI, ‘AITI - Who We Are’.

¹⁷⁸ AITI, ‘AITI Strategic Plan 2020-2025’, 22.

¹⁷⁹ DEC, ‘Digital Economy Masterplan 2025’.

¹⁸⁰ KOMINFO, ‘Kementerian Komunikasi dan Informatika’.

¹⁸¹ Minister of Communication and Informatics Regulation Number 2 Year of 2021, x.

¹⁸² Karunian, ‘Country Profile: Indonesia’.

into three projected completion dates: 2022 for projects to enhance 4IR awareness and adoption; 2025 for those seeking to drive 4IR transformation and inclusivity; 2030 to achieve balanced, responsible, and sustainable growth by leveraging 4IR technologies.¹⁸³ Policy Thrust One focuses on education and talent management, and covers the entire labour force, including the latent workforce of older persons, housewives, and PwD.¹⁸⁴ Policy Thrust Two aims to forge a connected nation through digital infrastructure development.¹⁸⁵ Policy Thrust Three includes future-proof regulations that include a more agile and collaborative approach to and governance of rapid technological changes and the convergence of physical, digital, and biological domains in the 4IR. Policy Thrust Four aims to accelerate 4IR technology innovation and adoption by focussing on research and development (R&D), commerce and industry, access to financing, and technical and informational support.

The Malaysian government also has various sectoral policies for 4IR sub-topics. For instance, the Ministry of Science, Technology, and Innovation (MOSTI) launched five technology roadmaps in 2022 to ensure that efforts to develop and apply local technology are intensified to make Malaysia a technology-developing country, reduce its dependence on foreign technology and labour, and increase productivity. The five technology roadmaps include the: (i) Electricity and Electronics Roadmap: Technology Development 2021- 2030, (ii) National Blockchain Technology Roadmap 2021-2025, (iii) Artificial Intelligence Roadmap 2021-2025, (iv) National Advanced Materials Technology Roadmap (Advanced Materials) 2021-2030, and (v) National Robotics Roadmap 2021-2030. The roadmaps are premised on technology development acting as an impetus to create 500,000 job opportunities for Malaysians. The Malaysian government has also made efforts to drive the adoption of IoT. For example, the 2014 National IoT Strategic Roadmap aims to modernise farming and improve the overall efficiency and productivity of the agriculture sector.¹⁸⁶

In **Singapore**, the government has enacted the *Smart Nation Strategy*, which aims to leverage the technologies associated with the 4IR to transform Singapore in key domains, such as health, transport, urban solutions, finance, and education.¹⁸⁷ The comprehensive strategy aims to build a digital economy, government, and society, serving as an overarching framework for other sectoral policies. To enable these digital transformations, the government has implemented strategic national projects including a National Digital Identity; E-Payments; Moments of Life, which bundles services and

¹⁸³ Hamid, 'Country Profile: Malaysia', 7.

¹⁸⁴ Hamid, 8.

¹⁸⁵ Hamid, 8.

¹⁸⁶ Hamid, 10.

¹⁸⁷ Smart Nation, 'Smart Nation Strategy'.

information using a citizen-centric lens and provides a digital way to transact high-touch services; Smart Urban Mobility, which uses AI, AVs, data, and digital technologies to improve public transport and commuting; Smart Nation Sensor Platform, which improves municipal services, city-level operations, planning and security; and CODEX, which stands for Core Operations, Development Environment, and Exchange.¹⁸⁸ The strategy includes goals to minimise negative impacts while leveraging technologies to generate positive social outcomes, such as universal technology design, technology integration into the everyday life of all citizens regardless of their technological ability, and a call for other measures to include vulnerable populations in the technological revolution.¹⁸⁹

In **Thailand**, the main policy concerning the 4IR is the Thailand 4.0 policy, launched in 2017. Its comprehensive economic model emphasises innovation, technology, and digitalisation to drive economic growth and transform the country into a high-income nation. The government focuses on deploying 4IR technologies and other innovations across various sectors to develop infrastructure, foster research and innovation, enhance human capital, and promote technology adoption.¹⁹⁰ Furthermore, the Digital Government Development Policy (2016-2020, 2017-2021, 2023-2027) of the Royal Thai Government aims to enhance the efficiency and effectiveness of government services through digitisation, digitalisation, and e-government initiatives. It includes several 4IR technologies, such as virtual reality and augmented reality, advanced geographic information systems, big data, open data, smart machines, AI, cloud computing, cybersecurity, IoT, blockchain, and distributed ledgers.¹⁹¹

In **Viet Nam**, the Party Central Committee has issued guidelines and policies to proactively participate in the 4IR.¹⁹² Resolution No. 52-NQ/TW affirms that the 4IR presents numerous opportunities and challenges and has a growing impact on all aspects of Viet Nam's economy and society. The Resolution emphasises the need to promptly understand and effectively leverage opportunities to enhance labour productivity, economic competitiveness, and social management efficiency through research, technology transfer, and the robust application of 4IR advancements. It also underscores the importance of proactively preventing and responding to negative impacts, ensuring social justice, and promoting sustainable development.¹⁹³ In addition to the Resolution, the Vietnamese government issued a National Strategy on the Fourth Industrial Revolution until 2030.¹⁹⁴ It aims to proactively seize opportunities presented by the 4IR by acquiring a solid understanding of new technologies and widely implementing

¹⁸⁸ Smart Nation, 26.

¹⁸⁹ Smart Nation, 25.

¹⁹⁰ Wantanasombut, 'Country Profile: Thailand', 6.

¹⁹¹ Wantanasombut, 6.

¹⁹² Central Committee, 'Resolution No. 52-NQ/TW'.

¹⁹³ Quynh, 'Country Profile: Viet Nam', 4.

¹⁹⁴ Prime Minister of Vietnam, Decision No. 2289/QĐ-TTg.

them across various socio-economic sectors, progressively fostering new technology development, promoting robust growth of the digital economy, and achieving rapid and sustainable development through science, technology, innovation, and a highly skilled workforce to enhance citizen's quality of life, welfare, and health.¹⁹⁵

1.2. Artificial Intelligence (AI)

Several countries have implemented frameworks or strategies that focus on AI, underlining the importance of this emerging technology trend. In **Brunei Darussalam**, the government is drafting regulatory and ethics guidelines on the responsible use of AI following increased adoption of generative AI tools, in accordance with regional policies, such as the *ASEAN Guide on AI Governance and Ethics*.¹⁹⁶ In **Indonesia**, the Minister of Communication and Informatics (MoCI)¹⁹⁷ and the Indonesian Financial Services Authority (OJK)¹⁹⁸ published their AI ethics principles in 2023. This followed the publication of a National Strategy of Artificial Intelligence by the Agency for the Assessment and Application of Technology Indonesia (BPPT) in 2020.¹⁹⁹

Malaysia has implemented a National Artificial Intelligence Roadmap 2021-2025. It includes strategies for establishing AI governance, advancing AI R&D, upgrading digital infrastructure to enable AI, fostering AI talents, and kick-starting a national AI innovation ecosystem.²⁰⁰ The strategy also includes principles, such as fairness and pursuit of human benefits and happiness, that aim to ensure that AI will benefit everyone, including marginalised and vulnerable groups.²⁰¹ It also includes a few personal data protection and cybercrime laws. In **the Philippines**, the National AI Strategy Roadmap was launched in May 2021 by the Department of Trade and Industry (DTI). The roadmap is a collaborative initiative of various government agencies, and describes the implementation, infrastructure, and investments needed to cover four dimensions important for AI readiness: digitisation and infrastructure, R&D, workforce development, and regulation. The roadmap centres on the creation of a National Centre for AI Research (NCAIR) that will serve as the country's hub for AI research and be instrumental in making the Philippines an AI Centre of Excellence. NCAIR is also expected to build and administer the National Data Centre (NDC) and the National Research Cloud (NRC), and to assist MSMEs interested in using different tools to help them improve their

¹⁹⁵ Quynh, 'Country Profile: Viet Nam', 4.

¹⁹⁶ Han, 'MTIC to Draft Guidelines on Use of Artificial Intelligence'.

¹⁹⁷ Minister of Communication and Informatics Circular Letter Number 9 Year of 2023 on the Ethics of Artificial Intelligence.

¹⁹⁸ Ethical Guidelines on Responsible and Trustworthy AI in the Financial Technology'.

¹⁹⁹ 'Indonesia National Strategy for Artificial Intelligence 2020-2045'; Karunian, 'Country Profile: Indonesia'.

²⁰⁰ MOSTI, 'Malaysia National Artificial Intelligence Roadmap 2021-2025'.

²⁰¹ MOSTI, 'Malaysia National Artificial Intelligence Roadmap 2021-2025'.

efficiency and productivity through AI and data-driven science.²⁰² **The Philippines** also announced that it will develop and present a legal framework for AI in ASEAN.²⁰³

Thailand's national AI strategy and action plan aims to improve Thailand's readiness for AI applications in social, ethical, and legal arenas. It includes measures to increase human capability and improve AI education, foster research innovation, promote the use of AI in public and private sectors, and adopt AI across industries to drive economic growth and societal benefits.²⁰⁴

Singapore's AI strategy aims to leverage AI for the country's development and position its economy at the forefront of the AI industry. The strategy envisions Singapore as a global hub for developing, testing, deploying, and scaling AI solutions, one where governments and businesses use AI to generate economic gains and improve lives and citizens can understand and use AI technologies to benefit from AI implementations in the economy.²⁰⁵ To work towards this vision, five national AI projects are being implemented under the policy. These include the Intelligent Freight Planning, Seamless and Efficient Municipal Service, Chronic Disease Prediction and Management, Personalised Education through Adaptive Learning and Assessment, and Border Clearance Operations projects.²⁰⁶ While no single agency or ministry oversees all aspects of AI adoption in Singapore, several state bodies are involved in its regulation, development and application. The Smart Nation and Digital Government Office (SNDGO) implements AI as part of the Smart Nation initiative described earlier, and AI is embedded within connected homes and transportation vehicles, among other smart systems. The Land Transport Authority (LTA) rolls out AI-powered AVs in collaboration with the private sector and relevant agencies. On a broader level, the Infocomm Media Development Agency (IMDA) develops foundational AI products for enterprise use while the Government Technology Agency (GovTech) is responsible for AI deployments within the government. Singapore has no formal regulations or laws for AI, although the Personal Data Protection Commission (PDPC) did release an AI governance framework in 2023.²⁰⁷

In **Viet Nam**, the Prime Minister Decision No. 127/QĐ-TTg, dated 26 January 2021,²⁰⁸ issued a national strategy on AI research, development, and applications, valid until 2030.²⁰⁹ In addition, the 2019 National AI Strategy aims to position Viet Nam as a leader in AI among four other Southeast Asian countries. In 2022, the Ministry of Information

²⁰² Santos, 'Country Profile: The Philippines', 10.

²⁰³ May-Ann, 'Access Alert'.

²⁰⁴ Wantanasombut, 'Country Profile: Thailand', 7.

²⁰⁵ Smart Nation, 'National Artificial Intelligence Strategy'.

²⁰⁶ Smart Nation, 5.

²⁰⁷ Wong, 'Can and Should We Rein in AI with Law?'.

²⁰⁸ Prime Minister of Vietnam, Decision No. 127/QĐ-TTg.

²⁰⁹ Quynh, 'Country Profile: Viet Nam', 6.

and Communication (MIC) released a draft of the *National Standard on Artificial Intelligence and Big Data* for public feedback. It included two documents on AI system quality and robustness, and proposed a risk-based regulatory approach, but currently lacks a rigorous risk assessment process or ethical design framework and focuses on increasing safety and reducing AI biases.²¹⁰

1.3. Digitalisation Policy

Even if all AMS do not have specific 4IR policies, all have enacted general digitalisation policies that reflect the importance they place on promoting digital technology deployment and use in all sectors of society. These policies often include high level master plans that sometimes align with national development plans.

For instance, **Cambodia** has emphasised the role of digital technology and ICT in various national and sectoral policy and strategy documents, including the Pentagonal Strategy (Phase I), National Development Strategic Plan (2019-2023), Cambodian Sustainable Development Goals (CSDGs) Framework (2016-2030), Cambodia Industrial Development Policy (2015-2025), Digital Economy and Society Policy Framework (2021-2035), and Cambodia Digital Government Policy (2022-2035).²¹¹ **Lao PDR** has enacted its 20-year National Digital Economy Development Vision (2021-2040), 10-year Digital Economy Strategy (2021-2030), 5-year National Digital Economy Development Plan (2021-2025), and 9th National Socio-Economic Development Plan (2021-2025). These vision and strategic plans cover the main requirements, scope, and potential for a Lao PDR digital economy and development opportunities it can draw from other countries.²¹² The Government of **Myanmar** has formulated the Myanmar Digital Economy Roadmap, which includes policies, strategies, and actions to enhance digital infrastructure, e-commerce, digital literacy, data protection, and cybersecurity.²¹³

These policies commonly aim to promote economic growth and development. The overall goal of **Lao PDR's** 40-year Digital Economy Vision is to use digital technologies and innovations, distribution, marketing, and digital-economy services to help support comprehensive national social and economic development and prepare the nation to graduate from LDC status through measures that develop digital infrastructure, skills, and adoption in the economy, banking sector, and government. The country's 10-year National Digital Economy Strategy goes into more detail about measures to be taken:

²¹⁰ Asia Pacific Institute, '2023 Trustworthy Artificial Intelligence in the Asia-Pacific Region'.

²¹¹ Roth, 'Country Profile: Cambodia', 5.

²¹² Soukhathammavong, 'Country Profile: Lao PDR', 4.

²¹³ Sein, 'Country Profile: Myanmar', 5.

- Develop legislation: reassess existing laws and improve and develop new legislation to promote and create favourable environments for digital economy development.
- Develop infrastructure: develop digital technology infrastructure with nationwide coverage that will accelerate the growth of the digital economy.
- Develop platforms: develop platforms for digital government, e-land management system, e-commerce, e-payment, e-banking, e-market, and data exchange.
- Develop human resources: promote learning and digital technology skills within the national education systems, support training, and strengthen government employees' capacity to use digital technologies.
- Create products and services: develop businesses involved in production and the digital economy, support the development of digital technology innovations to facilitate MSMEs, and establish digital parks.
- Ensure cyber safety in relation to digital technology: ensure that information and privacy, digital data governance, digital data flow, and e-commerce are protected, and prevent distribution of counterfeit goods and illegal goods and cheating.
- Apply digital technologies: Raise awareness regarding the use of digital technologies and about the use of products and services related to the digital economy.
- Cooperate with national and international development partners.
- Enhance and promote comprehensive cooperation on digital technologies with strategic country partnerships, and bilateral cooperation and enhance cooperation with ASEAN, sub regionally and with international organisations and foreign enterprises.²¹⁴

In **Cambodia**, the Pentagonal V Development of Digital Economy and Society Strategy cuts across the public and private sectors, with an emphasis on public-private partnerships. In the public sector, digital technologies streamline processes and procedures for national and sub-national public services delivery public administration registries, digital public services delivery standards, and common digital platforms. To achieve this, the Strategy emphasises continued digital capacity building among public servants. In the private sector, the strategy emphasises the need to develop and launch the Enterprises Go Digital Program to speed up digital technology adoption, particularly by MSMEs, which requires sufficient digital infrastructure and connectivity.²¹⁵

²¹⁴ Soukhathammavong, 'Country Profile: Lao PDR', 5.

²¹⁵ Roth, 'Country Profile: Cambodia', 5.

Other policies aim to foster technological innovation, such as **the Philippines'** 2023 National Innovation Agenda (NIA) Framework, which operationalises the 2019 Philippine Innovation Act,²¹⁶ which steers a whole-of-government approach to innovation governance and puts innovation at the forefront of national development and sustainable growth agendas. Led by the National Innovation Council (NIC) and headed by the President and the National Economic Development Authority (NEDA), the NIA seeks to hasten the establishment of a dynamic innovation ecosystem in the country through five main actions: (1) streamlining NIA decision-making and resource allocation through the NIC; (2) strengthening consumer protection and intellectual property policies in relation to innovation activity-related contracting and collaborative work among innovation actors; (3) providing physical and digital structures and systems, equipment, and tools to translate ideas into viable technologies and services; (4) setting up innovation financing mechanisms, including seed money and incentives for the commercialisation of innovative tech, products, and services; and (5) creating and rolling out awareness raising programmes about innovation processes, capability building among innovation actors, and opportunities for co-creation and collaboration.²¹⁷

AMS have developed sectoral policies that govern digital technology in specific sectors. The Cambodian Ministry of Science, Technology and Innovation (MISTI) has launched **Cambodia's** Science, Technology and Innovation Roadmap (2030) and a series of sectoral technology roadmaps covering education (EduTech), health (HealthTech), agriculture (AgriTech), tourism (Tourism Tech), digital (Digital Tech), and energy (Energy Tech).²¹⁸ The Cambodia Digital Government Policy (2022-2035) aims to enhance citizens' quality of life and build trust through improved public service provision. The policy requires every government ministry and national or sub-national agency to establish a dedicated digital transformation unit to promote digital technology adaptation and adoption for public services delivery.²¹⁹ Similarly, **Myanmar** implemented its E-Government Master Plan (2016-2022), developing online citizen engagement platforms, e-payment systems, and digital identity systems.²²⁰

Another area of policy intervention is cybersecurity. **The Philippines'** National Cybersecurity Plan (NCSP),²²¹ launched in 2022 by the Department of Information and Communications Technology (DICT), addresses the urgency for cybersecurity in four areas: critical infrastructure and infostructure,²²² government networks, businesses, and individuals using the internet in the country. The NCSP was developed in response

²¹⁶ NEDA, Republic Act No. 11293 or the Philippine Innovation Act.

²¹⁷ Santos, 'Country Profile: The Philippines', 9.

²¹⁸ Roth, 'Country Profile: Cambodia', 5.

²¹⁹ Roth, 14.

²²⁰ Sein, 'Country Profile: Myanmar', 5.

²²¹ DICT, 'National Cybersecurity Plan 2022'.

²²² The technical infrastructure supporting an information system.

to the 2016 Philippine Voters' Database hack, which took 54 million sensitive data points, including 1.3 million passport numbers of Filipinos working overseas. At least 68 government websites had also been cyberattacked. The Plan has four goals: 1) ensure continuous operation of critical infrastructure and public and military networks, 2) implement cyber resiliency measures, 3) facilitate effective coordination with law enforcement agencies, and 4) build a cybersecurity-educated society. The Plan calls for the establishment of a National Computer Emergency Response Team (NCERT) to prepare and aid government agencies in dealing with cyber threats, and the integration of cybersecurity-related courses in higher education curricula and the ladderized programmes of TESDA. A second iteration of the NCSP is being finalised in 2025. Its outline is organised around six pillars: 1) a Cybersecurity Act to strengthen the policy framework, 2) critical information infrastructure security and protection, 3) proactive defence of the government and people in cyberspace, 4) operational and well-coordinated network of computer emergency response teams (CERT) and security operations centres (SOC); 5) capacitate the workforce in cybersecurity; and 6) enhanced international cooperation.²²³

2. Key Actors

Reflecting the cross-sectoral implications of the 4IR, public, private and nongovernmental actors are involved in the application and implementation of 4IR technologies, policies, and programmes. AMS government ministries and departments take a leading role in setting 4IR policy. Because of policymakers' strong focus on the digitalisation of the banking sector, national banks and other finance institutions are prominent players. Nongovernmental and other development partners also intervene in AMS LDCs.

2.1. Government

Most AMS have a dedicated technology ministry, agency, or department that is responsible for 4IR technologies and strategies. In **Cambodia**, the Ministry of Industry, Science, Technology and Innovation (MISTI) has wide mandate. According to Sub-Decree 48 on its role and responsibility, MISTI serves as a secretariat to the government in preparing policies, strategies, roadmaps, and plans for science, technology, and innovation. It also plays a coordinating and monitoring role in the implementation of national and sub-national science, technology and innovation (STI) policies and strategies. Furthermore, it is responsible for organizing STI awareness-raising and dissemination activities, such as National STI Day.²²⁴

²²³ Santos, 'Country Profile: The Philippines', 11.

²²⁴ Roth, 'Country Profile: Cambodia', 8.

In **Brunei Darussalam**, the government established a Digital Economy Council (DEC) led by the Prime Minister's Office (PMO) and the Ministry of Finance and Economy (MOFE), and co-chaired by the Prime and MOFE Ministers and attended by two ministers from the Ministry of Primary Resources and Tourism (MPRT), and Ministry of Education (MoE), and two deputy ministers from MOFE and the Ministry of Energy (MoEn). Council members also include industry representatives from the State Legislative Council (LegCo), and the chairman of the InfoCom Federation of Brunei.²²⁵

In **Lao PDR**, the Ministry of Technology and Communications (MTC) leads the country's digital transformation. MTC was established in October 2021. It is composed of 15 departments and has oversight functions over key areas, including connectivity, telecommunications, cybersecurity, digital government, and innovation. The Digital Government Centre, currently part of MTC, started as an e-government project in 2006 with the goal of increasing the government's effectiveness and service delivery through ICT. It has since evolved to offer several digital government services, including: (a) centralisation of government computing services; (b) management and development of administration and service software; (c) management and provision of services for the centralisation of government information; and (d) training and promotion of e-government.²²⁶

In **Malaysia**, the main agency is the Malaysian Communications and Multimedia Commission (MCMC), a regulatory body which aims to establish a competitive, efficient, and increasingly self-regulating communications and multimedia industry, generating growth to meet Malaysia's economic and social needs.²²⁷ Other ministries play important roles, including the Ministry of Science, Technology, and Innovation (MOSTI). It has implemented five technology road maps that govern the adoption of new technologies, including 4IR related technologies, such as the National Blockchain Technology Roadmap 2021-2025, Artificial Intelligence Roadmap 2021-2025, National Advanced Materials Technology Roadmap (Advanced Materials) 2021-2030, and National Robotics Roadmap 2021-2030. The Ministry of Education (MOE) leads efforts in increasing digital skills and integrating digital technology into the education system. Other ministries and agencies that touch on digital technology include the Ministry of Communications, Malaysian Administrative Modernisation and Management Planning Unit (MAMPU), and MIMOS Berhad, Malaysia's national applied research and development centre under MOSTI.

In **Thailand**, the Ministry of Digital Economy and Society (MDES) assumes a crucial role in facilitating the process of digital transformation. It develops strategies, policies, and

²²⁵ Brunei Darussalam Digital Economy Council, *Digital Economy Masterplan 2025*.

²²⁶ Soukhathammavong, 'Country Profile: Lao PDR', 5.

²²⁷ Hamid, 'Country Profile: Malaysia', 8.

programmes that will optimise digital technology use, extend broadband connectivity, advocate for e-government services, guarantee cybersecurity, and foster a vibrant digital ecosystem that encourages innovation and economic advancement. It also aims to address social challenges and concerns pertaining to digital inclusion.²²⁸ In addition to MDES, a host of sub-ministerial agencies and departments also play important roles. The National Innovation Agency's (NIA) role is to foster innovation and drive the development and adoption of new technologies, including those related to 4IR. The National Science and Technology Development Agency (NSTDA) undertakes research and development projects to promote scientific and technological advancements, including 4IR technologies. The Digital Economy Promotion Agency (DEPA) oversees various initiatives to promote digital technologies, innovation, and entrepreneurship across sectors. This includes fostering startup ecosystems, supporting research and development, and promoting digital adoption. Other relevant government agencies include the Office of National Higher Education Science Research, Innovation Policy Council, and National Electronics and Computer Technology Centre under the Ministry of Higher Education, Science, Research, and Innovation.²²⁹

However, due to the broad impact of digitalisation and the 4IR, other ministries are often involved in efforts to promote and regulate digital technology. For instance, in **Brunei Darussalam** the Ministry of Transport and Infocommunications (MTIC) plays a central role in overseeing Brunei's ICT infrastructure and telecommunications sector, formulating policies and strategies related to ICT development, including initiatives to promote digital connectivity, cybersecurity, and e-Government services. The Ministry of Education plays a crucial role in integrating ICT into the curriculum, promoting digital literacy, and fostering innovation and entrepreneurship among students to prepare them for the demands of the digital economy.²³⁰ Educational inclusivity for the special needs' population encompasses older persons and PwD through strategies to enhance lifelong learning and home-based 4IR technology enabled education respectively.²³¹ The Ministry of Health is involved in initiatives to leverage ICT and digital health technologies to improve healthcare delivery and patient outcomes.²³² The Ministry of Finance and Economy oversees economic policies and initiatives that supports the development of a vibrant digital economy, including initiatives to attract investment in technology startups, promote digital entrepreneurship, and foster innovation ecosystems.²³³ The Ministry of Development is involved in infrastructure development and urban planning that support the adoption of 4IR technologies. This includes projects to enhance digital infrastructure,

²²⁸ Wantanasombut, 'Country Profile: Thailand'.

²²⁹ Wantanasombut.

²³⁰ Brunei Darussalam Digital Economy Council, *Digital Economy Masterplan 2025*.

²³¹ Goh, 'Reimagining and Revitalizing Lifelong Learning in Brunei for a Digital Age'.

²³² Azahari, 'Ministry Hopes to Improve Health Literacy through Digitalisation'.

²³³ Brunei Darussalam Digital Economy Council, *Digital Economy Masterplan 2025*.

promote Smart City initiatives, and integrate technology into sustainable development efforts.²³⁴

In **Cambodia**, the Ministry of Post and Telecommunications uses free market and social equity principles to: (1) modernise post, telecommunications, and ICT sectors with high-quality, affordable prices and nationwide service coverage; (2) develop digital technologies at the national and sub-national levels to improve the administrative management of the government institutions and to enhance timely, transparent, effective, safe, and economical public services; (3) mainstream awareness on the use and the benefits of ICT through wider dissemination, training, and capacity building for officials, students, and the private sector; (4) encourage investors to modernise the postal, telecommunications, and ICT sectors, and organise efforts to promote research and development in the ICT sector; and (5) encourage postal, telecommunications, and ICT operators to comply with relevant regulations, ensuring fair competition and protecting the consumers' rights. Reliable, sufficiently fast, and affordable internet services and connections are key ingredients in the adoption of digital technology. The Cambodia Academy of Digital Technology (CADT), formerly known as the National Institute of Posts, Telecommunications, Information, and Communication Technology (NIPTICT), is a public education and research institution for digital technology and innovation that consists of three institutes: technology, governance, and research and innovations. CADT also incubates startups.²³⁵

In **Indonesia**, several ministries oversee digitalisation efforts. At the national level, the Ministry of Communication and Informatics (MoCI) leads several programmes and initiatives:²³⁶ providing fast and reliable internet connection in rural areas (Palapa Ring Program);²³⁷ improving digital talents (Digital Talent Scholarship Program²³⁸ and Siberkreasi Digital Literacy Program²³⁹) and the ecosystem of digital economy (1000 Startup Digital and Nexticorn Program);²⁴⁰ SMEs Go Online Program;²⁴¹ Farmers and Fishers Go Online;²⁴² a centralised national data centre (Satu Data Indonesia Program); and accelerating the implementation of an electronic-based government system (100 Smart City Movement Program).²⁴³ Other ministerial bodies have also implemented programs to support the 4IR. The Coordinating Ministry for Economic Affairs launched

²³⁴ MOD, 'Digital Paradigm Framework 2020-2025'; Brunei Darussalam Digital Economy Council, *Digital Economy Masterplan 2025*.

²³⁵ Roth, 'Country Profile: Cambodia'.

²³⁶ Minister of Communication and Informatics Regulation Number 2 Year of 2021, x.

²³⁷ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 14.

²³⁸ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 32.

²³⁹ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 50.

²⁴⁰ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 23,24.

²⁴¹ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 41.

²⁴² Minister of Communication and Informatics Regulation Number 2 Year of 2021, 25.

²⁴³ Minister of Communication and Informatics Regulation Number 2 Year of 2021, 29.

the Strengthening Women Micro-entrepreneurs to Digital Security and Financial Inclusion (SERUNI) Program in 2021²⁴⁴ to increase well-being, financial literacy, and digital literacy among women micro-entrepreneurs (including PwD) in Indonesia.²⁴⁵ The Ministry of Health implements the Indonesia Health Services (IHS) platform known as SATUSEHAT,²⁴⁶ a digital health ecosystem that facilitates data connectivity, analysis, and services, effectively supporting and integrating various health applications across Indonesia.²⁴⁷ With the objective of establishing a comprehensive health big-data ecosystem that incorporates AI-based analyses at central and local government levels, SATUSEHAT aims to revolutionise data-driven decision-making in the healthcare sector.²⁴⁸ This initiative is poised to enhance the quality of health policies by leveraging accurate, up-to-date, and complete data in Indonesia.²⁴⁹

The ambitious **Thailand 4.0** policy relies heavily on the Ministry of Interior. Digitisation of data and information is an important part of the policy. Massive datasets are managed and integrated by the Ministry's Big Data Administration and Integration Centre. Departments are encouraged to innovate and grow through an Innovation Centre that fosters inventive solutions to social issues. A connecting hub facilitates information sharing and teamwork within the ministry, which increases transparency and expedites licensing procedures through e-DOPA, a National Single Window for Licences. Finally, to increase efficiency and adjust to modern workplaces, the Ministry of the Interior is also creating smart office solutions. It also follows cabinet directives to alter regulations to strengthen governance and service delivery, helping Thailand 4.0 succeed.²⁵⁰

In **Viet Nam**, the Ministry of Science and Technology (MOST) is responsible for formulating relevant policies and strategies, including for innovation and the 4IR. The Ministry of Information and Communications (MIC) focuses on developing and implementing policies related to information technology, digital transformation, and cybersecurity. The Ministry of Planning and Investment (MPI) coordinates and implements national development plans, including strategies for 4IR. The Ministry of Education and Training (MOET) is involved in integrating digital skills and technology education into the national curriculum.²⁵¹

Some countries have also established cross-ministerial and sectoral committees to coordinate efforts. This includes **Cambodia's** National Council for Digital Economy

²⁴⁴ 'Pemberdayaan Ekonomi serta Literasi Keuangan dan Digital bagi Perempuan Pelaku Usaha Mikro - Kementerian Koordinator Bidang Perekonomian Republik Indonesia'.

²⁴⁵ antaranews.com, 'Tingkatkan inklusi keuangan, Kemenko Perekonomian gulirkan Seruni'.

²⁴⁶ 'Kemenkes Luncurkan Platform SATUSEHAT Untuk Integrasikan Data Kesehatan Nasional'.

²⁴⁷ 'Blueprint of Digital Health Transformation Strategy 2024', 12.

²⁴⁸ 'Blueprint of Digital Health Transformation Strategy 2024', 27.

²⁴⁹ 'Blueprint of Digital Health Transformation Strategy 2024', 28; Karunian, 'Country Profile: Indonesia'.

²⁵⁰ Wantanasombut, 'Country Profile: Thailand'.

²⁵¹ Quynh, 'Country Profile: Viet Nam'.

and Society (NCDES), chaired by the prime minister, with a deputy prime minister as permanent deputy chairman, and five minister deputy chairmen from the ministries of the Interior, Defence, Economy and Finance (MEF), MISTI, and Ministry of Post and Telecommunications (MPTC). Ministers from 20 other ministries, a representative of the Supreme National Economic Council, and the governor of the National Bank of Cambodia are also members.²⁵²

2.2. Private Sector

Given the critical role that industrial and business linkages play in the 4IR, the private sector is an indispensable player in the AMS ecosystem. In **Cambodia**, the Royal Group, Smart Axiata Co., Ltd., Advanced Bank of Asia Ltd., Huawei Technologies (Cambodia) Co., Ltd., and Chip Mong Group count as leading actors in digital technology adoption. The Royal Group, for example, has invested in mobile and internet services (Cellcard and EZECOM), broadcasting, transport, banking (WING Bank), and energy. Telecommunication companies have also collaborated with government agencies, such as the Ministry of Post and Telecommunications, to contribute to a Capacity Building Research and Development Fund that aims to build digital capacity of young people through information technology scholarship programmes, equip schools with technology, and promote technology competitions.²⁵³

In **Indonesia**, private sector actors complement governmental efforts. Companies and business associations play a pivotal role in driving innovation and economic growth. Nongovernmental and civil society organisations lend their expertise and collaboration to ensure that the benefits of 4IR are inclusive and equitable for marginalised and vulnerable groups. This collaborative interplay of government, private sector and nongovernment actors is crucial in fostering an inclusive approach to 4IR.²⁵⁴

The private sector is pivotal in **Thailand's** 4IR projects, significantly influencing its dynamic landscape. For instance, the Digital Council of Thailand, founded in 2019, sprang from the Thai Federation of ICT Technology Association (TFIT).²⁵⁵ The Council is essential for corporate, government, and public sector collaboration. Numerous associations have joined it, including the Association of Thailand Open-Source Federation (TOSF), Association of Thai ICT Industry (ATCI), Thai Software Export Promotion Association, and Thai E-Commerce Association.²⁵⁶ The Thai Internet and Cloud Service Provider Association (TICPA) began as the Thai Internet Service Provider Association (TISPA) in

²⁵² Roth, 'Country Profile: Cambodia'.

²⁵³ Roth.

²⁵⁴ Karunian, 'Country Profile: Indonesia'.

²⁵⁵ The Thai Federation of ICT Technology Association, 'สมาคมดิจิทัลเพื่อเศรษฐกิจและสังคมแห่งประเทศไทย (The Thai Federation of ICT Technology Association)'.

²⁵⁶ The Nation, "ICT Council" Wants Joint Push towards Digital-Economy Era.'

2005.²⁵⁷ TICPA aims to assist internet services providers grow their business in response to technical advances, including cloud and data centre services. TICPA facilitates interaction and collaboration between entrepreneurs, government agencies, and organisations, sharing experiences among its members and actively engaging with other associations to improve development and industry practices. This collaboration creates a synergy that fosters sustainable growth and innovation. The Thai Startup Association promotes a vibrant startup ecosystem by connecting startups with public and private enterprises to increase business, including with other entrepreneurs.²⁵⁸ These initiatives demonstrate the private sector's active role in driving Thailand's progress in the 4IR.²⁵⁹

Similarly, in **Viet Nam** several private sector organisations have been crucial in generalising the adoption of digital technology. Viettel Group, one of the top telecommunications service providers, is actively developing 4IR-related technologies. VNG Corporation, a leading technology company, specialises in online entertainment, social networking platforms, e-commerce, and digital content creation. CMC Corporation is a diversified technology corporation that offers IT services, software development, cloud computing solutions, and digital transformation services. CMC also operates in various sectors such as telecommunications, media, and finance. VinGroup is a conglomerate with subsidiaries operating in technology, electronics, and 4IR applications.²⁶⁰

2.3. Banking

Reflecting the importance many countries put on the digitalisation of the financial sector, national banks play a role in formulating many AMS digital technology policy frameworks. In **Cambodia**, National Council for Digital Economy members MEF, MISTI, MPTC, and the National Bank of Cambodia (NBC) spearhead advances in digital technology and introduce reforms. The MEF has led several initiatives on the adoption of digital technology, such as Online Business Registration, Techo Startup Centre, Khmer Enterprise, and Skills Development Fund. Digital technologies have been utilised to streamline administrative processes and procedures to improve the ease of doing business, an issue which has been a binding constraint to attract more foreign direct investment and establish a vibrant business environment.²⁶¹ In **Lao PDR**, the Bank of Lao PDR oversees the national payment system. The 2017 Law on Payment Systems puts forward a strategic approach to payment system reforms, explicitly including the increased adoption of non-cash payment instruments as one of the country's strategic priorities. Bank of Lao's payment system department was formed in 2018 with a broad

²⁵⁷ TICPA, 'เกี่ยวกับ TICPA (ABOUT TICPA)'.

²⁵⁸ Thai Startup, 'Thai Startup Objective'.

²⁵⁹ Wantanasombut, 'Country Profile: Thailand'.

²⁶⁰ Quynh, 'Country Profile: Viet Nam'.

²⁶¹ Roth, 'Country Profile: Cambodia'.

mandate that spans day-to-day payments oversight and supervision to a proactive role in promoting innovation.²⁶²

2.4. Development Partners

For the least developed and emerging economies in the ASEAN region, development partners, which included donors, nongovernmental organisations, civil society organisations, and academic institutions, play an important role in expanding the accessibility and uptake of digital and 4IR technologies. In **Cambodia**, an LDC, development partners are primarily donors and implementing agencies. They include the Asian Development Bank; The World Bank; United Nations Development Programme; United Nations Industrial Development Organization; Australian Department of Foreign Affairs and Trade; The Asia Foundation; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ); Swiss Agency for Development and Cooperation; Swedish International Development Cooperation; European Commission; Foreign, Commonwealth and Development Office; Plan International Cambodia; Konrad Adenauer-Stiftung; and the Government of the Russian Federation.²⁶³

In **Viet Nam**, an emerging economy, development partners include academic institutions that contribute directly or work in tandem with donors and implementing agencies. The Viet Nam National Innovation Centre (NIC) was established to promote innovation and entrepreneurship in emerging and 4IR technologies. The Viet Nam Academy of Science and Technology (VAST) conducts research, development, and technology transfer in various fields, including 4IR technologies. Viet Nam also has several universities that offer programmes and initiatives related to the 4IR and emerging technologies, including: Viet Nam National University, Hanoi; Ho Chi Minh City University of Technology (HCMUT); Hanoi University of Science and Technology (HUST); Posts and Telecommunications Institute of Technology (PTIT); University of Engineering and Technology; Viet Nam National University, Hanoi; and University of Information Technology, Viet Nam National University, Ho Chi Minh City.²⁶⁴

3. Programmes

Some of the more common programmes related to the 4IR and digitalisation across AMS include the promotion and implementation of e-finance, digital skills development, smart cities, special economic zones, R&D, technology start-ups. The following sections

²⁶² Soukhathammavong, 'Country Profile: Lao PDR'.

²⁶³ Roth, 'Country Profile: Cambodia'.

²⁶⁴ Quynh, 'Country Profile: Viet Nam'.

are not an exhaustive list of initiatives or interventions in AMS. Rather, they give an overview of the most common types of relevant interventions and initiatives.

3.1. E-Finance

In **the Philippines**, the National Financial Inclusion Strategy (NFIS) of the Bangko Sentral ng Pilipinas (BSP)²⁶⁵ serves as the nation's blueprint for driving widespread growth and financial resilience through financial inclusion. The six-year strategy runs until 2028 and defines four desired outcomes: 1) reduced disparities in financial inclusion, 2) improved financial health and resilience, 3) more financially capable and empowered consumers, and 4) increased access to finance for MSMEs. To achieve these outcomes, the Strategy has four strategic objectives and intervention areas: 1) promote inclusive digital finance to fully harness the welfare-enhancing potential of digital innovations; 2) strengthen financial education and consumer protection by developing the right financial knowledge, skills, and behaviour through well-designed, comprehensive, and sustainable digital financial literacy programmes, and having an appropriate regulatory environment to strengthen the market conduct of all types of providers; 3) enhance access to risk protection and social safety nets through public and private mechanisms such as cash assistance, health and unemployment insurance, disaster risk insurance, and pensions for vulnerable sectors, aided by digital finance; and 4) enhance agriculture and MSME financing ecosystems to enable and attract diverse players to serve more agriculture and MSME clients, including start-ups, by having in place the financial infrastructure, such as credit guarantees, credit information registry, and legal frameworks, such as a secured transactions framework, that will reduce the risks and costs of serving these sectors, whether in the form of credit or equity. Government assistance programmes, financial or nonfinancial, can be designed to increase the income potential and bankability of their beneficiaries. The setting up of a national ID system for government service access, and the disbursement of the emergency subsidies for lowest-income (4Ps) beneficiaries are major initiatives supported by this strategy.²⁶⁶

3.2. Special Economic Zones and Research

In **Cambodia**, R&D is important under the framework of 4IR and digital technologies. The government has emphasised R&D as a cross-cutting theme. MISTI has launched the National Research Agenda 2025 that outlines eight priority sectors and areas for research and development: food, energy, education, health, electronics and mechanical spare parts, carbon, electricity and water, and cloud-based services.²⁶⁷ The government has also focussed on 4IR and digital technologies transfer and adoption. MISTI is leading

²⁶⁵ BSP, 'National Strategy for Financial Inclusion 2022-2028'.

²⁶⁶ Santos, 'Country Profile: The Philippines'.

²⁶⁷ Roth, 'Country Profile: Cambodia'.

an inter-ministerial working group to draft a technology transfer law that is expected to be promulgated during the current mandate of the national assembly and government. Other laws support the adoption of digital technology, including an investment law, e-commerce law, telecommunications law, competition law, and the law on public-private partnerships.²⁶⁸

Similarly, **Myanmar** has established technology parks and innovation hubs to foster innovation, entrepreneurship, and 4IR technology development. Notable examples include the Yangon Technological University Technopark, Mandalay Technological University Technopark, and Yatanarpon Teleport. These parks provided international broadband internet access, reliable power supply, software-based industries, and hardware manufacturing. Myanmar has also focussed on digital transformation efforts to enhance its digital infrastructure, increase connectivity, and improve digital literacy across the country. As part of these efforts, the government has strengthened cybersecurity measures to protect critical infrastructure and secure digital spaces and services. In addition, it has established specialised technology and computer focused universities across the country.²⁶⁹

In **Thailand**, the IoT Institute in the Digital Industry Promotion Zone was established under the Thailand Digital Valley project led by the Digital Economy Promotion Agency (DEPA) to promote the digital industry by focusing on 4IR-related research and development. Its construction is scheduled for completion in 2025. In addition to that project, the Eastern Economic Corridor (EEC) is a central initiative of the Thailand 4.0 plan to establish a technologically advanced, interconnected, and eco-friendly economic zone in eastern Thailand. To drive this ambitious project, the Eastern Economic Corridor Office of Thailand (EECO) was established to promote investments, foster innovation, and advance technology. The office functions as a facilitator for businesses and maintains close and proactive collaboration with public authorities and private sector actors to ensure the successful implementation of EEC projects.²⁷⁰ The government is also establishing a centre for essential technological infrastructure and innovative digital services, creating IoT tools and intelligent systems for small businesses, disseminating digital technology knowledge, fostering new IoT entrepreneurs, improving IoT technology skills and expertise for business, and facilitating private sector-startup consultancy and business partnerships with a 5G lab, cloud innovation lab, AI design lab, and data analytics centre. The IoT Institute is expected to attract so-called “S-Curve” industries, such as automotive, electronics, food, robotics, hardware, software, telecom, digital services, content, and data, by providing infrastructure, a digital ecosystem, and

²⁶⁸ Fabre and Straub, ‘The Impact of Public–Private Partnerships (PPPs) in Infrastructure, Health, and Education’; Roth, ‘Country Profile: Cambodia’.

²⁶⁹ Sein, ‘Country Profile: Myanmar’.

²⁷⁰ Wantanasombut, ‘Country Profile: Thailand’.

matchmaking services. The Board of Investment (BOI) and DEPA offer incentives to investors, including corporate and personal income tax exemptions and the Smart VISA Program for foreign workers.²⁷¹

Viet Nam established the Viet Nam Innovation Challenge in 2019. Led by the Ministry of Planning and Investment, and jointly organised with the National Innovation Center and Meta Corporation, it seeks innovative solutions from organisations or individuals worldwide to address significant national challenges, with the goal of building a prosperous and sustainable Viet Nam.²⁷²

3.3. Smart Cities

The AMS have also strived to develop smart cities. **Cambodia** has undertaken initiatives to develop smart city projects to improve urban services, infrastructure, and sustainability. Many regional and state Governments in **Myanmar** are deploying 4IR technologies for local economic development. These initiatives include e-government systems, digital payment solutions, and digital entrepreneurship promotion.²⁷³ The Smart City Initiative in **Thailand** aims to expedite the growth of smart cities through a comprehensive strategy that evaluates the progress of innovative city development using global benchmarks and monitors proactive implementation of national and local policies.²⁷⁴ Meanwhile, **Singapore** continues to push ahead with Smart Nation, a major initiative to transform the country into a high-tech metropolis enabled by digital technology. The goal is to improve the lives of citizens and build trust by harnessing 4IR technologies like AI and robotics.

3.4. Skills Development

In **the Philippines**, the passage of Republic Act 11927 or the Philippine Digital Workforce Competitiveness Act in 2021 was a big step towards making Filipino workers not just globally competitive but better prepared for the jobs and workplace of tomorrow. It is expected to drive whole-of-government efforts to ensure worker access to lifelong learning platforms and digital skills development at par with global standards. The implementing rules and regulations of the Act, approved in October 2023, created the Inter-Agency Council (IAC) for the Development and Competitiveness of the Philippine Digital Workforce, chaired by National Economic Development Authority (NEDA). The IAC is expected to engage other sectors such as, but not limited to, academia, business, nongovernmental organisations, and civil society when carrying out its work. Its task

²⁷¹ Wantanasombut.

²⁷² Quyen, 'Country Profile: Viet Nam'.

²⁷³ Sein, 'Country Profile: Myanmar'.

²⁷⁴ Wantanasombut, 'Country Profile: Thailand'.

is to develop a National Roadmap for Reskilling, Upskilling, and Training the Filipino Workforce; align it with the Philippine Skills Framework; create a National Skills Map; and lay down a suite of support programmes, including scholarships, full or partial subsidies for co-working or shared service facilities, equipment, and access to the Department of Industry and Trade's (DTI's) start-up and MSME programmes.²⁷⁵

3.5. Promoting Start-ups

To stimulate economic growth, some AMS have implemented initiatives to support entrepreneurship and the growth of tech start-ups. In **Brunei Darussalam**, the Digital Economy Council's Master Plan 2025 aims to foster an innovation ecosystem to support the growth of technology-driven enterprises through initiatives such as the Brunei Economic Development Board's (BEDB) iCentre, which provides support services and resources for aspiring entrepreneurs and innovators.²⁷⁶

In **Cambodia**, entrepreneurial development has gained attention from the government, private sector, and donor community as a growth-driving activity. Relevant actors in the ecosystem have provided a range of programmes and activities to support initiatives, including incubation and acceleration programmes, hackathons, and competitions.²⁷⁷ In **Viet Nam**, the TECHFEST10 Program serves as Viet Nam's largest annual event (since 2015) for the startup and innovation ecosystem. It is organised to promote entrepreneurship and technological innovation in the country. TECHFEST10 provides a platform for startups, investors, experts, and other stakeholders to connect, collaborate, and showcase their ideas, products, and services. The programme includes a series of activities such as conferences, exhibitions, pitch competitions, workshops, and networking sessions that aim to foster the growth and development of Viet Nam's start-up ecosystem.²⁷⁸

²⁷⁵ NEDA, 'Implementing Rules and Regulations of the Philippine Digital Workforce Competitiveness Act'; Santos, 'Country Profile: The Philippines'.

²⁷⁶ Brunei Darussalam Digital Economy Council, *Digital Economy Masterplan 2025*.

²⁷⁷ Roth, 'Country Profile: Cambodia'.

²⁷⁸ Quynh, 'Country Profile: Viet Nam'.



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