The Comprehensive Asia Development Plan 3.0 (CADP 3.0): Towards Integrated, Innovative, Inclusive, and Sustainable Economy

ERIA

The Comprehensive Asia Development Plan 3.0 (CADP 3.0): Towards an Integrated, Innovative, Inclusive, and Sustainable Economy

ERIA CADP Research

The Comprehensive Asia Development Plan 3.0 (CADP 3.0):
Towards an Integrated, Innovative, Inclusive, and Sustainable Economy

Published by
Economic Research Institute for ASEAN and East Asia (ERIA)
Sentral Senayan II 6th Floor
Jalan Asia Afrika no.8, Gelora Bung Karno
Senayan, Jakarta Pusat 12710
Indonesia

Layout by Artmosphere
Cover design by Antasena Adi Perdana

ISBN: 978-6025-460-42-5

Preface

Many countries are still struggling with the coronavirus disease (COVID-19) pandemic, which has brought various negative impacts upon the Association of Southeast Asian Nations (ASEAN) and East Asia economy, including trade disruptions; a decline in foreign direct investment; and scarring effects on poverty, education, and women. Alongside these, the pandemic has also revealed some positive aspects. International production networks in the East Asia region have been resilient to the pandemic, with *Factory Asia* continuing to produce and export throughout the pandemic, in contrast to other major production network regions such as North America and Europe. Furthermore, COVID-19 has accelerated the uptake of digitalisation, especially in the field of information and communication technology (ICT). This increasing deployment of ICT has created a positive impact on economic growth. Moving forward to the post-COVID-19 phase, maintaining the competitiveness of international production networks and leveraging the increased momentum of digitalisation are the keys to the region's development.

Based on that understanding, in 2022, the Economic Research Institute for ASEAN and East Asia (ERIA) has compiled the Comprehensive Asia Development Plan (CADP) 3.0, which is a key deliverable for the ASEAN and East Asia Summit. Nearly 7 years have passed since the previous plan, CADP 2.0, was published in 2015. While the basic concept of the CADP still applies – enhancing connectivity within the region – CADP 3.0 explicitly considers the above-mentioned urgent challenges and discusses economic development and social problem-solving in the region from the comprehensive perspectives of integration, innovation, inclusiveness, and sustainability. CADP 3.0 has 18 original chapters, discussing various topics related to the above four perspectives and digitalisation.

For the readers of the book, I have three points to emphasise. First, ASEAN and East Asia are at a historical turning point where industrial and economic structures are undergoing major changes, such as the rapid progress of digitalisation, the integration of manufacturing and services, and the promotion of a circular economy. COVID-19 has expedited the deployment of digital technologies in our daily activities. The integration of manufacturing and services is transforming the industrial structure (e.g. from manufacturing gasoline automobiles to providing Mobility as a Service (MaaS) that uses electric vehicles and autonomous driving). The principle of the circular economy will require turning current supply chains that span multiple countries into circular ones in which everything – from product planning and design to parts, assembly, and consumption – is unified under the common concept of recycling.

Second, it is urgent to create a completely digital society by building a digital single market in which all businesses, governments, and public institutions in the region use common data – aiming for a fully digitalised supply chain. To do so, it is essential to build a common ASEAN and East Asia data infrastructure (platform) and realise a society in which everything is connected through mutual compatibility (interoperability) of systems amongst ASEAN and East Asia countries. Of course, it is also necessary to promote unified cybersecurity measures within the region that support the digital society at the same time.

Third, more practical policy planning will be required when moving to the concrete implementation phase in the near future. In doing so, it is essential to widely reflect the voices of private businesses, which are key players in realising a fully digitalised circular economy.

I hope that, based on the directions outlined in CADP 3.0, more ambitious and realistic policies will be formed, new social and economic foundations will be constructed, and a completely digitalised society will be achieved, and that ASEAN and East Asia will continue to lead the global economy.

Professor Hidetoshi Nishimura
President, Economic Research Institute for ASEAN and East Asia

Acknowledgements

The Comprehensive Asia Development Plan (CADP) 3.0 is the third version of the development framework for the ASEAN and East Asia economy, compiled by the Economic Research Institute for ASEAN and East Asia (ERIA). CADP 3.0 advocates for the simultaneous achievement of deepening economic integration, narrowing disparities, and sustainable development by using the power of the production networks and harnessing existing economic disparities as a source of further economic development. The CADP was firstly published in 2010 and submitted to the East Asia Summit. As a flagship ERIA project, the CADP has been updated based on changes in the development stages of the region, technological changes, and geopolitical circumstances.

Since around 2015, when the second version of the CADP was published, the wave of digital technologies such as artificial intelligence (AI) and robotics has dramatically impacted the ways of doing business and people's lives worldwide, including the ASEAN and East Asia region. In addition, the coronavirus disease (COVID-19) pandemic has had a significant impact on the ASEAN and East Asia region while further accelerating the digitalisation trend. Based on the digitalisation trend and pandemic experience, CADP 3.0 discusses economic development and social problem-solving in the ASEAN and East Asia region from the comprehensive perspectives of integration, innovation, inclusiveness, and sustainability.

CADP 3.0 was prepared by the ERIA CADP research team, which is composed of almost all the ERIA experts. Professor Fukunari Kimura, Chief Economist; Dr Keita Oikawa, Economist; and Dr Masahito Ambashi, Research Fellow performed the editorial role for CADP 3.0. The other members of the ERIA CADP research team are Mr Mohd Yazid Abdul Majid, Dr Venkatachalam Anbumozhi, Mr Salvador Buban, Dr Lurong Chen, Dr Ha Thi Thanh Doan, Mr Takuya Fujita, Mr Ikumo Isono, Mr Fusanori Iwasaki, Mr Shigeru Kimura, Mr Michikazu Kojima, Mr Masanori Kozono, Mr Satoru Kumagai, Dr Dionisius A. Narjoko, Dr Han Phoumin, Ms Anita Prakash, Dr Alloysius Joko Purwanto, Dr Intan Murnira Ramli, Dr Rashesh Shrestha, Mr Hiroshi Suzuki, Dr Shandre Mugan Thangavelu, Mr Keisuke Ueda, Dr Yasushi Ueki, Dr Vanessa Yong, and Dr Fauziah Zen. Professor Hidetoshi Nishimura, President of ERIA; Professor Jun Arima, Senior Policy Fellow for Energy and Environment of ERIA; and Dr Lili Yan Ing, Lead Advisor (Southeast Asia Region) of ERIA provided valuable inputs to CADP 3.0.

The ERIA CADP research team would like to express our gratitude to Dato Paduka Lim Jock Hoi, Ms Elisabeth Bowes, Ms Hajah Latifah Haji Mahmud, H.E. Ros Seilava, Professor Ye Hailin, Mr Rohan Shah, Dr Teguh Dartanto, Mr Sadayuki Sakakibara, Mr Tae-Shin Kwon, Dr Leeber Leebouapao, Professor Tan Sri Dato' Seri Dr Noor Azlan Ghazali, H.E. Mr Than Aung Kyaw, Dr Alan Bollard, Dr Cielito F Habito, Ambassador Barry Desker, Dr Sansern Samalapa, and Dr Tran Thi Hong Minh for providing valuable insights at the 15th Governing Board Meeting of ERIA; and the management team of ERIA for their support, both financially and logistically, of our study. All the members of the ERIA CADP research team hope that this publication will contribute to realising an integrative, innovative, inclusive, and sustainable Asia through digitalisation.

Table of Contents

List of Figures and Tables

Figures

Tables

Executive Summary

It has been more than 3 years since the beginning of the coronavirus disease (COVID-19) pandemic. Countries around the world are gradually transitioning to endemic phases and shifting to the new normal after COVID-19. A survey by the Economic Research Institute for ASEAN and East Asia (ERIA) on business activities during the pandemic showed that global value chains (GVCs) in the East Asia Summit (EAS) region were robust and resilient. Factory Asia remained resilient throughout the pandemic crisis, reconfirming the continued importance of the manufacturing sector at the core of the regional economy. Maintaining and strengthening competitive GVCs and international production networks (IPNs) is critical for the growth of the EAS region post pandemic. COVID-19 also accelerated the uptake of digitalisation, mainly in the use of communication technologies, which created a positive impact on economic growth. The Association of Southeast Asian Nations (ASEAN) and East Asia countries must use the opportunity presented by the pandemic to accelerate the necessary economic and social transformation.

While we have witnessed the acceleration of information and communication technology (ICT) in the ASEAN and East Asia region, increasingly complicated global geopolitical tensions have emerged. Countries that formerly supported free trade and investment now seek greater control over their economic activities. This political trend may weaken the rules-based trading regime, which negatively affects production, trade, and investment in the EAS region. Furthermore, the Russia–Ukraine war is resulting in inflationary pressures on the EAS economy, as well as food and energy insecurity, which will negatively and unevenly affect people's lives, especially the poor or marginalised communities.

Further, global warming and the quest for a low-carbon economy have heightened environmental concerns. The COVID-19 pandemic temporarily decreased energy consumption and carbon emissions due to the measures adopted to mitigate its impacts. However, it seemed that many parts of the world would concentrate on more immediate problems rather than the environment. Nevertheless, Europe's green movement did not stop and even escalated, while the Biden Administration in the United States (US) rekindled global warming concerns. The Russia–Ukraine War may increase demand for fossil fuels in the near term, but civil society's environmental concerns have not abated. ASEAN and East Asia rely greatly on fossil fuels. Manufacturing-based economic growth is energy-intensive and carbon-emitting. Climate change makes the area vulnerable to natural calamities. ASEAN and East Asia's decarbonisation agenda may not be advanced enough for the global movement.

The ASEAN and East Asia region needs a new development framework with deep consideration of the COVID-19 experience, the impact of digital technology, and the geopolitical uncertainty. The Comprehensive Asia Development Plan 3.0 (CADP 3.0), the third version of ERIA's development framework for the region, provides such a framework. It covers the following four pillars: integration, innovation, inclusiveness, and sustainability. In ensuring recovery and resilience to global uncertainty, the ASEAN and East Asia region should move towards a more integrated, innovative, inclusive, and sustainable economy laid out in the CADP 3.0.

Pillar 1: Integration – fully use the new wave of the international division of labour by enhancing connectivity

The ASEAN and East Asia region has developed competitive and resilient IPNs by leveraging multinational corporations' strategy of global optimisation of production locations and the relative advantage of economic disparities in the region. The driving force was the reduction in service link costs connecting production units, enabled by early-stage ICT advancement, coupled with a generally liberalised trade environment. Multinationals' production units, located in less developed countries, have promoted building industrial agglomeration there by trading with local firms. Local firms that have engaged in IPNs have obtained indirect access to overseas markets and have acquired technology transfer and managerial know-how from multinationals. For less developed countries, participating in IPNs or GVCs or joining the international division of labour (IDL) became an effective way to develop their economies.

Now, the trend of digital technologies such as robotics and wireless broadband networks (e.g. 5G networks) has dramatically lowered service link costs in terms of face-to-face communication, and is unbundling individual production units or tasks performed by a dedicated group of people in a fixed location into subdivided units performed remotely by discrete people in multiple locations. This is the new wave of the IDL, which is not dependent on location. To illustrate, it allows a person in an urban area to run an agriculture business in a suburban area remotely via digital tools. For example, Upwork Global Inc provides matching services for freelancers throughout the world; Coconala Inc provides a matching platform for online service individuals and customers; Philippines-based enterprises offer business processing services worldwide; and online English lessons from instructors in Cebu compete with on-site lessons in Japan.

Digital connectivity is key to participating in the new wave of the IDL. Upgrading connectivity stands for not only better physical infrastructure, but also smooth and safe information flows in cyberspace. Securing free flow of data with trust is indispensable. The public and private sectors in the region must work together to improve infrastructure, rules and regulations, and the data usage environment.

Efforts to pursue further regional integration are also required given increasing geopolitical uncertainty. The geopolitical tension strengthens the popularity of protectionist policies – weakening the rules-based international trading order, which is an essential condition for effective and efficient functioning of IPNs in the region. ASEAN and East Asian countries should uphold the importance of implementing the trade and investment agenda set by the Regional Comprehensive Economic Partnership (RCEP) and update other regional integration frameworks under ASEAN centrality. In addition, although the dispute settlement mechanism in regional trade agreements has barely been used, we should think of the possibility of harnessing the potential of this mechanism. Ultimately, ASEAN and East Asia should work together and support the World Trade Organization (WTO) as an anchor for the rules-based trading regime.

Pillar 2: Innovation – shift some weight from incremental innovation to disruptive innovation

Digitalisation has remodelled the nature of innovation from incremental to disruptive. Digital businesses have shifted their weight from simply providing a market-matching function to helping to upgrade other industries, including traditional industries. Digital technology has generated vast opportunities for new businesses, and the deployment or social implementation of digital technology itself can be a good business. Newly developed countries also have ample room for exploring the advantage of backwardness by catching up with and even leapfrogging to a higher development stage.

ASEAN can benefit from digital innovation by tapping into the potential of younger generations, which have an affinity for digital technology. The growing number of ASEAN start-ups and unicorns led by young leaders is a positive development. The ASEAN and East Asia governments have played an essential role in establishing Factory Asia and accumulating incremental innovation through research and development (R&D). Now, the region needs to combine the accumulated incremental innovation with disruptive digital innovation. Not only R&D but also the deployment of technology must be emphasised. The ASEAN and East Asia governments should support innovative activities of the private sector.

To do so, they need to provide a favourable ecosystem for start-ups. First, they should create a trial-and-error business environment. For high-risk, high-return investments, venture capital is required. Incubators, co-working spaces, accelerators, and university education for entrepreneurs provide vital technology hubs. Second, they should nurture and attract human capital. Creative entrepreneurs and programmers are required. Urban facilities need to be improved to attract domestic and international human capital and ensure the mobility of educated individuals. Third, they should link global technology stocks and deployment. Universities and research institutions should allocate resources to start-ups. They should refrain from safeguarding infant industries without careful consideration. Competition, technology, and management skills are crucial.

COVID-19 increased the use of ICT when the second ICT revolution lowered the cost of face-to-face communication online. However, face-to-face encounters still have value, especially in spontaneous encounters amongst intellectuals and intellectual agglomeration. Attracting creative individuals and activating innovation will be an important policy agenda for ASEAN and East Asia. Four urban amenities attract well-educated people: a variety of services and consumer goods, aesthetics, good public services, and speed. Creative jobs and urban amenities reinforce one other. ASEAN and East Asian cities are entering the era of competition. Attracting both foreign and domestic creative talent will be vital for full development.

In the digital age, data and data-related businesses require relevant policies. These policies are frequently not aligned with economic reality. Improper data policies may be costly. The free flow of data offers efficiency, but government action may be required to improve efficiency and productivity and to solve economic and social problems. Policies may be categorised into the following areas: (i) further liberalisation and facilitation; (ii) correcting or mitigating market failures; (iii) reconciling values or social concerns with economic efficiency; (iv) accommodating data flows and data-related businesses in domestic policy; and (v) industry, trade, and investment.

Data governance policy disputes continue. Privacy is contentious and easily politicised. Excessive or ineffective protection may hinder data transfers and lead to digital isolation; worldwide agreement should be sought. Giant platforms need adequate competition, taxes, and information transparency. The digital economy also requires government discipline over private data. Cybersecurity requires international collaboration (e.g. a monitoring system similar to that of the financial market and a joint taskforce to coordinate and/or synchronise actions against fraudulent attacks).

The WTO's Joint Initiative on E-commerce appears to be making headway, although a global policy framework remains impossible in the short term. Even in ASEAN and East Asia, the legislative structure and digital governance philosophy are different. Technological growth and economic innovation are fast, thus an international legislative framework for free flow of data with trust is needed. To develop new international norms, like-minded countries must collaborate.

Institutionalising governance structures and methods (e.g. in-country coordination and dialogue amongst digitalisation authorities, effective stakeholder engagement with industries, and a monitoring system for digitalisation programmes) may also help. Sharing best practices and enhancing collaboration with regional organisations could strengthen the efficacy of the monitoring system. Institutionalising a governance structure for effective implementation is also required.

Pillar 3: Inclusiveness – address from three dimensions: geographical, industrial, and societal

Inclusiveness or equity is a significant value that cannot be completely realised through economic efficiency. Achieving inclusion may be economically expensive at times, yet inclusiveness and economic efficiency are not always inverses. There are three ways to approach inclusiveness: geographical, industrial, and societal.

The geographical dimension includes income and welfare disparity across countries and regions, as well as urban versus rural areas. Balancing urban and rural regions is a key difficulty in economic growth. Rural communities are often separated from urban growth, so improving connections is crucial. However, connectivity alone may not improve rural well-being. When urban–rural transport costs fall, two economic forces are generated. One is concentration forces. Urban agglomeration produces economies of scale and market proximity. These draw economic activity from rural areas. Dispersion forces are another. Agglomeration causes land price rises, labour increases, traffic jams, and pollution. Rural areas may provide benefits such as cheap labour, which drive the relocation of urban to rural economic activity. Policymakers may relocate certain economic activities to rural areas for geographical inclusion. The equilibrium between concentration and dispersion forces must be assessed. To manage these two forces, rural location benefits such as industrial estates are typically needed.

Three measures may benefit the welfare of rural people. First, providing favourable geographical advantages in rural areas shifts economic activity from the centre. Location benefits include inexpensive labour and industrial estates, with dependable economic infrastructure. Digital technologies, especially communication technology (CT), must be vigorously promoted to boost food processing, cottage businesses, and software outsourcing. Second, rural workers could be enabled to relocate to urban areas and send money home. Industrialisation causes some rural residents to relocate to cities and suburbs, which enriches rural families. However, too much relocation would hollow out rural regions, so both measures must be balanced. Third, the scope of the supply of goods and services should be expanded in rural areas. Rural people's well-being could be greatly enhanced. Digitalised services – including medical, educational, and government services – could be offered to bridge geographical distance by overcoming the digital gap.

The industrial dimension includes multinational corporations versus local firms; large firms versus micro, small, and medium-sized enterprises (MSMEs); and manufacturing versus other industries. Industrial inclusiveness is crucial – there is a massive development gap between large companies and MSMEs. Government subsidies for MSMEs have long been the subject of argument. However, at least to eliminate market failures, disadvantageous conditions must be removed for MSMEs. At a lower development stage, MSMEs have internal limits on their product quality and delivery schedule, business strategy, bookkeeping, entrepreneurship, and engineers. Building core MSME capabilities should be a priority. At a higher growth level, external limitations become vital. Improved access to finance, market/matching, and technological resources will be necessary.

Filling the gap between multinationals and local enterprises is also an important issue. Several empirical studies indicate vertical technology spillovers in manufacturing – local enterprises acquire access to innovation from multinational purchasers in the same industrial cluster. Firms in developing countries may learn technologies from (i) foreign countries, (ii) local colleges and research organisations, and (iii) multinational plants in the country. While Japan, the Republic of Korea, and Taiwan relied on the first and second channels, ASEAN has used the third for process innovation and efficiency improvements. Agglomeration fosters interfirm links.

Additionally, the aggressive use of digital technologies should be encouraged. COVID-19 has hastened the adoption of CT in GVCs. MSMEs are often sluggish to embrace digital technologies, but they must catch up with the irreversible shift. E-payments and e-IDs continue to spread, which could help MSMEs expand their operations. The digital divide must be overcome. Strengthening digital skills education (the abilities, skills, and knowledge necessary to keep up with digital transformation), as well as technical and financial support for MSMEs, will not only contribute to digitalisation in the region but also help MSMEs overcome their sensitivity to economic shocks in the post-pandemic era.

The societal dimension includes gender, ageing, disability, healthcare, education and human resources development, economic and social resilience, food security, and social protection. The digital divide amongst people has widened during the pandemic – people who can secure a computer and internet connection can continue to work and learn, but those who cannot are left behind. ASEAN and East Asian countries should cooperate in developing digital infrastructure and digital skills at the individual level.

Financial inclusion is another long-term challenge. Smartphones, e-payments, and e-banking have enhanced impoverished rural people's access to the payment system and bank accounts. Digital technology is shifting the paradigm, yet financial inclusion needs to be developed. Social protection is another concern. Ageing populations may require a pension system, but health insurance is a more serious concern. An immediate task is to establish universal coverage. Further, although traditional social protection with familial connections remains, the government burden of social protection such as caring for older persons will certainly increase. The lack of a progressive tax structure and wealth redistribution policies in ASEAN and East Asian emerging nations will be a serious political problem in the future.

Pillar 4: Sustainability – three key areas: energy and environment for low-carbon growth, resource and waste management, and disaster management

For the ASEAN and East Asia region, sustainability is not only a long-term issue but also responds to immediate and urgent problems. The impacts of climate change and natural disasters are more pronounced in ASEAN than in any other part of the world. By 2050, climate change is projected to reduce ASEAN's gross domestic product (GDP) by up to 6%. In 2021, ASEAN adopted the Framework for Circular Economy for the ASEAN Economic Community, developed with the support of ERIA, emphasising the role of digitalisation as one of the strategic priorities.

Fully utilising digitalisation and creating solutions that complement economic development are key for a region with countries at different development stages. Technologies of the Fourth Industrial Revolution have proven to be effective accelerators for the circular business model or circular supply chains in several industries such as ICT, mining and manufacturing, education, and healthcare.

As Parties to the Paris Agreement, ASEAN Member States (AMS) are making vigorous efforts towards a low-carbon energy transition. Following the Glasgow Climate Pact, the ASEAN region will need to intensify such efforts to reach carbon neutrality. Pathways towards carbon neutrality could be diverse between countries as one size does not fit all, and each country's specific national circumstances must be taken into account.

In pursuing their respective carbon neutrality goals, AMS need to explore a variety of options and use all available fuels and technologies. Their decarbonisation pathways also need to ensure other policy objectives – availability, accessibility, and affordability. Given the high priority placed on poverty eradication, affordability is of great importance. Technology development (e.g. carbon capture, utilisation, and storage), international cooperation, and a technology-optimal approach will be needed to minimise the cost of decarbonisation.

ASEAN and East Asia are vulnerable to natural disasters as well as disasters induced by human behaviour, such as drought, floods, typhoons, earthquakes, tsunamis, and volcanoes. Preparedness, early reactions, and recovery are crucial for disaster management. The region's good and bad experiences can be shared. Satellites, early warning systems, and swift rescue schemes should be pursued.

COVID-19 raised concerns about GVC interruptions. Providing additional options for private sector expansion and diversification will make GVCs more robust and resilient. Participation in GVCs by developing countries improves diversification and risk management. The digitalisation of supply chains and trade and market integration improve GVCs' robustness and resilience. Investing in digital technology may help map and monitor supply networks to detect risks and bottlenecks. Facilitating cargo clearance and investing in e-commerce platforms would speed up and secure cross-border trade for economic recovery. Supply chains have been built on private sector efforts and activities, and governments have worked to develop the market environment. Going forward, it may be necessary to work towards quality supply chains through more public–private coordination, including standardising data sharing and creating an ecosystem where not only hyper-scalers but all industry players benefit from digitalising end-to-end supply chains.

Chapter Summary and Policy Implications

Chapter 1: The Conceptual Framework of New Development Strategies

The Comprehensive Asia Development Plan 3.0 (CADP 3.0) reflects the coronavirus disease (COVID-19) experience, the impact of digital technology, the geopolitical uncertainty, and environmental concerns. It covers four pillars: integration, innovation, inclusiveness, and sustainability.

Chapter 2: Trade Facilitation and Non-Tariff Measures

Trade facilitation aims to address bottlenecks to export and import activities both at the border and behind the border. The World Trade Organization (WTO) estimated that trade costs in developing countries are equivalent to applying a 219% ad valorem tariff on international trade. Poor design and implementation of non-tariff measures (NTMs) could result in remarkable trade costs.

As tariffs decline, addressing NTMs has become a focus of the regional economic integration efforts of the Association of Southeast Asian Nations (ASEAN). Remaining challenges include enhancing the technical infrastructure capability of ASEAN Member States (AMS) to support the adoption of harmonised standards. The absence of a coherent mechanism and institution could create difficulties in drafting effective regulations.

Most of the ASEAN Plus One free trade agreements have a general provision on trade facilitation or customs procedures and NTMs. The Regional Comprehensive Economic

Partnership (RCEP) provides a wider scope for addressing measures that impede trade. It also provides a clear period for countries to implement commitments through the provision of implementation arrangements.

The gap between developed and developing countries is particularly stark in terms of digital trade facilitation. This gap reflects the availability (or lack) of soft and hard infrastructure to support digital trade such as information and communication technology (ICT) and a legal framework to manage it. Moderate progress has been seen in cross-border coordination and transit facilitation, as well as transport facilitation. AMS are lagging on paperless trade.

ASEAN+6 Partners may be quite advanced in terms of their own trade facilitation initiatives. Enhanced cooperation with the wider East Asia Summit (EAS) region would contribute to improved implementation. Prioritising investment in ICT infrastructure and building the capacity of ASEAN government officials could also be on the agenda.

Chapter 3: The Importance of Regulatory Coherence for a Connected and Integrated ASEAN

Regulations are important in achieving public policy objectives such as protecting the environment, worker protections, and public health and safety. Regulatory coherence is important to encourage businesses to participate in the market and avoid the dominance of certain firms. This is especially important as ASEAN integrates more fully in the global value chain (GVC).

AMS regulators should (i) develop rules using evidence; (ii) conduct inclusive engagement by obtaining worldwide input or learning from global organisations about regulatory best practices; (iii) consider using international standards while drafting domestic rules or subsidiary regulations; (iv) reduce information asymmetry and encourage practical solutions via international/regional collaboration; (v) ensure regulatory quality at the highest political level; (vi) adhere to transparency and accountability as open government values; (vii) establish committees to monitor, assess, and support good regulatory practice (GRP) implementation; (viii) integrate regulatory impact assessment (RIA) into early policy phases for new regulatory ideas; (ix) conduct evaluations of the stock of regulations to verify that rules are up-to-date, cost-justified, cost-effective, consistent, and achieve policy goals; (x) publish periodic reports on regulatory policies, reform programmes, and governmental agencies implementing rules; (xi) build the ability to improve regulators' assessment and proposal skills; (xii) engage stakeholders and provide mechanisms and/or portals to access documents; (xiii) risk-assess rules throughout development, including implementation costs and enforcement strategies; (xiv) promote regulatory consistency at all levels to minimise redundancy or conflicts of interest; and (xv) offer state and local governments a research team to conduct RIA and analyse current rules.

To promote ASEAN's regulatory quality and economic performance, the ASEAN Secretariat should help AMS create and strengthen their regulatory quality capabilities and monitor their GRP implementation.

Chapter 4: Connecting the Connectivity Plans in Asia and Beyond – International Cooperation for Expanded Supply Chains and Resilient Growth

Asia is the centre of pan-regional connectivity activities. All connectivity programmes – Master Plan on ASEAN Connectivity (MPAC), Belt and Road Initiative (BRI), Asia–Africa Growth Corridor (AAGC), European Union (EU) Global Gateway, and Asia–Europe Meeting (ASEM) – seek to expand Asia's economic vitality to trans-regional partners. Integral to this area are mega-regional integration projects such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the RCEP. ASEAN's notions of connectivity and community development are consistent with European and African thought and may thus be successfully used for pan-Asian, Asia–Africa, and Asia–Europe connectivity. In a global context, however, connection plans compete for space, influence, and outcomes, often for the promoting country.

Developing global connection standards is tough yet achievable. Global development programmes and multilateralism could help in government, regional, and multilateral inter-connectivity efforts. The Bretton Woods scheme monitored money and monetary institutions to support post-war peace and progress. Connectivity is the new worldwide growth strategy; thus, global governance must oversee its different elements and participants. Triangular and multilateral collaboration on connectivity produces more inclusive and sustainable plans owing to better control of project preparation procedures and plan results.

Trans-regional connectivity requires a unified or shared framework for cross-continental transport of commodities and people. Technical requirements, safety management frameworks, the social and economic well-being of sector employees, competition legislation, and customs cooperation are major beyond-the-border problems, notably in rail and road transport. International laws govern air and marine connections, but new cooperation and routes require assessment. Promoting a peaceful, safe, and open ICT environment, including data protection, needs a coordinated regulatory strategy and policies and incentives to bridge the digital gap. Common norms and standards are essential for connection synergy.

Global standards and governance guidelines for infrastructure-related connectivity initiatives may be taken from the commitment to prioritise people and their prosperity. Good governance and accountability must drive strategies for sustainable development and equitable growth. Monitoring plans will be simpler when connectivity plans align with regional, national, and global development goals. Monitoring and regulatory procedures must guarantee that connectivity schemes are not used to undermine regional leadership or export debt issues from the promoter country or group of countries. Taxation, digital finance, the internet, data ownership and transmission, and artificial intelligence (AI) are undergoing global standardisation. Global agreement on climate change, the Sustainable Development Goals (SDGs), multilateralism, and trade is also being renewed. Global (and regional) methods for monitoring and regulating connectivity initiatives should guarantee that they improve economic and social well-being and build confidence amongst partners.

Chapter 5: Digital Connectivity

Connectivity requires digital hardware and software. In terms of digital connectivity, the region must improve physical and cyberspace infrastructure, implement rules to enable a development-friendly digitalisation environment, and combine national policies and regional partnerships to reduce institutional hurdles. Given the significant development disparities across AMS, latecomers must catch up quickly. Capacity building deserves special attention. Digital infrastructure constraints may be caused by financial or technology limitations. The public sector may need to lead the rise in quantity and quality of public goods. Sustainable development requires private sector participation.

Free flow of data with trust is the most important stage in establishing a regulatory structure to enable the digital economy. ASEAN must remove the threat to free trade and promote digital adoption to preserve regional growth. Restrictions on data flows potentially affect international trade similarly to trade protectionism. The laws and regulations should include classic trade concerns (e.g. tariffs and NTMs, trade facilitation, consumer protection, and intellectual property rights) and emerging ones (e.g. cross-border information flows, privacy protection, data localisation, and source code disclosure).

The RCEP includes a number of digital connectivity issues. Countries must balance the economy, society, national security, long-term advantages, and short-term expenses to reach agreements on these problems. This requires government and business sector partnership.

Chapter 6: Hard Infrastructure Development and Chapter 7: Geographical Simulation Analysis

Chapters 6 and 7 are closely interrelated. Chapter 6 lists the ongoing and planned hard infrastructure projects, which are selected based on the following factors: (i) the impact on the project area; (ii) the medium- and long-term plans of each country, priority projects, and projects related to neighbouring countries; and (iii) the project's feasibility and capacity to be implemented and/or constructed. In all, 779 potential and exemplary projects were chosen. By sector, the projects are categorised as follows: roads/bridges (176 projects), railways (121 projects), ports/maritime (68 projects), airports (58 projects), other transportation (7), industrial estates/special economic zones (62 projects), ICT (19 projects), energy/power (135 projects), urban development (39 projects), water/sanitation (63 projects), and other projects (31). In terms of subregional aggregation, 396 projects (more than half of the total) are planned for the Mekong subregion,[1] while 361 projects are planned for the Brunei Darussalam–Indonesia–Malaysia–Philippines+ (BIMP+) subregion[2] and 19 projects are planned for the Indonesia–Malaysia–Thailand+ (IMT+) subregion.[3] Chapter 7 conducts an economic impact analysis of the selected projects in AMS and neighbouring countries.

Chapters 6 and 7 reveal that interregional infrastructure initiatives are becoming less important. In 2010 and 2015, large cities required toll roads and other infrastructure projects as quickly as feasible. Because of the progress achieved on these highways in heavily populated regions, infrastructure projects linking cities are less important. Urban transportation, rural infrastructure, and expanding existing infrastructure are gaining governmental attention. Some AMS need to strengthen their transport infrastructure to connect cities and communities. Countries approaching the completion of their core transport infrastructure must confront increasingly tough issues to obtain extra economic advantages, such as deploying ICT infrastructure and introducing energy-saving technologies.

Geographical simulation analysis (GSA) compares scenario outcomes to determine economic impacts in terms of cumulative gross domestic product (GDP) for 2025–2035. One scenario assumes no selected infrastructure development (baseline scenario). Another is a specific infrastructure development scenario. The economic effect is the difference between the baseline scenario and the development scenario. Development scenarios count only infrastructure projects that are scheduled to start operations by 2025.

First is the physical infrastructure scenario. The listed physical infrastructure projects, such as roads and bridges, will have the largest positive economic effect on the Lao People's Democratic Republic (Lao PDR) (110.5%), followed by the Philippines (36.8%), Viet Nam (31.6%), and Indonesia (19.5%).

[1] The Mekong subregion under the CADP has a broader scope than the Greater Mekong Subregion (GMS) program of the Asian Development Bank (ADB), in that we emphasise connectivity between ASEAN and India. The Mekong subregion consists of vibrant industrial agglomerations such as Bangkok, Hanoi, Ho Chi Minh City, and Chennai; cities with high potential to join international production networks in the region such as Phnom Penh, Vientiane, Yangon, Danang, Kunming, and many cities in Thailand; and mountainous regions in Cambodia, the Lao People's Democratic Republic (Lao PDR), and Myanmar.

[2] The Indonesia–Malaysia–Thailand+ (IMT+) subregion under the CADP is an extension of the Indonesia–Malaysia–Thailand Growth Triangle (IMT-GT) in the sense that the IMT+ emphasises connection with nearby industrial agglomerations, i.e. Bangkok and Jakarta.

[3] The BIMP+ subregion in the CADP is significantly larger than the Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA), as the BIMP+ expands the geographical scope to include Manila and Jakarta (and Surabaya) as neighbouring industrial agglomerations within the subregion.

Second is the information technology (IT) infrastructure scenario. IT advances are expected to lead to an extensive build-up of facilities in selected metropolitan cities owing to technicians, clients, and associated services. GSA shows that countries with big IT build-ups have considerable economic consequences, and the benefits of IT are not just good for the city where the IT infrastructure is built, but for the whole country where the city is located.

Third is the CT infrastructure scenario. The adoption of 5G and associated services in CT is expected to reduce transit costs and trade barriers in the services sector, since CT allows trade in products and services and might change how they are exchanged. GSA indicates that most AMS areas benefit economically – including Singapore, Brunei, and especially Cambodia.

Fourth is the energy conservation infrastructure scenario. AMS are expected to benefit economically from new energy-saving solutions. The GSA reveals that Cambodia, the Lao PDR, Myanmar, and Viet Nam are economically prosperous.

Fifth is the scenario combining the above four scenarios (combined scenario). The economic effect of the nine AMS excluding Singapore is more than the sum of the four scenarios, which shows synergies between the four scenarios.

Last, we simulate the 'all' scenario, where the remaining key transport infrastructure projects that have a significant economic impact on the region, such as the Hanoi–Ho Chi Minh City expressway, the Manila–Davao expressway network, and the Trans-Sumatran Highway, are added to the combined scenario. Under the 'all' scenario, almost all AMS will receive positive economic impacts.

The GSA findings demonstrate that if infrastructure developments, ICT growth, and the introduction of new technologies to achieve energy efficiency are coupled effectively, many outlying parts of the AMS may expand further. Policymakers should push this. Remaining big projects must be finished, and 5G and new services must be rolled out nationwide.

Chapter 8: Innovation Systems and Digital Transformation

Many AMS have reached middle-income status by engaging in GVCs due to their comparative advantage in labour costs. This development paradigm may seem adequate for nations to reach high-income levels, given that sophisticated technology is expected to flow to AMS via foreign direct investment (FDI), generally in manufacturing. Middle-income AMS struggle to overcome the middle-income trap. Comparing Asian Miracles to middle-income countries, it is difficult to discover FDI-only high-income economies. All Asian Miracles that established innovation systems, built innovation skills, and fostered competitive private enterprises did so in a healthy competitive market environment.

To establish innovation-friendly marketplaces, middle-income AMS must remember empirical lessons about technology diffusion from global frontier enterprises to national firms. Promoting global-level enterprises in a country promotes other national firms, yet national laggards have trouble acquiring global frontier technology directly. Second, building global-level businesses requires stimulating entrepreneurship, FDI for global innovative enterprises, an enhanced educational system, research and development (R&D) activities, industry–university R&D partnerships, and an effective intellectual property rights structure. Third, reducing inefficient and incompetent enterprises improves macro-level innovation. To accomplish this, AMS must cut administrative expenses for businesses and balance employee protection and inefficiency restrictions. Last, product market rules, employee protection, and industry–university R&D collaboration must be eased to allow national laggards to catch up.

ICT will be implemented in all industries – manufacturing and non-manufacturing – and render present business models outdated. Both the business and governmental sectors in AMS economies must grow by transferring weight from accumulated incremental innovation (usually in manufacturing) to disruptive digital innovation (adopted in all sectors). Through the benefit of backwardness, technology use gaps provide the possibility to expand swiftly by catching up to or leapfrogging a higher development stage. AMS governments must remember that arbitrarily subsidising enterprises will not generate innovative firms. Theoretically or empirically, such industrial policies are unjustified. Pro-innovation industrial policies should keep the market competitive and require accountability.

Chapter 9: Skills Development System – Soft Infrastructure for Leapfrogging and Feedback

Formal education is the most significant part of skills development that needs improvement. Most people spend their formative years there, so it can help build life skills. The present education system, built during the first and second unbundlings, must be upgraded for the third unbundling.

Governments may enhance education in numerous ways. First, they can develop a national plan for human resources development. A national strategy focused on meeting the modern economy's requirement for qualified people may provide the political push for change. Second, in many nations, education laws were created decades ago and must be updated to reflect the modern economy. Identifying and empowering high-performing educational institutions and allowing collaboration between educational institutions that create skilled workers and companies that employ them are some proposals. Third, quality needs to be improved. A high-quality education affects not just short-term results such as test scores but also lifelong incomes. Physical infrastructure, the curriculum, and instructors define a school's quality. This entails investing in teacher development, improving school infrastructure, and establishing a curriculum that encourages cognitive and non-cognitive abilities in demand in the current labour market. Fourth, vocational education may help fill semi-skilled jobs. Comprehensive education policies that integrate general and vocational tracks may enhance the image of vocational education. Fifth, the business sector should cooperate with the government to strengthen the education system. Private sector engagement improves industry–education links, especially in vocational and higher education.

Reskilling and upskilling are also important to update the skill levels of people in the workforce and address the fear of robots replacing humans. Reskilling gives employees a set of abilities closely connected to their present competence, allowing people to execute activities that technology cannot. Upskilling demands a more drastic shift in skill sets and may need rigorous retraining. Much reskilling may happen at work, but it is not free. Businesses must choose between reskilling existing employees or replacing them. Some displacement is unavoidable; therefore, the government must help displaced people reskill and upskill so they can work in new industries. Training must fit local economic realities, and business collaborations are key.

Reskilling and upskilling are connected to lifelong learning, where skills are acquired through time. Lifelong learning helps people adjust to unavoidable but unanticipated economic changes. Adaptability involves the ability to analyse new information and make data-driven judgements. Lifelong learning may be formal (at a school), informal (on the job), or non-formal. This may happen in community learning centres, online platforms, and seminars. As it is decentralised, it needs complementary policy activities. Employment placement services, training programmes, skilling incentives, and labour market laws are examples. Non-formal and informal education, including self-learning, are key to lifelong learning. How do we recognise non-formal skills? Formal testing needs a qualifying structure. Peer recognition and professional network endorsements could be used for informal evaluation. Employers are the greatest judges of a candidate's talents, thus legislation should boost recruiting.

Chapter 10: Global Value Chain, Cities, and Urban Amenities – Case Study of ASEAN and East Asia

East Asia's economy is being transformed by the GVC network. Since 2010, the domestic value added of AMS exports has been reasonably strong and constant. The evolution of GVCs facilitated by digital and communication technology generates new economic prospects. Globally, there is considerable movement from the trading of finished items to the interchange of parts and components. Geographically, GVCs have spread – encompassing a greater range of countries across diverse locations.

To fully harness GVC transformation, AMS need to address weak foundations in the economy. Regional and global value network growth depends on important elements, such as human capital development in skills, technical development and leveraging digital technologies in ICTs, and urban centre development to promote economic and social agglomeration. The following are more specific policy recommendations.

First, human capital in ASEAN is still too low to fully engage in GVC activities. The ASEAN least developed countries (LDC) labour force only has elementary or lower education; higher primary and secondary education is needed. The more developed AMS – Indonesia, Malaysia, Thailand, and Viet Nam – require a more comprehensive human capital development framework that emphasises quality education and enhances upper secondary and post-secondary education, especially in scientific and technical education. Further, there is also a need to create an integrated framework for training and retraining of workers in relevant skills. Aligning industrial and educational policies in the overall development plan will enable coordinated structural transformation of the domestic economy.

Second, services and investment in ASEAN require more openness. Behind-the-border concerns and domestic regulatory burdens still hinder the services industry. The next step of liberalisation might concentrate on important services sectors (e.g. aviation, transportation, banking, e-commerce, educational services, and business services) to strengthen GVC links in the area. Traditional services trade industries in ASEAN LDCs, such as tourism, might be upgraded to green or cultural tourism. Liberalising services is also crucial for innovation and entrepreneurship in building new GVC and services connections in the local economy and the region. Information governance reforms, domestically and regionally, will offer a foundation for developing a region-wide digital framework that will generate a GVC network to enable new innovations and services in the area.

Lastly, liberalisation of services should be connected with the mobility of people, especially semi-skilled and skilled employees. People's mobility will be key to developing city and urban links within the domestic economy and between regional cities. Further, links between cities are needed to facilitate the mobility of people and ideas to boost creative and entrepreneurial activity in the domestic economy. Urban agglomeration is vital for creating competitive suburban and metropolitan regions around cities. These cities' competitiveness will fuel the region's next development cycle. The competitiveness of ASEAN cities will rely on the quality of urban amenities, which boost liveability, attract skilled labour, and promote innovation. Urban amenities will help manage medium- and large-city congestion and increasing living costs. The competitiveness of Asian and ASEAN cities will rely on the quality of urban facilities, which will attract qualified labour and develop innovation and value chain links.

Chapter 11: Realising Smart Cities

About half of ASEAN and East Asia's population resides in cities, which will fuel future development. The ASEAN Smart City Network was created in 2017 as more cities explored smart solutions to solve economic, environmental, and social concerns. Planning, economic growth, robust water supply, and linked data and security systems are straining cities. Smart cities need to address how digital infrastructure choices may help manage resources. The emerging concept of smart cities uses highly advanced technologies in urban design, where energy service is becoming one big and highly complex cyber-physical system in which computer-based algorithms improve the quality of life of city residents and build a sustainable and clean environment for them. ICT-enabled service delivery is smart city architecture.

Smart cities gather data via instrumentation, integrate it, and analyse it to enhance city services. Interconnecting enabling technologies via a platform offers a substructure that improves service to connected consumers/users. Sensor services and instrumentation equipment may monitor resource usage or people's movement in energy, transport, waste, and water. Automated optimisation uses camera, sensor, and anonymised mobile phone data to optimise traffic patterns in real time. Predictive analysis tracks and predicts anything from rainfall to typhoon landslides, boosting business continuity strategies. Evidence-based decision-making and planning may monitor milestones and objectives so that cities can take corrective action as required to meet productivity goals cost-effectively.

Smart cities foster innovation. Cities share local data with the public via open data, fostering openness, accountability, and collaborative problem-solving. Using living laboratories, governments designate sections of the city as test beds to jointly pilot-test novel concepts. Cities collaborate with local universities and businesses via incubation centres to seed transdisciplinary research institutions with systematic access to local city data.

Smart city initiatives should serve all inhabitants. Three regional trends are noteworthy. First, using data to target the most disadvantaged, as Singapore is doing by creating a database of socioeconomic and physical indicators to prioritise housing projects. Second, using open data to enhance accountability, such as mapping facilities, pollution, and community needs in Salem. Third, using mobile connections and citizen involvement for participatory government and crowdsourcing polluting vehicle detection, as in Jakarta.

The third unbundling will be caused by smart technology and data explosion. Cities could catalyse this by becoming living laboratories for smart technologies that transform local experiments into global knowledge and global knowledge into local solutions. Accelerating development requires multilevel efforts. ASEAN and East Asian cities may adopt open internet of things (IoT) devices and data collecting standards. This would prevent dependence on a few tech giants. It would also make it simpler to exchange solutions like a Jakarta-developed application programming interface that can be quickly implemented in Kuala Lumpur via mutual recognition agreements. Local governments may address the fragmented structure of their bureaucracy and obsolete rules to create and implement an integrated ICT system that allows the flow of people, information, and ideas across city/national borders.

Chapter 12: The Role of the Automotive Sector in Regional Economic Development

By 2040, most AMS will be high-income. AMS should improve manufacturing and promote sustainable industrial growth for a successful, healthy society. Automotives and the motorisation society[4] also harm society. ASEAN and East Asia require electrification and autonomous driving infrastructure. Rapid vehicle and motorisation advancement harms our towns.

Connected, autonomous, shared/service, and electrified (CASE) and Mobility as a Service (MaaS) can reduce the societal costs of the motorisation society. AMS must incorporate these waves into automobile industry rules. Connected vehicles will enable autonomous driving, but they must be secure and private. Digitalisation and CASE enable sustained motorisation and economic development. Increasing connectedness improves the socio-economic well-being of each country and the region.

Some AMS lag in infrastructure development, yet the lack of current infrastructure would enable them to establish new energy vehicle infrastructure (e.g. charging stations). ASEAN wants vehicle-to-Infrastructure (V2I) technology to unify autonomous cars and infrastructure. To adopt CASE and MaaS, ASEAN requires physical and institutional interconnection.

AMS must promote the circular economy to dominate the global automobile sector. Telecom connections, sophisticated transportation networks, and high-speed charging stations must be implemented. ASEAN approved the Automotive Mutual Recognition Arrangement in 2019. Smart City Development is crucial to green transportation. Automotive sector growth will depend on education and human resources. CASE and MaaS, powered by digital technology, will be the 21st-century automotive infrastructure for decreasing societal costs.

[4] 'Motorisation' refers to the social transformation that happens when many individuals are able to own their own vehicles owing to a rapid rise in incomes.

Chapter 13: Inclusive Growth

Cambodia, the Lao PDR, Myanmar, and Viet Nam have achieved considerable development gains in the last two decades. Viet Nam is an example. As in many locations across the globe, growth tends to favour urban over rural regions, creating large disparities. Rural development has size and capacity issues, fragmented populations, and lack of economic connectedness. By recognising the rural economy's unique qualities, authorities may establish effective policies. AMS may enhance rural inclusion via social, geographical, and sectoral development.

Despite its small scale and non-viable investment features, investing in rural development is important for several reasons: (i) people in rural areas have the same rights as people in urban areas to fulfil their basic needs; (ii) the potential of rural areas is significant and influential at a macro level; (iii) the linkages between rural and urban areas show their interdependence; and (iv) successful urbanisation depends on the quality of migrants, who mainly come from rural areas.

China and other countries have had success investing in rural infrastructure and development. Viet Nam's economic growth and productivity stem from enormous investments in infrastructure, education, and healthcare. Electricity in Bangladeshi villages improved output, profit margins, business growth, women's empowerment, quality of life, and human capital development. The EU designed the common agricultural policy to contribute to innovation, the environment, and climate change mitigation and adaptation.

The efforts of AMS to enhance rural living, particularly in the Mekong subregion, should be appreciated and sustained. Partnerships with the international community (as a lender and through technical assistance) and local communities have produced beneficial results. Other approaches include engaging private sector engagement through mutually advantageous schemes; connecting rural areas to bigger economic regions, notably cities and neighbouring nations; integrating rural–urban development planning; and adopting a market-based strategy.

Green bonds and development bonds could help fund market-based social infrastructure. The Cambodia Rural Sanitation Development Impact Bond (DIB) is the world's first DIB for sanitation. It seeks to reduce Cambodia's high rates of open defecation and promote universal sanitation. The DIB encompasses six provinces and attempts to alleviate stunting, sickness, and water pollution. Green bonds may be issued for rural energy sector development under the climate change adaptation plan.

Chapter 14: MSME Responses to the COVID-19 Pandemic and Their Way Forward

MSMEs play a crucial role in a nation's economy and growth. They dominate the enterprise population and employ a significant proportion of the workforce. The firms are strong pillars of industrial growth, particularly in the construction of industrial agglomerations and worldwide production networks. The global economy had a severe recession in the second quarter of 2020 and had not completely recovered by the year's end. The purpose of this chapter is to provide suggestions on how policy should be tailored to support MSMEs more efficiently.

First, boost MSMEs' use of e-commerce. During the pandemic crisis, numerous MSMEs in several nations onboarded to e-commerce platforms. Because of social distancing during the pandemic, e-commerce reached a larger number of consumers. The intensive margin may be improved through product quality, customer service, etc. As for the extensive margin, government programmes supporting MSMEs could be spread to as many e-commerce platforms as possible. However, MSMEs' onboarding to e-commerce platforms is not easy. Most micro and small businesses require the knowledge and skills to join such platforms. This requires micro and small businesses' digital literacy. Governments can assist in improving digital literacy. Lack of internet infrastructure is another hurdle, particularly in rural regions. Governments must invest to fix this issue. Further, discount vouchers, particularly those sent digitally via e-commerce platforms, may be used to help MSMEs survive.

Second, build the capacity of MSMEs. To shift to a new business model, MSMEs need capacity building support. Capacity building programmes should work with digital business players (e-commerce, marketplaces, digital payments, logistics, etc.), business groups, and corporations to provide practical know-how. Successful capacity building programmes have these features: (i) coaching and mentoring with close trainer–entrepreneur contact, (ii) entrepreneurial acumen training, and (iii) adaptability for company requirements. Capacity building programmes for industrial clusters will also help boost company innovation capabilities.

Third, streamline MSME funding. Companies need financial aid to survive economic crises like the pandemic. MSMEs are less linked to official financial or banking systems, hence their necessity is much greater than that of large companies. The pandemic makes it crucial to develop fintech as an alternate source of funding for MSMEs. Fintech's easier procedures and rapid processing times are made possible by digitising the back-end credit review process. Fintech services may help MSMEs finance working capital if the cost of borrowing can be met by the operating margin.

Chapter 15: Healthcare

ASEAN and East Asian nations are witnessing a significant demographic transformation that will increase the number and percentage of older persons. Population ageing poses substantial sustainability challenges for societies, including demands on health systems and social care. Long-term care needs are set to grow. Under the present demographic scenario, it may be more vital than ever to create new models of care in the health industry to better meet the requirements of an ageing population. To overcome their healthcare concerns, numerous nations have resorted to ICT. We highlight five critical aspects for a digital healthcare strategy.

First, people and new ways of thinking and doing are more important than technology for effective healthcare digitalisation. Failures in technology initiatives are usually due to poor conceptualisation and execution, not the technology itself. Leaders and decision-makers must be able to envisage and accept new ways of working and rethink present procedures. Executives must establish a change-receptive culture and change management methodology. When organisations and people are open to change and have the right mentality, tools, skills, and knowledge, technology adoption is more successful.

Second, the technologies with the most immediate advantages were specifically developed to make people's work or patient interactions simpler. Where technological interventions have failed, inadequate attention was paid to the architecture of the system or the interventions were simply put on without careful study, on top of existing structures and work patterns, resulting in increased effort and user aggravation. For technological solutions to fulfil user demand and address their issues, detailed knowledge of the job and worker needs is essential. Organisations must strike a balance between installing an off-the-shelf package solution and knitting together current healthcare systems. Top-performing digital hospitals combine a core package solution with a few clinical specialists.

Third, while healthcare digitalisation provides the opportunity to collect and store big data more easily than with analogue records, the best use of these data will be constrained without comprehensive data management and analytics. Improving efficiency involves rethinking work processes; using predictive models to decrease variance, manage resources, anticipate demand, and act early; and learning and adapting. Successful healthcare digitalisations have invested in data analytics to generate insights from clinical and non-clinical data. All data systems are concurrently mined using powerful search tools and hyper-indexing. Investing in and expanding a professional workforce's data analytics skills may enhance operational and clinical operations, population health management, and medical care.

Fourth, interoperability and data security must be considered from the outset. Data sharing across contexts is crucial for coordinated treatment and realising the full advantages of digital technologies in healthcare. Shared clinical information systems that meet national data and interoperability standards may benefit the whole health industry. Sharing data requires sophisticated security mechanisms and data governance in the form of privacy regulations and enforcement rules, especially in the face of cyberattacks and data breaches. Data governance procedures must be put in place to reassure patients and healthcare professionals as they transition away from paper-based systems. National and local actions are needed to assist organisations in storing and distributing data properly and in preserving medical records.

Fifth, it is a given that technology will become outdated over time. Continuous iterations and upgrades are required alongside new process and product improvements. Constant growth and adaptation of digital technologies enable them to reach their full potential. Natural language processing allows free text to be structured and analysed; AI, decision support, and cognitive computing offer opportunities for more automation and improved decision-making; and the increasing intelligence and reach of devices supported by IoT and sensor technology will open new possibilities for better resource management, patient segregation, and more.

Chapter 16: Food and Agriculture

Food and agriculture confront numerous obstacles. Accelerating the development in agriculture and food production is required to feed the expanding regional and global population, yet natural resources such as fertile agricultural land and fresh water are becoming scarce. Recent external shocks, such as the COVID-19 epidemic and droughts and floods, have reminded us of the need to strengthen agricultural productivity and food supply systems. Food and agricultural output need to be increased while lowering the environmental strain using digital technology.

The ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Industry are the first digitalisation guidelines for the food and agriculture sector and will be a standard for digital transformation. In the near future, each AMS may consider establishing a country- and sector-specific road plan for digitalising food and agriculture, taking into account each country's agricultural status and growth strategy.

The cold chain system adds value to food and agriculture while lowering the environmental impact. The cold chain system reduces post-harvest and food loss, lowering the environmental impact. Many developing nations struggle to create a modern cold chain and involve smallholders. The best method to improve the situation, particularly for LDCs, is to provide a successful model case to smallholders and other stakeholders. This would improve stakeholders' understanding of cold chain benefits and modify smallholders' mentality.

A sustainable food system is gaining worldwide attention. This concept includes smart farming, smart food chains, low greenhouse gas (GHG) emissions, organic farming, a competitive food industry with decarbonised and environmentally friendly technologies, food loss reduction, sustainable material sourcing, investment for development, and the diffusion of innovative technologies. Some nations and areas, particularly wealthy ones, have constructed sustainable food systems. ASEAN should establish region-specific rules, policies, or plans for a sustainable agricultural and food system in partnership with dialogue partners and international organisations.

Chapter 17: Energy Infrastructure Development

Stable economic and demographic expansion will boost EAS energy demand. It will continue to rely on coal, oil, and gas until 2040 under the business-as-usual (BAU) scenario, even with increased crude oil prices (about $120 per barrel in 2040 at 2016 constant prices). Governments focused on the epidemic, employment, and the economy may not prioritise energy conservation and climate change. Reassessing China's technological dominance might reduce reliance on Chinese solar panels. Nationalism's rise and globalism's decline will hurt national, regional, and global climate change efforts. Since governments prioritise epidemic spending and rescuing people and small companies, renewable energy investment and subsidies will be restricted. During economic strife, inexpensive energy is a higher priority, so domestic energy supplies and coal might survive longer than projected before the epidemic.

Ongoing social distancing practices, such as moving almost all activities to the internet (e.g. meetings, works, and shopping), the modal shift from mass to private transport, and avoiding long-distance air travel, could change the energy consumption pattern and lessen energy use, air quality, and carbon emissions. ASEAN and East Asia should have used low fossil fuel prices, particularly in 2020, to phase out ineffective fossil fuel subsidies.

If nations execute their energy efficiency and conservation (EEC) policies and promote low-carbon energy technologies, such as nuclear power and solar photovoltaic (PV)/ wind, the region could realise substantial energy savings – mainly via decreased fossil fuel consumption – and greatly reduce carbon emissions. Many nations' alternative policy scenarios (APSs) are suitable since their estimated carbon reduction is the same as or more than their intended nationally determined contribution (INDC) objectives. ASEAN and East Asian nations must use the Plan-Do-Check-Act (PDCA) cycle to promote their EEC and renewable energy policies, including energy-saving objectives and action plans.

Natural gas will expand the fastest amongst fossil fuels through 2040 and will be an essential fuel in the transition to a new energy system because of cheaper pricing than crude oil, varied import sources, and fewer carbon emissions than oil and coal. Creating a transparent liquified natural gas (LNG) market in Asia, removing the destination clause, and consumer engagement in LNG production are advocated to achieve this rise.

Future energy demand research suggests that energy efficiency operations will save a lot of energy, notably on oil and power consumption by end users. Therefore, these EEC policies should be promoted: (i) standardise the labelling system for appliances and energy facilities such as boilers and compressors; (ii) develop energy-saving companies; (iii) increase next-generation vehicles including hybrids, electric vehicles (EVs), plug-in hybrids, and fuel cell vehicles; (iv) establish and implement a green building index; and (v) develop an advanced energy management system.

Increasing the amount of renewable energy (hydro, geothermal, solar PV, wind, and biomass) would decrease fossil fuel use and carbon emissions, contributing to the INDCs and the SDGs. This requires appropriate government policies, such as renewable objectives, legal procedures, and improved feed-in tariffs to incorporate bidding and tendering processes.

EAS energy security is a primary concern. EEC and renewable energy reduce fossil fuel usage and increase domestic energy use, boosting regional energy security. Regional energy networks like the Trans-ASEAN Gas Pipeline, which transports LNG as a virtual pipeline, and the ASEAN Power Grid (APG) may diversify energy supply sources. The Lao PDR, Thailand, and Myanmar is where the APG begins. Oil hoarding and nuclear power production are potential options for regional energy security. Clean coal technology and carbon capture and storage will make the region's coal power facilities carbon-free. Hydrogen technology may be used in power production, manufacturing, and road transport as an alternative to fossil fuels.

The EAS nations will require $4 trillion for power plants, refineries, and LNG-receiving terminals under BAU, with power plants accounting for $3.5 trillion. ASEAN requires $686 billion in BAU for power production, refineries, and LNG terminals, and $605 billion in the APS. Refineries and LNG terminals save oil and gas, causing the disparity. Under BAU, a lot of money will go to coal power plants (clean coal technology), while under the APS, more money will go to low-carbon energy electricity, such as nuclear, geothermal hydropower, solar PV/wind, and biomass.

Developing energy infrastructure will require public–private partnerships, international/regional bank public funding, the Clean Development Mechanism, and/or the Joint Credit Mechanism. As part of the COVID-19 recovery, governments are designing economic stimulus packages that might create opportunities for high-quality low-carbon infrastructure projects. AMS should take advantage. A cross-border electrical network could bring energy security and climatic advantages.

Chapter 18: Environment and Sustainability

As Asian countries shift from GDP-driven economic development to well-being standards of sustainable and inclusive growth, demand for innovative environmental technology rises. Transformational changes are possible, but they will not happen effortlessly. Proactive and collaborative approaches – involving politicians, technological champions, academics, and international organisations – will be necessary at the regional level to provide maximum sustainability benefits and increase resilience.

Governments, international organisations, academics, and industry all play roles. In the early phases of digital technology adoption, markets alone will not provide enough incentives. Most AMS are low- and middle-income countries, and governments must discover solutions to stop environmental damage with regulations that keep up with rising technology penetration. This involves enabling governments and localities to experiment with innovative technologies to manage environmental concerns. Regulatory systems need to be reformed to use digital technologies to better assess and regulate environmental hazards and resilience concerns.

Technology companies and entrepreneurs may promote the development and worldwide deployment of technologies for environmental sustainability and resilience by creating business models. New business models are required for satellite and drone fleets that can supply crucial new data streams, and for algorithms and computer programmes that can turn those streams into planning tools for improved natural resources management, pollution control, and climate resilience. Governments and communities could regard such business models as public benefits.

The following collaboration frameworks are necessary. First, dialogues and collaborations that bring Industry 4.0/digital/smart technology developers and suppliers together with environmental specialists to co-develop innovations for public benefits, i.e. sustainability, while minimising cybersecurity concerns. Second, innovative investment platforms, funding arrangements, and business models that can scale potential eco-innovations enabled by smart technology, whether they have a clear commercial pitch or less lucrative environmental advantages. Third, partnership with other and international organisations to establish shared and adaptable institutions and governance systems, including common policy principles for handling emerging technologies, data protocols, and transparency methods. Last, regularly assessing and amending the growing legal and regulatory framework to clarify and fully express the roles of new technologies that boost environmental benefits and promote family and community resilience.

Chapter 1

The Conceptual Framework of New Development Strategies

Fukunari Kimura
Chief Economist, ERIA
Professor, Faculty of Economics, Keio University

Keita Oikawa
Economist, ERIA

Current situation and challenges

Development strategies to be upgraded

In the past three decades, East Asia – including Northeast Asia and Southeast Asia – has aggressively used globalisation forces in its development strategies and has led the world in developing the task-by-task international division of labour or the second unbundling and in building up Factory Asia (Ando and Kimura, 2005; Baldwin, 2016). Factory Asia has overcome a number of economic crises and natural disasters since the 1990s. The global financial crisis caused a serious trade collapse in 2008–2009, but the sophisticated international production networks (IPNs) in East Asia revived strongly. World trade growth decelerated in the slow trade period of 2011–2016 when growth in international trade became slower than global gross domestic product (GDP) growth. However, IPNs in East Asia did not stop growing, contrary to public belief (Obashi and Kimura, 2018). East Asia has taken advantage of globalisation forces effectively, backed by long-lasting peace and the rules-based trading regime. Further, the relative importance of Factory Asia for the world, particularly in producing general and electric machineries, has steadily enhanced over time.

However, the situation has rapidly changed since the latter half of the 2010s. Factory Asia is now facing two immediate challenges that could generate structural changes: the coronavirus disease (COVID-19) and enhancing geopolitical tensions. COVID-19 was a huge tragedy for the whole world, and brought into question the fragility of global value chains (GVCs). In this context, it is important to ascertain whether the international division of labour has qualitatively changed in the COVID-19 era. In parallel, geopolitical tensions have intensified. This started as a tariff war between the United States (US) and China under the Trump Presidency in the US in 2017. The confrontation has since expanded to a more widely scoped competition between superpowers, and the decoupling pressure from both sides has intensified the move towards managed trade and investment. As many articles in the mass media claim, the recent geopolitical tensions may mark the end of the globalisation era.

On the other hand, a couple of new elements have been added to our development scene: digital technology and environmental concerns. The application of digital technology has expanded from relatively simplistic matching businesses to all aspects of our economy and society. How we take advantage of digital transformation for economic development is becoming a crucial issue. In addition, environmental concerns have intensified even during the COVID-19 pandemic, particularly in Europe and other developed countries, and the transition to a low-carbon society is a global trend. Many countries in the Association of Southeast Asian Nations (ASEAN) and East Asia have had higher dependence on fossil fuels and have been relatively slow in setting up a feasible long-term plan for a zero-emissions strategy. Digital technology and environmental concerns are issues that need to be incorporated more explicitly in our development strategy.

The CADP 3.0 proposes that ASEAN and developing East Asia should still believe in the globalisation forces for their economic development. The following sections briefly discuss the two challenges stated above as well as some new elements.

COVID-19

At the outbreak of COVID-19, massive numbers of pessimistic comments on the future of GVCs and globalisation were published in mass media. However, in the end, GVCs, particularly the sophisticated IPNs in East Asia, proved to be robust (less likely to be interrupted) and resilient (more likely to resume even if once interrupted).[1] Although mutations are still spreading sporadically, GVCs have survived COVID-19.

GVCs, or the international division of labour more generally, have developed primarily via economic forces. Technological progress for overcoming geographical distance, supported by the enhancement of physical and institutional connectivity, has dictated the form of the international division of labour. To extend and deepen their involvement in the international division of labour, firms carefully consider a trade-off between economic efficiency in the normal period and the cost of management against expected/unexpected risks. Once a supply or demand shock occurs somewhere in the world, GVCs may work as a shock transmission channel. Such shocks could originate from natural disasters or might be induced by human behaviour. COVID-19 was perhaps an unexpected shock at the beginning, and may not have been fully covered by firms' original contingency plans, but it was not the first shock that firms had experienced.

Perhaps contrary to public belief, IPNs in East Asia have a good record of robustness and resilience against various shocks. Facing the Asian Financial Crisis (1997–1998), the global financial crisis (2008–2009), and the Great East Japan Earthquake (2011), IPNs in East Asia proved to be more robust and resilient than other forms of international trade.[2] IPNs or the task-by-task international division of labour is robust and resilient because the design and operation of such networks require substantial sunk costs, compared with transactions in

1 Miroudot (2020) explained the difference between robustness and resilience by drawing on risk management literature.

2 See Obashi (2010); Ando and Kimura (2012); and Okubo, Kimura, and Teshima (2014).

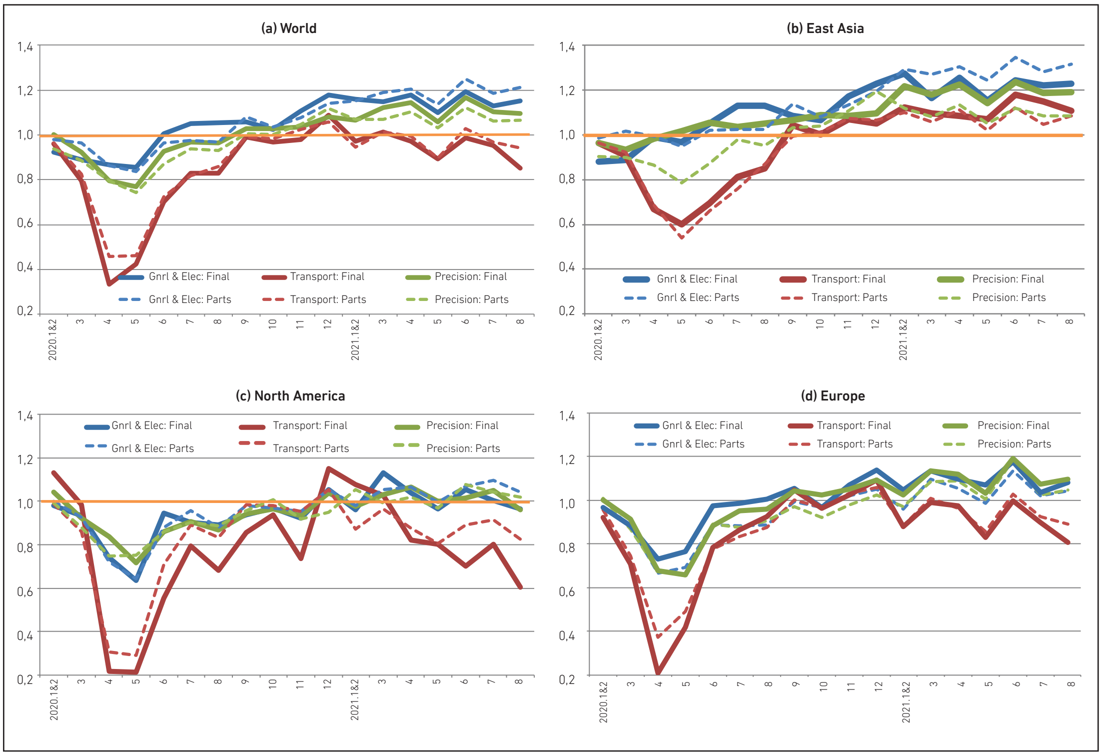
spot markets. Because of the sunk costs, firms try to keep the connection with customers and suppliers even if they face the risk of network interruption as long as the shock is regarded as temporary.

GVCs, particularly East Asian IPNs, also showed their strength against COVID-19.[3] Three kinds of shocks were generated by COVID-19: negative supply shocks, negative demand shocks, and positive demand shocks. At the beginning, in February and March 2020, negative supply shocks came from China in the form of the interruption of Chinese exports of parts and final products in the value chains. In the following months, positive demand shocks on personal protective equipment (e.g. face masks and hand sanitisers) came to each country worldwide. Both types of shocks generated panic in many countries, and many claimed that this would mark the end of globalisation. That did not happen. Supply shortages were overcome in a few months in most countries – mainly by private forces, with vaccines as the exception – which was much quicker than people expected. In 2020, we were afraid of negative demand shocks due to the collapse of the financial sector and asset markets, and the deep recession. However, unprecedented huge mitigation policies in major countries largely weakened such shocks. Moreover, positive demand shocks were generated for remote work and stay-at-home related products (e.g. personal computers, computer monitors, dishwashers, and electric hand drills), allowing East Asia's exports to recover quickly.

Figure 1.1 presents the performance of machinery exports by region (Ando and Hayakawa, 2021). Machinery exports are decomposed into general and electrical machinery, transport equipment, and precision machinery; and separated into parts and final products. Although COVID-19 initially caused serious negative supply and demand shocks, global machinery exports emerged from the trough in April/May 2020 and returned to 2019 levels by October 2020. The fall in exports was significantly shallower in East Asia than in North America or Europe. Notably, East Asian exports of general and electrical machinery remained almost at 2019 levels – even in April and May 2020 – due to positive demand shocks. The Economic Research Institute for ASEAN and East Asia (ERIA) conducted a questionnaire survey for firms in ASEAN Member States (AMS) and India, and found quick and active responses to COVID-19 shocks by many Asian firms, often turning a profit (Oikawa et al., 2021).

[3] See Ando, Kimura, and Obashi (2021); and Ando and Hayakawa (2021).

Figure 1.1 **Regional Comparison of Machinery Exports to the World During COVID-19** (each month of 2019 =1)



Source: Ando and Hayakawa (2021).

The turmoil due to COVID-19 is not over yet. The emergence of variants and the sporadic spread of infection remain, and strict lockdown and other measures in some countries are generating negative supply shocks. The movement of people is not yet back to normal, and our economies are experiencing a so-called K-shaped recovery, which means that the pace of recovery differs widely across sectors. Some confusion remains in the transport sector; and the shortage of semiconductors, mainly due to positive demand shocks, continues. However, these factors do not negate the functioning of IPNs in East Asia; rather, COVID-19 has enhanced the region's competitiveness. In addition, the accelerated introduction of digital technology – particularly the use of communication technology (CT) – is a good phenomenon for East Asia.

Geopolitical tensions

The increase in geopolitical tensions has become another serious concern for the future of GVCs. IPNs in East Asia have developed thanks to the long-lasting peace in the region and the mostly well-kept rules-based trading regime in the world. However, we may face difficulty in maintaining the rules-based trading regime in the near future.

Since the Trump Administration came into power in 2017, the US–China confrontation has steadily worsened. Initially, it was a relatively simple bilateral tariff war, though it substantially weakened the authority of the World Trade Organization (WTO). Bilateral tariffs between the US and China distorted trade patterns, while some countries (including Viet Nam and Mexico) increased exports to the US due to positive trade and investment diversion.[4] Third countries do not have to be shy in capturing such windfall gains, which is actually good for the world. However, the overall effect on third countries would be negative. In addition, ad hoc bilateral deals between the superpowers, which tends to include preferential bilateral arrangements, can be harmful for third countries.[5]

The US–China confrontation has not been limited to trade issues; it has expanded its scope to national security and technological competition between the superpowers, arguments over political and economic systems, and human rights issues. The pressure to decouple supply chains has been gradually intensified by both the US and China, even though middle powers between the US and China, including ASEAN, have close economic relationships with both.

The Russo–Ukrainian War presents extreme danger to the whole world. At the least, impacts on energy and food prices and their availability will hurt us. Price hikes might get worse, with export restrictions imposed by major exporting countries, which would prioritise domestic consumption as well as speculative transactions in the market. We now also need to carefully monitor macroeconomic stability. Inflation rates are high in the US and Europe, so the US and others have started to raise interest rates, which may cause currency depreciation and capital outflows in newly developed and developing countries.

Geopolitical debates are heated in G7 countries. However, as Lamy and Köhler-Suzuki (2022) pointed out, we should beware of the large gap between geopolitical discussion in politics and in economic reality. Decoupling of supply chains seems to proceed in specific areas such as products with sensitive technologies, batteries, and rare earth-related products, but trade-reducing effects are not mostly invisible at the aggregated level so far. The US

[4] See, for example, Fajgelbaum et al. (2021).

[5] Freund et al. (2020) simulated possible effects of the first-round deals between the US and China and found that third countries are likely to have negative economic effects.

exports of semiconductors to China actually increased in 2020 and 2021. Japan's exports to China reached a record high in 2021, particularly in electronic parts and machinery. Although geopolitical tensions may increase further, decoupling is likely to remain partial rather than escalating to a total cold war.

Based on this assumption, third countries – including AMS – must try to apply the rules-based trading regime as widely as possible. The trade rules under the WTO and free trade agreements (FTAs) now become more important than ever. If they were further weakened, uncertainties in economic activities would be enlarged and the vigorous economic activity would inevitably shrink. The role of dispute settlement should be emphasised. The WTO dispute settlement mechanism has been impaired as the US has blocked the appointment of Appellate Body members. Continuing efforts are needed to restore the full mechanism. In addition, AMS and East Asian countries must seriously consider their participation in the European Union (EU)-led initiatives of Multi-Party Interim Appeal Arbitration as a temporary backup. FTAs, including the Regional Comprehensive Economic Partnership (RCEP), should be fully used to reduce policy risks.[6] By keeping the rules-based trading regime, ASEAN and the surrounding countries may attract trade and investment diversion.

However, even in third countries, some preparation is needed to face possible direct impacts of geopolitical tensions. For example, US export control laws and regulations include extraterritorial controls, i.e. firms located both inside and outside the US may need export licences issued by the US government for the re-export or domestic transfer of specific US products, parts, software, or technologies. This would be applied for firms located in ASEAN and East Asia. The US and the EU are legislating import restrictions for human rights issues, which may also apply to firms in various Asian countries apart from China. Cybersecurity needs to be enhanced. ASEAN and East Asia must develop collaboration with like-minded countries for constructing effective and efficient economic security systems.

Digital technology

Digital technology is a blessing that we must use in a constructive way. It will substantially change the development strategies of newly developed and developing countries. That is why this report places it at the centre of the framework.

Digital technology mostly consists of general-purpose technologies.[7] Such technologies have two important properties relevant for our development strategies. The first is the

[6] Kimura (2021, 2022) highlighted the potential role of the RCEP in reducing policy risks and maintaining the rules-based trading regime.

[7] The following conceptual framework is drawn from Chapter 8 in this volume.

pervasiveness. The deployment of digital technology can be pervasive so that it can be applied to a wide range of economic and social activities. Digital technology will not only generate new businesses but also upgrade traditional industries. People's lifestyles will also change.

The second is innovation spawning. Although the technologies are high-tech, supported by the accumulation of research and development (R&D) mostly in developed countries, the deployment of such technologies is relatively easy. Creative imitation is often possible. This property will provide room for catching up and leapfrogging for newly developed and developing countries. We can thus drastically revise innovation policies. By applying digital technology, the pattern of the international division of labour and international trade will also change. Technologies will accelerate globalisation even if some political and economic backlash arises.

We will deepen these discussions in the following section of this chapter.

Environmental concerns

Environmental concerns, particularly in the context of global warming and the quest for a low-carbon economy, have rapidly intensified all over the world. Although COVID-19 temporarily slowed energy consumption and carbon emissions, the movement for a green revolution – particularly in Europe – has intensified. The US Biden Administration has revived interest in global warming issues. Although the Russo–Ukrainian War may enhance the need for fossil fuels in the short run, environmental concerns in civil society have not subsided.

ASEAN and East Asia depend heavily on fossil fuels, with a wide variety of situations across countries. Manufacturing-centred economic development is typically energy-intensive and prone to carbon emissions. The region is also vulnerable to natural disasters due to climate change. The planned decarbonation strategy in ASEAN and East Asia may not be enough for the global movement towards a low-carbon economy.

Together with decarbonising our economies, we would like to achieve steady and inclusive economic growth. Rapid abolition of fossil fuel usage may not be a feasible solution for many countries in the region. The Energy Unit of ERIA's Research Department is leading constructive policy research in ASEAN and East Asia. The region requires an optimal scenario of energy and the environment to achieve well-balanced economic development with sustainability.

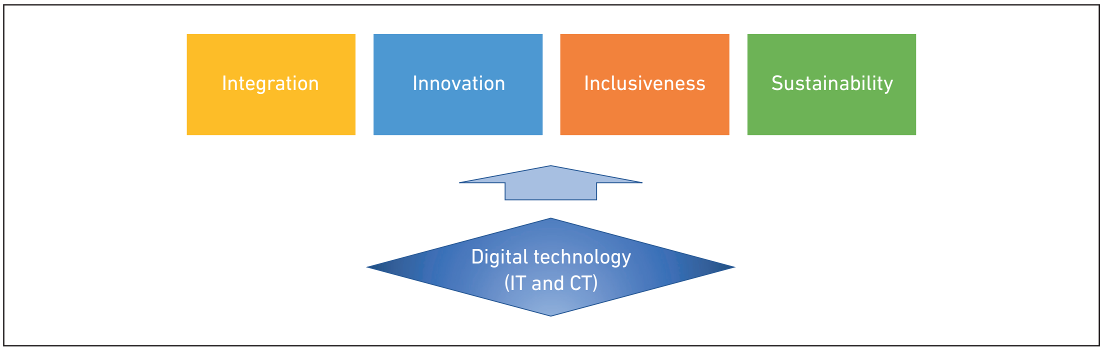
Development strategies: Four pillars with digital technology

COVID-19 and geopolitical tensions are immediate concerns all over the world. From the viewpoint of ASEAN and developing East Asia, countries should continuously take advantage of globalisation forces for economic development. The following section discusses how development strategies must be renewed based on the new economic environment.

Digital technology is becoming a strong booster for economic development. With digital technology, globalisation can accelerate the catching up of newly developed and developing countries. Technologies expand the scope of globalisation. To take advantage of digital technology, a comprehensive set of policies must be prepared.

This chapter claims that the following four pillars with digital technology conceptualise the new development strategies for ASEAN and developing East Asia: integration, innovation, inclusiveness, and sustainability (Figure 1.2).

Figure 1.2 Four Pillars for Economic Development with Digital Technology



CT = communication technology, IT = information technology.

Source: Authors.

The first pillar – integration – has been at the core of development strategies in ASEAN and East Asia for three decades. Starting from *de facto* economic integration in the 1990s, progressive *de jure* economic integration followed in the 2000s and 2010s, and FTA networks with ASEAN at the core have been established. In particular, involvement in the task-by-task international division of labour or IPNs has been widened and deepened in the region. The scope of integration has also gradually been expanded from purely economic to social and cultural integration. A large disparity remains amongst countries in the region in term of the degree of effective use of globalisation forces, and continuous efforts are required to fill the gap. In addition, the emergence of digital technology has started to modify the mechanics of the international division of labour. Therefore, our successful model must be reviewed and adjusted in line with new technological developments.

The second pillar – innovation – calls for a substantial reformulation of our development strategies. ASEAN and developing East Asia have steadily moved up the development ladder and have started looking at the final step towards fully developed economies. Innovation has naturally grown in importance – realising an innovation system is the last stage of becoming an advanced country. In addition, digital technology has drastically altered the nature of innovation. The old model of a national innovation system, where the government, universities/research institutes, and private sector get together to conduct massive R&D, may not be fully applicable anymore. The innovation strategy must be reconsidered to support digital transformation of our economy and society.

The third pillar – inclusiveness – is a popular notion in the political context, though it is used as a vaguely defined concept. The concept of inclusiveness must cover three dimensions: geographical, industrial, and societal. Efficiency and equity are based on different value judgements but are closely interrelated. Particularly in the context of newly developed and developing countries, it is important to think of how far inclusiveness can be achieved by using market forces, rather than leaving it for social policy accompanied by government expenditures or transfers. Digital technology has also been changing various aspects of the economy and society in achieving inclusiveness. A holistic approach must be established for inclusiveness.

The last pillar – sustainability – is another focal point in reforming our development strategies. ASEAN and developing East Asia are facing both short- and long-run issues related to sustainability. Decarbonisation requires a long-run grand strategy, while the current hike in fossil energy prices must be taken care of in the short run. Resource and waste management and the circular economy are also important issues for sustainability. In addition, ASEAN and developing East Asia are prone to severe damage from natural and disasters induced by human behaviour, which calls for adequate disaster management. Economic development is imperative for the region. The issue is how to pursue both economic growth and sustainability with digital technology.

The following section discusses these four pillars in detail.

Integration

De facto and *de jure* economic integration

Integration has been the central theme in ASEAN and East Asian development strategies for three decades. This report contends that it should continue to be placed at the core of development strategies, with modifications to accommodate digital technology.

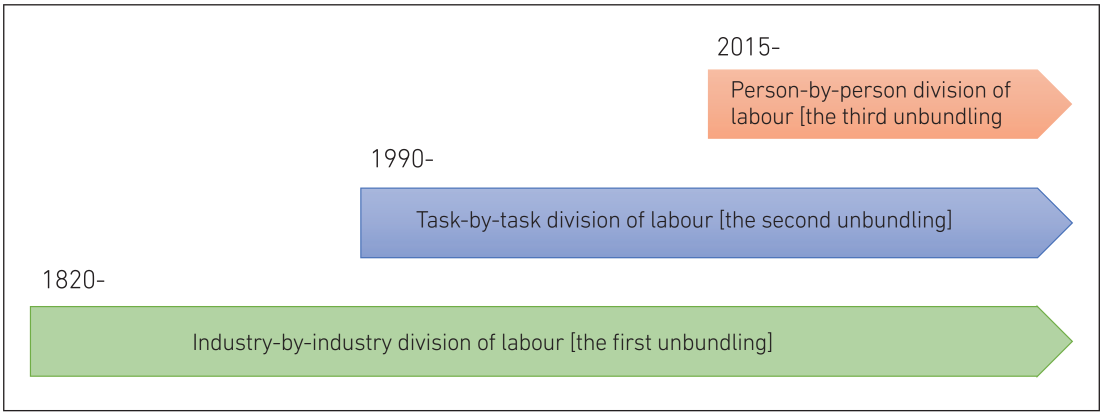
ASEAN and East Asia have been a best practice case in aggressively taking advantage of the mechanics of IPNs or the task-by-task international division of labour. This started from *de facto* economic integration in the latter half of the 1980s when ASEAN forerunners adopted unilateral tariff cuts and trade facilitation to attract export-oriented foreign direct investment (FDI), particularly in electrical machinery. In the 1990s, the formation of IPNs in electrical and electronic machinery advanced substantially with the WTO-led Information Technology Agreement. Then the Asian Financial Crisis occurred in 1997–1998. ASEAN as a group accelerated the *de jure* economic integration process, and the overall liberalisation of trade in goods and FDI liberalisation for manufacturing were advanced. The connectivity concept has effectively supplemented efforts towards economic integration. The key was to communicate with the private sector and address policy needs progressively. Although the existing gaps in the degree of IPNs utilisation are still substantial, ASEAN latecomers have grown faster than the forerunners, and a steady catching up has been observed.

To go beyond the development stage the region has reached, we should review the mechanics of the international division of labour and examine how digital technology would transform it.

The unbundling concept

The unbundling concept proposed by Baldwin (2016) is useful in categorising the pattern of the international division of labour. The first unbundling, i.e. the geographical separation between production and consumption, started around 1820 when the transport revolution with steamships and railways occurred and transportation costs for goods were reduced. This generated an industry-by-industry international division of labour, supported by trade in raw materials and final products. The second unbundling, or the task-by-task international division of labour, was initiated around 1990 when the first wave of the information and communication technology (ICT) revolution reduced communication costs and ideas started moving. The success of ASEAN forerunners in the past three decades has been based on the aggressive use of this type of the international division of labour. The third unbundling, or the person-by-person international division of labour, started around 2015 when the second wave of the ICT revolution reduced face-to-face costs. The unbundling patterns overlap (Figure 1.3). A country or region that is ready to move to a higher unbundling has more choices for using the international division of labour to exploit different location advantages in a better manner.

Figure 1.3 Three Modes of Unbundling or the International Division of Labour



Source: Authors.

Table 1.1 summarises the three modes of unbundling and digital technology.[8] It tabulates, for each unbundling, the type of international division of labour, what is made mobile, typical industries, and required institutional and physical connectivity. Although ASEAN and developing East Asia still use the first unbundling as the rest of the developing countries in the world does, the region, particularly the ASEAN forerunners, take extensive advantage of the second unbundling. Further, the seeds of the third unbundling have become visible in the past several years. Digital technology affects all modes of unbundling as a game changer. For the first unbundling, digital technology can be used for problem solving, productivity enhancement, and sometimes upgrading to the second unbundling. The second unbundling may widen and deepen IPNs through digital technology. In the context of the third unbundling, digital technology allows us to explore the frontier of new businesses.

The following section focuses on the second and third unbundlings.

[8] Kimura (2018) discussed the introduction of the unbundling concept to the development strategy argument in ASEAN.

Table 1.1 The Three Modes of Unbundling and Digital Technology

Item	The first unbundling	The second unbundling	The third unbundling
International division of labour	Industry-wise (production and consumptions are unbundled)	Task-wise (and industry is unbundled); IPNs	Person-wise (a task is unbundled)
What moves?	Goods	+ Ideas (capital, technology, managerial ability, business persons)	+ Data
Typical industries	Agriculture/fisheries/food, mining, labour-intensive industries, tourism	Machinery industries and industries in global value chains	Service outsourcing
Institutional connectivity	WTO-based liberalisation: Tariff removal or specific industries, GSP	FTAs: Overall tariff removal, trade facilitation, TBT, B2B services liberalisation, FDI liberalisation in manufacturing	Mega-FTAs: SPS, standards and conformance, regulatory coherence, overall services liberalisation, movement of people, IPR, flow of data
Physical connectivity	Medium-grade logistics infrastructure (roads, ports/airports), infrastructure services	High-grade logistics infrastructure (full-scale ports/airports, multimodal), urban/suburban development (logistics, mass-scale infrastructure services)	Digital connectivity, urban amenities (urban transport, living environment, varieties of possible consumption of goods and services), smart cities
Digital technology as a game changer	Problem solving Enchance productivity Upgrade to the second unbundling	Further widening and deepening of international production networks	Explore frontiers of new business

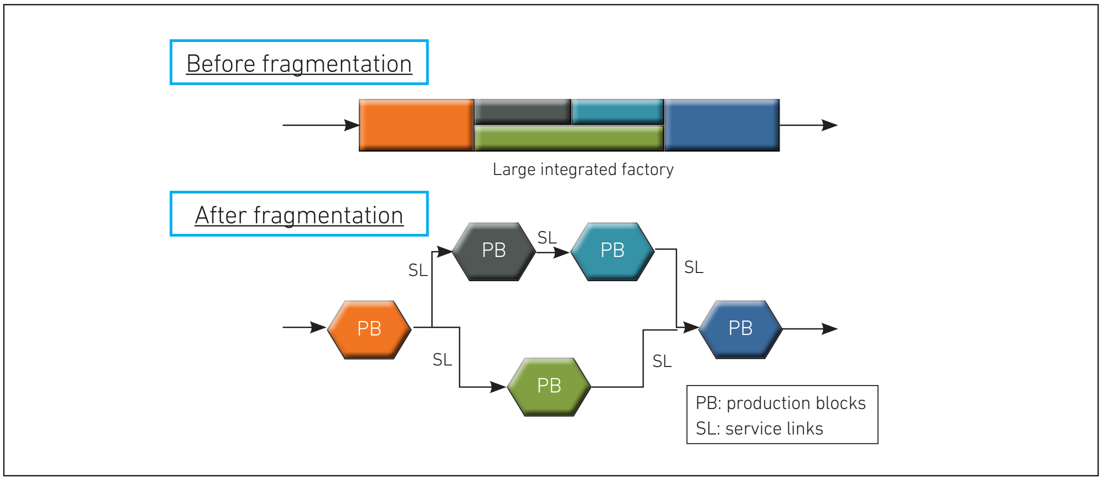
GSP = Generalized System of Preferences, WTO = World Trade Organization, IPN = International Production Network, TBT = Technical Barriers to Trade, B2B = Business to Business, FDI = Foreign Direct Investment, FTA = Free Trade Agreement, SPS = Sanitary and Phytosanitary, IPR = Intellectual Property Right.

Source: Authors.

Fragmentation and agglomeration in the second unbundling

The mechanics of the second unbundling were conceptualised by Jones and Kierzkowski (1990) as the fragmentation theory (Figure 1.4). Fragmentation of production means that a set of production processes that are originally in one place will be separated into multiple production blocks located in different places. This means that the international division of labour will become process-wise or task-by-task production, and remotely located production blocks will be connected by service links that include parts and components trade and tight coordination. To make production fragmentation economically viable, two conditions must be met. First, production costs in production blocks must be substantially reduced by using differences in location advantages. Second, the costs of service links that connect remotely located production blocks will not be too high. Only a limited number of newly developed and developing countries, including ASEAN and East Asia, have been successful in participating in IPNs based on these two conditions. Saving service link costs is crucial. To meet this condition, ASEAN and East Asia have made significant efforts at improving institutional and physical connectivity.

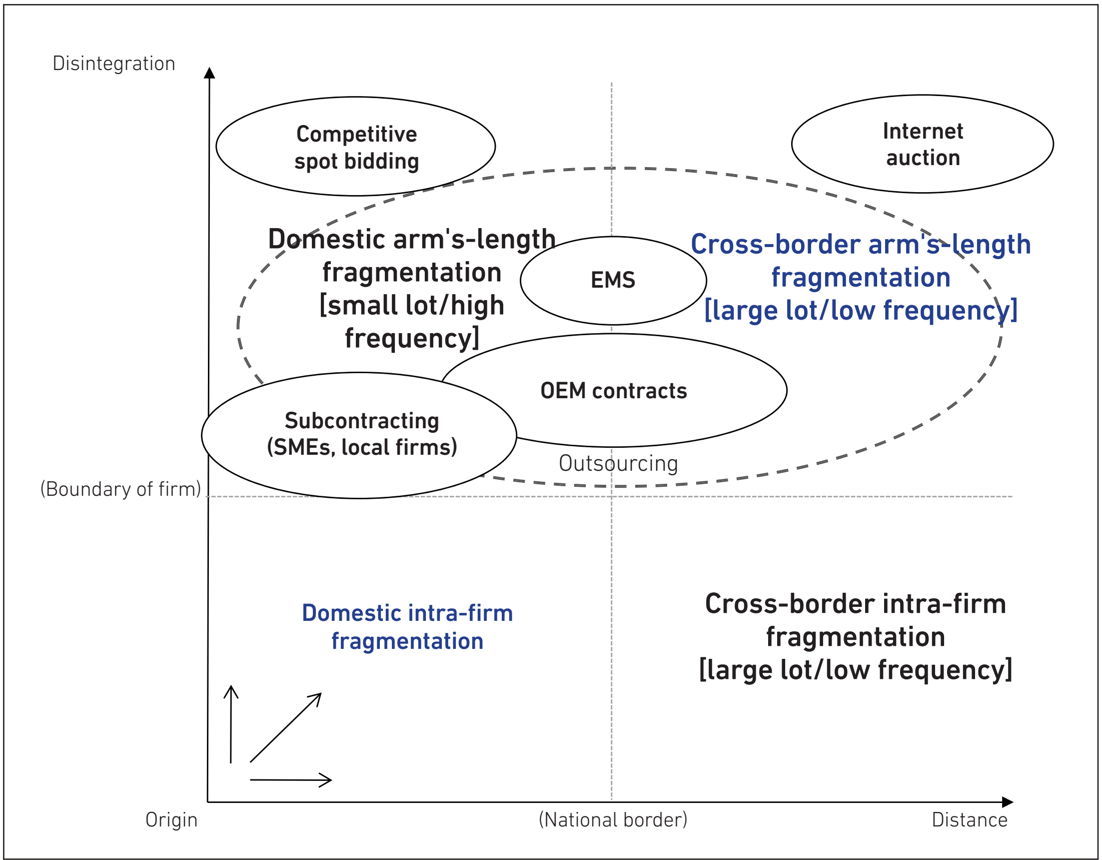
Figure 1.4 Fragmentation of Production – An Illustration



Source: Authors.

Although Baldwin (2016) did not emphasise it, the formation of industrial agglomeration is also important from the viewpoint of economic development.[9] Fragmentation and agglomeration may be regarded as opposing moves, but they are not. Figure 1.5 illustrates the concept of two-dimensional fragmentation, which has the geographical distance axis (domestic or cross-border) and the disintegration axis (intra-firm or arm's length (inter-firm)). In a second unbundling-type industry such as the machinery industry, a firm typically designs and operates a production network by combining multiple short-/long-distance and intra-firm/arm's-length transactions. Long-distance transactions tend to be intra-firm while short-distance ones are likely to be arm's length. In Figure 5, the top-left area corresponds to short-distance and arm's-length transactions, which generates industrial agglomeration. This is the mechanism to have fragmentation at the firm level and agglomeration at the aggregate level at the same time.

Figure 1.5 Two-Dimensional Fragmentation and Industrial Agglomeration



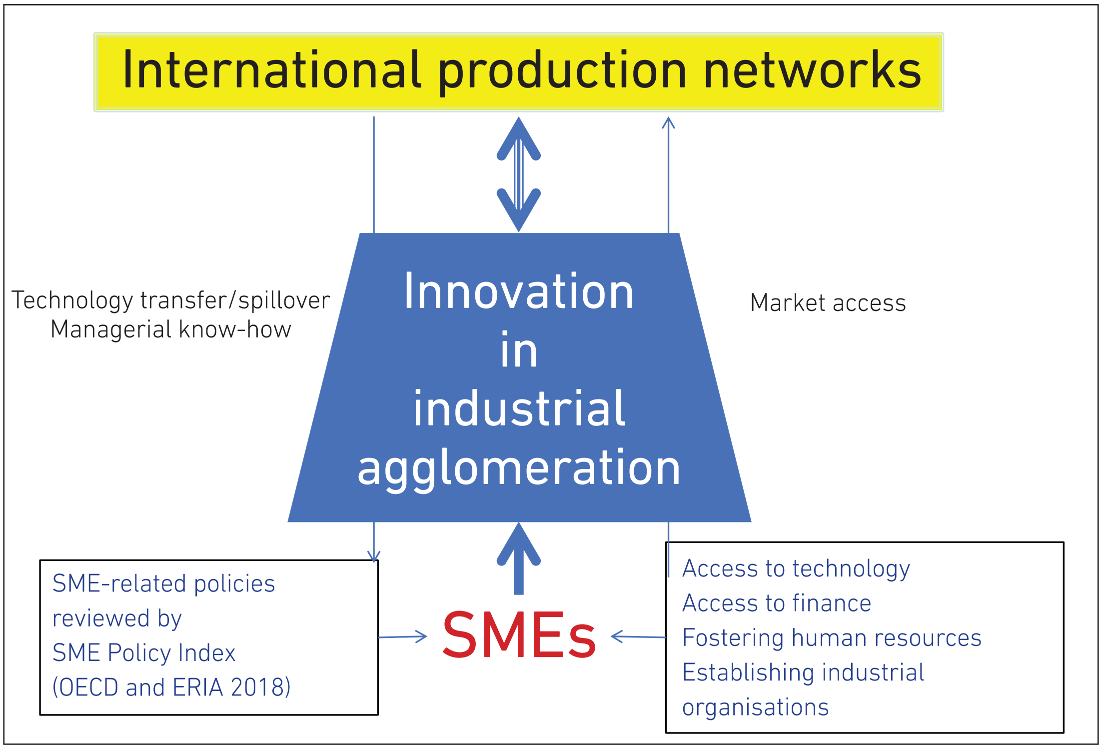
EMS = Electronics Manufacturing Service, OEM = original equipment manufacturer, SME = small and medium-sized enterprise.

Source: Kimura and Ando (2005), modified by the authors.

[9] ERIA (2010, 2015) also emphasised the importance of the formation of industrial agglomeration.

Industrial agglomeration provides precious opportunities for local firms, particularly small and medium-sized enterprises (SMEs), to participate in IPNs (Figure 1.6). Multinational enterprises often require high-frequency small-lot deliveries of intermediate inputs over a short distance, and local firms or SMEs with price competitiveness may have chances to become suppliers. Once local firms participate in IPNs locally, they obtain access to foreign markets indirectly and might be able to receive technology transfer as well as obtaining managerial know-how from multinationals. Such technological channels are particularly important in the case of local firms in ASEAN.[10] By combining a set of SME development policies, industrial agglomeration can be a vigorous place for upgrading the industrial structure while achieving inclusiveness. The formation of industrial agglomeration requires substantial investment in urban/suburban infrastructure, but it is essential to achieving full industrialisation, particularly for countries with large populations.

Figure 1.6 Industrial Agglomeration and Local Firms



SMEs = small and medium-sized enterprises.

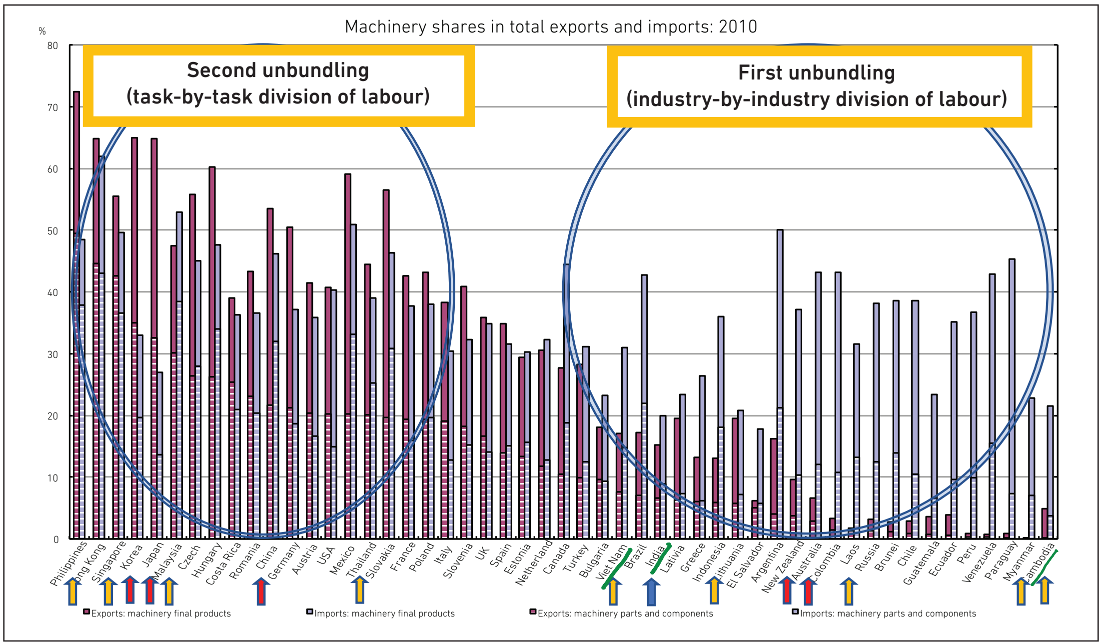
Source: Authors.

[10] See, for example, Kimura, Machikita, and Ueki (2016).

Status of Factory Asia: The second unbundling

In the following, we primarily look at machinery trade because machinery industries – including general machinery, electrical machinery, transport equipment, and precision machinery – are representative industries for the second unbundling. Although other industries may conduct the second unbundling, machines typically consist of a large number of parts and components that require different materials and technologies, so the machinery industry is likely to have sophisticated vertical and horizontal production networks. Figure 1.7 and Figure 1.8 present the proportion of machinery exports and imports (HS 84–92) in total merchandise exports and imports in selected countries in 2010 and 2019. The red bar denotes exports while the blue bar represents imports. The stripe portion is parts, and the rest is final products. Countries are placed in the order of the height of parts export ratios from the left. Countries on the left-hand side – including the Philippines, Singapore, Malaysia, and Thailand as well as the Republic of Korea (henceforth, Korea), Japan, and China –export and import machinery intensively, and a large portion is occupied by parts exports and imports. In the first unbundling world, the industry-by-industry international division of labour dominates, so international trade in one industry tends to be one-way trade. Here, intra-industry trade is generated by the task-by-task international division of labour. This is a clear indication that these countries participate in IPNs or the second unbundling.

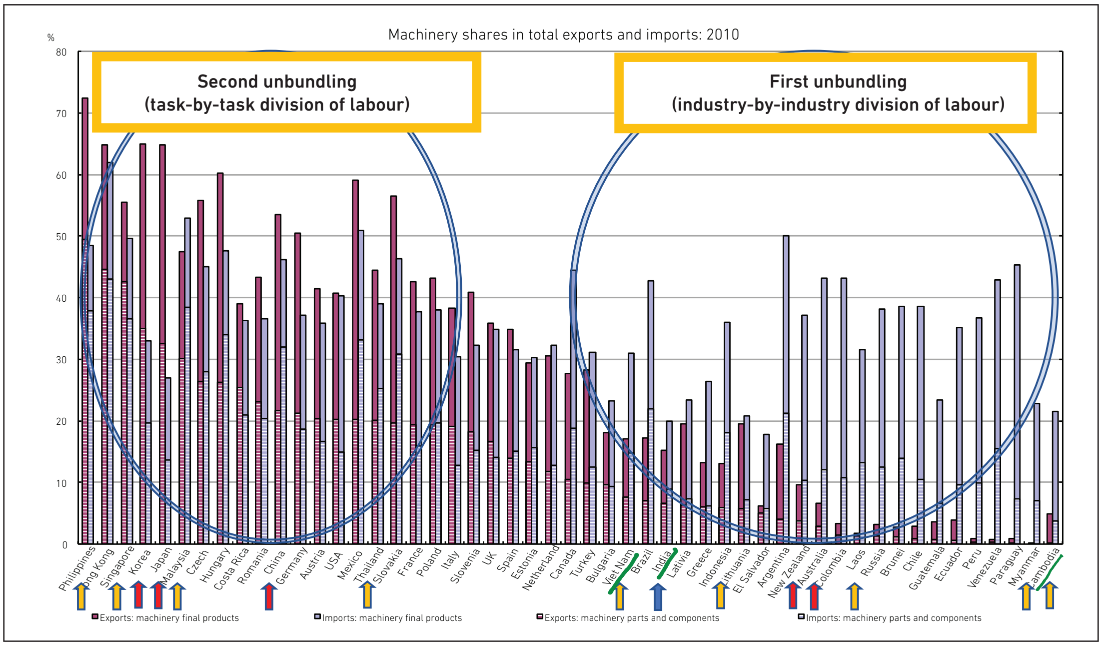
Figure 1.7 Machinery Shares in Total Exports and Imports, 2010



UK = United Kingdom, UN = United Nations, US = United States.

Source: Ando, Yamanouchi, and Kimura (2021).

Figure 1.8 Machinery Share in Total Exports and Imports, 2019



Source: Ando, Yamanouchi, and Kimura (2021).

Some countries, such as India and Indonesia, are not yet fully participating in IPNs. On the other hand, countries including Viet Nam and Cambodia move leftwards in the 2010s. In other parts of the developing world, some Eastern European countries and Mexico indicate high parts export ratios while others are mostly still in the realm of the first unbundling.

Table 1.2-1.4 are from a gravity equation exercise to indicate the strength of commitments to machinery IPNs by East Asian countries and the world (drawn from Ando, Kimura, and Yamanouchi, 2022b). Table 1.2 is a trade matrix for machinery trade (HS 84–92) in 2019. Rows are exporters, and columns are importers. 'Actual (A)' shows the actual trade value in 2019. 'Predicted (B)' is a fitted value of bilateral trade calculated from the gravity equation regression, which indicates a 'world standard' trade value after controlling for the economic size of exporters and importers, distance, and others. '(A)/(B) (%)' is the ratio of (A) to (B); 'more than 100%' means that the country exports machinery to the counterpart more than expected, and vice versa. The most notable finding in this table is high actual predicted ratios in ASEAN for both exports and imports. ASEAN's commitment to machinery IPNs is very high, considering its economic size and others. The ratio of intra-ASEAN exports reaches 271%, and export and import connections with China, Japan, and Korea are also very high. Ratios with the rest of the world are also high, particularly on the export side. Despite high levels of machinery exports, China's ratios of actual to predicted exports are not very high. At the other extreme, India has very low ratios, particularly on the export side.

Table 1.2 Actual and Predicted Machinery Trade, 2019

Exporter (row)/ Importer (Column)	Value ($ million), %	China	Japan	Rep. of Korea	ASEAN	Australia and New Zealand	India	North America	Europe	Rest of the world	Total (World)
China	Actual (A)		75,889	58,515	161,657	7,708	37,831	295,546	249,381	476,571	**1,364,100**
	Predicted (B)		118,568	65,893	72,285	9,463	50,069	163,984	177,079	295,714	**953,054**
	(A)/(B)(%)		*64*	*89*	*224*	*81*	*76*	*181*	*141*	*161*	***143***
Japan	Actual (A)	81,031		20,245	59,962	2,582	5,817	126,272	64,669	110,119	**470,448**
	Predicted (B)	74,293		22,386	21,715	3,928	7,716	64,147	60,411	84,697	**338,752**
	(A)/(B)(%)	*109*		*90*	*276*	*66*	*81*	*197*	*107*	*130*	***139***
Rep. of Korea	Actual (A)	84,679	9,161		54,181	744	6,551	66,569	36,682	77,051	**335,618**
	Predicted (B)	45,860	24,865		8,639	1,307	2,996	21,772	22,348	35,613	**163,400**
	(A)/(B)(%)	*185*	*37*		*627*	*57*	*219*	*306*	*164*	*216*	***205***
ASEAN	Actual (A)	83.070	39,456	24,559	122,522	4,107	17,733	117,662	83,394	151,101	**644,176**
	Predicted (B)	39,799	18,528	6,644	45,225	2,846	8,388	34,797	38,940	65,409	**260,576**
	(A)/(B)(%)	*209*	*213*	*370*	*271*	*144*	*211*	*338*	*216*	*231*	***247***
Australia and New Zealand	Actual (A)	114	57	66	373	11	45	1,215	930	8,395	**11,206**
	Predicted (B)	2,694	1,766	531	1,521	300	540	7,916	5,269	13,322	**33,859**
	(A)/(B)(%)	*4*	*3*	*12*	*25*	*4*	*8*	*15*	*18*	*63*	***33***
India	Actual (A)	1,971	792	566	9,107	228		13,273	11,687	27,601	**65,224**
	Predicted (B)	56,238	12,864	4,836	18,953	2,042		32,905	45,745	87,819	**261,402**
	(A)/(B)(%)	*4*	*6*	*12*	*48*	*11*		*40*	*26*	*31*	***25***
North America	Actual (A)	63,106	28,621	23,338	43,379	5,678	9,328	617,230	161,678	177,220	**1,129,577**
	Predicted (B)	105,297	65,732	20,088	42,459	15,982	18,806	591,802	291,501	327,579	**1,479,047**
	(A)/(B)(%)	*60*	*44*	*116*	*103*	*36*	*50*	*104*	*55*	*54*	***76***
Europe	Actual (A)	144,804	37,144	30,659	64,599	8,846	24,562	286,773	1,517,637	428,107	**2,543,132**
	Predicted (B)	122,616	66,879	22,266	51,213	11,851	27,976	318,751	1,298,753	542,040	**2,462,344**
	(A)/(B)(%)	*118*	*56*	*138*	*126*	*75*	*88*	*90*	*117*	*79*	***103***
Rest of the world	Actual (A)	92,501	22,859	16,508	60,029	8,727	21,201	95,207	180,288	192,063	**689,382**
	Predicted (B)	137,655	59,758	23,082	55,204	17,478	38,627	227,839	380,672	360,433	**1,300,757**
	(A)/(B)(%)	*67*	*38*	*72*	*109*	*50*	*55*	*42*	*47*	*53*	***53***
Total (World)	**Actual (A)**	**551,277**	**213,978**	**174,456**	**575,838**	**38,631**	**123,069**	**1,620,747**	**2,306,885**	**1,648,311**	7,523,193
	Predicted (B)	**584,462**	**368,959**	**165,726**	**317,013**	**65,196**	**154,578**	**1,463,914**	**2,320,719**	**1,812,625**	7,523,192
	(A)/(B)(%)	***94***	***58***	***105***	***182***	***59***	***80***	***111***	***99***	***91***	*100*

ASEAN = Association of Southeast Asian Nations.

Notes: 'Actual (A)' denotes the actual values of specific country/region pairs, 'Predicted (B)' denotes the corresponding predicted values, and '(A)/(B) (%)' denotes the ratio of actual to predicted values in percentage. North America refers to Canada, Mexico, and the United States; Europe refers to the 27 European Union member countries and the United Kingdom; and 'Rest of the world' refers to 128 countries and regions, including Hong Kong, Macao, and Taiwan. The predicted values for regions are calculated by totalling the member countries' predicted values.

Source: Ando, Kimura, and Yamanouchi (2022b).

Table 1.3 aggregates countries into three regions – East Asia (ASEAN, China, Japan, and Korea); North America; and Europe – and the rest of the world. East Asia's intra-regional exports reach 155% in the actual predicted ratio, while those in North America and Europe are 104% and 117%, respectively. East Asia also exports machinery to other regions much more that predicted. This indicates the high commitment of East Asia to machinery IPNs. East Asia is strong in electric machinery while North America and Europe show their presence in transport equipment.

Table 1.3 **Actual and Predicted Machinery Trade for Three Major Regions, 2019**

Exporter (row)/ **Importer** (column)	**Value ($ million),** %	**East Asia**	**North America**	**Europe**	**Rest of the world**	**Total (World)**
East Asia	**Actual (A)**	874,958	607,050	434,667	897,997	**2,814,672**
	Predicted (B)	564,700	284,701	298,778	567,605	**1,715,783**
	(A)/(B) (%)	*155*	*213*	*145*	*158*	***164***
North America	**Actual (A)**	158,443	617,230	161,678	192,226	**1,129,577**
	Predicted (B)	233,376	591,802	291,501	362,368	**1,479,047**
	(A)/(B) (%)	*68*	*104*	*55*	*53*	***76***
Europe	**Actual (A)**	277,206	286,773	1,517,637	461,516	**2,543,132**
	Predicted (B)	262,974	318,751	1,298,753	581,866	**2,462,344**
	(A)/(B) (%)	*105*	*90*	*117*	*79*	***103***
Rest of the world	**Actual (A)**	204,942	109,694	192,904	258,272	**765,812**
	Predicted (B)	375,111	268,660	431,686	520,561	**1,596,019**
	(A)/(B) (%)	*55*	*41*	*45*	*50*	***48***
Total (World)	**Actual (A)**	1,515,549	1,620,747	2,306,885	1,810,011	**7,253,193**
	Predicted (B)	1,436,160	1,463,914	2,320,719	2,032,400	**7,253,193**
	(A)/(B) (%)	*106*	*111*	*99*	*89*	***100***

Source: Ando, Kimura, and Yamanouchi (2022b).

Figures for individual AMS are shown in Table 1.4. Although Brunei, the Lao People's Democratic Republic (Lao PDR), Cambodia, and Myanmar are a bit behind on this criterion, other AMS present strong commitments to machinery IPNs. Indonesia is developing tight connections with some other AMS, particularly in transport equipment. Viet Nam has caught up quickly with the forerunners.

Table 1.4 Actual and Predicted Machinery Trade for ASEAN Member States, 2019

Exporter (row)/ Importer (column)	Value ($ million), %	Singapore	Brunei	Malaysia	Thailand	Indonesia	Philippines	Viet Nam	Lao PDR	Cambodia	Myanmar	ASEAN	China, Japan, and Rep. of Korea	Total (World)
Singapore	Actual (A)		393	13,234	3,955	5,543	4,543	3,470	30	338	815	32,321	34,364	**156,011**
	Predicted (B)		128	5,444	678	1,469	274	210	34	59	150	8,446	6,468	**34,514**
	(A)/(B)(%)		309	243	583	377	1,657	1,653	88	572	543	383	531	***452***
Brunei	Actual (A)	90		55	4	2	0	4	0	0	0	155	42	**250**
	Predicted (B)	74		70	25	38	19	10	1	2	6	245	327	**1,416**
	(A)/(B)(%)	122		79	15	5	1	38	2	0	0	63	13	***18***
Malaysia	Actual (A)	19,879	110		6,593	1,785	1,609	2,958	8	97	86	33,125	27,355	**147,174**
	Predicted (B)	8,476	188		1,486	2,124	269	214	36	62	161	13,015	6,308	**38,377**
	(A)/(B)(%)	235	59		444	84	598	1,384	22	156	54	255	434	***383***
Thailand	Actual (A)	3,786	49	4,377		3,574	3,860	4,798	915	1,581	827	23,768	22,145	**113,417**
	Predicted (B)	1,310	82	1,844		1,114	435	513	231	283	538	6,348	11,006	**44,997**
	(A)/(B)(%)	289	59	237		321	888	935	397	559	154	374	201	***252***
Indonesia	Actual (A)	3,471	40	1,210	2,311		3,226	1,851	21	91	147	12,367	4,551	**30,530**
	Predicted (B)	3,323	150	3,087	1,305		691	455	71	109	171	9,361	16,248	**70,177**
	(A)/(B)(%)	104	26	39	177		467	407	30	83	86	132	28	***44***
Philippines	Actual (A)	5,852	2	1,497	2,189	473		1,061	0	10	6	11,090	17,663	**62,111**
	Predicted (B)	608	74	383	499	678		239	32	44	65	2,623	9,235	**27,307**
	(A)/(B)(%)	962	3	391	438	70		445	0	23	9	423	191	***227***
Viet Nam	Actual (A)	1,718	20	1,493	2,535	1,122	1,073		105	295	244	8,606	40,332	**131,657**
	Predicted (B)	492	40	322	623	472	252		225	162	85	2,674	11,129	**28,431**
	(A)/(B)(%)	349	51	464	407	238	425		47	182	286	322	362	***463***
Lao PDR	Actual (A)	6	0	8	397	4	0	27		1	0	444	82	**770**
	Predicted (B)	45	3	30	159	42	19	127		17	19	462	814	**2,460**
	(A)/(B)(%)	13	0	28	250	9	0	21		8	1	96	10	***31***
Cambodia	Actual (A)	8	0	16	202	1	62	47	1		2	341	346	**1,403**
	Predicted (B)	91	6	62	225	74	30	107	19		10	624	648	**2,906**
	(A)/(B)(%)	9	0	27	90	2	206	44	7		18	55	53	***48***
Myanmar	Actual (A)	133	0	13	113	6	11	60	0	0		336	205	**852**
	Predicted (B)	304	19	209	564	153	60	74	30	13		1,426	2,777	**9,993**
	(A)/(B)(%)	44	0	6	20	4	19	81	0	1		24	7	***9***
ASEAN	Actual (A)	34,944	614	21,904	18,299	12,510	14,385	14,276	1,082	2,412	2,126	122,552	147,085	**644,176**
	Predicted (B)	14,723	690	11,451	5,563	6,613	2,050	1,948	679	752	1,205	45,225	64,971	**260,576**
	(A)/(B)(%)	237	89	191	329	203	702	733	159	321	177	217	226	***247***
China, Japan, and Rep. of Korea	Actual (A)	49,071	427	34,230	41,200	31,174	25,148	86,404	995	2,485	4,664	275,800	329,520	**2,170,496**
	Predicted (B)	18,495	1,609	11,602	16,517	20,509	11,853	14,692	1,893	1,236	4,234	102,639	351,865	**1,455,207**
	(A)/(B)(%)	265	27	295	249	152	212	588	53	201	110	269	94	***149***
Total (World)	Actual (A)	**154,458**	**1,729**	**86,621**	**81,632**	**58,174**	**51,501**	**119,042**	**2,257**	**6,313**	**8,112**	**575,838**	**939,711**	**7,253,192**
	Predicted (B)	**72,025**	**5,168**	**47,512**	**50,633**	**65,241**	**27,378**	**28,933**	**4,342**	**4,069**	**11,713**	**317,013**	**1,119,147**	**7,253,192**
	(A)/(B)(%)	**214**	**33**	**182**	**161**	**89**	**210**	**411**	**52**	**155**	**69**	**182**	**84**	**100**

ASEAN = Association of Southeast Asian Nations.

Source: Ando, Kimura, and Yamanouchi (2022b).

Variations remain amongst AMS. Cambodia, the Lao PDR, and Myanmar have just started stepping into the second unbundling and seeking industrial diversification. Indonesia, the Philippines, and Viet Nam are working to form thick industrial agglomeration. Malaysia and Thailand have already reached maturity in the second unbundling. There is a lot of room for catching up.

Digital technology and IPNs

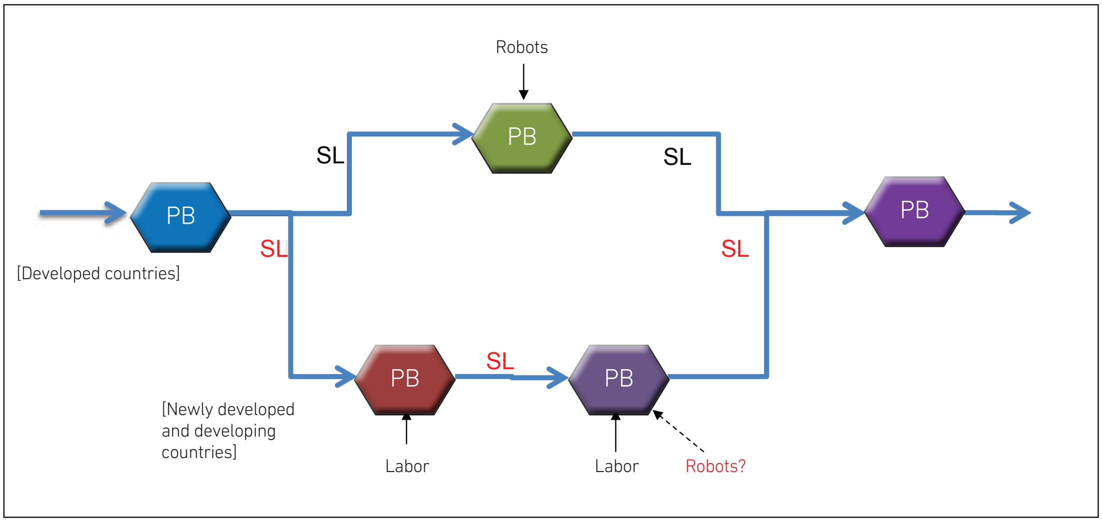
Economic development in ASEAN and developing East Asia has been manufacturing-centred, and countries in the region have mostly been successful in graduating to upper middle-income economies. However, how much can we depend on the manufacturing sector? More concretely, how will digital technology change the pattern of the international division of labour?

Digital technology may affect manufacturing IPNs in multiple ways. As a thought experiment, let us divide digital technology into two elements: information technology (IT) and CT.[11] IT such as artificial intelligence (AI) and robotics speeds up data processing and economises tasks; therefore, it may generate 'concentration forces' against the international division of labour. CT such as the internet and smartphones overcomes geographical distance; thus, it may create 'dispersion forces' that facilitate the international division of labour. Which forces will be stronger may decide the future of IPNs, including newly developed and developing countries.

The above argument assumes that IT is introduced solely by developed countries and works as a substitute for labour in newly developed and developing countries (Figure 1.9). However, IT may be introduced by newly developed and developing countries and works as a complement for labour. Obashi and Kimura (2021) conducted a gravity equation exercise for 104 countries in 2011–2017, and found that the introduction of industrial robots in newly developed and developing countries in East Asia enhanced network trade, together with imported digitally deliverable services that represent CT. Although the introduction of industrial robots is still in the preliminary stage, IT may not necessarily work against newly developed and developing countries. Manufacturing as a whole will become more digital technology-intensive, so newly developed and developing countries must be positive for the introduction of IT to seek the possibility of complementarity with labour as well as enhancing the usage of CT.

[11] The concept of IT and CT is drawn from Baldwin (2016).

Figure 1.9 Introduction of Industrial Robots to International Production Networks



PB = production block, SL = service link.

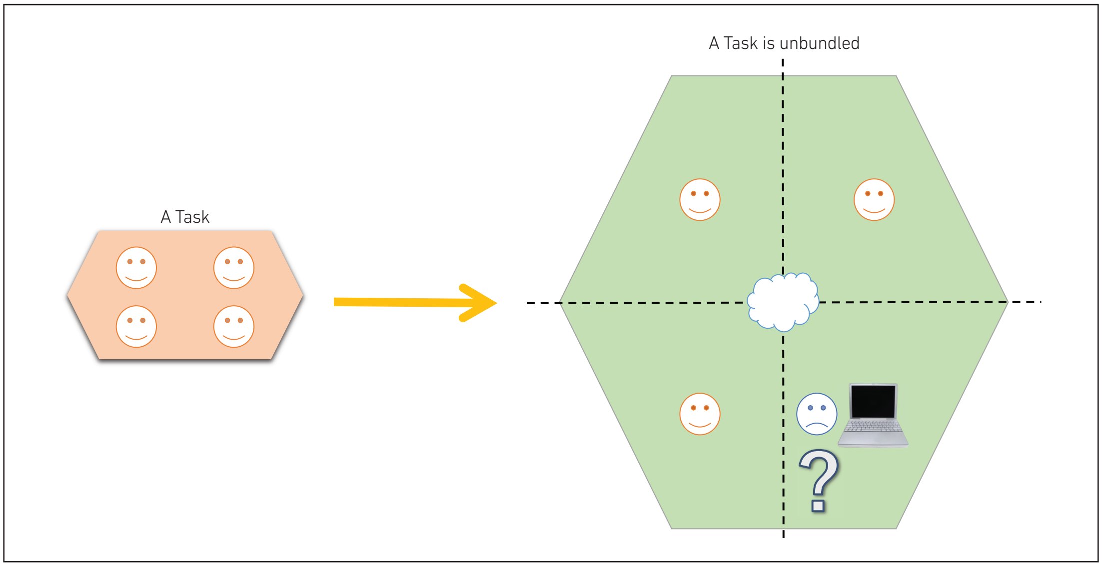
Source: Author, illustrating the idea of Obashi and Kimura (2021).

In the short run, COVID-19 accelerates the usage of CT in IPNs. ASEAN and developing East Asia must take this opportunity to enhance the usage of CT in IPNs even in a normal period. Further, the introduction of IT may also be promoted to keep production blocks. Nurturing human resources for digital technology will be key.

The third unbundling

The third unbundling is finer than the first and second unbundlings. In the third unbundling, a task is unbundled and people in different locations perform it (Figure 1.10). The second wave of the ICT revolution reduces face-to-face costs, and people in different countries coordinate to conduct a task. The reach of the third unbundling is still quantitatively small but has the potential to be a major channel of the international division of labour in the future.

Figure 1.10 The Third Unbundling

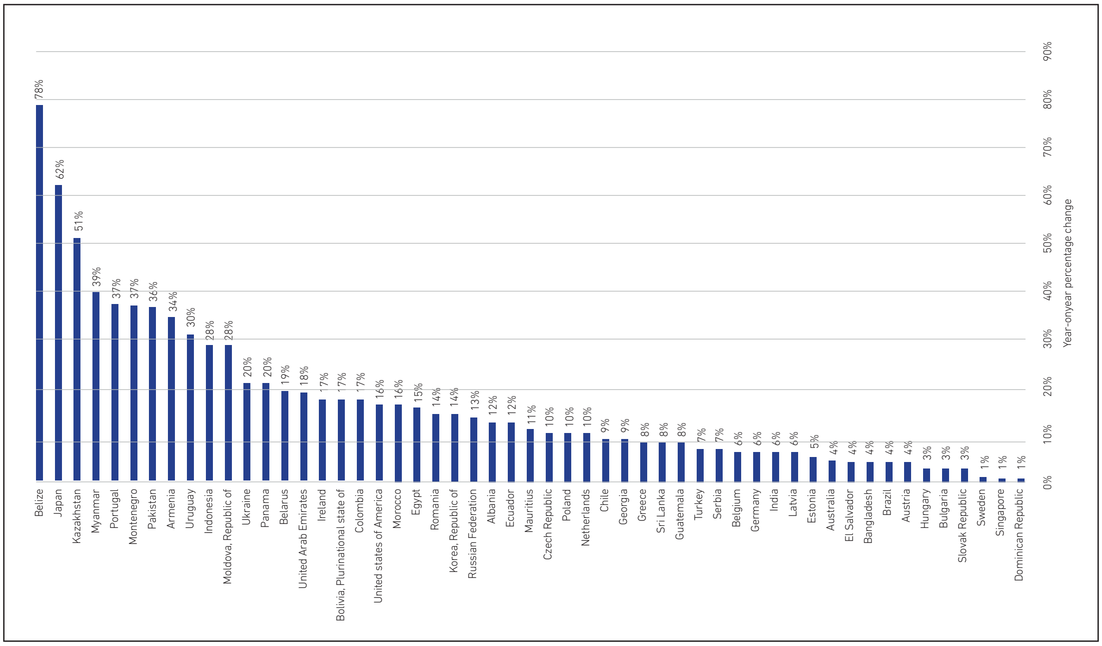


Source: Authors.

A good example of the third unbundling is Upwork, which provides matching services for freelancers throughout the world. Although its operations are limited to Japan, Coconala provides a matching platform for online service individuals and customers. Various kinds of business process outsourcing are provided for the world by companies located in the Philippines. Online English conversation classes provided by teachers in Cebu have been successful in Japan. Digital connectivity easily overcomes geographical distance. Of course, some barriers or frictions remain in such cross-border transactions, including asymmetric information, language barriers, e-payments, troubleshooting, and others. However, wage gaps across countries are huge compared with gaps in talent. COVID-19 forced us to work remotely and lowered the psychological barrier to service outsourcing, both domestic and cross-border. When credible mediators provide matching services, the third unbundling may expand significantly.

It is not easy to capture the third unbundling precisely in statistics. However, some figures are available for trade in ICT services and other business services that overlap with the third unbundling. During the COVID-19 era, the recovery of trade in services was much slower than that of trade in goods. Travel services are still experiencing a large slump. On the other hand, ICT services trade did not drop much, and trade in computer services (part of ICT services) grew in 2020 (Figure 1.11). COVID-19 accelerated the growth in digitalised and digitalising services trade.

Figure 1.11 Computer Services Exports, 2020
(year-on-year percentage change)

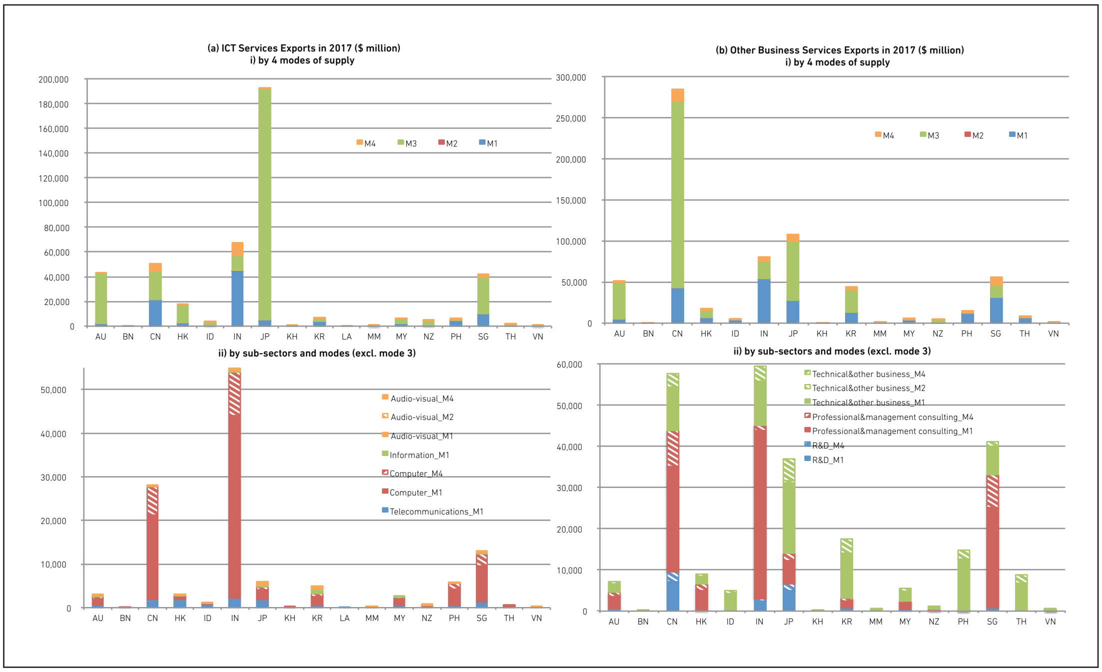


Source: WTO (2021).

Services trade statistics based on balance of payments statistics do not capture the service provision made by service providers moving to a customer's country. In other words, a large portion of mode 3 (commercial presence) and mode 4 (movement of natural persons) in the services trade definition under the General Agreement on Trade in Services is not captured in statistics. The Foreign Affiliates Trade in Services statistics are an initiative for filling this gap, and the WTO homepage (WTO, n.d.) presents tentative estimates up to 2017. The upper part of Figure 1.12 shows 4-mode[12] estimates of ICT services and other business services exports by ASEAN and East Asian countries. The lower part of the figure displays further disaggregation based on the balance of payments statistics. We can see that exports of these services are still in their infancy in many countries, even considering the quality of the data.

[12] The four modes of supply of services are: cross-border transactions (mode 1), consumption abroad (mode 2), commercial presence in another country (mode 3), and presence of natural people in another country (mode 4).

Figure 1.12 ICT Services and Other Business Services Exports, 2017

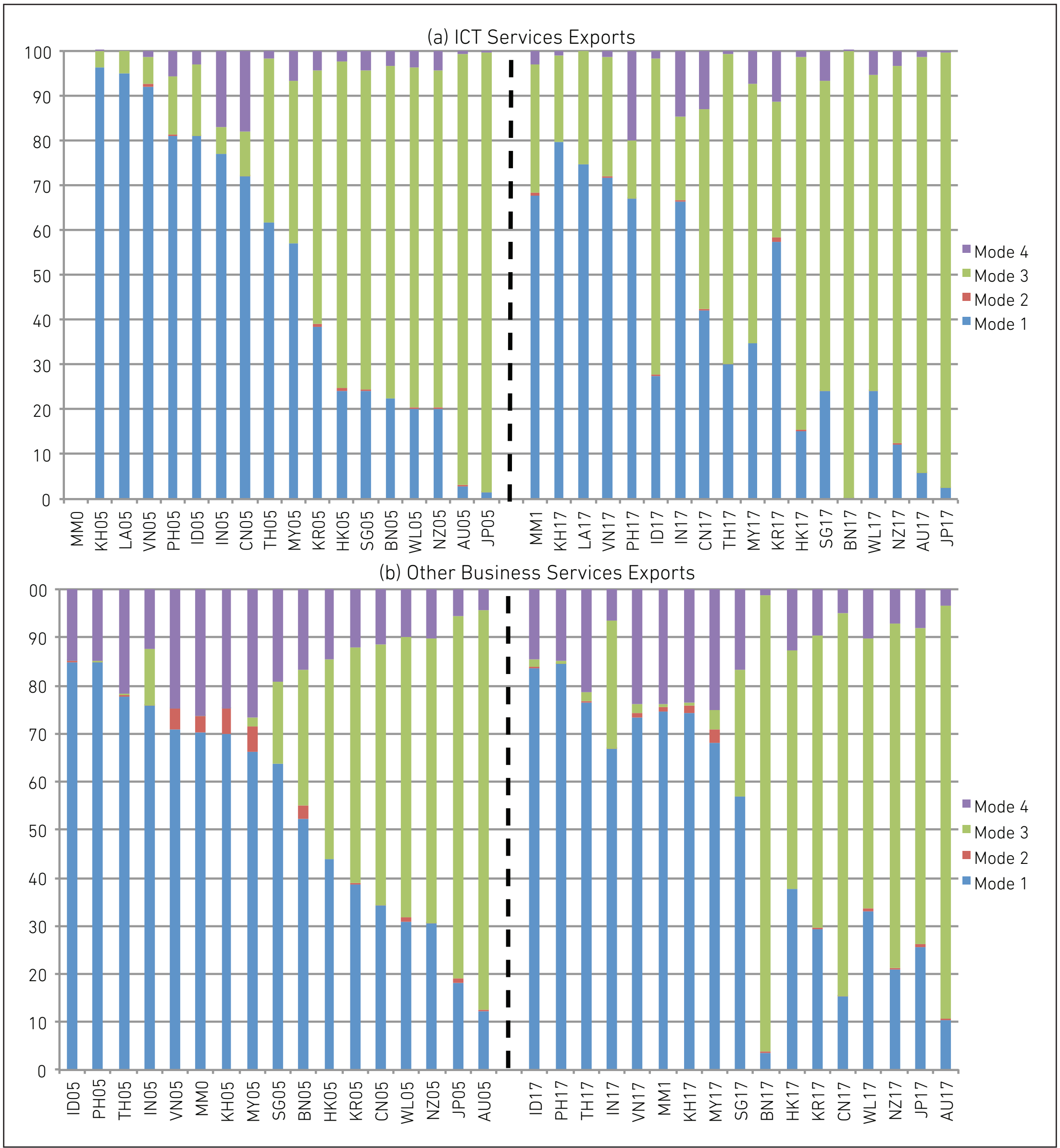


ICT = information and communication technology, R&D = research and development, M1 = Service trade mode 1, M2 = Service trade mode 2, M3 = Service trade mode 3, M4 = Service trade mode 4, AU = Australia, BN = Brunei Darussalam, CN = China, HK = Hong Kong, ID = Indonesia, IN = India, JP = Japan, KH = Cambodia, KR = Republic of Korea, MM = Myanmar, MY = Malaysia, NZ = New Zealand, PH = Philippines, SG = Singapore, TH = Thailand, VN = Viet Nam.

Source: Ando, Kimura, and Yamanouchi (2022a). Data are originally from the WTO HP (WTO, n.d.).

Figure 1.13 presents the mode composition of these services exports in 2005 and 2017. Mode 1 (cross-border) and mode 4 are relatively large in developing countries. However, as a country goes up the development ladder, mode 3 is becoming dominant. This indicates the importance of mode 3 once the services trade reaches the mature stage and business matching becomes crucial. Services trade liberalisation as well as data governance rules appear to be linked with the development of the third unbundling.

Figure 1.13 Mode Composition of ICT Services and Other Business Services Exports, 2005 and 2017



ICT = information and communication technology, AU = Australia, BN = Brunei Darussalam, CN = China, HK = Hong Kong, ID = Indonesia, IN = India, JP = Japan, KH = Cambodia, KR = Republic of Korea, MM = Myanmar, MY = Malaysia, NZ = New Zealand, PH = Philippines, SG = Singapore, TH = Thailand, VN = Viet Nam, WL = World.

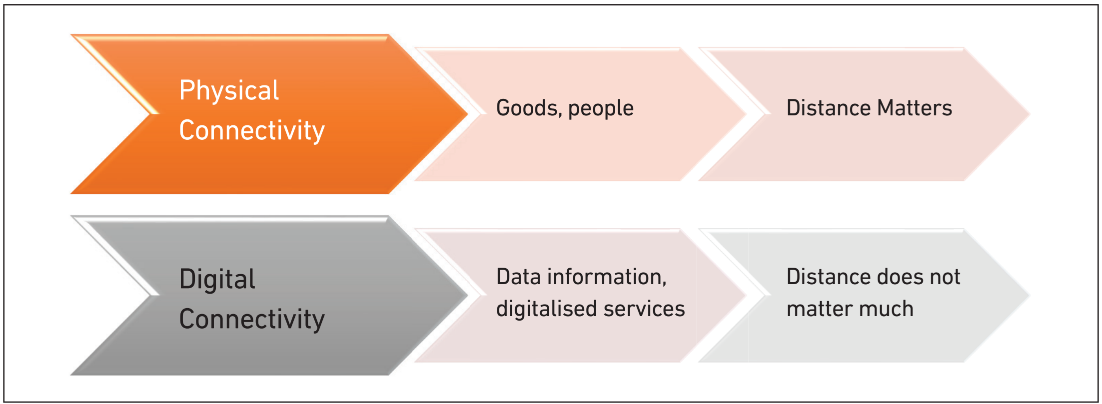
Source: Ando, Kimura, and Yamanouchi (2022). Data are originally from the WTO HP (WTO, n.d.).

Policies to upgrade achievable unbundling

In the past three decades, ASEAN and East Asia have been successful in expanding the scope of unbundling or the international division of labour by unleashing private dynamism with ASEAN-centred integration initiatives. Development gaps that generate arbitrage opportunities for the international division of labour have not yet been exhausted. By enhancing institutional and physical connectivity with digital technology, ASEAN and East Asia can use globalisation forces even more effectively. [13]

The first unbundling can use digital technology more extensively, particularly in rural areas for inclusiveness. Continuous efforts at enhancing institutional and physical connectivity are required. Digital technology, particularly CT, improves access to information, business matching, and marketing, partially through e-commerce. Digital connectivity can complement physical connectivity (Figure 1.14). There is also huge room for enhancing productivity by introducing IT. [14]

Figure 1.14 Physical and Digital Connectivity



Source: Authors.

[13] In Chapter 6, Ambashi, Fujita and Suzuki list important hard infrastructure projects in the region. In Chapter 7, Kumagai and Isono employ the Geographical Simulation Model and estimate the economic effects of enhancing physical and institutional connectivity.

[14] Kozono discusses the agricultural sector in Chapter 16, particularly the introduction of digital technology, cold chains, and a sustainable food system.

[15] Buban and Ha provide a detailed discussion in Chapter 2 on the improvement of trade facilitation and non-tariff measures. Ramli and Majid discuss the importance of regulatory coherence in Chapter 3.

The second unbundling, particularly in electrical machinery, takes advantage of positive demand shocks due to COVID-19 as well as the possible relocation of production sites due to increasing geopolitical tensions. To attract more economic activities, institutional connectivity beyond tariff cuts – such as the enhancement of FTA use, trade facilitation, the improvement of non-tariff measures operation, standards and conformance, and regulatory coherence – will work.[15] Physical connectivity may still need to improve, particularly in urban and suburban infrastructure, to support industrial agglomeration. COVID-19 was a natural experiment on how far CT can substitute the movement of people, and we found that CT worked strongly. After COVID-19, the movement of people will revive, but not exactly like in the pre-COVID-19 era. More intensive and extensive use of CT will expand the applicability of the second unbundling.

The third unbundling world requires a more people-centred approach for connectivity. With e-commerce, international cargos shift their weight from containers to parcels, from sea to air. International transactions are still dominated by business to business (B2B), but business to consumer (B2C) and consumer to consumer (C2C) are increasing in importance. Digital connectivity overcomes distance though it may not be a perfect substitute for face-to-face meetings. In addition to essential infrastructure like high-speed internet connections, the institutional setting for digital businesses and data flows will become important.

ASEAN-centred integration initiatives

ASEAN-centred integration initiatives have played a very important role in supporting private economic activities by advancing liberalisation and international rule-making. ASEAN integration has deepened and expended its scope to political and socio-cultural integration. ASEAN has led the ASEAN+1 initiative and established the RCEP with ASEAN Centrality at its core. It is imperative to deepen ASEAN-centred integration initiatives for upgrading institutional and physical connectivity with a digital technology flavour. [16]

[15] Buban and Ha provide a detailed discussion in Chapter 2 on the improvement of trade facilitation and non-tariff measures. Ramli and Majid discuss the importance of regulatory coherence in Chapter 3.

[16] In Chapter 4, Prakash proposes to connect the connectivity plans in Asia and beyond.

In addition, considering recent geopolitical tensions, the role of regional economic integration expands to reduce policy risks and defend the rules-based trading regime. Some trade and investment controls seem to be inevitable, but the rest of the economy must be placed in the rules-based trading regime. Ad hoc use of trade and other policies for political purposes should be avoided at far as possible. Trade forums such as the ASEAN Economic Community and the RCEP could be used as a troubleshooting mechanism.[17] In addition, although the dispute settlement mechanism in regional trade agreements has barely been used, we should consider the possibility. Ultimately, ASEAN and East Asia should join forces and support the WTO as an anchor for the rules-based trading regime.

Innovation

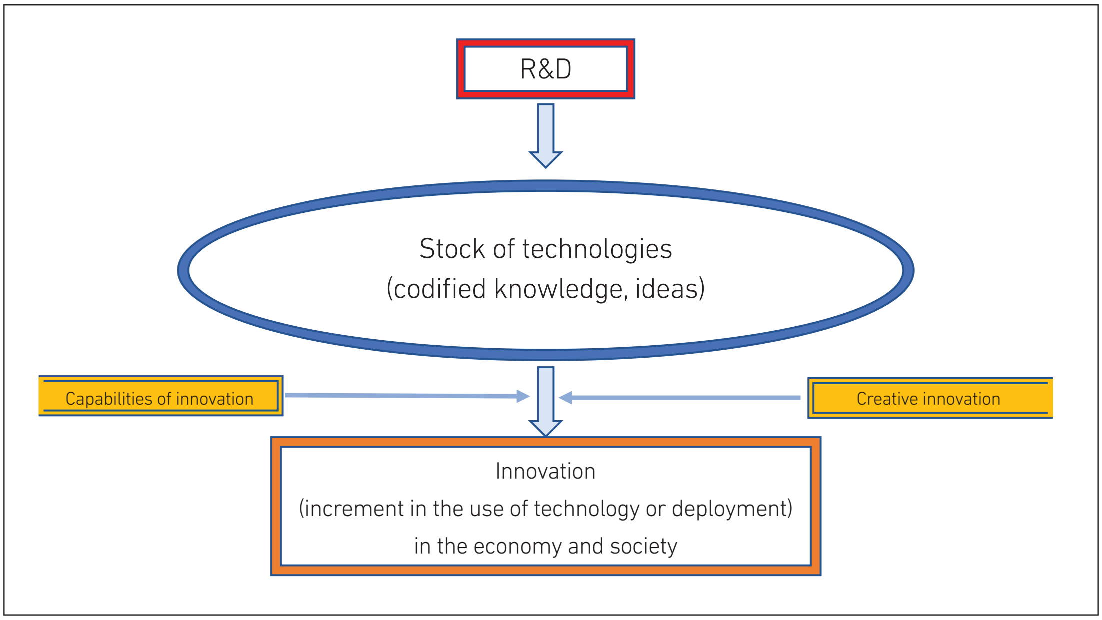
Technologies and innovation with digital technology

Now we will discuss the second pillar – innovation. In the past two decades, digital technology has drastically changed innovation. Innovation strategies in newly developed and developing countries must be substantially renewed quickly.

As a starting point, let us set the definition of 'innovation' in our context (Figure 15). R&D and other activities generate technologies, which can also be called codified knowledge or ideas. We have a stock of technologies that may or may not be used. Innovation is defined as the increment in the use or deployment of technology, selected from the stock of technologies, in the economy and society.

[17] Kimura (2021) discussed the expanded role of regional trade agreements in the era of geopolitical tensions.

Figure 1.15 Stock of Technologies and Innovation



R&D = research and development.

Source: Authors.

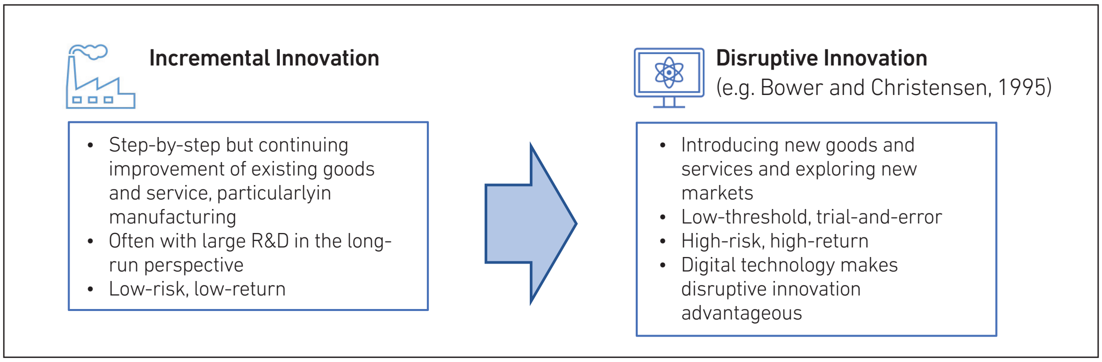
R&D requires substantial investment for the accumulation of human capital and experience and thus tends to be conducted mainly in developed countries. In addition, up to the 20th century, innovation also required substantial capabilities together with R&D, and thus innovation was also mostly done in developed countries. Digital technology changed this structure. Most digital technology is general purpose, characterised by its pervasiveness and innovation spawning. Deployment and imitation are often quite easy, which allows disruptive innovation to emerge.

Incremental and disruptive innovation

The old innovation strategy applied in Northeast Asia was a national innovation system model in which the triangle of the government, universities/research institutes, and the private sector conducted incremental innovation backed by massive R&D. The manufacturing sector was at the core of innovation. However, in the past two decades, disruptive innovation has dominated the business scene with explosively expanding internet/smartphone users. Major companies throughout the world have had to adapt and change in these 2 decades.

Differences between incremental innovation and disruptive innovation are summarised in Figure 1.16. Incremental or gradual innovation is step-by-step innovation that aims to continue improving goods and services, typically in manufacturing. It often accompanies extensive R&D in the long-run perspective. Therefore, it is relatively low-risk and low-return. On the other hand, disruptive innovation (Bower and Christensen, 1995; Schmidt and Druehl, 2008) introduced new goods and services and explored new markets while rendering existing goods and services obsolete. It has a low threshold for entry, characterised by trial and error. It is thus high risk and high return. Digital technology makes disruptive innovation advantageous, particularly in matching platform businesses.

Figure 1.16 Stock of Technologies and Innovation



R&D = research and development.

Source: Authors.

Shapiro and Varian (1998) pointed out the important characteristics of digital businesses, including low fixed costs, strong lock-in effects, and the existence of network externalities. These characteristics of digital business platforms support the emergence of unicorns and potential risks on information control, privacy protection, and competition policy.

However, since 2015 or so, digital businesses in Asia have started shifting their weight from relatively simple matching businesses to businesses that rejuvenate or upgrade traditional industries. This means that digital technology begins to transform our economy and society as a whole, i.e. digital transformation (DX) starts. This may make some form of collaboration between incremental and disruptive innovation meaningful from now on, particularly in manufacturing where incremental innovation has accumulated.

Advantages of backwardness and leapfrogging

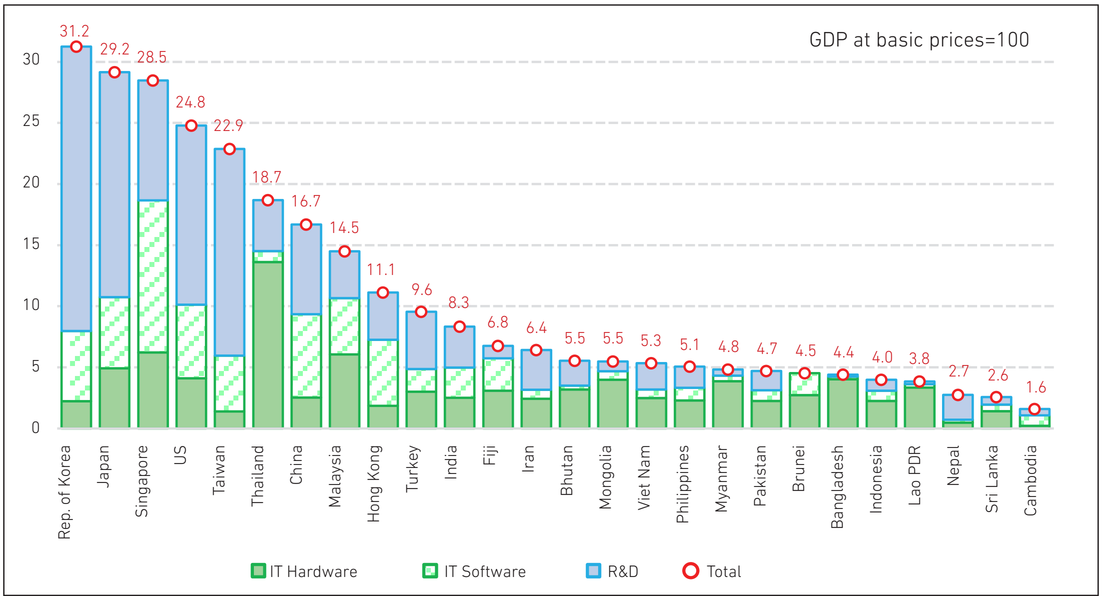
Up to the end of the 20th century, developed countries almost monopolised both R&D and innovation. But the situation has changed drastically. Digital technology itself is high-tech, and thus substantial R&D investment is required. However, digital technology is often easy to deploy. Even if serious R&D may be difficult, newly developed and developing countries can jump into the deployment of digital technology. Deployment often requires local adaptation of digital businesses that potentially give local entrepreneurs some advantages over multinationals.

The deployment of digital technology is sometimes easier in newly developed and developing countries than in developed countries. Developing countries tend to have immature economic systems and institutions, and the deployment of digital technology for matching, escrow services, and e-payments, for example, may be accepted more easily – without coordination with existing systems or resistance from people with vested interests. Even where a business model is well established in developed countries, local adaptation of such a model may still make good business sense. Local players tend to have advantages even if they are not at the global technological frontier. 'Super application', developed by transport matching platformers, is an example of this. In addition, many newly developed and developing countries have a young population, which is a big advantage in introducing digital technology.

Low R&D–GDP ratios have long been regarded a serious problem in developing countries. The old national innovation system model in Northeast Asia attaches significant importance to large R&D investment. However, digital technology may call for a fundamental revision of this strategy. Figure 1.17 presents the estimates of the stock of IT and R&D capital, relative to GDP, in 2019. As expected, Korea, Japan, Singapore, the US, Taiwan, and China have relatively large R&D capital stock to GDP ratios. Other countries in Asia have small R&D capital stock; instead, their IT hardware and software capital stock is relatively large. This may not necessarily be a bad thing if the deployment of digital technology, rather than R&D, is important for these countries.

Figure 1.17 Stock of IT and R&D capital relative to GDP, 2019

(ratios of end-of-year capital stocks of IT and R&D to the basic price GDP in 2019)



GDP = gross domestic product, IT = information technology, R&D = research and development, US = United States.

Source: APO (2021).

Innovation policy in newly developed and developing countries may need to be revised to take advantage of digital technology. By doing so, countries in the region may capture the opportunities of catching up and leapfrogging.

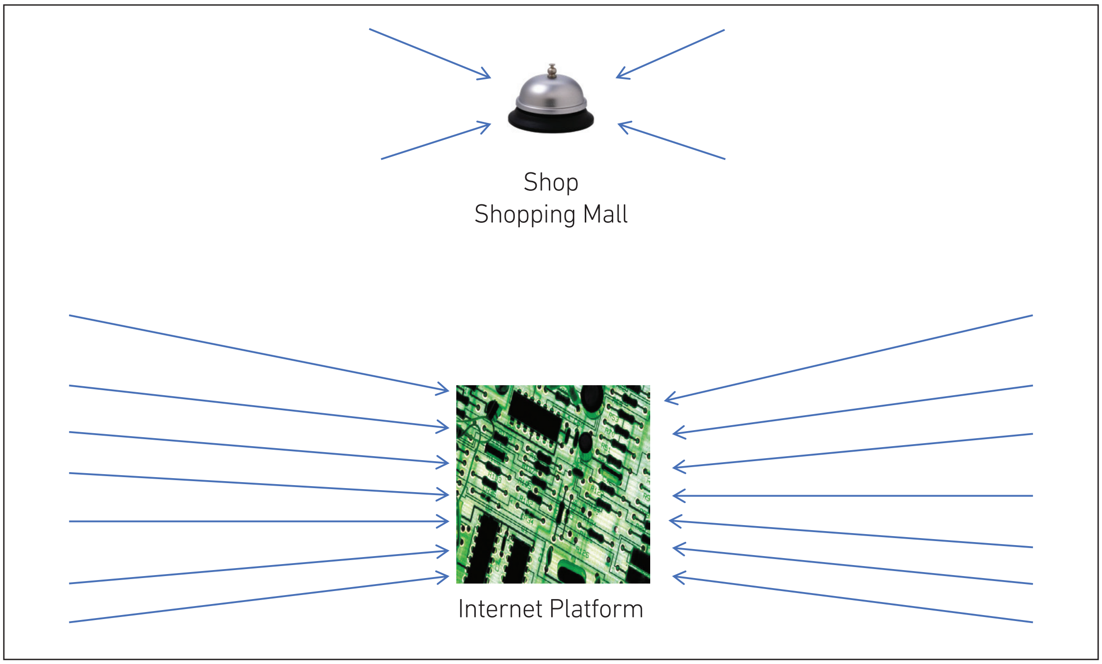
Digital businesses

The size of digital-related businesses seems to be still limited in ASEAN and developing East Asia, but the wave of digitalisation has arrived. It started from the proliferation of internet platforms with rapidly expanding subscribers of smartphones and use of the internet.

Internet platforms can drastically reduce the cost of matching in communication, information dissemination, and B2B/B2C/C2C matching as well as in delivering government services. Figure 1.18 illustrates the reduction in matching costs. For example, in B2C commerce, we used to have a corner shop or a store in a shopping mall where sellers of goods and services displayed their products and customers came to choose and consume. Substantial matching costs are borne by both sellers and buyers in such a physical transaction.

Although the internet platform for e-commerce may not be a perfect substitute for the joy of physical shopping, sellers can post their products at much cheaper prices and buyers save substantially on their search costs. The internet matching platforms intensify competition and at the same time expand the number of market participants while enhancing the variety of goods and services.

Figure 1.18 Reduction in Matching Costs by Platformers



Note: Arrows represent customers and suppliers.

Source: Authors.

The growth of social networking services has been impressive in ASEAN and developing East Asia, and e-commerce is also growing. Transport matching business has been very successful, and super applications have expanded the scope of digital businesses. The advantages of backwardness seem to work strongly.

Although the benefits of matching platforms are obvious, a number of concerns should be taken care of by providing an enabling policy environment. The key is to retain healthy competition amongst platforms, both domestic and foreign. Competition policy and proper taxation of multinational digital platforms are essential. The recent development of policy frameworks observed in the region may mostly solve other concerns such as consumer protection, privacy protection, and cybersecurity.

The next step is to accelerate the introduction of digital technology in other industries. COVID-19 accelerated the use of digital technology for businesses in the world. However, progress seems to be slow in Asia. ERIA conducted a questionnaire survey for firms in ASEAN and India and found that only 23% of respondents promoted digitalisation to respond to the pandemic shocks to supply chains (Oikawa et al., 2021). To make progress in the digital transformation, customised digitalising services must be promoted. Although platformers can take care of this to some extent, the development of digital venture businesses is crucial. To do so, economic systems must be prepared to allow trial and error for disruptive innovation, and policymakers should not be afraid of learning from foreign businesses rather than jumping into inefficient infant industry protection.

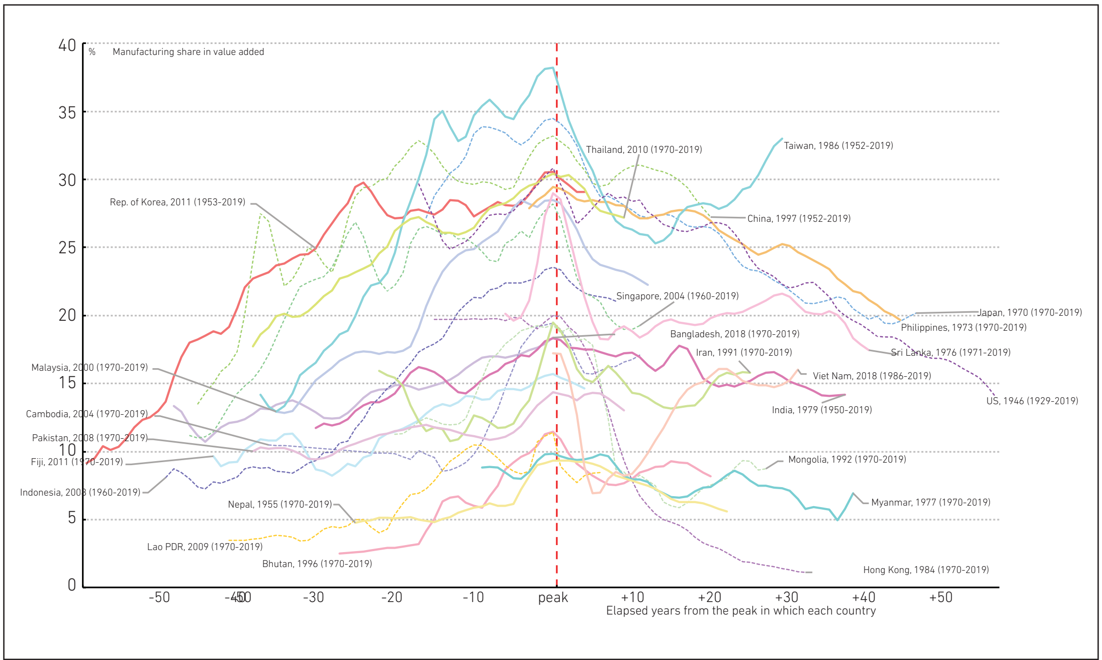
Manufacturing and disruptive innovation

Digital technology has made disruptive innovation dominant in the past two decades. The manufacturing sector, which used to be a champion of innovation, has not kept pace with it. What will happen regarding manufacturing in the future?

ASEAN and East Asia have manufacturing-centred development strategies and have been successful in achieving steady economic growth and rapid poverty alleviation. Manufacturing and related services generate massive numbers of jobs for relatively poor people, which accelerates the shift of employment from the informal to formal sectors. This inclusive growth contrasts well with jobless growth in some resource-based developing countries in the world. Many countries in ASEAN and developing East Asia have large populations and still require massive job creation.

Rodrik (2016) pointed to the phenomenon of premature deindustrialisation, in which many developing countries in recent periods have started to lose their GDP/employment share of the manufacturing sector without experiencing full industrialisation. Rodrik claimed that premature deindustrialisation is salient, particularly in Latin America and Sub-Saharan Africa. How about Asia? Figure 1.19 presents GDP shares of the manufacturing sector in selected countries, placing the peak of each country's inverse U shape at the centre. The US, Japan, Taiwan, Korea, China, and Thailand reached above 30% at the peak, while Malaysia and Singapore were somewhere between 25% and 30%. Indonesia climbed up to 23% while India and Viet Nam never reached 20%. Some tendency of lowering peaks may be read from the diagram.

Figure 1.19 Country Peaks in Manufacturing GDP Shares



GDP = gross domestic product, US = United States.
Source: APO (2021).

However, ASEAN and developing East Asia may not need the manufacturing shares too much. Pure unskilled labour-intensive manufacturing operations in the first unbundling always look for cheap labour and thus are footloose. The region is committed to the second unbundling with more stable, thick IPNs. It is important to take advantage of fragmentation and agglomeration forces at the same time.

The demand for manufacturing goods will continue, with a gradual shift toward the quest for customised and differentiated products. Product lines will be more demand-driven, small quantities and many varieties supported by quick reshuffling of production lines will be called for, and services that labour is good at performing vis-à-vis robots will be attached. These can be realised in the extension of the second unbundling. ASEAN and developing East Asia must move up in the GVCs. The key is the thickness of industrial agglomeration and the nurturing of human capital and entrepreneurship.

Manufacturing has experienced tough times in the digital era in the past 2 decades, but the demand for manufactured goods is still huge. Manufacturing has long accumulated R&D investment and retains a large pool of technologies backed by a wide range of science and technology. The second unbundling, particularly in electronics, is the strength of ASEAN and East Asia. The next step must be to seek the possibility of combining incremental innovation and disruptive innovation.

Renewed innovation policy

ASEAN and developing East Asia have long subscribed to the conventional national innovation system model, but now is the time to combine incremental and disruptive innovation. Not only R&D, but also the deployment of technology, must be emphasised.

To do so, a favourable ecosystem for venture businesses must be prepared. First, a business environment that allows trials and errors must be provided. Venture capital and other financial facilities are needed for high-risk and high-return investment. Technology hubs are essential, including incubator centres, co-working spaces, accelerators, university education for entrepreneurs, and others. Second, human capital should be nurtured and attracted. Not only programmers, but also creative entrepreneurs, are needed. The mobility of educated people must be secured, and urban amenities to attract domestic and foreign human capital should be improved. Third, the link between technology stocks in the world and technology deployment must be strengthened. Universities and research institutes allocate resources for expanding the scope of venture businesses. Last, refrain from protecting infant industries without careful consideration. Competition and access to technology and managerial know-how are essential.

At the same time, digital infrastructure networks must be fully established under government guidance. 5G deployment, data centres, and networks are essential to digital businesses and digital transformation.

Innovation and urban amenities

Thanks to the second ICT revolution, the cost of ‘face-to-face’ communication via the internet has plummeted, and the use of CT was intensified by COVID-19. However, face-to-face interactions have many benefits on generating innovative ideas. How to attract creative people and activate innovation will be an important policy agenda for ASEAN and East Asia.

The US has a long tradition of fierce competition amongst cities to attract qualified workers by providing favourable urban amenities. A paper by Glaeser, Kolko, and Saiz (2001) is a seminal work that listed four key elements of urban amenities to attract well-educated people: (i) the presence of a rich variety of services and consumer goods, (ii) aesthetics and physical setting, (iii) good public services, and (iv) speed. Job opportunities and urban amenities for creative people go together and are mutually reinforcing.

Cities in ASEAN and East Asia are entering the era of competition. How to attract creative people, both foreign and local, will be crucial in the path towards a fully developed stage of development. ERIA has conducted a series of studies on GVCs, cities, and urban amenities; and Thangavelu, Kimura, and Narjoko provide policy discussion on this topic in Chapter 10.

Digital governance

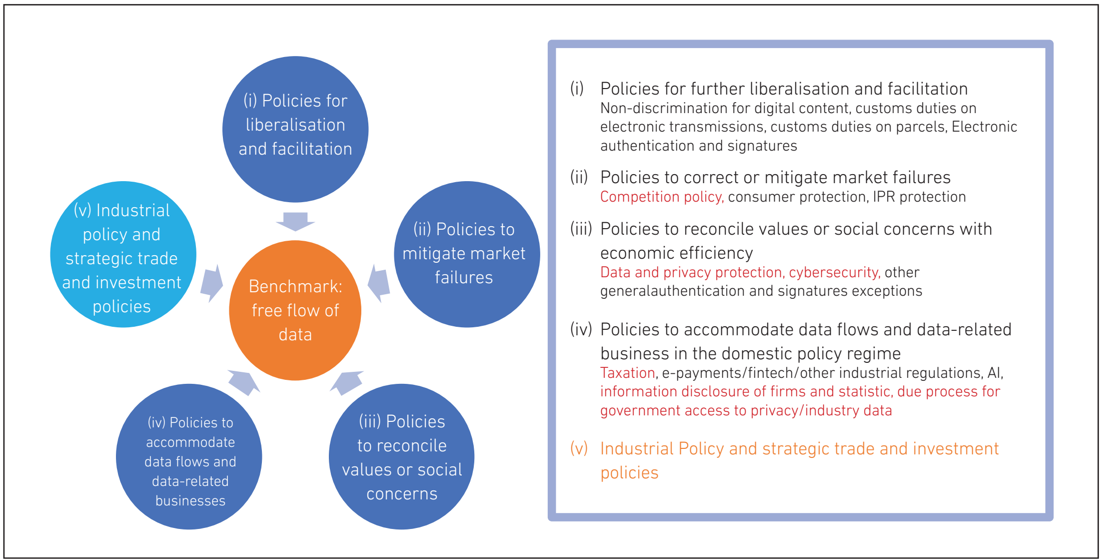
In the digital era, policies related to data and data-related businesses are essential. However, quite often, these policies are introduced and implemented without a solid basis of economic logic. The potential costs of improper data-related policies are huge.

Chen et al. (2019) provided an overall policy framework of data flows and data-related businesses (Figure 20). The standard economic approach to justify economic policies is to set a laissez-faire economy as a benchmark and justify policies as measures to correct distortion. In this case, a situation with free flow of data is set as a benchmark. An economy with free flow of data basically provides efficiency, but some government intervention may be needed for enhancing efficiency and addressing economic and social concerns. There are five categories of possible policies:

(i) Policies for further liberalisation and facilitation
(ii) Policies to correct or mitigate market failures
(iii) Policies to reconcile values or social concerns with economic efficiency
(iv) Policies to accommodate data flows and data-related businesses in the domestic policy regime
(v) Industrial policy and strategic trade and investment policies

Examples of policies in each category are listed in Figure 1.20.

Figure 1.20 Digital Governance to Support the Free Flow of Data



AI = artificial intelligence, IPR = intellectual property rights.

Source: Chen et al. (2019).

Policies in red font in Figure 1.20 are pending policy issues. Privacy protection is the most controversial and can be easily politicised. Excessive or inefficient protection may deter data flows substantially and may end in isolation from the digital world;[18] a careful review of other countries' examples is needed, and efforts to form an international consensus should continue. For giant platforms, competition policy and taxation, together with information disclosure, must be established. Discipline regarding government access to private data is another important element in the digital economy. The importance of cybersecurity calls for international cooperation (e.g. a surveillance mechanism like the one monitoring the financial market, and establishing a joint task force to coordinate and/or synchronise actions against fraudulent attacks).[19]

The WTO Joint Initiative on E-commerce statement appears to have made some progress, but it will be difficult to develop a holistic policy framework at the multilateral level in the short run. Even amongst ASEAN and East Asia, large differences remain in the regulatory framework and the basic philosophy on digital governance. However, the speed of technological progress and business innovation is fast, and the establishment of an international policy framework for free flow of data with trust is an urgent need. Initiatives for like-minded countries must be promoted to create new international rules.

[18] For example, unleashing the potential of data sharing in the social dimension enables the effectiveness of using an application to trace COVID-19 and supports measures to control the COVID-19 pandemic.

[19] Chen discusses the way to achieve free flow of data with trust in Chapter 5.

Moving forward, institutionalising governance structures and mechanisms – e.g. in-country coordination and consultations amongst agencies in charge of digitalisation, effective stakeholder engagement with industries, and a monitoring system for various digitalisation initiatives – might help. Further, such best practices could be shared and cooperation with related regional organisations could be enhanced to increase the effectiveness of the monitoring system.

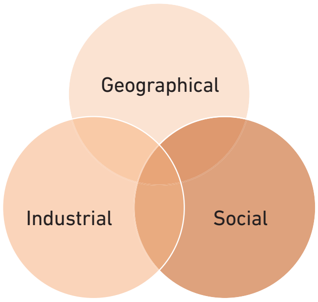
Inclusiveness

Three dimensions of inclusiveness

Inclusiveness or equity is an important value that cannot be fully achieved through economic efficiency. Achieving inclusiveness is sometimes economically costly, but inclusiveness and economic efficiency are not necessarily substitutes. Whenever possible, we must look for the use of economic forces to achieve inclusiveness.

Inclusiveness is a popular word in political discourse, but the scope of inclusiveness is not necessarily clearly defined. This report conceptualises inclusiveness in three dimensions: geographical, industrial, and societal (Figure 1.21). Geographical inclusiveness addresses income or welfare disparity across countries and regions. A typical example is the development gap between urban and rural areas. Industrial inclusiveness examines gaps between different industrial sectors such as multinationals versus local firms, large firms versus micro, small, and medium-sized enterprises (MSMEs), manufacturing versus other industries, and formal versus informal sectors. Societal inclusiveness covers various societal gaps in terms of gender, ageing, education and human resources development, access to medical services, economic and social resilience, social protection, and others. These three kinds of inclusiveness issues partially overlap but may require different policies and social movements.

Figure 1.21 Three Dimensions in Inclusiveness



Geographical:
Income/welfare disparity across and regions, urban vs. rural.

Industrial:
Multinationals vs. local firms, large firms vs. MSMEs, manufacturing vs. other industries, and others.

Social:
Gender, ageing, education and human resources development, economic and social resilience, social protection, other societal inclusiveness.

These overlap and are complementary

MSMEs = micro, small, and medium-sized enterprises.
Source: ERIA (2012).

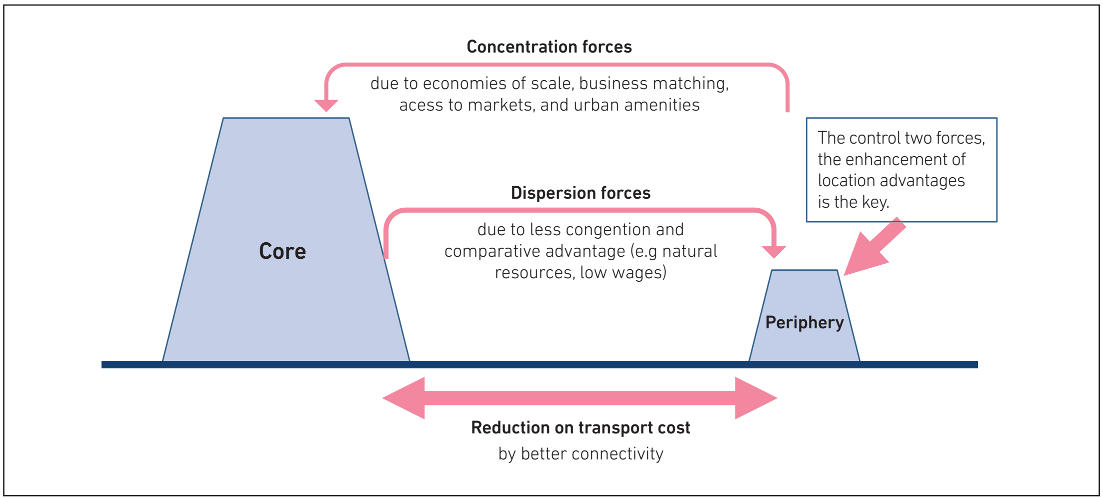
Geographical inclusiveness

Achieving a balance between urban and rural areas has been a big challenge in economic development. Rural areas tend to be isolated from the development of urban areas, and thus the betterment of connectivity is one of the essential policies. However, connectivity alone may not automatically enhance the welfare of rural people. What else is needed? The new economic geography provides a useful conceptual framework.

Figure 1.22 illustrates the basic structure of the new economic geography on the location of economic activities.[20] There is a core and a periphery, which can be interpreted as urban and rural areas. When transport costs between the core and the periphery fall, two forces on economic activities are generated. One is concentration forces. The core develops agglomeration, which creates two kinds of positive agglomeration effects: economies of scale in production and proximity to markets. These make the core attract economic activities. The other is dispersion forces. Agglomeration also generates negative agglomeration effects or congestion in the form of land price hikes, wage increases, traffic jams, and pollution. In addition, the periphery may have some type of location advantage, such as the availability of inexpensive labour. This causes some economic activities to move out of the core to the periphery. For geographical inclusiveness, policymakers may want to move some economic activities to the periphery. To do so, an assessment of the balance between concentration forces and dispersion forces is important. To control two forces, the enhancement of location advantages in the periphery, such as the development of industrial estates, is often necessary.

[20] The theory of the new economic geography was presented by Fujita, Krugman, and Venables (1999) and Baldwin et al. (2003).

Figure 1.22 **The New Economic Geography – Concentration and Dispersion Forces**

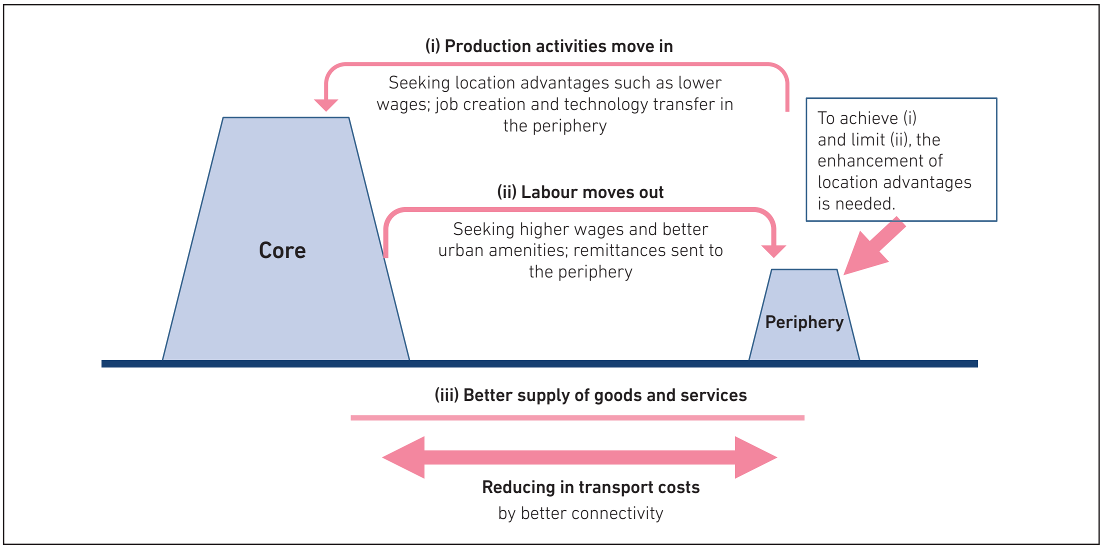


Source: ERIA (2010).

To make this thought experiment more realistic, we introduce the movement of people or labour and digital technology in addition to the movement of economic activities. Figure 1.23 illustrates three measures to improve the welfare of rural people when transport costs between the core and the periphery decline. The first is to move economic activities from the core to the periphery by providing good location advantages in the periphery. The availability of inexpensive labour is an element of location advantages, and the construction of industrial estates with reliable economic infrastructure services may work to some extent. In addition, the use of digital technology, particularly CT, must be aggressively promoted to make food processing, cottage industries, and possibly software outsourcing enjoy larger markets.[21]

[21] Zen discusses various aspects of rural development in ASEAN and East Asia in Chapter 13.

Figure 1.23 **Three Ways to Enhance Geographical Inclusiveness**



Source: ERIA (2020).

The second is to allow workers to move from the periphery to the core and send part of the money earned back to the periphery. In the process of industrialisation, some people from rural areas move to urban and suburban areas, making rural households richer. However, if this goes too far, rural areas are hollowed out. The balance between the two measures is important.

The third is better supply of goods and services for the periphery. This effect should not be understated; the welfare of rural people could be substantially improved. By overcoming the digital divide at least partially, digitalised services can be delivered by overcoming geographical distance.

These are the essence of policymaking to achieve a balance between urban and rural areas.

Industrial inclusiveness

Industrial inclusiveness is a serious issue. There exists a huge development gap between large companies and MSMEs. There is a long-lasting debate on whether governments should provide subsidies or other preferential arrangements for MSMEs or not. In any case, we must at least remove disadvantageous conditions to cancel out market failures.

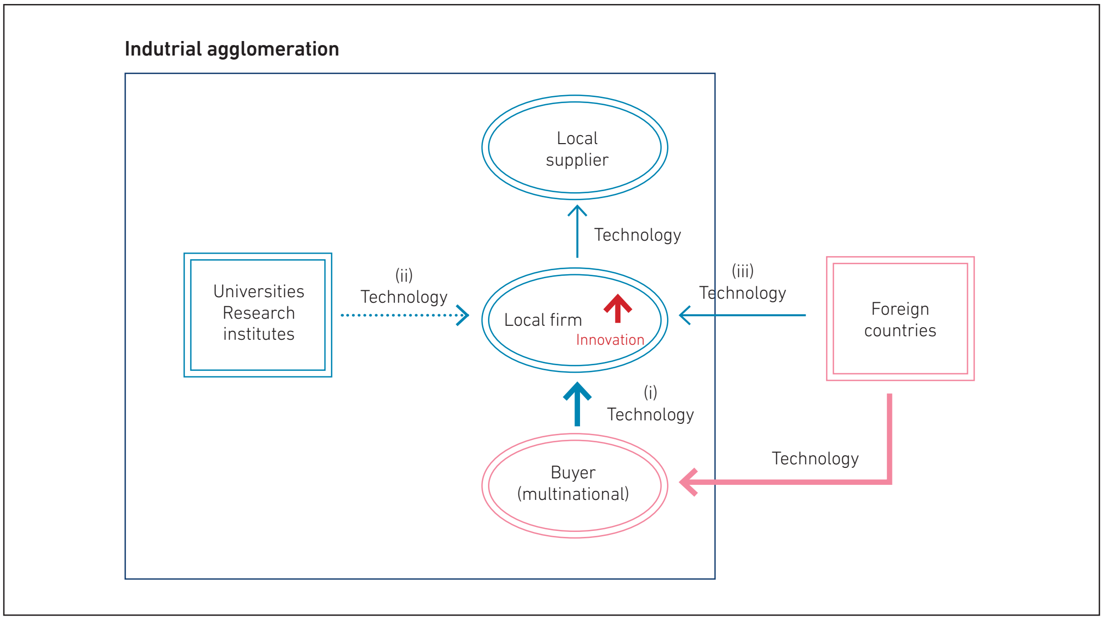
Policies for SME development in AMS are systematically reviewed by the SME Policy Index (OECD and ERIA, 2018) in eight dimensions:
(i) Productivity, technology, and innovation
(ii) Environmental policies and SMEs
(iii) Access to finance
(iv) Access to market and internationalisation
(v) Institutional framework
(vi) Legislation, regulation, and tax
(vii) Entrepreneurial education and skills
(viii) Social enterprises and inclusive SMEs

At a lower development stage, SMEs tend to have internal constraints regarding product quality and delivery timing, business plans, bookkeeping, entrepreneurship, and engineers; thus, building up basic capability at the firm level should be a priority. At a higher development stage, external constraints become crucial; solving market failure through better access to finance, market/matching, and technological resources will be important.[22]

Filling the gap between multinationals and local firms is often crucial. For the manufacturing sector, a number of empirical studies have confirmed vertical technology spillovers; the seminal work is Javorcik (2004). Based on an extensive questionnaire survey in ASEAN, Kimura, Machikita, and Ueki (2016) found that local firms get access to technologies through technology transfer from multinational buyers in the same industrial agglomeration. In general, firms in developing countries may obtain technologies (i) directly from foreign countries, (ii) through domestic universities and research institutes, and (iii) through vertical links with multinational plants in the country (Figure 1.24). While Japan, Korea, and Taiwan used to depend mainly on the first and second channels, ASEAN takes advantage of the third channel, at least for process innovation or productivity upgrading. Industrial agglomeration nurtures inter-firm linkages.

[22] In Chapter 14, Narjoko reviews MSME responses to COVID-19 and discusses the way forward.

Figure 1.24 Channels to Obtain Access to Technologies in ASEAN



Source: ERIA (2015).

Aggressive use of digital technology should also be promoted. COVID-19 has accelerated the use of CT in GVCs. SMEs are generally slow in adopting digital technology but need to catch up with the irreversible changes. E-payments and e-IDs are penetrate further, potentially helping SMEs expand their scope of businesses. The digital divide must be resolved. Strengthening digital skills (the abilities, skills, and knowledge essential to keep up with digital transformation), education, and technical and financial support for SMEs will not only contribute to digitalisation in the region but also help them overcome their vulnerability to economic shocks in the post-pandemic era.

Social inclusiveness

Social inclusiveness covers various aspects of the economy and society. Some items require not only government policies and regulations but also people's awareness. Gender, ageing, and persons with disabilities exemplify such issues.[23]

[23] The Healthcare Unit of ERIA has conducted several studies on ageing and basic healthcare, and discussion papers cover issues such as gender (Sey, 2021) and persons with disabilities (Crosta et al., 2021).

The impact of COVID-19 and digital technology on social inclusiveness is also an important topic to investigate. Key issues include education and medical services.[24] Due to COVID-19, education services suddenly had to be delivered online. With significant effort on the ground, the use of CT by educational services has drastically advanced. However, at the same time, regional and income disparity have stood out in the capability of CT use. CT usage will remain to some extent even after COVID-19, depending on the level of education. Inclusiveness must be enhanced not only for short-run equity but also for nurturing human capital for the future.

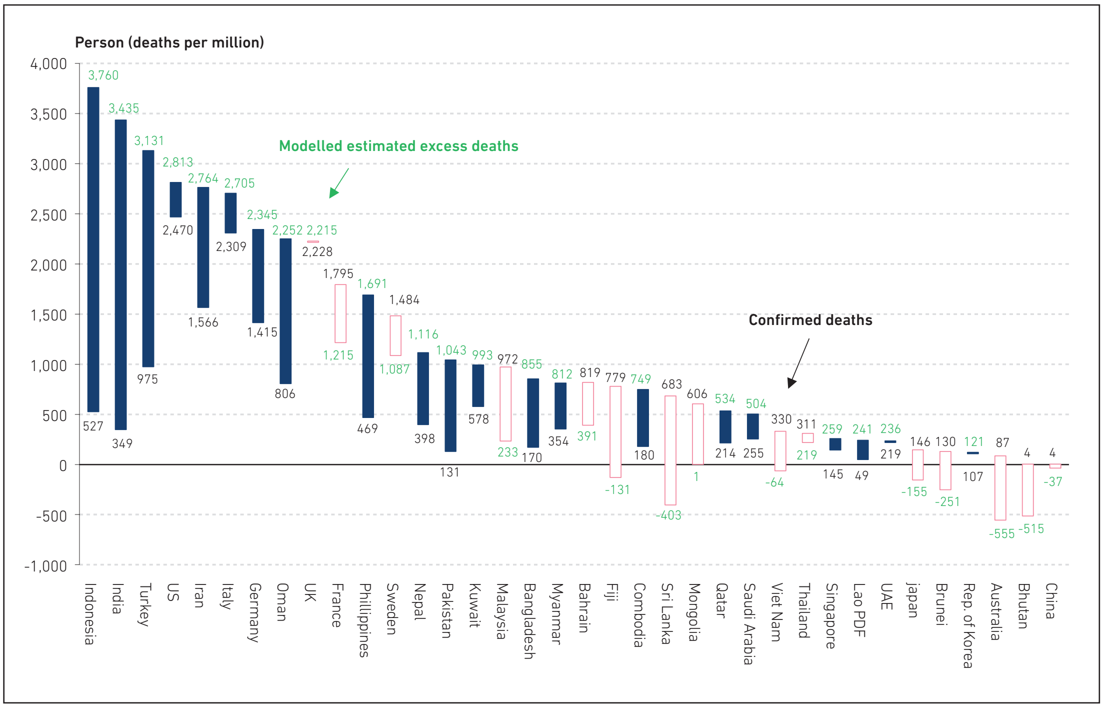
The capability of medical services has attracted attention since the beginning of the pandemic. Figure 1.25 presents the confirmed COVID-19 deaths and estimated excess deaths per million population up to the end of 2021 in selected countries, based on the World Health Organization (WHO). The number of confirmed COVID-19 deaths per million is not very high in Asian countries compared with the US and European countries. However, excess deaths per million estimated from the past trend are large in some countries. The gaps between estimated excess deaths and confirmed deaths are positive and large in Indonesia, India, and the Philippines. Although the reason why these countries have positive gaps must be carefully investigated, a possible hypothesis is that the gap comes from the underreporting of COVID-19 deaths or excess deaths from other diseases or injuries due to the lack of capacity of medical facilities.[25] In any case, these figures alert us to assess the quality and quantity of medical facilities and services. Basic universal health coverage is essential, and the hierarchy of levels of medical facilities must be well organised. We must also take advantage of digital technology whenever appropriate.[26]

[24] Shrestha discusses the education and skill development system in detail in Chapter 9.

[25] Suriastini et al. (2022) reported the results of a phone survey in two waves for older people in Indonesia during COVID-19.

[26] Yong reviews the healthcare system in the region in Chapter 15 and calls for digitalisation.

Figure 1.25 Confirmed COVID-19 Deaths and Estimated Excess Deaths
(as of 31 Dec 2021)



UAE = United Arab Emirates, UK = United Kingdom, US = United States.

Source: APO (2022). The original data are from World Health Organization and World Bank website.

Another long-term issue is financial inclusion. Access to the payment system and bank accounts has drastically improved with the introduction of smartphones, e-payments, and e-bank accounts, including poor rural people. Various kinds of fintech have also proliferated. Digital technology is changing the paradigm though many things remain to be done to improve financial inclusion.[27]

Another big issue is social protection.[28] Countries with ageing populations will need to consider reform of their pension systems. Before that, health insurance is a priority. Some sort of universal coverage would be the immediate issue. In the private sector, life and auto insurance markets are expanding. Traditional social protection through family ties still exists, but the need to provide formal social protection will intensify in the future.

ASEAN and developing East Asian countries do not have strong progressive tax system and income redistribution measures yet. In the future, this will be an important political issue.

[27] Cavoli and Shrestha (2021) is a recent study on financial inclusion, including the impact of digital technology.

[28] ERIA publications on social protection include Asher and Kimura (2015).

Sustainability

Multidimensional issues for sustainability

The distant future presents many uncertainties. Life is short, and we may not be able to care about the life of our descendants as much as ours, but we can begin by looking at repercussions of the rapid economic growth in the past two centuries and try to avoid a possible crisis for humanity.

At the same time, we should address large development gaps that remain across countries and regions. Developing countries have strong aspirations for economic growth. Economic growth and sustainability must be balanced.

For ASEAN and East Asia, sustainability is not only a long-term goal but also an immediate challenge. Climate change is one challenge that must be addressed immediately. Although the causality may not be well verified, fluctuation in rainfall and frequent typhoons are now annual events. Sea levels are rising. Resource management, particularly water and waste management, are urgent issues. The region is prone to various natural disasters, and an organised system of preparation, rescue, and recovery must be established. How to make sustainability solutions complementary to economic development is key for the region, with countries at different development stages.

Towards a low-carbon economy

Decarbonisation is now a worldwide mission, and countries declaring net zero emissions goals by 2050 or 2060. COVID-19 slowed energy consumption, but the green movement has rather intensified, particularly in Europe. Although the Russia–Ukrainian War is forcing some countries to return to fossil fuels at least temporarily, the move towards decarbonisation is likely to continue.

ASEAN and East Asia have grown on the basis of manufacturing, and some countries heavily depend on fossil fuels. ERIA regularly publishes the *Energy Outlook and Energy Saving Potential in East Asia* to review the long-term energy outlook of the East Asia Summit countries (Kimura and Han, 2021). The report indicates that extra efforts may be required in the region. The long-term transition scenario of primary energy composition must meet energy demands driven by economic and population growth. Not only the supply quantity and carbon dioxide (CO_2) emissions but also elements such as costs and prices, safety and stability, daily/seasonal volatility and complementarity, storability, and others must be carefully considered. The demand side of energy can also do many things. There is huge potential for energy saving and technological progress in industry, transport, homes, and services. International trade and collaboration, such as power grid connections, could also be promoted. The role of the private sector in decarbonisation and environmental issues is increasing.[29] Some companies are trying to establish clean supply chains, and the financial sector prioritises green investment. These efforts must be strengthened further.[30]

Environmental concerns will soon be linked to trade policy. The EU is about to introduce the Carbon Border Adjustment Mechanism, in which the producer side primarily bears the cost of emissions. This will created heated debate.

Resource management and environmental issues

Resource management, other than energy, is also an important sustainability topic for ASEAN and East Asia. Resources may include water, forests, biodiversity, fisheries, and other natural resources. Some issues related to water and fisheries, for example, are cross-border so international coordination may be needed. Technical collaboration, including the introduction of digital technology, must be developed by countries in the region.

Waste management is an urgent matter in many urban and suburban areas in the region. Plastic debris has recently attracted special attention, for which ERIA established the Regional Knowledge Centre for Marine Plastic Debris for ASEAN+3.[31]

ASEAN is promoting the circular economy, for which ERIA is providing policy research.[32] The movement of smart cities also promotes efficient resource circulation as well as innovation capabilities of cities.[33] To solve environmental problems with new technologies (e.g. Industry 4.0, and digital and smart technology), collaboration frameworks with governments, technology developers/suppliers, environmental specialists, the financial sector, and international organisation must be established (Chapter 18). These are important initiatives for the region.

[29] Iwasaki and Ueki discuss the development of electric vehicles and the introduction of digital technology in automobile-related sectors in Chapter 12.

[30] Kimura et al. provide a holistic view of the energy/resource transition in the region in Chapter 17.

[31] https://rkcmpd-eria.org/

[32] https://www.eria.org/news-and-views/eria-supports-development-of-framework-for-circular-economy-for-the-asean-economic-community/

[33] Anbumozhi discusses the concept of smart cities and their possible links with the development of new industries in Chapter 11.

Disaster management

ASEAN and East Asia are vulnerable to natural and disasters induced by human behaviour such drought, floods, typhoons, earthquakes, tsunamis, volcanos, and others. We must learn to live with such disasters. Three important elements for disaster management are preparedness, early responses, and recovery. The region is accumulating good and bad experiences, and countries can learn from each other. The introduction of new technologies such as the use of satellites, early warning systems, and quick rescue schemes should be promoted.

COVID-19 made people think of the risk of GVC disruptions. The best way to make GVCs robust and resilient is to provide more choices for the private sector to extend and diversify its networks. Participation in GVCs by developing countries through improving location advantages and connectivity helps further diversification and better risk management. Our region can be an attractive place for it.

To make GVCs robust and resilient, digitalisation of supply chains and support for trade and market integration are also of great importance. Amongst the immediate actions are investment in digital technologies that can be used for mapping and monitoring supply chains to identify potential risks and bottlenecks. Facilitating cargo clearance and investment in e-commerce platforms will enable fast and secure cross-border movement of goods and services for economic recovery. Supply chains have been built upon the private sector's efforts and activities, and governments have been working towards developing the market environment. Going forward, it might be necessary to work towards a 'quality supply chain' through more public–private coordination, including the standardisation of data sharing and making an ecosystem where not only large companies but all industry players benefit from digitalisation of end-to-end supply chains.

Conclusion

This chapter claims that new development strategies for ASEAN and developing East Asia must be based on four pillars: integration, innovation, inclusiveness, and sustainability.

Integration is always at the core of development strategies. ASEAN and developing East Asia have an advantage in their capability of using three types of international division of labour – i.e. the first to the third unbundling – at the same time. The region should continuously commit to globalisation to accelerate economic development.

Digital technology has changed innovation. ASEAN and developing East Asia must shift their weight from national innovation systems with heavy R&D to accelerating technology deployment. The combination of incremental and disruptive innovation may transform the manufacturing sector into a creative industry again.

Inclusiveness in three dimensions – geographical, industrial, and societal – is an important value for ASEAN and East Asia. Whenever possible, the region should use economic forces to achieve inclusiveness before resorting to income/welfare redistribution.

Sustainability must be achieved with economic growth and enhancement of people's welfare. Decarbonisation, resource management, and disaster management are not only long-term goals but also immediate challenges. The deployment of new technologies will help us with international collaboration.

References

Ando, M. and K. Hayakawa (2021), 'Global Value Chains and COVID-19: An Update on Machinery Production Networks in East Asia', *ERIA Policy Brief*, No. 2021-04. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Ando, M. and F. Kimura (2005), 'The Formation of International Production and Distribution Networks in East Asia', in T. Ito and A.K. Rose (eds.) *International Trade in East Asia,* NBER–East Asia Seminar on Economics, Volume 14. Chicago: University of Chicago Press: pp.177–213.

Ando, M. and F. Kimura (2012), 'How Did the Japanese Exports Respond to Two Crises in the International Production Networks? The Global Financial Crisis and the Great East Japan Earthquake', *Asian Economic Journal*, 26(3), pp.261–87.

Ando, M., F. Kimura, and A. Obashi (2021), 'International Production Networks Are Overcoming COVID-19 Shocks: Evidence from Japan's Machinery Trade', *Asian Economic Papers*, 20(3), pp.40–72.

Ando, M., F. Kimura, and K. Yamanouchi (2022a), 'The RCEP and International Production Networks', in F. Kimura, S. Thangavelu, and D. Narjoko (eds.), Regional Comprehensive Economic Partnership (RCEP): Implications, Challenges, and Future Growth of East Asia and ASEAN. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Ando, M., F. Kimura, and K. Yamanouchi (2022b), 'East Asian Production Networks Go Beyond the Gravity Prediction', *Asian Economic Papers*, 21(2), pp.78–101.

Ando, M., K. Yamanouchi, and F. Kimura (2021), 'Potential for India's Entry into Factory Asia: Some Casual Findings from International Trade Data', *ERIA Discussion Paper Series*, No. 381, ERIA-DP-2021-14. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Asher, M.G. and F. Kimura, eds. (2015), *Strengthening Social Protection in East Asia.* Oxon and New York: Routledge.

APO (2021), *APO Productivity Databook 2021*. Tokyo: Asian Productivity Organization.

APO (2022), *APO Productivity Databook 2022*. Tokyo: Asian Productivity Organization.

Baldwin, R. (2016), *The Great Convergence: Information Technology and the New Globalization*. Cambridge, MA: The Belknap Press of Harvard University Press.

Baldwin, R, R. Forslid, P. Martin, G. Ottaviano, and F. Robert-Nicoud (2003), *Economic Geography and Public Policy*. Princeton: Princeton University Press.

Bower, J.L. and C.M. Christensen (1995), 'Disruptive Technologies: Catching the Wave', *Harvard Business Review*, 73(1), pp.43–53.

Cavoli, T. and R. Shrestha, eds. (2022), *Financial Inclusion in Asia and Beyond: Measurement, Development Gaps, and Economic Consequences*. Oxon and New York: Routledge.

Chen, L. et al. (2019), 'The Digital Economy for Economic Development: Free Flow of Data and Supporting Policies', Policy Brief for T20 Summit 2019. https://t20japan.org/policy-brief-digital-economy-economic-development/.

Crosta, N., A. Sanders, G.A. Marsan, and L.M. Sabrina (2021), 'Social Enterprises and Disability: Promoting Inclusion, Innovation, and Entrepreneurship in ASEAN', *ERIA Policy Brief*, No. 2021-06. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

ERIA (2010), *The Comprehensive Asia Development Plan*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

ERIA (2012), *Phnom Penh Initiatives for Narrowing Development Gaps*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

ERIA (2015), *The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

ERIA (2020), *Subregional Development Strategy in ASEAN After COVID-19: Inclusiveness and Sustainability in the Mekong Subregion (Mekong 2030)*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Fajgelbaum, P., P.K. Goldberg, P.J. Kennedy, A. Khandelwal, and D. Taglioni (2021), 'The US–China Trade War and Global Reallocations', *NBER Working Paper Series,* No. 29562. Cambridge, MA: National Bureau of Economic Research.

Freund, C., M. Maliszewska, A. Mattoo, and M. Ruta (2020), 'When Elephants Make Peace: The Impact of the China–US Trade Agreement on Developing Countries', *Policy Research Working Paper*, No. 9173. Washington, DC: World Bank.

Fujita, M., P. Krugman, and A.J. Venables (1999), *The Spatial Economy: Cities, Regions and International Trade*. Cambridge, MA: MIT Press.

Glaeser, E.L., J. Kolko, and A. Saiz (2001), 'Consumer city', *Journal of Economic Geography,* 1(1) (January), pp.27–50.

Javorcik, B.S. (2004), 'Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages', *American Economic Review*, 94(3), pp.605–27.

Jones, R.W. and H. Kierzkowski (1990), 'The Role of Services in Production and International Trade: A Theoretical Framework', in R.W. Jones and A.O. Krueger (eds.) *The Political Economy of International Trade: Essays in Honor of Robert E. Baldwin.* Oxford: Basil Blackwell, pp.31–48.

Kimura, F. (2018), 'Unbundling Regimes and Development Strategies in ASEAN: Old Issues and New Challenges', *Journal of Southeast Asian Economies*, 35(1), pp.13–21.

Kimura, F. (2021), 'RCEP from the Middle Powers' Perspective', *China Economic Journal,* 14(2), pp.162–70.

Kimura, F. (2022), 'A Framework for Ongoing Commitments to RCEP Process', *East Asia Forum Quarterly*, 14(1), pp.3–5.

Kimura, F. and M. Ando (2005), 'Two-Dimensional Fragmentation in East Asia: Conceptual Framework and Empirics', *International Review of Economics and Finance*, 14(3), pp.317–48.

Kimura, F., T. Machikita, and Y. Ueki (2016), 'Technology Transfer in ASEAN Countries: Some Evidence from Buyer-Provided Training Network Data', *Economic Change and Restructuring*, 49(2–3), pp.195–219.

Kimura, S. and P. Han, eds. (2021), *Energy Outlook and Energy Saving Potential in East Asia 2020*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Lamy, P. and N. Köhler-Suzuki (2022), 'Deglobalization Is Not Inevitable: How the World Trade Organization Can Shore Up the Global Economic Order', *Foreign Affairs*, 9 June.

Miroudot, S. (2020), 'Resilience Versus Robustness in Global Value Chains: Some Policy Implications', VOX CEPR Policy Portal, 18 June. https://voxeu.org/article/resilience-versus-robustness-global-value-chains.

Obashi, A. (2010), 'Stability of Production Networks in East Asia: Duration and Survival of Trade', *Japan and the World Economy*, 22(1), pp.21–30.

Obashi, A. and F. Kimura (2018), 'Are Production Networks Passé? Not Yet', *Asian Economic Papers*, 17(3), pp.86–107.

Obashi, A. and F. Kimura (2021), 'New Developments in International Production Networks: Impact of Digital Technologies', *Asian Economic Journal*, 35(2), pp.115–41.

Okubo, T., F. Kimura, and N. Teshima (2014), 'Asian Fragmentation in the Global Financial Crisis', *International Review of Economics and Finance*, 31, pp.114–27.

OECD and ERIA (2018), *SME Policy Index: ASEAN 2018 – Boosting Competitiveness and Inclusive Growth*. Paris and Jakarta: Organisation for Economic Co-operation and Development (OECD) and Economic Research Institute for ASEAN and East Asia (ERIA).

Oikawa, K., Y. Todo, M. Ambashi, F. Kimura, and S. Urata (2021), 'The Impact of COVID-19 on Business Activities and Supply Chains in the ASEAN Member States and India', *ERIA Discussion Paper Series*, No. 384, ERIA-DP-2021-17. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Rodrik, D. (2016), 'Premature Deindustrialization' *Journal of Economic Growth*, 21(1), pp.1–33.

Schmidt, G.M. and C.T. Druehl (2008), 'When Is Disruptive Innovation Disruptive?' *Journal of Product Innovation Management*, 25(4), pp.347–69.

Sey, A. (2021), 'Gender Digital Equality Across ASEAN', *ERIA Discussion Paper Series,* No. 358, ERIA-DP-2020-31. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Shapiro, C. and H.R. Varian (1998), *Information Rules: A Strategic Guide to the Network Economy*. Cambridge, MA: Harvard Business Review Press.

Suriastini, N.W., E.D. Mulyanto, I.Y. Wijayanti, O. Komazawa, T. Kato, Maliki, and D.D. Kharisma (2022), *Older People and COVID-19 in Indonesia (2022 Edition)*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), National Development Planning Agency (BAPPENAS), and SurveyMETER.

WTO (2021), *World Trade Statistical Review* 2021. Geneva: World Trade Organization.

WTO (n.d.), Trade in Services data by mode of supply (TISMOS). https://www.wto.org/english/res_e/statis_e/trade_datasets_e.htm (accessed 26 August 2022)

PART 1
Integration

Chapter 2

Trade Facilitation and Non-Tariff Measures

Salvador Buban
Policy Fellow, ERIA

Doan Thi Thanh Ha
Economist, ERIA

This chapter (i) discusses the role of trade facilitation in reducing trade costs, (ii) sketches the progress on trade facilitation in East Asian countries, and (iii) discusses policy options for East Asian countries to accelerate trade facilitation in the context of the second and third unbundlings. Trade facilitation comprises two dimensions - hard infrastructure, such as information and communication technology (ICT), transportation facilities, and storage facilities; and soft infrastructure, which covers regulatory reforms to simplify and speed up export and import procedures. In this chapter, we focus on the latter dimension.

Introduction

Broadly speaking, trade facilitation includes policy measures aimed at minimising the cost, time, and uncertainty associated with engaging in international trade. As such, trade facilitation aims to address bottlenecks to export and import activities both at the border and behind the border. At its core, a trade facilitation framework focuses on four key pillars: (i) transparency and predictability of trade regulations, (ii) risk management in trade, (iii) effective implementation of trade-related laws and regulations, and (iv) efficient movement of goods and associated services and information across borders (ADB and UNESCAP, 2013: 6).

Tariffs, as a conventional trade policy tool, have decreased significantly across the years. Yet, trade costs remain sizeable. Aside from the inadequate hard infrastructure, weak soft infrastructure – such as poor design of standards; complex export and import procedures; difficulty in getting access to information; lack of transit, transport, and e-commerce facilities; and incompetency of official personnel – contribute to this cost. The World Trade Organization (WTO, 2015), for instance, estimated that trade costs in developing countries are equivalent to applying a 219% ad valorem tariff on international trade. Even in advanced economies, the figure is as high as 134%. The report also found that full implementation of the WTO's Trade Facilitation Agreement (TFA) could potentially reduce the trade cost by 14.3% on average. For Asia and the Pacific, full implementation of the WTO TFA would result in a 9% reduction in trade costs (ADB and UNESCAP, 2017). In a more ambitious scenario where paperless trade measures not included in the WTO TFA are implemented, trade costs could fall by as much as 16%.

It is worth noting here that, unlike tariffs, trade cost-generating policy measures could enhance social welfare. That is particularly the case for non-tariff measures (NTMs), which are defined as policy measures, other than ordinary tariffs, that can have an impact on international trade by changing the price or quantity traded (UNCTAD, 2013). Examples of potential welfare-enhancing NTMs are regulations on product quality, consumers' health and safety, and environmental protection. While they are legal under the WTO, a plethora of administrative procedures associated with NTMs could be costly and time-consuming for firms to comply with. Indeed, the poor design and implementation of NTMs could result in remarkable trade costs (Kee, Nicita, and Ollareaga, 2009; Hoekman and Nicita, 2011; Ing and Cadot, 2019). Efforts to reduce the regulatory burden, therefore, should address NTMs in a pragmatic manner to minimise trade costs without compromising the legitimate objectives of NTMs.

The increasing fragmentation of international production networks, where goods move across borders multiple times, magnifies these costs. A barrier on imports of intermediate inputs, for example, could result in higher costs for firms in the downstream sectors, thus reducing competitiveness in the export market. Lower cumulative trade costs would then enable firms' entry and growth in the global value chain (GVC). As such, trade facilitation becomes a crucial determinant of GVC participation and export success (OECD and WTO, 2015; Portugal-Perez and Wilson, 2012; Helble, Shepherd, and Wilson, 2009; Kummritz, Taglioni, and Winkler, 2017).

In this context, the policy focus aimed at lowering trade costs has shifted from tariffs and conventional non-tariff barriers such as quotas and voluntary export restraints to broader trade facilitation. Indeed, the growing importance of trade facilitation in international trade is manifested by the efforts and initiatives undertaken worldwide. A forerunner of these efforts was the Revised Kyoto Convention, which aims to harmonise and simplify customs procedures and practices to ensure transparency and predictability in the clearance of goods. Another milestone was the entry into force of the WTO TFA in February 2017, which contains commitments from WTO members in expediting the movement, release and clearance of goods, transit, including measures for effective cooperation between customs administrations and relevant authorities on trade facilitation and customs compliance issues, and technical assistance provisions.

On the regional front, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Framework Agreement on Facilitation of Cross-Border Paperless Trade in Asia and the Pacific aims to accelerate the implementation of digital trade facilitation measures for trade and development, as well as help develop countries' capacity to engage in cross-border paperless trade. Likewise, recent and modern free trade agreements (FTAs) such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP), also contain more ambitious and trade facilitative provisions than earlier FTAs.

Overall Status of Implementation of Trade Facilitation Measures (ASEAN+6 Countries/East Asia Summit)

Economies all over the world have been progressing their implementation of trade facilitation measures and initiatives through the World Customs Organization (WCO), WTO, FTAs, and other regional initiatives. It is imperative, however, that progress be regularly monitored to assist economies to better understand their respective situations to produce evidenced-based policies.

The United Nations (UN) has been conducting the biennial Global Survey on Digital and Sustainable Trade Facilitation to collect information on the implementation of digital and sustainable trade facilitation measures from economies around the world. The surveys are prepared according to the final list of commitments in the WTO TFA, as well as cross-border paperless trade measures covered under the Framework Agreement on Facilitation of Cross-Border Paperless Trade in Asia and the Pacific, and other measures implemented by the UN Regional Commissions.

The UN survey report in 2021 (UNESCAP, 2021) categorised common measures into five groups, with measures on (i) general trade facilitation, (ii) digital trade facilitation, (iii) sustainable trade facilitation, (iv) trade finance, and (v) trade in times of crisis.[1] For the purpose of this chapter, only measures in the subgroups under general trade facilitation and digital trade facilitation will be covered in describing the implementation of trade facilitation measures (Table 2.1).

[1] The last two groups were introduced in the 2021 survey.

Table 2.1 **Grouping of Trade Facilitation Measures and Correspondence with WTO TFA Articles**

Grouping		Trade Facilitation Measures
General Trade Facilitation Measures	Transparency	Publication of existing import–export regulations on the internet
		Stakeholder consultation on new draft regulations (prior to their finalisation)
		Advance publication/notification of new regulations before their implementation (e.g. 30 days prior)
		Advance ruling (on tariff classification)
		Independent appeal mechanism (for traders to appeal customs rulings and
	Formalities	Risk management (as a basis for deciding whether a shipment will be physically inspected or not)
		Pre-arrival processing
		Post-clearance audit
		Separation of release from final determination of customs duties, taxes, fees, and charges
		Establishment and publication of average release times
		Expedited shipments
		Trade facilitation measures for authorised operators
		Acceptance of paper or electronic copies of supporting documents required for import, export, or transit formalities
	Institutional cooperation and arrangement	Establishment of a national trade facilitation committee or similar body
		Cooperation between agencies on the ground at the national level
		Government agencies delegating controls to customs authorities
		Alignment of working days and hours with neighbouring countries at border crossings
		Alignment of formalities and procedures with neighbouring countries at border crossings

Grouping		Trade Facilitation Measures
Digital Trade Facilitation Measures	Transit facilitation	Transit facilitation agreement(s) with neighbouring country(ies)
		Customs authorities limit the physical inspection of transit goods and use risk assessment
		Supporting pre-arrival processing for transit facilitation
		Cooperation between agencies of countries involved in transit
	Paperless trade	Electronic/automated customs system established (e.g. Automated System for Customs Data)
		Internet connection available to customs and other trade control agencies at border crossings
		Electronic Single Window System
		Electronic submission of customs declarations
		Electronic application and issuance of Import and Export Permit
		Electronic submission of sea cargo manifests
		Electronic submission of air cargo manifests
		Electronic application and issuance of Preferential Certificate of Origin
		E-payment of customs duties and fees
		Electronic application for customs refunds
	Cross-border paperless trade	Laws and regulations for electronic transactions are in place (e.g. e-commerce law, e-transaction law)
		Recognised certification authority issuing digital certificates to traders to conduct electronic transactions
		Customs declaration electronically exchanged between your country and other countries
		Certificate of origin electronically exchanged between your country and other countries
		Sanitary and phytosanitary certificate electronically exchanged between your country and other countries
		Banks and insurers in your country retrieving letters of credit electronically without lodging paper-based documents

TFA = Trade Facilitation Agreement, WTO = World Trade Organization.

Source: UNESCAP (2021).

Table 2.2 shows the average implementation rate of the TFA across the Association of Southeast Asian Nations (ASEAN) Plus Six (ASEAN+6) countries, according to UNESCAP (2021). [2] We observe significant heterogeneity across measures. On average, ASEAN Member States (AMS) have performed relatively well in the implementation of transparency measures, including the circulation of draft regulations and law, achieving the highest score of 80%. Formalities follow closely at 70%. Two categories with implementation rates below 50% are institutional cooperation and arrangement (37%) and cross-border paperless trade (14%). Cross-border paperless trade records a score of 0 in six out of 10 AMS, suggesting ample room to reduce trade costs through digital trade facilitation. This area is relatively new and requires extra investment in human resources and ICT infrastructure, which poses new challenges for less developed countries. Not surprisingly, the Plus Six countries score higher than the ASEAN average, although we observe a similar pattern of progress compared with AMS.

Table 2.2 also reveals large cross-country differences in the implementation rate, reflecting the development gap amongst individual economies. In ASEAN, Singapore, Thailand, and Malaysia are more advanced. Interestingly, Cambodia is catching up remarkably. Singapore is the lead in the region, pairing well with Australia, Japan, and New Zealand in categories where data are available, whereas the Lao People's Democratic Republic (Lao PDR), Myanmar, and Viet Nam have a long way to catch up.[3]

[2] The Plus Six countries are Australia, China, India, Japan, the Republic of Korea, and New Zealand.

[3] Japan and New Zealand do not have transit facilitation.

Table 2.2 Implementation of Various Trade Facilitation Measures in the ASEAN+6 Countries, 2021 (%)

Item	ASEAN											Plus Six Partners						
	Average	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	Average	Australia	China	India	Japan	Rep. of Korea	New Zealand
Transparency	**80%**	80%	100%	80%	80%	100%	20%	100%	100%	80%	60%	**100%**	100%	100%	100%	100%	100%	100%
Formalities	**70%**	100%	75%	88%	13%	100%	0%	100%	100%	100%	25%	**96%**	100%	88%	88%	100%	100%	100%
Institutional cooperation and arrangements	**37%**	0%	67%	33%	33%	33%	33%	33%	100%	33%	0%	**72%**	100%	67%	67%	67%	67%	67%
Paperless trade	**53%**	56%	44%	89%	0%	78%	22%	56%	100%	78%	11%	**93%**	100%	89%	89%	89%	100%	89%
Cross-border paperless trade	**14%**	0%	17%	0%	0%	40%	0%	0%	33%	50%	0%	**42%**	50%	17%	33%	33%	33%	83%
Transit facilitation	**61%**	100%	100%	75%	25%	75%	25%	NA	100%	25%	25%	**44%**	100%	25%	0%	NA	50%	NA
Country average		56%	67%	61%	25%	71%	17%	58%	89%	61%	20%		92%	64%	63%	78%	75%	88%

ASEAN = Association of Southeast Asian Nations, NA = not applicable.

Note: The table shows the proportion of measures that are fully implemented in each ASEAN Member State. The proportion for ASEAN is a simple average across all ASEAN Member States.

Source: UNESCAP (2021).

Table 2.3 shows the change in implementation rates from 2019 to 2021 in the ASEAN+6 countries. Overall, trade facilitation has improved, as the rates increase across all categories, reflecting the efforts of individual economies as well as the progress made through regional initiatives. The pattern, however, remains relatively similar in both years. Limited progress in cross-border paperless trade, in particular, requires further effort and investment.

Table 2.3 Implementation of Various Trade Facilitation Measures in the ASEAN+6 Countries, 2019–2021

Item	ASEAN Plus 6		ASEAN		Plus 6 Partners	
	2019	2021	2019	2020	2019	2021
Transparency	80%	88%	72%	80%	93%	100%
Formalities	75%	80%	68%	70%	88%	96%
Institutional cooperation and arrangements	42%	50%	30%	37%	61%	72%
Paperless trade	60%	68%	49%	53%	78%	93%
Cross-border paperless trade	21%	24%	9%	14%	41%	42%
Transit facilitation	50%	56%	56%	61%	38%	44%
Average	55%	61%	47%	53%	66%	74%

ASEAN = Association of Southeast Asian Nations.

Note: ASEAN refers to the 10 ASEAN Member States: Brunei Darussalam, Cambodia, Indonesia, the Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam. The Plus Six Partners refer to Australia, China, India, Japan, New Zealand, and the Republic of Korea.

Source: Authors' calculation from UNESCAP (2021).

An important point that can be drawn from the results of this survey is that while the regional average on general trade facilitation measures like transparency (including measures such as stakeholder consultations on new draft regulation) rank high in the implementation rates, the regional average on the implementation of digital trade facilitation measures is lower. Digital trade facilitation is also the area where the gap between developed and developing countries in our sample is the largest. Amongst AMS, the general trade facilitation measures have a high level of implementation (transparency 80%, formalities 70%), while paperless trade (53%) and cross-border paperless trade (14%) have a low level of implementation. On the other hand, in the Plus Six Partners, the average level of implementation of digital trade facilitation measures for paperless trade (93%) and cross-border paperless trade (42%) are significantly higher than the ASEAN average. This gap reflects the availability (or lack) of soft and hard infrastructure to support digital trade, such as ICT, the legal framework to manage digital trade, and skilled labour.

The results of the UN Survey Report 2021 also reflect the outcome of the ASEAN Seamless Trade Facilitation Indicators (ASTFI) Baseline Study prepared by the Economic Research Institute for ASEAN and East Asia (ERIA) and submitted to the ASEAN Trade Facilitation Joint Consultative Committee in 2018. The ASTFI is an ASEAN-specific trade facilitation indicator which was developed to measure the extent of progress on trade facilitation and to identify the gaps in its implementation in each AMS and in the region. It provides the status and progress of the trade facilitation environment in ASEAN and in AMS, highlighting trade facilitation efforts and best practices as of 2018. The ASTFI is based on a survey of the major trade-related government agencies of each AMS. It includes measures on transparency and engagement with the private sector; the core trade facilitation measures of clearance and release formalities as well as export and import formalities and coordination; and measures for transit, transport, and e-commerce facilitation (ERIA, 2021b).[4]

According to the 2018 ASTFI survey, AMS performed well in transparency and information on laws, regulations, and procedures, as well as in components related to communication and engagement with the private sector. Under these components, AMS established informative and user-friendly websites containing customs and trade-related laws and regulations. Likewise, some AMS did well on release and clearance formalities. Moderate progress was seen in cross-border coordination and transit facilitation, and transport facilitation, where ASEAN transport-related protocols were yet to be implemented. Finally, both the ASTFI and the UN surveys indicate that AMS are lagging on cross-border paperless trade.

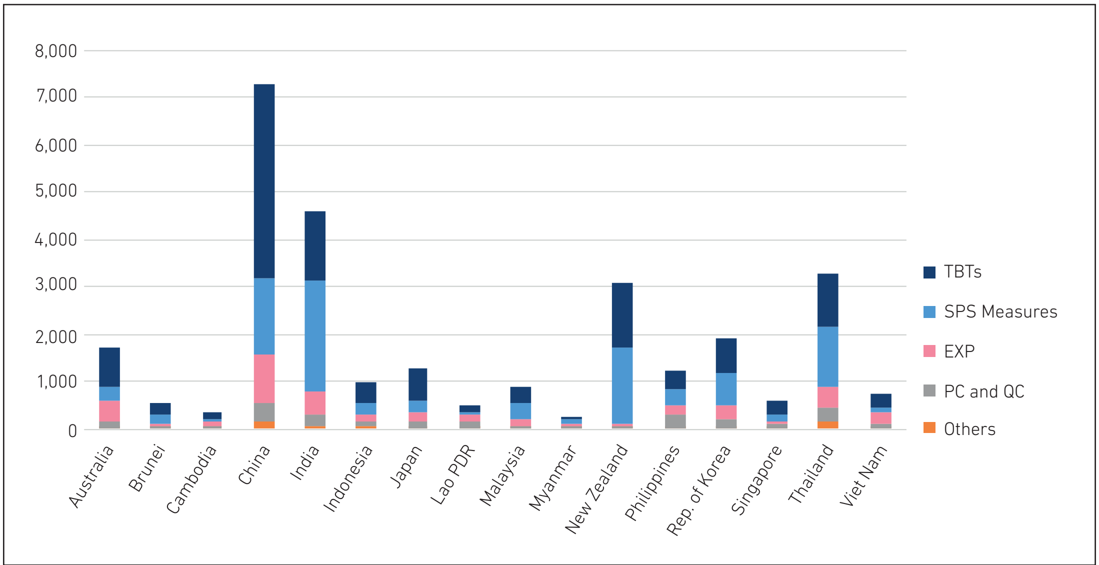
[4] As of September 2021, a follow-up study is being prepared to capture the progress of AMS in improving the trade facilitation environment.

Non-Tariff Measures

As tariffs decline, addressing NTMs has become a new focus of regional economic integration efforts. The ASEAN+6 NTM database developed by ERIA, in collaboration with the United Nations Conference on Trade and Development (UNCTAD), is an attempt to support this endeavour (Doan, Rosenow, and Buban, 2019; UNCTAD, n.d., 2020). Contrary to the common perception that the number of NTMs should decline following trade liberalisation, over a 3-year period we observe a 15% increase in the NTM count across AMS.[5] ASEAN-wide, about 9,500 measures were in place in 2018. In sectors with strong value chain participation (e.g. food products, machinery, and electrical), 80%–90% of trade is subject to NTMs (Doan, Rosenow, and Buban, 2019).

Traded products are also heavily regulated in the Plus Six countries, where the total number of NTMs is twice that of ASEAN. China alone accounted for more than 7,000 measures. Overall, for 16 countries in the region, we find about 6,700 regulations containing NTMs, with the corresponding number of measures totalling 28,000 – affecting virtually all products traded at the national tariff line.

Figure 2.1 NTMs Count in ASEAN+6 Countries by NTM Category



ASEAN = Association of Southeast Asian Nations, NTM = non-tariff measure, SPS = sanitary and phytosanitary, TBT = technical barrier to trade.

Note: Numbers are not comparable across countries. Data years vary.

Source: Author's calculation from UNCTAD's TRAINS database. Accessed from https://trains.unctad.org on June 12 2020 (Doan, Rosenow, and Buban, 2019; UNCTAD, n.d., 2020).

[5] For the Plus Six countries, we only have cross-sectional data for 2017. Therefore, we cannot capture changes across time.

These numbers, though illustrative, should be interpreted with caution. A large NTM count does not imply stricter protection. On the one hand, NTM prevalence reflects how countries respond to various policy needs, including protecting consumers and enhancing competitiveness by improving product standards. As a country becomes more integrated into the global economy, it needs a greater number of high-quality trade regulations. Having just a few NTMs could reflect gaps in consumer and environmental protection and potential under-regulation. On the other hand, the rise of NTMs in the context of tariff reduction suggests that NTMs are sometimes used as a substitute for tariffs.

In addition, the numbers are not easily comparable across countries. NTM count statistics reflect important sources of discrepancy in the way countries issue their regulations. For example, a country that promulgates product- or partner-specific regulations will have more NTMs than a country that uses a single regulation to regulate broad product categories. In addition, a single import restriction can be significantly more restrictive than several transparent labelling and packaging requirements (Doan, Rosenow, and Buban, 2019).

While the increase in NTMs reflects the legitimate need to protect humans, animals, and the environment, the prevalence of NTMs has generated non-trivial trade costs. Ing and Cadot (2019), for instance, estimated that the ad valorem equivalent of NTMs in ASEAN is up to 5.7% in manufacturing and 16.6% in agriculture, implying significant added trade costs. In the context of the expanding production network, this cost is magnified and accumulated along the supply chain. Shepherd (2020) found that the ASEAN average effective rate of protection, i.e. the ad valorem equivalent rate taking into account both costs on inputs and final goods, doubles when NTMs are included, compared with the estimate with the tariff per se.

NTM costs are exacerbated by the non-harmonised regulatory structure across countries. A multi-destination exporter has to comply with regulations in all the markets it serves. Regulatory divergence, which refers to inconsistencies or dissimilarity in regulations across countries, multiplies the procedures faced by traders. Table 2.4 suggests ample room for regulatory convergence across AMS. Indeed, the Similarity Index of the NTM structure across ASEAN is relatively low. Even for country pairs with the highest level of similarity, such as between Brunei and Singapore or Brunei and Malaysia, the figure is only 30%. The ASEAN average regulatory Similarity Index is about 16% and has remained stable between 2015 and 2018.

Table 2.4 Top 10 ASEAN Country Pairs with Highest Regulatory Similarity Index, 2015 and 2018

Rank	2018			2015		
	Country pair		Similarity	Country pair		Similarity
1	BRN	SGP	0.27	BRN	MYS	0.30
2	BRN	MYS	0.26	BRN	SGP	0.30
3	LAO	MMR	0.23	MYS	SGP	0.27
4	BRN	THA	0.22	MYS	THA	0.26
5	MYS	THA	0.22	SGP	THA	0.23
6	MYS	SGP	0.22	BRN	THA	0.21
7	SGP	THA	0.21	LAO	MMR	0.20
8	BRN	LAO	0.20	IDN	KHM	0.20
9	KHM	VNM	0.20	MMR	VNM	0.19
10	IDN	KHM	0.20	BRN	IDN	0.18

ASEAN = Association of Southeast Asian Nations, BRN = Brunei Darussalam, IDN = Indonesia, KHM = Cambodia, LAO = Lao PDR, MMR = Myanmar, MYS = Malaysia, NTM = non-tariff measure, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Note: We follow the procedure developed by Gourdon, Cadot, and Tongeren (2018) in measuring NTM regulatory similarity between any two countries at the HS6 product level. The Similarity Index is the normalised, aggregated average of regulatory similarity across all NTM-product combinations between a country pair. It yields a value between zero and one since the value of regulatory similarity is binary (zero if country i applies NTM k on product l, but country j does not, and vice versa; and one if both countries apply NTM k on product l). A higher Similarity Index implies more similar NTM regulations between ASEAN Member States. Export-related measures are excluded from the calculation.

Source: Authors' calculation from ERIA-UNCTAD NTMs in ASEAN database (Doan, Rosenow, and Buban, 2019).

Regional Cooperation in ASEAN and its FTA Partners

The ASEAN Economic Community (AEC) 2025 Trade Facilitation Strategic Action Plan (SAP) outlines measurable targets to increase trade flows by facilitating the efficient movement of goods across borders. It also identifies a short-term target of reducing trade transaction costs in the AEC by 10% by 2020, as set by the ASEAN Economic Ministers in 2017 (ASEAN, 2017). The impact target is the doubling of intra-ASEAN trade between 2017 and 2025, while the outcome target is the improvement of AMS in global rankings/surveys (e.g. the World Bank's Ease of Doing Business). A rise in global rankings and surveys would narrow the gap amongst AMS, which is a reflection of improved trade facilitation regimes in ASEAN. To achieve the short-term impact and outcome targets, the SAP lists the strategic objectives and the corresponding outcomes, outputs, and indicators. The progress made in the implementation of various trade facilitation measures in ASEAN, as indicated in the UN survey, is reflected in the improved implementation of the SAP in similar areas. For instance, the performance in trade facilitation categories such as transparency is quite high in ASEAN and the respective AMS because of the establishment of the ASEAN Trade Repository and the national trade repositories (NTRs). AMS have completed the implementation of a number of category A measures of the WTO TFA, while those measures under categories B and C adopted by AMS are at different stages of implementation. Another important initiative – the Authorised Economic Operator programme – has been implemented by six AMS through national programmes that facilitate secure movement of goods and help to reduce trade transaction costs in the region.

Meanwhile, paperless trade and cross-border paperless trade have started taking off with the ASEAN Single Window Live Operation, where granting of preferential tariff treatment under the ASEAN Trade in Goods Agreement (ATIGA) (ASEAN, 2013) is now based on the electronic Certificate of Origin Form D (e-ATIGA CO Form D). In addition, as of 31 March 2021, five AMS (Cambodia, Malaysia, Myanmar, Singapore, and Thailand) have implemented the live exchange of the electronic ASEAN Customs Declaration Document (ACDD), a multipurpose document used for facilitating the exchange of export declaration information amongst AMS. The electronic ACDD aims to support customs authorities in importing countries to carry out risk management process. ASEAN is working on the inclusion of other documents for cross-border paperless trade, such as the electronic Phytosanitary Certificate (e-Phyto), electronic Animal Health Certificate (e-AH), and electronic Food Safety Certificate (e-FS). Some of these documents (e.g. e-Phyto) are in pilot implementation in AMS. ASEAN has also implemented the ASEAN Customs Transit System (ACTS) platform, which aims to create an enhanced cross-border transport environment for efficient and seamless movement of goods within the region. The ACTS facilitates trade by allowing traders to transport their goods freely between participating AMS, so that trucks can travel from their point of loading or departure to their destination in a different country with fewer obstacles and delays (ASEAN, 2020). ACTS land operations were pilot-tested in 2017 and launched in November 2020. The ACTS is implemented along the North–South corridor through Malaysia, Singapore, and Thailand; and the East–West corridor through Cambodia, the Lao PDR, Myanmar, and Viet Nam. The ACTS has been implemented in the six AMS, except Myanmar. Depending on the business needs, the use of the ACTS could be expanded to other AMS such as Brunei, Indonesia, and Thailand.

ASEAN has also introduced four key initiatives to streamline and simplify NTMs in order to enhance trade: (i) ATIGA (ASEAN, 2013), (ii) AEC 2025 Trade Facilitation SAP (ASEAN, 2017), (iii) Guidelines for the Implementation of ASEAN Commitments on Non-Tariff Measures on Goods (ASEAN, 2018), and (iv) Good Regulatory Practice (GRP) Core Principles (ASEAN, 2009).

First, the ATIGA includes provisions relevant to ensuring the transparency and management of NTMs, including (i) the responsibility to notify NTMs that could affect the ATIGA's operation, (ii) the publication of trade-related information through NTRs and the ASEAN Trade Repository, (iii) the elimination of non-tariff barriers, and (iv) the construction of an ASEAN NTM database. In addition to the general provisions on NTMs, the ATIGA contains provisions on the harmonisation of standards, technical regulations, and conformity assessment procedures; mutual recognition arrangements; and the development of a single regulatory regime in certain priority integration sectors.

Second, the third strategic objective of the SAP is to 'Put in place an effective and responsive regional approach to efficiently address the trade distorting effect of NTMs with a view to pursuing legitimate policy objectives while reducing cost and time of doing business in ASEAN' (ASEAN, 2017: 4).

Third, the Guidelines for the Implementation of ASEAN Commitments on Non-Tariff Measures on Goods provide a general framework to improve the transparency and management of NTMs. The recently adopted non-binding guidelines provide for operationalising key ATIGA elements and provisions related to NTMs as mentioned above.

Fourth, the ASEAN GRP Core Principles regional initiative was adopted by AMS to help improve approaches in preparing national laws and regulations. Given the renewed emphasis on better regulations and to follow through on the importance of the GRP in the AEC Blueprint 2025, the ASEAN Economic Ministers adopted the ASEAN Work Plan on GRP, 2016–2025 at the 23rd ASEAN Economic Ministers' Retreat in March 2017, and the AEC Council endorsed it in April 2017. It has also been underscored that enhanced regulatory practice and capacity of individual AMS are key to the successful delivery of national development agendas, and to implementing regional commitments and achieving ASEAN's long-term competitiveness.

Notwithstanding the comprehensive initiatives, progress is uneven and limited. For example, the NTM sections of NTRs are missing for some countries, whereas for others, a centralised trade repository with NTM information is fully operational. Similarly, notification obligations are not well-observed by AMS when it comes to new measures that are established that would affect exports of other AMS. Even for the most progressive initiative – the harmonisation of standards and conformance – implementation is uneven across AMS. Some countries have yet to establish an accreditation body, relying instead on accredited testing facilities in other AMS. This lack of facilities prevents countries from fully benefiting from mutual recognition agreements.

Remaining challenges include enhancing the technical infrastructure capability of AMS to support the adoption of harmonisation standards; the ability to support local industry by making available accredited testing and certification of products in some AMS; and continuous training of personnel to support and sustain the work on standards, technical regulations, and conformity assessments. On top of that, the establishment and effective operation of an inter-ministerial coordinating agency in charge of NTMs ensure smooth implementation of policy. The absence of a coherent mechanism and institution could create difficulty not only for collecting and classifying data but also for drafting effective regulations. The lack of coordination could create inconsistency in the regulations issued by government agencies across ministries.

Unlike the specific initiatives or provisions on trade facilitation and NTMs in ASEAN agreements, which help in contributing to a better trade facilitation environment, most of the ASEAN Plus One FTAs include a more general provision on trade facilitation or customs procedures and NTMs. Aside from the ASEAN–China Free Trade Area and the ASEAN–Australia–New Zealand Free Trade Area, other ASEAN Plus One FTAs have limited provisions or do not have specific trade facilitation or customs procedures chapters. Although the chapters on customs procedures in the ASEAN–China Free Trade Area and the ASEAN–Australia–New Zealand Free Trade Area contain provisions on the use of automated systems and advance rulings, which are important elements, their treatment in the text of the agreements is quite broad and their application is on a best endeavour basis. On NTMs, these ASEAN Plus One FTAs have provisions to address non-tariff barriers, notification of measures, application of standards, and technical regulations, but they are broad and mostly reiterations of their commitments under the WTO. Specific initiatives and work plans on trade facilitation and NTMs need to be worked on further.

In the case of the RCEP, there have been indications of a wider scope and deeper coverage of commitments on trade facilitation and to a certain extent on NTMs. On trade facilitation, it provides clear and predictable implementation of the provisions of the agreement. Although it recognises the different levels of readiness of the parties to the RCEP to implement their obligations, there is certainty as it provides a clear period for countries to implement their commitments through the implementation arrangements provision. Amongst the ASEAN Plus One FTAs, the RCEP provides a clearer picture of trade facilitation commitment and environment.

With regard to NTMs, the RCEP also provides a wider scope for addressing measures that impede trade. It provides mechanisms for technical consultation on NTMs and clear notification procedures, and allows parties to initiate work programmes on sector-specific issues. These elements are important, and may not be as elaborate or clear in ASEAN Plus One FTAs.

Trade Facilitation During the COVID-19 Pandemic

The coronavirus disease (COVID-19) pandemic has brought unprecedented economic disruption. It has also restricted domestic and international travel, which has affected the movement of workers and key technicians/experts, causing delays in the production and expansion of manufacturing in some industries. Supply chains were temporarily affected in the early months of the COVID-19 pandemic, as inputs and intermediate goods failed to reach their destinations due to border closures or production halts in factories, resulting in higher production and logistical costs.

At the onset of the pandemic, governments and businesses were concerned that some countries would impose restrictive measures such as NTMs as part of the COVID-19 protocols, which would impact on trade. However, except for some export restrictions on personal protective equipment and other medical supplies initially imposed due to limited supply, governments have instituted trade facilitative, rather than restrictive, measures. In ASEAN, some AMS introduced trade-related administrative procedures and measures to help ease the burden on businesses. For instance, to help companies avail of the preferential tariff treatment, exporting parties simplified the procedures and requirements for the issuance of certificates of origin, while importing parties facilitated customs authorities' acceptance of certificates of origin by extending the deadline for their submission and accepting copies or scanned certificates of origin instead of printed documents. In addition, export and import procedures were streamlined through digitalisation. In Malaysia, regulators took this opportunity to compel industry to switch to the digital platform. In the Philippines, incentives helped accelerated online services. Licences to use mobile money to pay for low-value goods and services are being pilot-tested in Viet Nam (ERIA, 2021a).

The pandemic has accelerated the use of digital technology. It should be noted that the intensification of the use of cross-border paperless trade and the implementation of ASEAN trade facilitation measures – such as the ACTS, exchange of the e-ATIGA CO Form D, and the initial implementation of the ACDD for some AMS using the ASEAN Single Window platform – took place during the COVID-19 pandemic. The acceptance of digital copies as supporting documents in applications for permits and licences, and in securing the release of goods, has shown to be useful in facilitating trade. The use of cross-border documentation could be improved and leveraging of digital technology has been necessary. Noting the significant benefits of the application of digital technology in facilitating trade, this should be continued and enhanced not only during this pandemic but also in the post-pandemic recovery.

ASEAN signed the Memorandum of Understanding on the Implementation of Non-Tariff Measures on Essential Goods in November 2020, which provides for a moratorium on imposing trade-restricting or distorting NTMs on more than 150 essential goods. The implementation of the memorandum of understanding and the list of essential goods is subject to certain conditions and review, and the list may be modified.

Recommendations

Although various studies have observed progress on trade facilitation, through the implementation of trade facilitation initiatives, digital trade facilitation is an important area which requires further attention. Paperless trade and cross-border paperless trade initiatives, such as the ASEAN Single Window, should be fully implemented to include more documents in cross-border paperless trade (e.g. e-Phyto, e-AH, and e-FS). Prioritising investment in ICT infrastructure and building the capacity of ASEAN government officials could also be on the agenda to ensure improvement in the trade facilitation environment. An important aspect of ICT infrastructure, or platforms such as the ASEAN Single Window, is ensuring interoperability to allow the future exchange of cross-border documents – not only in ASEAN but also with the ASEAN Plus One FTA Partners.

Although the ASEAN+6 Partners may be quite advanced in terms of their own trade facilitation initiatives, cooperation with the wider East Asia Summit region would contribute to improved implementation of measures and initiatives and thus create a better trade facilitation environment. Such cooperation should be enhanced within the purview of the ASEAN Plus One FTAs or in a wider East Asia Summit forum.

References

ADB and UNESCAP (2013), 'Conceptualisation of Trade Facilitation', in *Designing and Implementing Trade Facilitation in Asia and the Pacific: 2013 Update*. Manila: Asian Development Bank and United Nations Economic and Social Commission for Asia and the Pacific, pp.3–14. https://www.unescap.org/resources/designing-and-implementing-trade-facilitation-asia-and-pacific-2013-update on April 28 (accessed 4 September 2020).

ADB and UNESCAP (2017), *Trade Facilitation and Better Connectivity for an Inclusive Asia and Pacific*. Manila: Asian Development Bank and United Nations Economic and Social Commission for Asia and the Pacific.

ASEAN (2009), 'ASEAN Good Regulatory Practice (GRP) Guide'. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/images/2012/Economic/sectoral_aem/standards_conformance/ASEAN%20Good%20Regulatory%20Practice%20(GRP)%20Guide.pdf (accessed 1 July 2020).

ASEAN (2013), 'ASEAN Trade in Goods Agreement'. Jakarta: ASEAN Secretariat. https://www.asean.org/wp-content/uploads/images/2013/economic/afta/atiga%20interactive%20rev4.pdf (accessed 1 July 2020).

ASEAN (2017), 'AEC 2025 Trade Facilitation Strategic Action Plan', https://asean.org/wp-content/uploads/2020/12/Adopted-AEC-2025-Trade-Facilitation-Strategic-Action-Plan-ATF-SAP.pdf (accessed 1 July 2020).

ASEAN (2018), 'Guidelines for the Implementation of ASEAN Commitments on Non-Tariff Measures on Goods'. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/2018/12/Guidelines_for_the_Implementation_of_ASEAN_Commitments_on_NTMs-July_2018-AEM-AFTAC_32.pdf (accessed 1 July 2020).

ASEAN Customs Transit System (2020), Information on ACTS. https://acts.asean.org/acts (accessed 3 October 2021).

Doan, H.T.T., S. Rosenow, and S.M. Buban (2019), 'Non-Tariff Measures and Regional Integration in ASEAN', in H.T.T. Doan and S. Rosenow (eds.) *Non-Tariff Measures in ASEAN – An Update*. Jakarta: ERIA, pp.1-31.

ERIA (2021a), *Joint Study on 10+3 Cooperation for Improvement of Supply Chain Connectivity: ASEAN Sub-Report*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/media/Research-Project-Report/Joint-Study-on-10%2B3-Cooperation-for-Improvement-of-Supply-Chain-Connectivity.pdf (accessed 4 September 2021).

ERIA (2021b), *Towards Seamless Trade Facilitation in ASEAN: Results from the ASEAN Seamless Trade Facilitation Indicators (ASTFI) Baseline Study*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/media/Research-Project-Report/2021-08-Towards-Seamless-Trade-Facilitation-ASEAN/Towards-Seamless-Trade-Facilitation-ASEAN-final.pdf (accessed 5 October 2021).

Gourdon, J., O. Cadot, and F. Tongeren (2018), 'Estimating Ad-Valorem Equivalent of Non-Tariff Measures: Combining Price-Based and Quantity-Based Approaches', *OECD Working Paper*, No. TAD/TC/WP(2017)12/FINAL. Paris: Organisation for Economic Co-operation and Development. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/TC/WP(2017)12/FINAL&docLanguage=En (accessed 14 October 2020).

Helble, M., B. Shepherd, and J.S. Wilson (2009), 'Transparency and Regional Integration in the Asia Pacific', World Economy, 32(3), pp.479-508.

Hoekman, B. and A. Nicita (2011), 'Trade Policy, Trade Costs and Developing Country Trade', World Development, 39(12), pp.2069–79.

Ing, L.Y. and O. Cadot (2019), 'Ad Valorem Equivalents of Non-Tariff Measures in ASEAN', in L.Y. Ing, R. Peters, and O. Cadot (eds.) *Regional Integration and Non-Tariff Measures in ASEAN*. Jakarta: Economic Research Institute for ASEAN and East Asia, pp.40-64. https://www.eria.org/uploads/media/10.ERIA_Book_2019_Reg.Int_NTM_Chapter_4.pdf (accessed 10 October 2020).

Kee, H.L., A. Nicita, and M. Ollarreaga (2009), 'Estimating Trade Restrictiveness Indices', The Economic Journal, 119(534), pp.172–99.

Kummritz, V., D. Taglioni, and D. Winkler (2017), 'Economic Upgrading Through Global Value Chain Participation: Which Policies Increase the Value Added Gains?', *Policy Research Working Paper*, No. 8007. Washington, DC: World Bank.

OECD and WTO (2015), *Aid for Trade at a Glance 2015: Reducing Trade Costs for Inclusive, Sustainable Growth*. Paris: OECD Publishing. https://www.wto.org/english/res_e/booksp_e/aid4trade15_e.pdf (accessed 14 October 2020).

Portugal-Perez, A. and J.S. Wilson (2012), 'Export Performance and Trade Facilitation Reform: Hard and Soft Infrastructure. *World Development*, 40(7), pp.1295–1307.

Shepherd, B. (2020), 'Effective Rates of Protection in a World with Non-Tariff Measures and Supply Chains: Evidence from ASEAN'. Jakarta: Economic Research Institute for ASEAN and East Asia.

UNCTAD (n.d.), TRAINS Portal. https://trainsonline.unctad.org/home (accessed 1 February 2021).

UNCTAD (2013), *Non-Tariff Measures to Trade: Economic and Policy Issues for Developing Countries*. Geneva: United Nations Conference on Trade and Development.

UNCTAD (2020), Non-Tariff Measures in Australia, China, India, Japan, New Zealand and the Republic of Korea. Geneva: United Nations Conference on Trade and Development. https://www.eria.org/publications/non-tariff-measures-in-australia-china-india-japan-new-zealand-and-the-republic-of-korea-preliminary-findings/ (accessed 6 June 2021).

UNESCAP (2021), *Digital and Sustainable Trade Facilitation in Asia and the Pacific 2021*. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific. https://www.unescap.org/sites/default/d8files/knowledge-products/UNTF%20Report.pdf (accessed 2 October 2021).

World Bank (2019), *Doing Business 2020*. Washington, DC: World Bank. https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020 (accessed 17 May 2021).

WTO (2015), *World Trade Report 2015 – Speeding Up Trade: Benefits and Challenges of Implementing the WTO Trade Facilitation Agreement*. Geneva: World Trade Organization. https://www.wto.org/english/res_e/booksp_e/world_trade_report15_e.pdf (accessed 20 October 2020).

Chapter 3

The Importance of Regulatory Coherence for a Connected and Integrated ASEAN

Intan Murnira Ramli
Policy Fellow, ERIA

Mohd Yazid Abdul Majid
Manager, Malaysian Productivity Corporation

Introduction

Regulations are important in achieving public policy objectives such as protecting the environment, worker protections, and public health and safety. Regulatory coherence is critical to the design of effective regulations, and regulatory cooperation should be considered but only implemented where it is both feasible and desirable. Therefore, governments should have established commitments to transparency and stakeholder involvement, as such inputs provide regulators the breadth of information needed to balance costs and benefits.

In attracting investment and spurring innovation in the Association of Southeast Asian Nations (ASEAN) region, ASEAN has developed a good network and exchange of information with other nations, especially developed countries. In the process, each government must meet internal (within the capacity of organisations), external (balancing the efficiency demands of businesses with social obligations), and international (treaty) expectations. In matching those expectations, the governments of the ASEAN Member States (AMS) have undertaken rapid changes and adjustments to ensure their competitiveness and to avoid being left behind.

Regulatory coherence is important to encourage businesses to participate in the market and avoid the dominance of certain firms – creating de facto barriers to entry and innovation. This is especially important as the world moves towards a more innovative economy through digitalisation, and as ASEAN integrates more fully in the global value chain (GVC), for which it needs to boost innovation while increasing trade and investment. Business groups, strong environmental advocates, and multinational corporations have always insisted on being part of decision-making (Farazmand, 2012). These demands have made governments proactive in balancing regulation with the economy, public safety, environmental conservation, and international trade agreements. To address these requirements, the adoption of 'good governance' by the respective governments can address market failures and improve the business environment through regulatory reform that will guarantee market efficiency (Sundaram and Chowdhury, 2013).

Measures of Good Governance

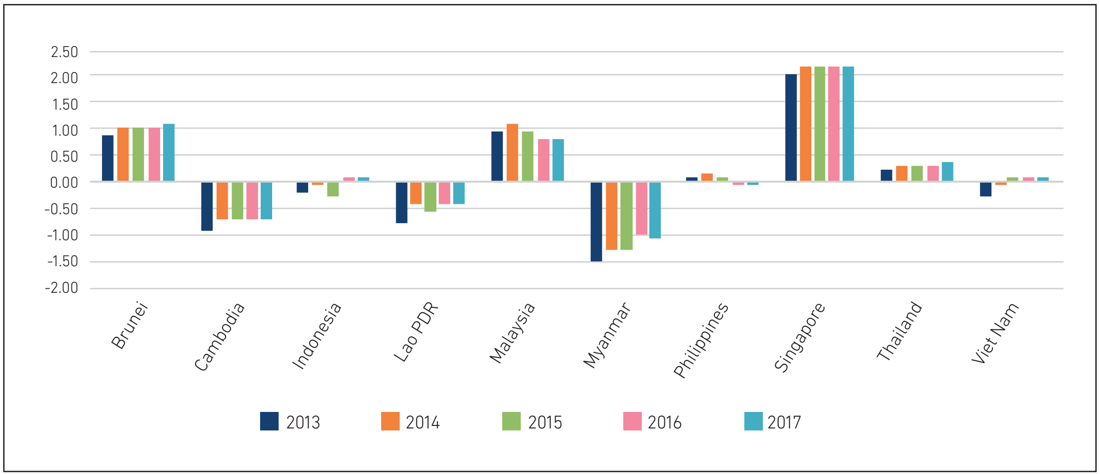
The Worldwide Governance Indicators published by the World Bank have introduced two indicators to measure good governance – **governance effectiveness** and **regulatory quality**:

> **Government effectiveness** captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
>
> **Regulatory quality** captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Government efficiency and regulatory quality indicators are deemed appropriate measures of a country's performance, as they relate to decision-making and the formulation of regulations or policy (Kaufmann, Kraay, and Mastruzzi, 2011).

Government efficiency lies in the quality of the regulations. The data for these indicators are based on the composite data index captured from 30 worldwide data sources (Kaufmann, Kraay, and Mastruzzi, 2011). The indicator ranges from −2.5 to +2.5, with −2.5 representing the lowest level of effectiveness and +2.5 the highest level of effectiveness (Alam, Kiterage, and Bizuayehu, 2017). The indicators summarise the performance of countries within a region. Figures 3.1 and 3.2 present the AMS with positive scores, indicating that they are performing better than AMS with negative scores in government effectiveness and regulatory quality. Empirical evidence shows that good institutions and governance stimulate economic growth (Alam, Kiterage, and Bizuayehu, 2017; Kaufmann, Kraay, and Mastruzzi, 2011).

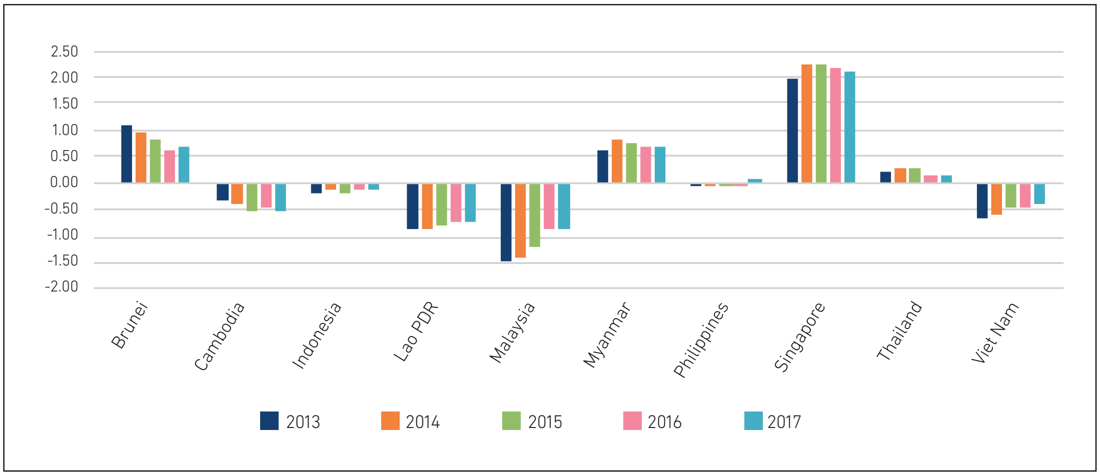
Figure 3.1 Government Effectiveness of AMS, 2013–2017



AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations.

Source: World Bank (2019), GovData360. https://govdata360.worldbank.org/ (accessed 30 November 2019).

Figure 3.2 Regulatory Quality of AMS, 2013–2017



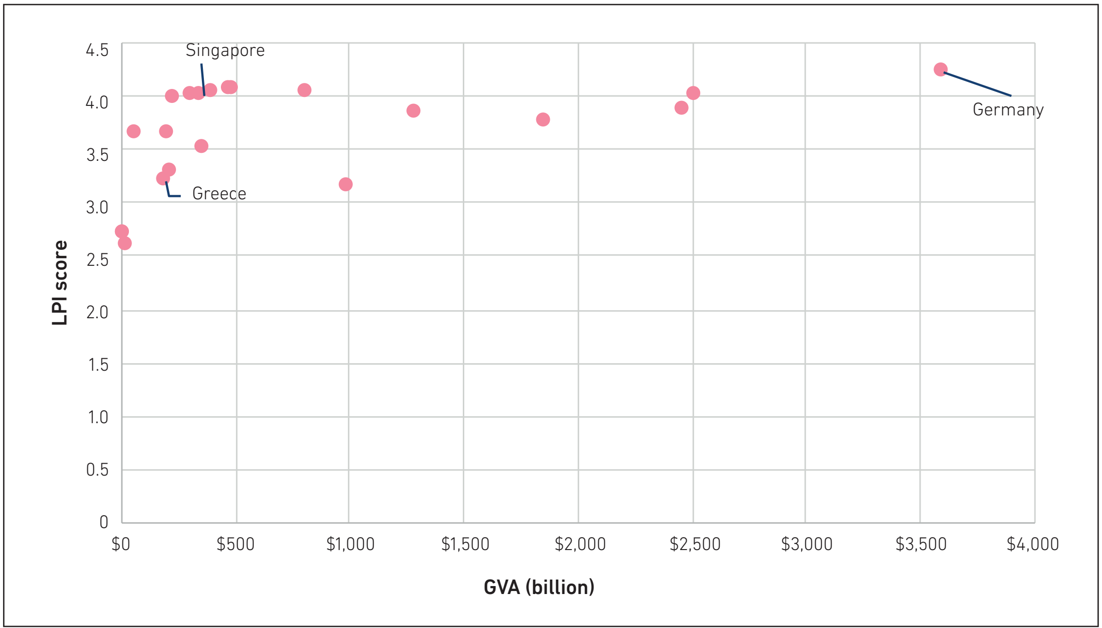
AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations.

Source: World Bank (2019), GovData360. https://govdata360.worldbank.org/ (accessed 30 November 2019).

The complex regulatory frameworks of certain regions may lead to inefficiency in the movement of goods from one country to another. The region will lose its competitive edge and become less attractive for foreign direct investment. Many countries with weak regulatory frameworks in a particular region may suffer high costs as trade becomes riskier. As a result, the enforcement of contracts and coordination of inter-firm operations is becoming more difficult (Pietrobelli and Rabellotti, 2010).

In Europe, the value-added content of gross exports in the European Union (EU) has risen tremendously with the expansion of the GVC. The flow of raw materials, and unfinished or finished products, is becoming easier from one country to another in the EU. However, regulations and standards can be absolute barriers to entry in the GVC where they involve products that do not comply with government regulatory requirements or that face inefficiencies in customs and permit approvals. Protectionism and burdensome procedures could also lead to low Logistics Performance Index (LPI) scores, as mentioned by the World Bank (Arvis et al., 2014). Figure 3.3 shows that almost all the EU 15 [1] countries have an LPI score of more than 3.5 (except Greece), and only Singapore scored more than 3.5 in ASEAN. The ASEAN region needs to explore integration to reduce unproductive procedures and red tape so that ASEAN can become more attractive to GVC activities.

Figure 3.3 Comparison of AMS with the EU 15 – LPI and GVA, 2018



AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations, EU = European Union, GVA = gross value added, LPI = Logistics Performance Index.

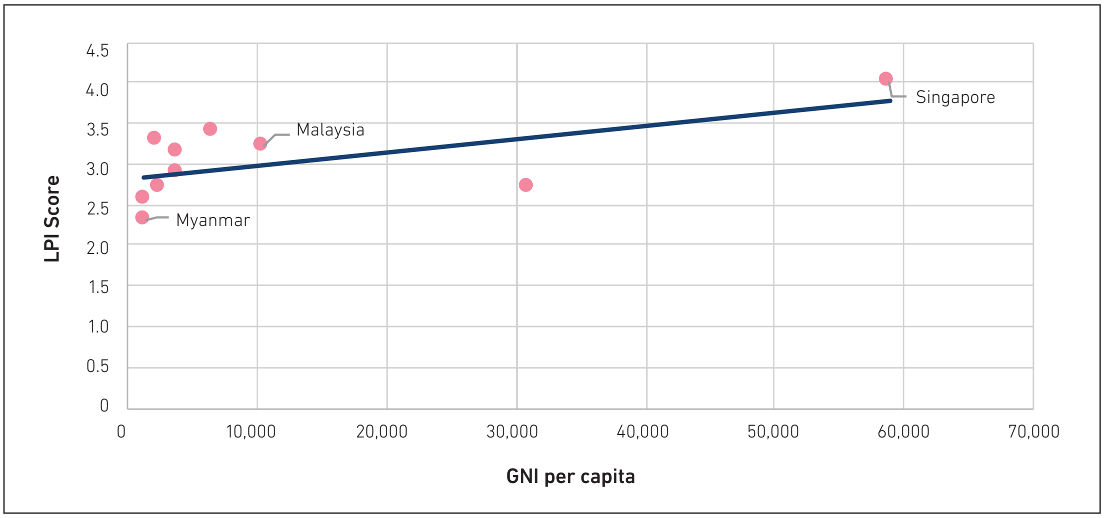
Note: No data were found for Malaysia, Myanmar, the Philippines, and Thailand.

Sources: World Bank (2019), International LPI. https://lpi.worldbank.org/international/global/2018 (accessed 25 November 2019); and World Bank (2019), Gross Value Added at Basic Prices (GVA) (Current LCU). https://data.worldbank.org/indicator/NY.GDP.FCST.CN (accessed 25 November 2019).

[1] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

Figure 3.4 shows that Singapore – the only AMS with gross national income (GNI) per capita above $50,000 – had an LPI score of 3.99.

Figure 3.4 LPI Score and GNI per Capita of AMS, 2018



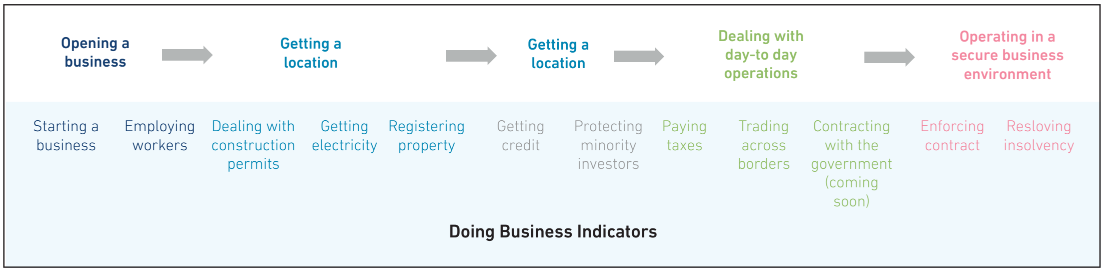
AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations, GNI = gross national income, LPI = Logistics Performance Index.

Sources: World Bank (2018), Global Rankings 2018. https://lpi.worldbank.org/international/global/2018 (accessed 30 November 2019); and World Bank (n.d.), GNI per Capita, Atlas Method (current US$). https://data.worldbank.org/indicator/NY.GNP.PCAP.CD (accessed 30 November 2019).

Performance of AMS in Ease of Doing Business

The World Bank introduced the Doing Business project in 2002 to measure business regulations and their enforcement across 190 economies. The Doing Business report, usually published each October, showcases the regulatory environment of business activities in one economy against others. It captures the interactions between businesses and regulators for starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency (Figure 3.5).

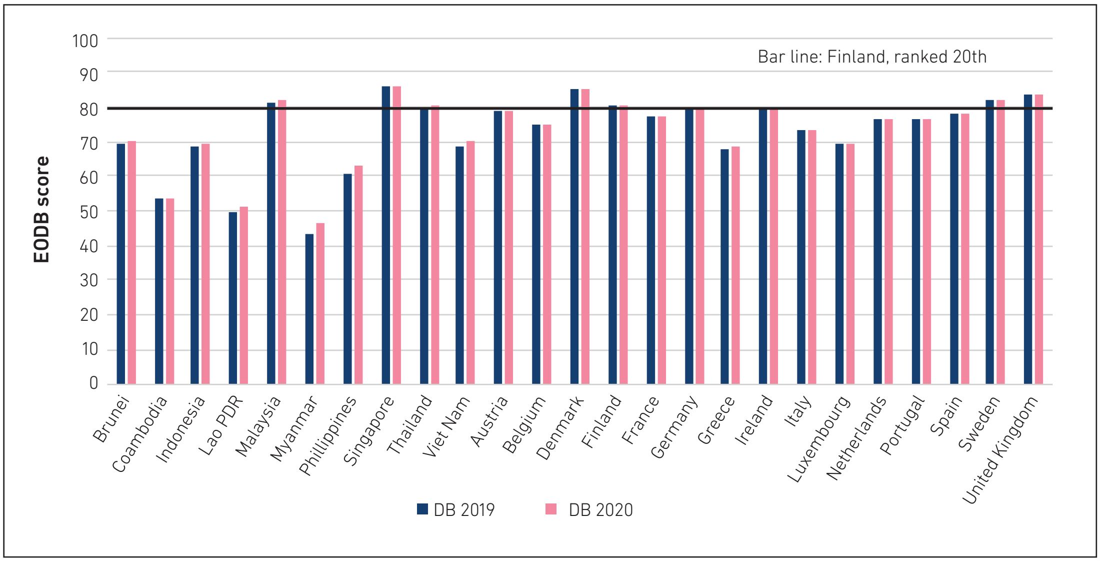
Figure 3.5 Indicators Used by the World Bank for Doing Business



Source: World Bank (2019).

The information given by each country is translated into a doing business score or ranking. Doing Business is a valuable tool that governments can use to design sound regulatory policies, as it helps policymakers compare notes with others on the best policy in one region or in the world. Governments can use the ease of doing business (EODB) rankings strategically to gain support for their policies. For all economies, the Doing Business report advocates regulatory quality and efficiency by instituting reforms. For example, it has inspired Malaysia to drive a multitude of public–private sector initiatives to improve the efficiency of service delivery in support of a vibrant, competitive, and conducive business environment. Malaysia has been consistently ranked amongst the most competitive economies. Thus, in the Doing Business Report 2020 (World Bank, 2019), Malaysia was ranked 12th amongst 190 economies worldwide – an improvement from 15th the previous year (Figure 3.6).

Figure 3.6 Overall Performance of ASEAN and the EU15 in Doing Business



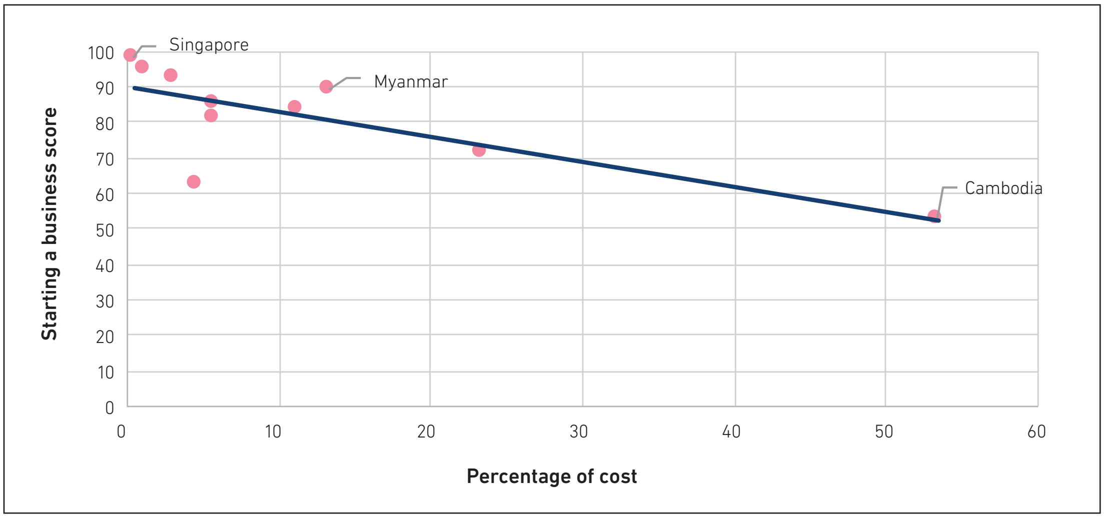
ASEAN = Association of Southeast Asian Nations, DB = Doing Business, EODB = Ease of Doing Business, EU = European Union.

Source: World Bank (2019).

The 10 areas of Doing Business are scored using case studies and are standardised for all 190 economies. A high EODB ranking means that the regulatory environment is conducive to starting and operating a local firm. The rankings are determined by sorting the aggregate scores on 10 topics. In ASEAN, Singapore has been consistently ranked the highest on EODB. Amongst its best practices are the use of electronic systems: online business incorporation processes, electronic tax filing platforms, online procedures related to property transfers, and online construction permits. More importantly, Singapore has sound business regulation with a high degree of transparency. It has triggered other AMS to benchmark and adapt these good practices to make their countries attractive destinations in which to do business.

Figure 3.7 shows the relationship between the regulation of entry and the income gap between developing and developed nations. It highlights that low-income countries may be associated with having more barriers to entry to start a business and one reason for this could be cost. Looking at this performance, ASEAN has plenty of room to close the gap between developed and developing economies in each EODB indicator. Many studies have revealed that a reduction in regulatory burdens on business will improve countries' economic performance and strengthen their competitiveness (e.g. MPC, 2016a). A recent World Bank report showed that improvement of regulations could lead to a better environment for doing business (World Bank, 2019). The World Bank (2019) report also showed that many developed nations with good EODB rankings recorded the highest gross domestic product.

Figure 3.7 Starting a Business and Cost in ASEAN



ASEAN = Association of Southeast Asian Nations.

Source: World Bank (2019).

Implementation of Good Regulatory Practice in ASEAN

AMS have recognised that regulatory quality is important to provide a conducive business environment and to improve citizens' quality of life. The Economic Research Institute for ASEAN and East Asia (ERIA) conducted a baseline study on ASEAN's Regulatory Management Systems (RMS) in 2018–2019 to evaluate good regulatory practice (GRP) in the ASEAN region (ERIA, 2019). The study was a joint initiative of the ERIA and the ASEAN Secretariat for the High-Level Task Force on ASEAN Economic Integration. It mapped the development of RMS in AMS to evaluate initiatives on streamlining regulations or administrative procedures and to discover the challenges faced by AMS in implementing GRP principles. The study also documented the EODB linkages in the operational GRP initiatives of AMS to harmonise regulations.

Regulatory Reform Mandate

Mandate of Individual AMS

Most AMS governments are striving towards making regulations more efficient and effective. This can be seen in initiatives reported by international bodies such as the Organisation for Economic Co-operation and Development (OECD) and the World Bank. Some AMS have gone beyond this by engaging experts to develop GRP frameworks, providing training on how to use GRP tools, and institutionalising GRP oversight bodies to monitor and remove regulatory burdens.

The ASEAN Economic Community (AEC) Blueprint 2025 stated that AMS have to implement 'Good Governance' (B.6) and 'Effective, Efficient, Coherent and Responsive Regulations and Good Regulatory Practice' (B.7) (ASEAN, 2015). This triggered the AMS to make the necessary changes to national regulations that hinder innovation and competition. The blueprint aims to strengthen AMS to remain competitive, conducive to business, and relevant in the global arena. The blueprint also emphasises that AMS have to implement non-discriminatory regulations, promote a competitive market, and exercise transparent processes, when it comes to enforcing new regulations and removing unnecessary regulatory burdens.

ERIA (2019) showed that all AMS have implemented regulatory reform initiatives, some have institutionalised the framework related to governance, and some are monitoring the vertical improvement programs.[2] The driving factor behind carrying out GRP is not just to meet the AEC's objective but, more importantly, to enhance the competitiveness of each AMS for the betterment of the domestic business environment. Table 3.1 shows the mandate of the individual AMS in enforcing GRP programs.

[2] Vertical improvement programmes cover comprehensive scans or the stocktake of all business licenses and the review of regulatory requirements within each ministry or agency.

Table 3.1 Mandate of Individual AMS for Conducting Regulatory Reform

AMS	Regulatory Reform Mandate
Malaysia	National Policy on the Development and Implementation of Regulation (2013) • Enforce RIA • Review existing regulations
Philippines	Ease of Doing Business and Efficient Government Delivery Act (2018) • Review business- and policy-related regulations, especially on EODB regulations
Thailand	First Action Law Reform Committee (2016) • Eliminate unnecessary regulations and simply remaining regulations through regulatory guillotine project
Viet Nam	Law on Promulgation of Legal Normative Documents (2013) • Require RIA before a new regulation can be enforced Resolution 19 (2019) • Simplify and/or eliminate burdensome administrative procedures
Indonesia	RIA Guidelines (2009) • Guide agencies to prepare RIA Presidential Decree No. 7/2017 • Mandate an RIA and public consultation, when needed, for each proposed ministerial regulation
Brunei Darussalam	Establishment of EODB Steering Committee • Conduct regulatory reforms to improve the regulatory framework of the business ecosystem
Cambodia	Regulatory Executive Team (previously the Office of Regulatory Impact Assessment) mandated to • implement RIA in selected ministries under the guidance of ADB in 2011; and • expand RIA to all ministries by December 2016.
Lao PDR	Ministry of Justice has instructed ministries to • ensure that regulators implement RIA; and • streamline EODB regulations.
Singapore	Culture of excellence and stakeholder-centricity • Apply impact assessments at all times • Use RIA when major reform is needed
Myanmar	Open dialogue with the Union of Myanmar Federation of Chambers of Commerce and Industry to express changes or gather feedback

ADB = Asian Development Bank, ASEAN = Association of Southeast Asian Nations, AMS = ASEAN Member State, EODB = ease of doing business, RIA = regulatory impact analysis.

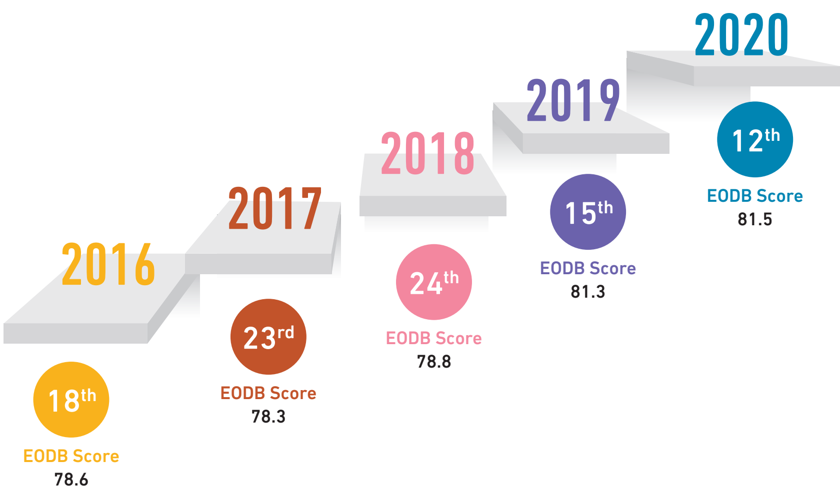
Sources: ERIA (2019), OECD (2018a), OECD and ERIA (2018), USAID/VNCI and CIEM (2011).

Each AMS is stepping up to make their country more conducive and friendly to business. As reported by the World Bank (2019), individual AMS have achieved improvements in the Doing Business indicators. Malaysia has structured mechanisms and processes in place to review existing and new regulations and is the only country that has institutionalised GRP with all the recommendations set by the OECD and the World Bank (see the Box). Table 3.2 shows the degree of legislative simplification and regulatory impact analysis (RIA).

Box PEMUDAH, A Public–Private Task Force to Make Reforms

In Malaysia, the government established the Special Taskforce to Facilitate Business (PEMUDAH) in 2007 to remove red tape. Since its establishment, the main task of PEMUDAH has been to study the World Bank's Ease of Doing Business report and to propose necessary recommendations for improving the ranking or score (Figure). Technical working groups (TWGs) have been set up to improve the indicators. The Malaysia Productivity Corporation, as the Secretariat of PEMUDAH, works closely with the respective TWGs to initiate and monitor the implementation of the various improvement initiatives under the 10 ranked indicators in the Doing Business reports. The TWGs update their strategies on how to improve their ranking; and identify irrelevant regulations, procedures, forms, or unproductive transactions to be proposed for review. The TWGs take turns to present their progress in monthly PEMUDAH meetings (MPC, 2019).

Figure Malaysia's Overall EODB Score and Ranking



EODB = ease of doing business.

Source: MPC (2019).

Table 3.2 Legislative Simplification and Regulatory Impact Analysis

Item	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM	Me-dian	SD
Planning and design	2.66	2.93	3.48	2.65	5.72	1.28	2.66	4.58	3.48	2.47	2.80	1.17
Implementation	4.36	2.32	3.70	2.72	5.04	1.55	3.27	5.70	2.30	3.09	3.18	1.22
Monitoring and evaluation	1.00	2.65	3.48	2.65	5.58	1.00	1.83	4.31	1.83	3.48	2.65	1.39
Total sub-dimension score	**2.94**	**2.60**	**3.57**	**2.68**	**5.38**	**1.34**	**2.77**	**5.03**	**2.62**	**2.95**	**2.85**	**1.14**

BRN = Brunei Darussalam, IDN = Indonesia, KHM = Cambodia, LAO = Lao PDR, MYS = Malaysia, MMR = Myanmar, PHL = Philippines, SD = standard deviation, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Note: Scores are on a scale of 1 to 6, with 6 being the highest. Please refer to Chapter 3 and Annex A for further information on the methodology.

Source: OECD and ERIA (2018).

Brunei Darussalam

Brunei formalised the EODB Steering Committee and its taskforce in 2011 to oversee, coordinate, and exercise regulatory improvement initiatives related to EODB and other business regulatory issues (Razak, 2011). The steering committee monitors the EODB results annually and makes recommendations regarding each indicator measured by the World Bank. Continuous monitoring and evaluation of the implementation of recommendations will help Brunei to improve its overall ranking (Thambipillai, 2018). The GRP component is limited to requests for a revisit of the existing regulation and depends on the attorney general and the regulator to carry out assessments before drafting bills (Khalid, Masri, and Muhamad, 2019).

Cambodia

The Regulatory Executive Team under the Economic, Social and Cultural Council at the Office of the Council of Ministers (previously the Office of Regulatory Impact Assessment) is mandated to promote GRP and assist ministries to implement RIA in Cambodia (Pohl Consulting & Associates, 2011). The government selected four ministries to apply RIA, with the support of a team of international and local GRP experts. In December 2016, all ministries were required to form RIA working committees to implement RIA. The Economic, Social and Cultural Council is also responsible for publishing RIA implementation reports (Pohl Consulting & Associates, 2011).

Indonesia

Indonesia has carried out RIA for almost 20 years. The Ministry of National Development Planning/National Development Planning Board (BAPPENAS) strengthened it in 2009 and published RIA guidelines to minimise business risk and make Indonesia more friendly to investors (Kurniawan, Muslim, and Sakapurnama, 2018). BAPPENAS continuously promotes RIA at central and regional agencies and facilitates the preparation of draft legislation.

Lao PDR

The Minister of Justice of the Lao People's Democratic Republic (Lao PDR) requires regulators to implement RIA before submitting draft legislation to ensure consistency of quality (MOJ, Lao PDR, 2016). The intention is to minimise the risk for both the government and businesses or citizens. The government has made efforts to streamline regulations to support businesses, especially small and medium-sized enterprises (SMEs). It is setting up a public–private forum to make regulations more practical (OECD and ERIA, 2018).

Malaysia

Malaysia's GRP mandate is more inclusive, as it aims to improve the regulatory management system by embedding GRP in government policy decision-making processes. The circular on the National Policy on the Development and Implementation of Regulations, issued on 15 July 2013, requires all federal ministries and agencies to undertake GRP and RIA in developing new and amended regulations (Prime Minister's Department, 2013). This policy seeks to ensure that regulations are developed according to international best practice in regulatory management (MPC, 2016b). Together with the introduction of the National Policy on the Development and Implementation of Regulations, the Best Practice Regulation Handbook and the Quick Reference of Best Practice Regulation Handbook were issued to provide guidelines for ministries and agencies (MPC, 2013). The circular also underlines the efforts to be taken by relevant ministries and agencies to review existing regulations periodically to ensure that the regulations still meet the objectives and that they are carried out efficiently.

Myanmar

In Myanmar, proposed recommendations are commonly discussed between the largest union – the Union of Myanmar Federation of Chambers of Commerce and Industry – and the government agencies. The union represents 30,000 members from private sector entities (central and regional businesses) and was established to communicate with the government. The union is also actively involved in shaping SME-related policy.

Philippines

In the Philippines, Republic Act No. 11032 – known as the Ease of Doing Business and Efficient Government Service Delivery Act of 2018 – is another example of legislation to attract investment. The act was introduced to review policy, regulations, and government procedures to improve the ease of doing business in the country. It promotes transparency and accountability by both the government and businesses (Romero, De Guzman, and Cuya-Antonio, 2019).

Singapore

Singapore is far more advanced than other AMS in shaping domestic regulations, as most of the requirements are well linked with international standards or requirements. RIA is not widely used or required under the regulatory framework in Singapore, but the country can ensure periodic reviews of business-related requirements (OECD and ERIA, 2018). Public administration in Singapore is less complex than in other AMS. The government only uses RIA when it wants to overhaul the total value chain of economy-wide sectors, unless the current administrative system is sufficient to support the dynamic requirements (OECD and ERIA, 2018). Almost all transactions in Singapore are via online platforms, and engagement between the government and business is focused on optimising resources and engendering greater ownership of outcomes (Bourgon, 2009).

Thailand

Thailand has made many attempts to establish RIA in its regulatory framework since 1988. The 1988 Rule explored the possibility of reducing red tape, making the cost of doing business cheaper, applying self-regulation, improving the competitiveness of local businesses, and enhancing government delivery (Samootsakorn et al., 2015). From 1991 to 2003, the Government of Thailand strengthened the regulatory reform committee to repeal obsolete or unnecessary regulations, retain relevant regulations and remove ineffective regulations, and simplify the regulations. In 2005, the Royal Decree of Submission of Agenda, the Cabinet Meeting 2005, and the Regulation on Rules and Procedure for Submission of Agenda to the Cabinet for Consideration 2005 were enacted to ensure that all government agencies submit a proposal according to the Checklist for Necessity to Law Issuance (Samootsakorn et al., 2015).

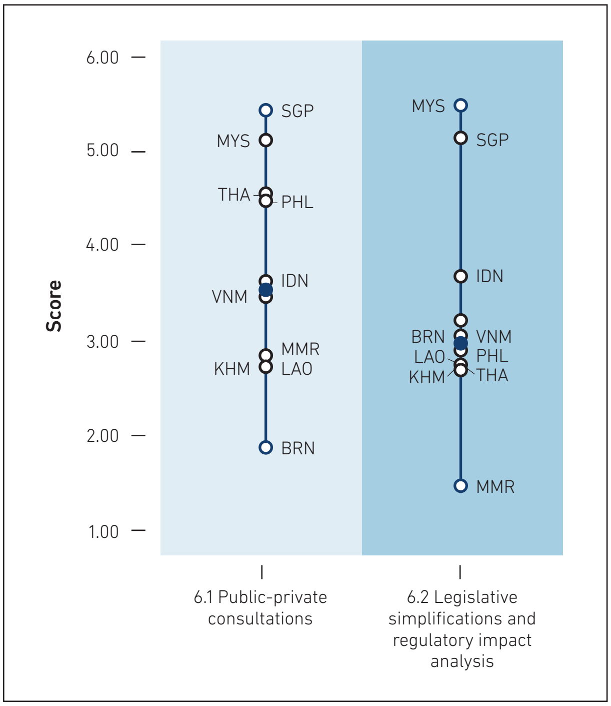
Viet Nam

Viet Nam introduced RIA in 2009 and was the first AMS to implement the GRP tool after the Law on Promulgation of Legal Normative Documents was enacted (effective as of 1 January 2009). The regulator has to implement RIA, and the proposal and the evaluation must be endorsed before drafting laws, ordinances, and decrees (USAID/VNCI and CIEM, 2011). On 12 March 2015, the Government of Viet Nam issued Resolution 19/NQ-CP/2015 to improve the business environment and national competitiveness. The objectives of the resolution include simplifying administrative procedures, and synchronising and integrating business processing at different agencies into a single window (ZICO Law, 2015).

ASEAN SME Policy Index

The ASEAN SME Policy Index 2018 (OECD and ERIA, 2018), which aims to assess and benchmark SME policies within ASEAN, has plotted the results of the current situation in each AMS as shown in Figure 3.8.

Figure 3.8 Weighed Scores of AMS



ASEAN = Association of Southeast Asian Nations, AMS = ASEAN Member State, BRN = Brunei Darussalam, IDN = Indonesia, KHM = Cambodia, LAO = Lao PDR, MYS = Malaysia, MMR = Myanmar, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Source: OECD and ERIA (2018).

The indicators reported in OECD and ERIA (2018) in Table 3.3 highlight the public–private dialogue of the 10 AMS. First, they measure the frequency and transparency of public consultation; the mandatory requirements for public consultation, which focus on the structure, practice, and frequency of those consultations; and the existence and use of feedback and comment-collection mechanisms. Second, they examine the openness and transparency of private–public dialogue, as well as the ability of the private sector to initiate dialogue. Third, they monitor and evaluate the performance of public–private consultations.

Table 3.3 Public–Private Dialogue

Item	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM	Me-dian	SD
Frequency and transparency	2.83	2.98	3.22	2.81	5.11	2.06	4.16	4.97	4.69	3.85	3.54	0.99
Private sector involvement in consultations	1.09	3.39	4.61	3.29	5.34	4.33	5.16	6.00	4.87	4.03	4.47	1.31
Monitoring and evaluation	1.55	1.00	2.65	1.55	4.87	1.55	3.75	5.43	3.75	1.55	2.10	1.50
Total sub-dimension score	**1.88**	**2.75**	**3.66**	**2.75**	**5.15**	**2.86**	**4.48**	**5.47**	**4.58**	**3.46**	**3.56**	**1.12**

BRN = Brunei Darussalam, IDN = Indonesia, KHM = Cambodia, LAO = Lao PDR, MYS = Malaysia, MMR = Myanmar, PHL = Philippines, SD = standard deviation, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Note: Scores are on a scale of 1 to 6, with 6 being the highest. Refer to Chapter 2 and Annex A for further information on the methodology.

Source: OECD and ERIA (2018).

Conclusion

ASEAN is becoming more connected and integrated with the rest of the world. Dynamic trade activities within ASEAN have put a lot of pressure on the existing domestic regulatory frameworks. Therefore, AMS need to adapt quickly to the challenge of globalisation by harmonising their domestic regulations or making full use of international standards to tap export opportunities and increase investments. Regulators should consider the following tips shared by OECD (2018b):

(i) Use evidence-based approaches when developing regulations.

(ii) Conduct inclusive engagement by gathering feedback from international parties or learn from multinational companies the best practices of other countries on regulatory requirements.

(iii) Blend international standards when developing domestic regulations or consider exploiting the use of standards for subsidiary regulations.

(iv) Organise international/regional coordination activities to reduce information asymmetry and promote practical solutions.

To strengthen ASEAN's regulatory quality and economic performance, the ASEAN Secretariat has a significant role to play in assisting AMS to build and strengthen their capacity for regulatory quality and in conducting continuous monitoring of the GRP implementation of AMS. As highlighted by OECD (2012), to reach high regulatory quality and good governance, each country needs to implement the following recommendations:

1. Commit at the highest political level to an explicit whole-of-government policy for regulatory quality.
2. Adhere to principles of open government, including transparency and accountability.
3. Institutionalise oversight committees to monitor and evaluate and provide support for GRP activities.
4. Integrate RIA into the early stages of the policy process for the formulation of new regulatory proposals.
5. Conduct systematic reviews of the stock – horizontal and vertical – to ensure that regulations remain up to date, cost-justified, cost-effective, and consistent; and that they deliver the intended policy objectives.
6. Publish regular reports on the performance of regulatory policy and reform programmes and the public authorities applying the regulations.
7. Build capacity to enhance regulators' competency to conduct adequate evaluation and prepare a sound regulatory proposal.
8. Organise sufficient engagement with stakeholders, and have mechanisms/portals in place for them to access all related documents.
9. Conduct risk assessment during the formulation of regulations – including the cost of implementation and the enforcement strategy to meet the objectives.
10. Promote regulatory coherence at all levels – central/national, state/provincial, or local – to avoid duplication of regulation or conflicts of interest.
11. Extend capacity building and offer a research team to state and local governments to carry out RIA and review of existing regulations.
12. Incorporate international standards and frameworks where appropriate.

Two strategies will help the AMS immediately. First, the AMS should be able to assess their performance against their peers on existing regulatory policies, GRP programmes, utilisation of tools, and GRP progress. Second, the AMS should track the satisfaction of stakeholders, especially multinational companies, based on improvements made by the government. This would assist the AMS to put in place the necessary measures to ensure regulatory coherence in their law-making and therefore reduce unnecessary burdens on business.

References

Alam, M.R., E. Kiterage, and B. Bizuayehu (2017), 'Government Effectiveness and Economic Growth', *Economic Bulletin*, 37(1), pp.222–27.

Arvis, J.-F., D. Saslavsky, L. Ojala, B. Shepherd, C. Busch, and A. Raj (2014), *Connecting to Compete 2014: Trade Logistics in the Global Economy – The Logistics Performance Index and Its Indicators*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/20399 (accessed 1 December 2019).

ASEAN (2015), *ASEAN Economic Community Blueprint 2025*. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/2021/08/AECBP_2025r_FINAL.pdf (accessed 24 November 2019).

Bourgon, J. (2009), 'Why Should Governments Engage Citizens in Service Delivery and Policy Making?', in OECD, *Focus on Citizens: Public Engagement for Better Policy and Services,* OECD Studies on Public Engagement. Paris: Organisation for Economic Co-operation and Development, pp.199–205. https://www.oecd-ilibrary.org/governance/focus-on-citizens/why-should-governments-engage-citizens-in-service-delivery-and-policy-making_9789264048874-24-en (accessed 27 October 2019).

ERIA (2019), 'Towards a Robust Good Regulatory Practice (GRP) Regime in the ASEAN Region: The ASEAN Regulatory Management System (RMS) Baseline Study'. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), unpublished.

Farazmand, A. (2012), 'Sound Governance: Engaging Citizens through Collaborative Organizations', *Public Organization Review*, 12(3), pp.223–41.

Gross, J. and P.S. Intal, Jr., eds. (2018), *Reducing Unnecessary Regulatory Burdens in ASEAN: Country Studies*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Kaufmann, D., A. Kraay, and M. Mastruzzi (2011), 'The Worldwide Governance Indicators: Methodology and Analytical Issues', *Hague Journal on the Rule of Law*, 3(2), pp.220–46.

Khalid, A.M., M. Masri, and N. Muhamad (2019), 'Baseline Study on Regulatory Management Systems', Universiti Brunei Darussalam, unpublished.

Kurniawan, T., M.A. Muslim, and E. Sakapurnama (2018), 'Regulatory Impact Assessment and Its Challenges: An Empirical Analysis from Indonesia', *Kasetsart Journal of Social Sciences*, 39(1), pp.105–8.

MOJ, Lao PDR (2016), *Regulatory Impact Assessment Guidelines.* Vientiane: Ministry of Justice https://www.moj.gov.la/lo/file/561/download?token=z6N0oHba (accessed 30 October 2019).

MPC (2013), *Best Practice Regulation Handbook*. Petaling Jaya: Malaysia Productivity Corporation. http://www.mpc.gov.my/wp-content/uploads/2017/04/Best-Practice-Handbook-2013.pdf (accessed 30 October 2019).

MPC (2014), *Guideline on Public Consultation Procedures*. Petaling Jaya: Malaysia Productivity Corporation.

MPC (2016a), *Innovation through Collaboration: Handbook on Regulatory Reform, a Case Study on Dealing with Construction Permits.* Petaling Jaya: Malaysia Productivity Corporation.

MPC (2016b), *Annual Report on Modernisation of Regulations 2016*. Petaling Jaya: Malaysia Productivity Corporation.

MPC (2018), *RURB Private Healthcare*. Petaling Jaya: Malaysia Productivity Corporation.

MPC (2019), *PEMUDAH 2019*. Petaling Jaya: Malaysia Productivity Corporation, unpublished.

OECD (2006), 'Background Document on Public Consultation'. Paris: Organisation for Economic Co-operation and Development. https://www.oecd.org/mena/governance/36785341.pdf (accessed 19 November 2019).

OECD (2012), *Recommendation of the Council on Regulatory Policy and Governance*, Paris: Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/governance/recommendation-of-the-council-on-regulatory-policy-and-governance_9789264209022-en (accessed 19 November 2019).

OECD (2015), *Implementing Good Regulatory Practice in Malaysia.* Paris: Organisation for Economic Co-operation and Development. https://www.oecd.org/regreform/implementing-good-regulatory-practice-in-malaysia-9789264230620-en.htm (accessed 19 November 2019).

OECD (2018a), OECD *Investment Policy Reviews*: Cambodia 2018, Paris: Organisation for Economic Co-operation and Development.

OECD (2018b), 'International Regulatory Co-Operation: Adapting Rulemaking for an Interconnected World', Policy Brief, October 2018. http://www.oecd.org/gov/regulatory-policy/international-regulatory-cooperation-policy-brief-2018.pdf (accessed 19 November 2019).

OECD and ERIA (2018), SME Policy Index: *ASEAN 2018: Boosting Competitiveness and Inclusive Growth*. Paris/Jakarta: Organisation for Economic Co-operation and Development/Economic Research Institute for ASEAN and East Asia ERIA. https://www.oecd-ilibrary.org/development/sme-policy-index-asean-2018_9789264305328-en (accessed 19 November 2019).

Pietrobelli, C. and R. Rabellotti (2010), 'Global Value Chains Meet Innovation Systems: Are There Learning Opportunities for Developing Countries?', *World Development,* 39(7), pp.1261–9.

Pohl Consulting & Associates (2011), 'Regulatory Impact Assessment Subproject Cambodia: Inception Report'. http://ocm.gov.kh/ocmwinwin20/wp-content/uploads/2018/12/04-event/2_Inception_Report_on_RIA_in_Cambodia_en.pdf (accessed 1 December 2019).

Prime Minister's Department (2013), *National Policy on the Development and Implementation of Regulations.* Putrajaya: MPC.https://grp.kelantan.gov.my/index.php/en/inisiatif-grp/zoo/pekeliling/18-2-pekeliling-am-dasar-negara-bagi-pembangunan-dan-pelaksanaan-peraturan/file

Razak, L.A. (2011), 'Brunei Darussalam's Labour Market: Issues and Challenges', *CSPS Strategy and Policy Journal*, 3, pp.65–99.

Romero, M.J., M.A. De Guzman, and O.C. Cuya-Antonio (2019), 'Degree of Observance of Ease of Doing Business and Efficient Government Service Delivery Act in the Department of Education in Nueva Ecija in the Philippines', *Journal of Public Administration*, 9(1), pp.92–106.

Samootsakorn, M., P. Ubonloet, M. Sutiwatananiti, and P. Suponpun, eds. (2015), 'Regulatory Impact Assessment (RIA) in Thailand: Current Practice', Paper presented at the APEC Workshop on Developing RIA Guidelines as an Anti-Corruption Tool, Bangkok, 8–9 July. Bangkok: National Economic and Social Development Office and the Ministry of Justice. https://www.nesdc.go.th/download/RIA/RIASituation.pdf (accessed 24 November 2019).

Sundaram, J. and A. Chowdhury (2013), *Is Good Governance Good for Development?* United Nations Series on Development. New York: United Nations Department of Economic and Social Affairs.

Thambipillai, P. (2018), 'Brunei Darussalam: The "Feel-Good Year" Despite Economic Woes', in M. Cook and D. Singh (eds.) *Southeast Asian Affairs*. Singapore: ISEAS Publishing, pp.77–94.

USAID/VNCI and CIEM (2011), *Evaluation of RIA Implementation in Vietnam,* 2009–2010. Hanoi: United States Agency for International Development Vietnam Competitiveness Initiative and the Central Institute for Economic Management.

World Bank (2019), Doing Business 2020. Washington, DC: World Bank. https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020 (accessed 1 December 2019).

ZICO Law (2015, 'Resolution 19/2015 to Improve Business Environment and National Competitiveness', Alert, 31 March. http://www.zicolaw.com/resources/alerts/resolution-19-2015-to-improve-business-environment-and-national-competitiveness/ (accessed 2 December 2019).

Chapter 4

Connecting the Connectivity Plans in Asia and Beyond: International Cooperation for Expanded Supply Chains and Resilient Growth

Anita Prakash
Senior Policy Advisor for International Economic Cooperation, ERIA

Introduction

'Connectivity' has always existed. People have communicated and interacted across boundaries for business, government purposes, and social activities from time immemorial. But the conceptualisation of 'connectivity' is recent. The English word can be found in the 19th century, but outside specialist fields, such as topology, its contemporary use derives from modern information and communication technology (ICT), especially the internet. Its use in economic diplomacy is metaphorical but intuitive – the 'state of being connected' applied to agreements or understandings amongst economies.

Popularisation of the term 'connectivity' was especially linked to the Association of Southeast Asian Nations (ASEAN), leading to its Master Plan on ASEAN Connectivity (MPAC) adopted in Hanoi in 2011. Significantly, it has the subtitle 'One Vision, One Identity, One Community'. The link to community is not common in standard North Atlantic thinking. 'Connectivity' – like 'open regionalism', 'comprehensive and cooperative security', and even 'Asia-Pacific' – has become a concept with a substantial Asian origin (Hawke, 2007).

In the 21st century, all connectivity plans have Asia at its core. This is not a coincidence. Asia, particularly East Asia, has been a model of trade and economic cooperation, and much of this region's prosperity is due to its hard and soft connectivity efforts.

Asia is the centre of pan-regional connectivity initiatives. The MPAC, Belt and Road Initiative (BRI), Asia–Africa Growth Corridor (AAGC), European Union (EU) Global Gateway, and Asia–Europe Meeting (ASEM) – all connectivity plans – aim to deepen Asia's economic dynamism and extend it to trans-regional partners. Mega-regional integration initiatives like the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP) are also integral to this region. The EU has also put in place building blocks for an EU strategy on connecting Europe and Asia, with concrete policy proposals and initiatives, including through interoperable transport, energy, and digital networks. The European strategy aims for sustainable, comprehensive, and rules-based connectivity. The initiatives aim to improve connections between Europe and Asia by establishing partnerships for connectivity based on commonly agreed rules and standards and contributing to address the sizeable investment gaps through improved mobilisation of financial resources and strengthened international partnerships. The United States (US) initiated the Infrastructure Transaction and Assistance Network to improve capacities in partner countries' project evaluation processes and project implementation, provide advisory services to support sustainable infrastructure, and coordinate US assistance support for infrastructure in the region. The Asia Reassurance Initiative Act, 2018 is an important part of US connectivity policy in Asia.

The challenge before Asia is how to ensure greater cooperation amongst the connectivity initiatives in the region, i.e., 'connecting the connectivities'. The importance of 'connecting the connectivities' is not limited to converging different connectivity plans in Asia, between Asia and Africa, and between Asia and Europe around the principles of governance and accountability, quality and sustainable financing, and alignment with national and regional plans. An important economic justification lies in the fact that the connectivity plans will aid the deepening of the supply chain networks in Asia, create new efficiencies for trade and movement of people, and help to construct the new economic architecture that is emerging in the Indo-Pacific.

Focus on Connectivity and Supply Chains Since the COVID-19 Pandemic

The coronavirus disease (COVID-19) pandemic, which originated in China at the beginning of 2020, has created an unprecedented crisis for connectivity in both the developed and developing world. What started as disruption and, in some cases, a temporary breakdown in the supply chain of goods and services due to the closure of factories in China has become a test for the endurance of production networks and the movement of people across international borders. Factory production in ASEAN, Germany, France, and parts of the US came to a spluttering halt as the supply of parts and components was disrupted at one end – China. Movement of people for trade in goods and services has still not been restored in 2021 and the restrictions are likely to continue into 2022. A new threat to the connectivity of production networks or supply chains is now under the policy watch of Asia to ensure resilient supply chains that do not fall prey to disruptions. This includes investments in alternative connectivity plans. It also means that the connectivity plans are to be implemented not just as infrastructure plans but as the conduit of supply chains – for both goods and people – in Asia. Some connectivity plans can provide alternative supply chains during a crisis like the current pandemic. The China centrality of the supply chains in Southeast and East Asia is also an important reason why new connectivity plans centred around supply chain networks are being put in place in Asia and other parts of the world.

Acceleration in the implementation of connectivity infrastructure is also being influenced by trade tensions between the US and China. These trade disputes are prompting new supply chain connectivities, where new centres of production and the consolidation of supply chains are emerging in Asia, Africa, and Europe. The emergence of the new supply chain linkages in Asia are an important addition to the existing connectivity plans in Asia.

The rise of new sectors and modes of delivery will further impact the connectivity plans in Asia. The digital economy and demand for environmental products will favour a shift towards connectivity plans that will help Asia, especially developing Asia, to take advantage of these opportunities in high-income markets.

Connectivity Plans in Asia

The Master Plan on ASEAN Connectivity

The MPAC 2015 is based on a twofold objective:
(i) Enhancing intra-regional connectivity will promote economic growth, narrow the development gaps by sharing the benefits of growth with poorer groups and communities, enhance the competitiveness of ASEAN, and connect ASEAN Member States (AMS) within the region and with the rest of the world.
(ii) The concept of ASEAN connectivity would complement and support integration within ASEAN and within the broader regional framework in East Asia and beyond. The deepening and widening of connectivity in the region would reinforce ASEAN's position as the hub of the East Asian region and preserve the centrality of ASEAN.

The ASEAN approach to connectivity uses the context of community building and the objective of 'a well-connected ASEAN that will contribute towards a more competitive and resilient ASEAN, as it will bring peoples, goods, services and capital closer together' (ASEAN, 2011: i). The MPAC contemplates physical, institutional, and people-to-people components. The MPAC 2025 broadens this vision to 'achieve a seamlessly and comprehensively connected and integrated ASEAN that will promote competitiveness, inclusiveness, and a greater sense of Community' (ASEAN, 2016: 7). Although the vision continues to operate under the three pillars listed above, the emphasis of its actions has greater economic and institutional connotations than those of the MPAC 2015. These actions are as follows: (i) sustainable infrastructure, (ii) digital innovation, (iii) seamless logistics, (iv) regulatory excellence, and (v) mobility of people.

The acknowledged goal of the MPAC 2025 is a seamlessly connected ASEAN. This may be more ambitious than the ASEAN Community Vision 2025, but may be a desirable goal for ASEAN in next two decades. The previous emphasis on the movement of goods and services, mobility of skilled labour, and energy and rail connectivity is supplemented by emerging trends that will influence the ASEAN connectivity agenda. These trends include (i) a doubling of the number of ASEAN households that are part of the 'consuming class' over the next 15 years; (ii) the challenge of improving productivity to sustain economic progress as growth in the size of the workforce starts to slow; (iii) the movement of 90 million more people to cities within ASEAN by 2030; (iv) the need for infrastructure spending to more than double from historical levels; (v) the challenge of equipping the world's third-largest labour force with the skills needed to support growth and inclusiveness; (vi) the emergence of disruptive technologies; (vii) the opportunity to transform natural resources efficiency in the region; and (viii) the imperative to understand the implications for ASEAN as the world shifts towards a multi-polar global power structure. The MPAC 2025 is therefore clearly consistent with the objectives of the ASEAN Economic Community, and shares in the objective of a Socio-Cultural Community.

The infrastructure component in the MPAC has been subject to budget constraints and competing demands for resources. To help accelerate investment in infrastructure in the region, the MPAC 2025 recommended the establishment of 'a rolling priority pipeline list of potential ASEAN infrastructure projects and sources of funds' (ASEAN, 2016: 7).

As an ASEAN regional process is not yet in place for identifying and prioritising infrastructure projects, the ASEAN Secretariat engaged the World Bank, with the support of the ASEAN–Australia Development Cooperation Program Phase II, to provide technical assistance in developing a rolling priority pipeline of potential ASEAN infrastructure projects across the transport, energy, and ICT sectors. The pipeline is intended to be a list of well-structured and economically viable physical infrastructure projects that enhances the movement of people, services, goods, and innovations within ASEAN; and that contributes to ASEAN's objectives of improving access to and increasing connectivity in and amongst the AMS.

The Trilateral Highway

Greater connectivity between India and ASEAN has long been both an economic and strategic objective for the ASEAN–India partnership. The Trilateral Highway (TLH) underlines ASEAN–India partnership in which trilateral connectivity between India, Myanmar, and Thailand is linked with ASEAN's connectivity plans. The TLH was conceived at the Trilateral Ministerial Meeting on Transport Linkages in Yangon in April 2002, where India, Myanmar, and Thailand agreed to make efforts to establish trilateral connectivity by 2016. The Chair's Statement of the ASEAN–India Summits in 2010 and 2012 acknowledged the importance of linking the TLH with ASEAN's connectivity plans, and its extension to the Lao People's Democratic Republic (Lao PDR), Cambodia, and Viet Nam.

The original alignment of the TLH starts at Moreh in India, crosses Myanmar from northwest to southeast passing Mandalay and Yangon, and ends at Mae Sot in Thailand. A major part of the TLH is the road network in Myanmar, together with border crossing facilities at two terminals in India and Thailand. Although delayed, the upgrading work of a 120.74-kilometre (km) section between Kalewa and Yagyi has been in progress with assistance from India. This will serve as an alternative route connecting Kalay and Chaung-U in Myanmar. Looking beyond Moreh, the terminal point of the TLH in India, a 95 km section between Moreh and

Imphal, including the section between Moreh and Palel, has been upgraded and expanded under assistance from the Asian Development Bank (ADB). Institutional arrangements have been improved as well.

Progress has been made in the development of the TLH, including the opening of the integrated checkpoint at Moreh (India) in January 2019, which will upgrade the functions of the existing land customs station. Many of the original alignments of the TLH have been recently completed or upgraded – the bypass road connecting Myawaddy and Kawkareik (Thailand) and the second friendship bridge connecting Myawaddy and Mae Sot being the most important. Ongoing upgrading and repair of roads between Kalewa (India) and Monywa (Myanmar), the new Bago bridge (supported by Japan), and the construction of an arterial road connecting Bago and Kyaikto (by ADB) are significant indicators of progress in the TLH project. Matching the urgency for the replacement of 69 bridges along the Tamu–Kyigone– Kalewa road and upgrading the Thaton–Eindu road is required, although both are subject to prolonged litigation and disputes.

Border trade between Moreh (India) and Tamu (Myanmar) was normalised in 2015 by removing the positive list of tradable items for barter trade. Border trade potential between India and Myanmar, and with ASEAN, is yet to be unlocked. Myanmar is the gateway to and from ASEAN. Completion of the TLH is expected to generate new demand for trade through the land border, particularly via Moreh and Tamu. Furthermore, to facilitate cross-border transportation along the TLH, India proposed a motor vehicles agreement to Myanmar and Thailand, although it remains under negotiation. The TLH is still under construction, so its contribution to the economic growth and development of the region has not yet reached its potential.

The Trilateral Highway and its Extension to Cambodia, the Lao PDR, and Viet Nam

Following the ASEAN–India Summit Meeting of 2018, the Government of India commissioned the Economic Research Institute for ASEAN and East Asia (ERIA) to undertake a study on the feasibility of establishing a seamless, efficient, and end-to-end transportation corridor along the existing TLH and its extension towards Cambodia, the Lao PDR, and Viet Nam. The first phase of the study is complete; and it offers physical, institutional, and economic pathways, along with policy recommendations for the development of the TLH and its eastward extension (Kimura, Umezaki, and Prakash, 2020).

Greater connectivity between India and ASEAN has long been both an economic and strategic objective for the ASEAN–India partnership. Based on the Thai proposal at the 16th ASEAN Highway Sub-Working Group Meeting in August 2018 and other existing initiatives – such as the Greater Mekong Subregion (GMS), Ayeyawady–Chao Phraya–Mekong

Economic Cooperation Strategy, MPAC 2025, and the ASEAN Highway Network – as well as the recognition that connectivity to international ports is an important factor for the development of economic corridors, this study considered the original alignment of the TLH (Moreh–Tamu–Kalewa–Monywa–Mandalay–Nay Pyi Taw–Bago–Myawaddy–Mae Sot) with two possible routes for eastward extension:

- the northern route from Meiktila in Myanmar to Ha Noi and Hai Phong in Viet Nam via the Myanmar–Lao PDR Friendship Bridge; and
- the southern route from Mae Sot to Aranyaprathet via Bangkok in Thailand to Phnom Penh/Sihanoukville–Bavet in Cambodia and Moc Bai–Ho Chi Minh City–Vung Tau in Viet Nam.

Except for one small section between Xieng Kok and Luang Namtha via Muang Sing in the Lao PDR, all sections of the suggested northern route are already designated as parts of transport corridor projects supported by ADB, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and the MPAC 2025. All sections of the southern route of the eastward extension overlap with ADB's East–West Economic Corridor (EWEC), North–South Economic Corridor (NSEC), and Southern Economic Corridor (SEC). The TLH extension plans therefore imply close cooperation with international projects.

The southern extension route has been better developed as part of the GMS economic corridors, including the already well-developed road networks in Thailand and the construction of the Tsubasa Bridge over the Mekong River in Neak Loung, Cambodia. In terms of physical infrastructure, the southern route will not require a large amount of additional investment. However, large sections of physical infrastructure in Myanmar will require financial assistance from partner countries for construction/upgrading and maintenance.

The TLH, including its eastward extension, would primarily be a transport corridor as the vibrant economic agglomerations are mainly at one end (e.g. Bangkok, Ho Chi Minh City, and Ha Noi). In the current alignment, Myanmar occupies the longest length of the TLH and is the largest beneficiary of its development and eastward extension. From an inclusive growth perspective, both actual and potential impacts on India and member countries are important as infrastructure and connectivity provide longer-term development and economic returns. As a seamless transport corridor, the TLH and its eastward extension imply the importance of implementing policies beyond the scope of infrastructure development and institutional arrangements for cross-border transport facilitation (Kimura, Umezaki, and Prakash, 2020).

Mekong–India Economic Corridor

During an ASEAN+6[1] meeting, the Economic Ministers endorsed the idea of an East Asia Industrial Corridor (EAIC) to be studied by the ERIA as a model for the integration of East Asia. The EAIC is envisioned as a region-wide comprehensive development plan, affirming the importance of linking infrastructure development and industrial development planning.

The EAIC aims to facilitate and enhance economic growth by linking economies in East Asia. It is envisaged to be realised through the development of several interregional industrial belts such as the Delhi–Mumbai Industrial Corridor, the EWEC, and the SEC.[2] Linking India with the Mekong region is an important component of the integration of East Asia under the EAIC umbrella project. The ERIA conceptualised the Mekong–India Economic Corridor (MIEC) as a step in this direction. Based on the SEC alignment (Ho Chi Minh City–Phnom Penh–Bangkok), the MIEC extends further to Dawei in Myanmar. With Dawei, it opens up on Andaman Sea and connects the Mekong region to India on its east coast. The MIEC is an important step towards realising the potential of the EAIC.

The MIEC involves the integration of four Greater Mekong countries – Myanmar, Thailand, Cambodia, and Viet Nam – with India through its east coast. It proposes to connect Ho Chi Minh City (Viet Nam) with Dawei (Myanmar) through Bangkok (Thailand) and Phnom Penh (Cambodia), linking further to the east coast of India (Figure 4.1). The integration with India is likely to benefit the corridor development in view of the growing trade and investment linkages between India and the Mekong countries.

Figure 4.1 The Mekong–India Economic Corridor

Source: ERIA (2009).

[1] ASEAN+6 refers to the AMS plus China, India, Japan, the Republic of Korea, Australia, and New Zealand.
[2] Conceptualised by ADB.

The corridor will provide opportunities to Myanmar, Thailand, Cambodia, and Viet Nam to build a strong economic and industrial base as well as world-class infrastructure. The emphasis of the corridor is on expanding the manufacturing base and trade with the rest of the world, particularly India. The corridor will enable these economies to integrate further and emerge collectively as a globally competitive economic bloc.

The MIEC is expected to enhance trade with India by reducing the travel distance between India and the MIEC countries and removing supply-side bottlenecks.

The GMS Economic Corridor

The GMS countries adopted the economic corridor approach at the Eighth GMS Ministerial Conference in Manila in 1998 to accelerate subregional development. The EWEC, NSEC, and SEC were subsequently designated as flagship programmes under the 10-year GMS strategic framework, 2002–2012. Thus, complementary efforts such as trade and transport facilitation, border and corridor towns development, investment promotion, and enterprise development have mainly focused on the EWEC, NSEC, and SEC. The development of GMS corridors as economic corridors continued to be at the centre of the GMS program under the GMS strategic framework, 2012–2022.

The original alignment of the TLH is a subset of the GMS NSEC. The primary considerations for including specific routes as part of the EWEC, NSEC, and SEC in the current configuration were their potential to become trade, investment, tourism, and transit corridors; and the presence of significant sections that can be developed into hubs for regional trade, investment, and tourism. The GMS member countries and ADB are undertaking a review of their configuration. The review will ensure that (i) developments arising from the opening up of Myanmar are taken into account, (ii) corridors include and link all GMS capitals and major economic centres, (iii) corridors are connected to key GMS maritime gateways and industrial hubs, and (iv) major trade flows are reflected in the alignment of the corridors.

The GMS economic corridor is an integrated system of road, rail, and ports interconnecting (i) GMS country borders; (ii) production centres (manufacturing hubs, industrial clusters, and economic zones); (iii) demand centres (capitals and major urban centres); and (iv) gateways (important seaports used for intra-regional and international trade). The areas of influence of GMS economic corridors extend beyond a single route, encompassing an economic zone running in parallel with the main transport artery.

Economic corridors can attract investment in economic activities along and around their main routes, thus generating additional demand and increasing their viability. They are critical for economic integration in the GMS because they not only facilitate cross-border movement of people, goods and services, labour, and capital along the corridors, but also promote the development of areas that can be accessed through improved connectivity.

Operationally, the economic corridor approach is aimed at (i) extending the benefits of improved transport links to remote and landlocked locations in the GMS, which have been disadvantaged by their lack of integration with more prosperous and better located neighbouring areas; (ii) providing a spatial focus on GMS activities, with the main routes, growth centres, and nodal points serving as a catalyst to the development of surrounding areas; (iii) serving as a mechanism for prioritising and coordinating investments amongst neighbouring countries; (iv) opening up opportunities for various types of investment from within and outside the GMS; (v) enhancing the impact of subregional activities through the clustering of projects; and (vi) generating tangible demonstration effects.

The EWEC, NSEC, and SEC were designated as priorities for economic corridor development, as they (i) have the greatest potential to become foreign trade, investment, and tourist corridors; and (ii) have relatively significant sections that can be developed into hubs for regional trade, investment, and tourism.

Asian Highway Network

The Asian Highway Network is a regional transport cooperation initiative aimed at enhancing the efficiency and development of road infrastructure in Asia, supporting the development of Euro–Asia transport linkages, and improving connectivity for landlocked countries. It comprises more than 141,000 km of roads passing through 32 member countries. The network extends from Tokyo in the east to Kapikule (Turkey) in the west and from Torfyanovka (Russia) in the north to Denpasar (Indonesia) in the south.

The Asian Highway project was initiated in 1959 with the aim of promoting the development of an international road transport system in the region. From 1960 to 1970, potential routes were identified and analysed. However, the progress was slow until political and economic changes in the region spurred renewed interest in the network in the late 1980s and early 1990s. Under a renewed UNESCAP initiative, the Asian Land Transport Infrastructure Development Project was launched in 1992. The project provided a framework for the development of a region-wide integrated transport network comprising road and rail networks. A series of studies for the development and formulation of the Asian Highway Network, covering all subregions, was conducted between 1994 and 2002. These studies, together with a series of meetings of the member countries at the subregional level, helped to build consensus on an agreed network.

The formalisation of the network was initiated in 2002. The UNESCAP Secretariat worked with national governments to develop the Intergovernmental Agreement on the Asian Highway Network, which was adopted on 18 November 2003 and entered into force on 4 July 2005. The agreement includes a list of Asian Highway routes and classification and design standards.

The major benefits of the agreement are that it:

- provides a basis for the coordinated development of road networks at the regional, subregional, and national levels;
- creates interest in greater connectivity at the regional/subregional level, which has led to the development of subregional networks;
- develops common design and technical standards for highway development for regional roads, which many subregional organisations have adopted;
- enhances domestic and road transport connectivity, which has supported the growth of national economies and inter-country trade;
- offers a better negotiating position for member states to secure financing from development banks as well as to maintain minimum design standards; and
- increases development banks' interest in financing road projects of regional importance.

UNESCAP maintains the Asian Highway Database, which includes detailed information on the road conditions.

ASEAN Highway Network

The 'Ministerial Understanding on the Development of the ASEAN Highway Network Project' was signed during the Fifth ASEAN Transport Ministers' Meeting in Hanoi in September 1999. The network consists of 23 designated routes, totalling about 38,400 km. It comprises the Asian Highway under UNESCAP, which passes through AMS, as well as several additional routes. While all ASEAN Highway Network links have been completed, the total length of roads that are still below the class III ASEAN standard is 2,454 km, mostly in Myanmar and the Lao PDR.

The ASEAN Highway Network Database has been developed and maintained through voluntary efforts of the Department of Highways, Ministry of Transport, Thailand. It has been updated occasionally and the latest update was done in 2015. No plan is indicated to update the database in the near future.

Trans-Asian Connectivity Plans

Regional connectivity is on the rise worldwide. Asia, Africa, Europe, and the other continents are becoming increasingly interlinked through pan-regional initiatives. Asia is the trailblazer in this regard, and most connectivity plans have Asia at its core. Asia is also the centre of pan-regional connectivity initiatives. The MPAC, BRI, Asia–Africa Growth Corridor, and Asia–Europe Meeting (ASEM) – all connectivity plans – aim to deepen Asia's economic dynamism and extend it to trans-regional partners. Mega-regional integration initiatives such as the CPTPP and the RECP are also integral to this region.

The Belt and Road Initiative

President Xi Jinping launched the BRI as a signature foreign policy initiative during his official visit to Kazakhstan in 2013. The BRI is envisioned as a grand development plan to increase global connectivity, with China at its centre. The BRI aims to promote connectivity amongst the Asian, European, and African continents and their adjacent seas. It also aims to establish and strengthen partnerships amongst the countries along the 'Belt and Road'; set up all-dimensional, multi-tiered connectivity networks; and realise diversified, independent, balanced, and sustainable development in these countries (Xinhua, 2017). The framework covers the area of the ancient Silk Road, but it is open to all countries.

The BRI has two components: (i) the land-based 'Silk Road Economic Belt', and (ii) the 'Maritime Silk Road'. It will focus on building a new Eurasian land bridge; and developing China–Mongolia–Russia, China–Central Asia–West Asia, and China–Indochina Peninsula economic corridors. To do so, it will take advantage of international transport routes, rely on core cities along the Belt and Road, and use key economic industrial parks as cooperation platforms. Many of China's bilateral infrastructure projects in Asia, Europe, Africa, the Indian Ocean islands, and the Pacific Islands have been brought within the BRI (Figure 4.2).

Figure 4.2 Belt and Road Initiative Snapshot

2013	The year the BRI was announced	**451**	The number of projects that are part of the BRI (as of December 2019)
2017	The year the BRI was officially enshrined in China's constitution	**1 trillion**	The amount of US dollars that China has pledged in BRI funding
138	The number of countries officially part of BRI	**80 billion**	The amount of US dollars that China has directly invested in the BRI

BRI = Belt and Road Initiative, US = United States.

Source: Prakash (2021).

The aim of improving connectivity across Asia–Europe is at the core of the initiative. Most of the projects and activities under the BRI focus on transportation infrastructure within and between Asia and Europe. Still, it should be noted that the BRI's geographic scope is near-global, as it also encompasses Africa, Oceania, and Latin America. Moreover, apart from transportation connectivity, energy and communication infrastructure are also key BRI sectors. The BRI has major implications for economic and financial integration, multilateral governance, and people-to-people ties across Asia–Europe and beyond. Many, though not all, countries in Asia and Europe have concluded bilateral memoranda of understanding with China for closer cooperation on BRI-related activities (Green Finance and Development Center, 2020).

While the BRI is a top-level plan, as President Xi's signature foreign policy, it is not a centralised strategy. A central task force – the Leading Small Group on Advancing the Construction of the Belt and Road – was created in 2015 to improve BRI coordination amongst various Chinese actors involved in the BRI. However, despite these efforts, the BRI at times still suffers from coordination issues due to its scope and the multitude of actors involved.

The Belt and Road vision extends well beyond investment in economic infrastructure. The Action Plan on BRI published in March 2015 sets out five dimensions of connectivity: (i) policy coordination; (ii) high-quality transport, communications, and energy networks to facilitate international commerce; (iii) reducing the cost and risks of trade and other international economic transactions along supply chains; (iv) financial integration; and (v) people-to-people bonds.

Strong financial commitments from China support the BRI. China has launched a $40 billion Silk Road Fund, which will directly support the initiative. Additional financial resources for the initiative will be provided by the Asian Infrastructure Investment Bank (AIIB), which was primarily set up to address the infrastructure funding gap in Asia (estimated by ADB (2017) to total $8 trillion between 2010 and 2020).

The scope of the BRI is unprecedented as it aims to link many of the economies of Asia and Europe and reach out to others. Trillions of dollars will need to be invested over several decades. If the BRI is implemented efficiently, many economies can become deeply integrated and engage successfully in global value chains (GVCs). The Chinese government has earmarked up to $1 trillion for investments. Decision-making on infrastructure projects is based on bilateral agreements with other governments. Many early investments are already under way, and focus on building on and improving existing infrastructure.

Activities under the BRI relating to transport infrastructure can be subdivided into financing and construction, rail transport, maritime transport, and air transport. In addition to transport infrastructure, the digital domain is a key connectivity feature of the BRI.

a. Transport Infrastructure Financing and Construction

From the announcement of the BRI in September 2013 to 2019, more than $500 billion of construction contracts for ports, railways, motorways, airports, bridges, power plants, and dams were signed (AEI, 2020). Annual financing peaked in 2014 at around $95 billion, then dropped somewhat to $76 billion in 2018. Many projects take longer than expected to complete. This trend has been more evident since the COVID-19 pandemic.

b. Transport Infrastructure Management and Use: Rail, Maritime, and Air

BRI rail freight has been operational between Asia and Europe since 2011. The main corridor connects multiple Chinese and European cities via Kazakhstan, Mongolia, Russia, and Belarus. Other corridors connect China to Europe via Central Asia and the Middle East. BRI rail freight between Europe and China is heavily subsidised by central, provincial, and local Chinese governments, which helps the trains operate and establish new routes. More cargo is transported from China to Europe than vice versa.

Port development and terminal management along the Maritime Silk Road is the most important aspect of maritime projects in the BRI. Since 2015, aviation has officially been part of the BRI, though it is not a dominant feature (CAPA Centre for Aviation, 2018). China has become a major origin and destination of air traffic. Air transport passengers from China increased from 352.79 million in 2013 to 611.43 million in 2018 (World Bank, 2020b). The COVID-19 pandemic interrupted the former trend, while China–Europe air cargo has increased due to the transport of medical equipment and pharmaceuticals (Knowler, 2020).

c. Digital Infrastructure

The digital component of the BRI, or Digital Silk Road (DSR), was first announced in 2015. The DSR aims at improving global digital connectivity, with China at its centre, through building digital infrastructure and expanding e-commerce offerings, amongst others. Chinese actors play a dominant role here – as manufacturers of products sold through e-commerce, as e-commerce platforms, and as logistics and transport providers to BRI countries. The main players are Chinese private technology giants such as Alibaba, Tencent, JD.com, Baidu, Huawei, and ZTE, which are part of the DSR, promoting global e-commerce and digital infrastructure.

The Action Plan on the BRI notes that investments in physical connectivity should be backed up by policy development and capacity building to make international commerce amongst Belt and Road economies cheaper, easier, and faster; and should include cooperation to strengthen institutional and people-to-people linkages. Following early investments in new or existing transport, communications, and energy networks, the BRI is looking for sustainable cooperation amongst a diverse group of countries where political leaders and officials, both in China and in partner countries, are able to (i) create bilateral projects based on mutual benefit and mutual trust, (ii) agree on investments that are sustainable and achieve the stated objectives, (iii) effectively manage risks through transparency and responsible governance, (iv) converge the infrastructure projects and associated capacities with the development priorities of the partner countries, and (v) invest in sustainable infrastructure.

The early phase of the BRI has focused on investment in the hard infrastructure of transport, communications, and energy networks. The developmental and fiscal results in some of the countries hosting BRI projects have brought the BRI under immense global scrutiny, especially on its policy coordination role with the host country. The BRI needs to transform from an infrastructure programme to a connectivity programme by embracing the multidimensional aspects of connectivity.

The BRI process links participants that differ greatly in terms of the size of their populations and economies, forms of governance, institutional development, and productivity. Several decades of experience of economic cooperation indicate that successful and sustained cooperation amongst such a diverse group should be voluntary and based on the principles of openness, transparency, mutual benefit, mutual trust, mutual respect, and careful evolution. The challenge for the BRI in the coming years is to put these sound guiding principles into practice, and to take BRI projects where they are needed.

Asia–Africa Growth Corridor

Asia–Africa relations are both historical in terms of their common past and contemporary in terms of their aspirations. They share past struggles, present efforts, and prospects for a bright future with enormous prospects for cooperation and growth. This bond is also apparent from their coming together on many occasions: bilaterally, sub-regionally, as global forces, and as the 'one voice' of the developing world on issues touching human concerns of every kind. The Indian Ocean is the natural link between the two regions, enabling trade and connectivity from time immemorial.

The Asian economy, especially that of East Asia, has demonstrated resilience and provided a robust drive for the global economy, and it continues to provide the tailwinds thereof. Africa, on the other hand, is on the path to growth. Its young demography and economy require integration and expansion into the GVCs of production that exist in Asia. The two regions account for 70% of the global population and 37% of global gross domestic product (GDP). Conjoined by the Indian Ocean, the two regions provide a renewed opportunity for partnership for sustainable development. As developing regions, both continents are committed to promoting strong, balanced, sustainable, and inclusive growth, at both the national and international levels.

The vision document of the AAGC – the 'Asia Africa Growth Corridor: Partnership for Sustainable and Innovative Development' – was presented at the African Development Bank annual meeting on 25 May 2017 in Ahmedabad, India. The AAGC foresees Africa's integration with Asia, in which South Asia, West Asia, Southeast Asia, East Asia, and Oceania play an important part. The AAGC proposes four major pillars of connectivity and cooperation to bring peoples, goods, services, capital, and institutions closer together to realise the objective of an Asia–Africa partnership for sustainable and innovative development. These pillars are (i) development and cooperation projects, (ii) quality infrastructure and institutional connectivity, (iii) enhanced capacities and skills, and (iv) people-to-people partnership.

These will facilitate and enhance economic growth by linking economies in Asia and Africa through the development of institutional and human capacity, connecting institutions and people, building capacities for planning and executing projects, facilitating trade, developing human resources, and improving the technology and infrastructure (ports, airports, industrial parks, telecommunications, and information technology) of the two continents. The AAGC emphasises capacity building and expanding the manufacturing base and trade between Africa and Asia. The aim is to transform the region into a growth corridor to embed development processes and value chains in Africa and Asia. It will enable the connected economies to integrate further and collectively emerge as a globally competitive economic region. The AAGC remains especially aligned with the 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development, and provides green projects with priority funding and implementation.

The AAGC provides new supply chain linkages between two developing regions and offers a multidimensional approach to industrialisation, trade, and integration in the regional and global value chains in which industrial development is matched with higher spending on education and the development of skills and training for adapting to digital age technologies and improved productivity. With improved productivity and rising wages in important East Asian economies, labour-intensive manufacturing jobs are likely to move to the developing regions of South Asia, Africa, and even Central Asia. The AAGC and the TLH together will provide the new economic linkages and GVC integration between Asia and Africa.

The AAGC strengthens Asia–Africa economic connectivity through development plans that are suitable for and in sync with the development priorities of countries in Africa, Asia, and the Asia-Pacific region. The AAGC, therefore, is not merely a plan for development and cooperation between Asia and Africa, but also encourages freedom of movement of people, goods, services, and capital in a geographical spread between the western edges of Africa to the eastern edges of Asia and Oceania. The AAGC is the first such attempt to prepare a growth plan that connects two continents, by which the development strengths of Asia can be shared and dovetailed with the development priorities of the countries and regions of Africa. The AAGC prioritises the prosperity of the people of Africa and Asia, and their development goals, in all plans and projects under its aegis.

Europe–Asia Connectivity

The European Commission proposed building blocks for an EU Strategy on Connecting Europe and Asia, with concrete policy proposals and initiatives to improve connections between Europe and Asia, including through interoperable transport, energy, and digital networks.

The EU–Asia connectivity strategy is built on the belief that the EU and Asia should ensure efficient and sustainable connectivity because it contributes to economic growth and jobs; global competitiveness and trade; and the movement of people, goods, and services across and between Europe and Asia. It has outlined concrete policy proposals and initiatives to improve connections between Europe and Asia, including through interoperable transport, energy, and digital networks. The EU promotes an approach to connectivity with Asia which is sustainable, comprehensive, and rules-based:

- Sustainable connectivity envisages that connectivity has to be economically, fiscally, environmentally, and socially sustainable in the long term.
- Comprehensive connectivity is about networks; and the flow of people, goods, services, and capital that pass through them. It emphasises the crucial human dimension and people's interests and rights, which should be at the core of connectivity.
- International rules-based connectivity is required for people, goods, services, and capital to move efficiently, fairly, and smoothly. Internationally agreed practices, rules, conventions, and technical standards – supported by international organisations and institutions – enable the interoperability of networks and trade across borders (European Commission, 2018b).

In addition, the EU will engage with its Asian partners along three strands:

(i) by contributing to efficient connections and networks between Europe and Asia through priority transport corridors, digital links, and energy cooperation at the service of people and their respective economies;

(ii) by establishing partnerships for connectivity based on commonly agreed rules and standards, enabling better governance of flows of goods, people, capital, and services; and

(iii) by contributing to addressing the sizeable investment gaps through improved mobilisation of resources, reinforced leveraging of the EU's financial resources, and strengthened international partnerships.

For building efficient connections between Europe and Asia, the EU–Asia connectivity strategy envisages physical connectivity (air, land, and sea transport). The EU will work towards connecting the well-developed Trans-European Transport Network (TEN–T) framework with networks in Asia. The EU has extended the TEN–T to the Western Balkans, and agreed on the extension of the TEN–T with six Eastern Partnership countries (Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine) (European Commission, 2018a). Both the north–south rail connections and the east–west rail connections could play an important role in the future. The EU–China rail connection, in particular, has been experiencing strong growth. The EU is supporting the Unified Railway Law initiative of the United Nations Economic Commission for Europe, which is seeking to unify the legal regime for the carriage of goods by rail across the Eurasian continent. The EU will work with relevant rail transport organisations to extend the application of the EU's technical specifications and safety management frameworks.

While the EU–Asia strategy covers air and sea connectivity in some measure, road transport receives more attention as it is deemed to make more sense over medium distances (such as to Central Asia) and as a secondary transport network in combination with other modes of transport. Promoting road safety by sharing best practices, furthering the exchange of customs information, and developing cooperation on transit (both bilaterally and through the World Customs Organization) are important policy measures for road transport.

Digital and energy connectivity are also envisaged as important for this plan. High-capacity network links are critical to support the digital economy. Backbone network links with Asian and other third countries will contribute to a fully meshed network, providing the required bandwidth and other quality criteria for this critical infrastructure. In its relations with Asian countries, the EU strategy promotes a peaceful, secure, and open ICT environment, while addressing cybersecurity threats and protecting human rights and freedoms online, including the protection of personal data. The EU–Asia connectivity has provisioned for a coherent regulatory approach in digital connectivity, as it is critical to support private and public investment in the digital infrastructure. It also underlines policies and incentives to bridge the digital divide, particularly in remote regions or landlocked countries. The EU's Digital4Development strategy in Asia will be pursued to promote digital technologies and services to foster socio-economic development.

The EU proposes to promote regional energy connectivity platforms that focus on market principles, encourage modernisation of the energy system and the adoption of clean (decentralised) solutions, promote energy efficiency, and support energy connectivity both amongst and with partners in Asia.
Some other important features of the EU's strategy for connectivity with Asia include actions that build on existing bilateral, regional, and international cooperation programmes and activities in Asia.

In the 2021 State of the Union Address by President von der Leyen, the EU presented its new connectivity strategy called Global Gateway (European Commission, 2021b). In this strategy, the EU proposes to build Global Gateway partnerships with countries around the world, including Asia. The EU is offering investments in quality infrastructure for connecting goods, people, and services around the world.

The European strategy stands for sustainable and trusted connections to tackle the most pressing global challenges, from climate change and protecting the environment, to improving health security and boosting competitiveness and global supply chains. Global Gateway aims to mobilise up to €300 billion in investments between 2021 and 2027 and it is expected that Asia will be an important beneficiary of this strategy (European Commission, 2021a).

EU–Japan Partnership on Sustainable Connectivity and Quality Infrastructure

Japan's plan for quality infrastructure and sustainable development is the basis of its connectivity partnerships in the region. Quality infrastructure is central to all of Japan's infrastructure and connectivity initiatives. In 2019, Japan and the EU affirmed their commitment to establishing a connectivity partnership based on sustainability as a shared value, quality infrastructure, and their belief in the benefits of a level playing field. In the EU–Japan Partnership on Sustainable Connectivity and Quality Infrastructure, the EU and Japan intend to work together on all dimensions of connectivity, bilaterally and multilaterally, including digital, transport, energy, and people-to-people exchanges (Ministry of Foreign Affairs, Japan, 2019). The connectivity plans will fully take into account partners' needs and demands, and pay utmost attention to their fiscal capacity and debt sustainability. The EU and Japan will coordinate their respective cooperation on connectivity and quality infrastructure with partner third countries, notably in the regions of the Western Balkans, Eastern Europe, Central Asia, and the Indo-Pacific, as well as Africa.

In view of their commitment to promoting rules-based connectivity globally, both sides intend to cooperate in international and regional bodies, including international fora such as the G7, G20, the Organisation for Economic Co-operation and Development, the World Bank, the International Monetary Fund, the European Bank for Reconstruction and Development, and ADB. Together with the Japan–EU Economic Partnership Agreement, promoting regulatory cooperation for free, open, rules-based, and fair trade and investment is an important institutional component of this connectivity partnership. Both sides have underlined the positive contribution of sustainable connectivity to the implementation of the 2030 Agenda for Sustainable Development, and recall their readiness to support partner countries in creating an environment that stimulates investment.

Both the EU and Japan have underlined digital connectivity as a powerful enabler of inclusive growth and sustainable development, including through digital and data infrastructure as well as policy and regulatory frameworks, in developing countries. Japan and the EU emphasise that the development of a digital economy depends on an open, free, stable, accessible, interoperable, reliable, and secure cyberspace; and on 'data free flow with trust' (as declared by the G20 leaders in Osaka). Japan and the EU intend to work together to further elaborate, promote, and operationalise the concept of 'data free flow with trust', including with a view to enhancing trust concerning data security and privacy, while respecting each other's respective regulatory framework.

Japan and the EU plan to use the existing Japan–EU Transport Dialogue as a framework for engaging in and cooperating on all modes of transport and horizontal issues. Enhancing sustainable transport connectivity – through deeper cooperation and synergies of regulatory frameworks, interconnection of transport corridors, and enhancement of safety and security of transport – will be central to this connectivity partnership. Cooperation plans and projects in the framework of the connectivity partnership will be identified through existing dialogues and cooperation frameworks, in particular in the Japan–EU Strategic Partnership Agreement and the Economic Partnership Agreement. The Joint Committee established under the Japan–EU Strategic Partnership Agreement will review the progress on a regular basis. Furthermore, the Japan–EU High Level Industrial, Trade and Economic Dialogue can function as a platform for strategic discussions under the connectivity partnership.

The US Initiative and Other Plans

The US initiated the Infrastructure Transaction and Assistance Network, which provides capacity building programmes to improve partner countries' project evaluation processes and project implementation capacities, advisory services to support sustainable infrastructure, and coordinate US assistance for infrastructure in the region. The US has deployed the Transaction Advisory Fund and the Global Infrastructure Coordinating Committee in the region for technical assistance and development finance. The Asia Reassurance Initiative Act, 2018, providing $1.5 billion for 5 years until 2023, is an important part of US policy for the Indo-Pacific.

The Greater Tumen Initiative (GTI) (originally known as the Tumen River Area Development Program) is an intergovernmental cooperation mechanism amongst four countries – China; Mongolia; the Republic of Korea (henceforth, Korea); and Russia – supported by the United Nations Development Programme (Dulambazar, 2015). In 1995, the member governments signed agreements to establish the GTI mechanism, aimed at strengthening economic and technical cooperation, and attaining greater growth and sustainable development in Northeast Asia, especially in the Greater Tumen Region (GTR). The GTI focuses on the priority areas of transport, trade and investment, tourism, agriculture, and energy, with environment as a cross-cutting sector.

The GTI effectively converges the BRI initiated by China, the Eurasia Initiative proposed by Russia, and the Grassland Road undertaken by Mongolia, in building the China–Russia–Mongolia transport corridor in the GTR. Some of the important projects in the Trans-GTR

Transport Corridor are the Tumen Road Corridor, Tumen Rail Corridor, Suifenhe Transport Corridor, Siberian Land Bridge, Dalian Transport Corridor, Korean Peninsula West Corridor and East Corridor, and the China Land Bridge Transport Corridor connecting Asia with Europe via Kazakhstan. In 2013, two additional transport channels between Ulaanbaatar and Bichigt were added in the Tumen transport area. The GTI Common Fund, contributed by the member countries, is a United Nations Development Programme Trust Fund to finance the operation of the GTI Secretariat.

Similarly, the Central Asia Regional Economic Cooperation (CAREC) Program offers connectivity between Northern Asia and Central Asia. Korea's New Southern Policy leverages ASEAN and India as its key regional partners and as a strategic priority for Korea.

Funding the Connectivity Plans

Asia is one of the most dynamic and productive regions, but it is held back from realising its full potential by huge constraints in crucial infrastructure caused by a lack of investment. ADB has estimated that developing Asia will need to invest $26 trillion for infrastructure from 2016 to 2030, or $1.7 trillion per year. This would allow the region to maintain its growth momentum, eradicate poverty, and respond to climate change. Without climate change mitigation and adaptation costs, $22.6 trillion, or $1.5 trillion per year, will be needed (ADB, 2017).

Infrastructure investment varies considerably by sector (Table 4.1). The power and transport sectors require the largest investments, accounting for 52% and 35%, respectively, of total infrastructure investments. Telecommunications and water and sanitation are no less important for an economy or for individual welfare, and therefore require investment. Each of these sectors has varying levels of regulatory, governance, and sustainability challenges in different countries.

Table 4.1 Infrastructure Investment Needs by Sector in 45 ADB Developing Member Countries, 2016–2030
($ billion in 2015 prices)

Sector	Baseline estimates			Climate-adjusted estimates			Climate-related investments (annual)	
	Investment needs	Annual average	Share of total	Investment needs	Annual average	Share of total	Adaptation	Mitigation
Power	11,689	779	51.8	14,731	982	6.76	3	200
Transport	7,796	520	34.6	8,353	557	6.56	37	-
Telecommunications	2,279	152	10.1	2,279	152	5.12	-	-
Water and sanitation	787	52	3.5	802	53	3.31	1	200
Total	**22,551**	**1,503**	**100.0**	**26,166**	**1,744**	**1.02**	**41**	

ADB = Asian Development Bank.

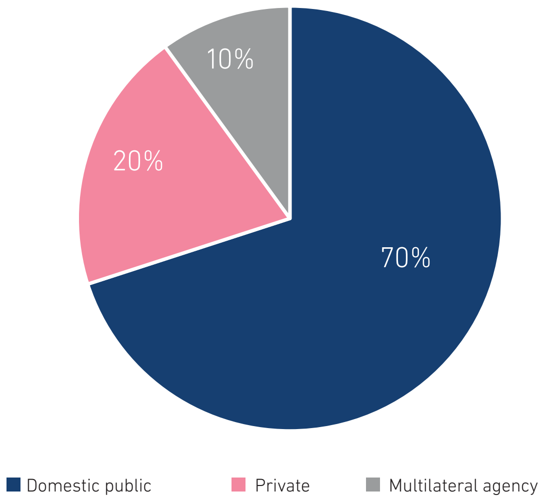
Note: Numbers may not total exactly because of rounding.

Source: Asian Development Bank estimates (ADB, 2017).

Funding Agencies and Partnerships

Infrastructure projects focused on cross-border connectivity present significant investment opportunities and are vital for long-term growth in Asia. Much of the funding would continue to come from public resources, through better domestic revenue mobilisation, cost recovery, and better prioritisation of fiscal resources. Yet, it is also very clear that more private sector financing is required. While public spending still provides the bulk of needed infrastructure investments, fiscal constraints and debt sustainability considerations limit the extension of public finance (Figure 4.3). Various multilateral development banks (MDBs) have also made mobilising private capital a priority. ADB emphasises private participation in infrastructure and capital market development in its private sector operations framework. The World Bank also takes an approach of 'maximizing finance for development' to leverage all sources of finance systematically. The AIIB has a more focused mandate on infrastructure project financing and does not offer concessionary financing. It aims to create infrastructure projects as an asset class for private sector investors by increasing the level of data quality. This helps market participants to make informed financing decisions.

Figure 4.3 Composition of Infrastructure Financing



Source: Subhanij (2018).

Besides the MDBs and public–private financing in Asia, the ASEAN Infrastructure Fund (AIF) promotes regional infrastructure financing and financial resilience to support the long-term development of the AMS. The AIF is dedicated to meeting some of the region's infrastructure investment needs. ADB has invested $150 million and administers the AIF and provides technical support.

Given the plethora of connectivity plans in Asia and their trans-regional nature, the future of financing of these projects may well remain in multilateral cooperation partnerships. The Multilateral Cooperation Center for Development Finance (MCDF) was set up through a memorandum of understanding between China's Ministry of Finance, the AIIB, ADB, the European Bank for Reconstruction and Development, the European Investment Bank, the New Development Bank, and the World Bank to promote infrastructure and connectivity. The MCDF will act as a platform to foster high-quality infrastructure and connectivity for developing countries. It multilateralises infrastructure financing and advocates for a transparent, non-discriminatory, and predictable financing environment, taking into account debt sustainability in mobilising finance. Information sharing, capacity building, and project preparation are the focus areas of the MCDF.

Addressing the Financing Gap

Project governance and sustainability increase the cost of infrastructure but are important for attracting financing from financial institutions (Prakash, 2020a). The financing gap for infrastructure is, in large part, the result of inadequate policies and processes and a lack of familiarity with projects. Governments play a central role in most infrastructure projects because infrastructure has strong public good characteristics, requires large-scale capital mobilisation, and is highly sensitive to local politics. However, the scale of infrastructure spending required over the next 10–15 years, coupled with widespread public sector fiscal constraints, means that private finance will be increasingly important. A positive 'enabling environment' – that is, one characterised by sound policies, effective institutions, transparency, reliable contract enforcement, and other sector-specific factors – makes it easier to mobilise private finance. Conversely, a poor enabling environment – one characterised by distorting subsidies, unreliable counterparties, and flawed procurement processes – can raise the cost of private finance to the point where infrastructure projects are no longer economically viable (Bielenberg et al., 2016).

Trans-regional plans such as the BRI, AAGC, MPAC, and EU–Asia connectivity are seeking greater emphasis on governance, standards, transparency, and sustainability to varying degrees. Institutions such as the Asian Development Bank Institute and the African Development Bank have helped to further this objective by providing climate adaptation and mitigation adjusted costs for infrastructure. Transparency in project preparation and accountability in project execution are important global concerns emerging from the financing and implementation of infrastructure plans. Global attention has been drawn towards issues of planning and project design, financing and debt sustainability, territorial integrity, and people's choices.

Multilateral Cooperation for Investment in Connectivity Plans

A multilateral cooperation programme amongst countries and MDBs could facilitate global investment in infrastructure for connectivity by creating more efficient, informed, transparent, and predictable investment conditions around infrastructure plans and projects. Development banks feature prominently in this multilateral cooperation because they have the mandate, motivation, and means to influence financing flows and shape markets and have experience in infrastructure funding that could help other actors, such as private sector and institutional investors, in taking on the projects (Prakash, 2020b). Such cooperation works best when undertaken at a regional level, as is seen in the case of connectivity infrastructure projects in Asia and Africa. This is also important because it helps policymakers to find synergies between national and regional development strategies. Some examples of this are projects such as the BRI, AAGC, TLH, and Greater Tumen Initiative.

However, the cooperation can extend to other regions too, as funds are expected to flow from near and far. The experience of members from other regions also matters (Prakash, 2020b). The measures undertaken for investment facilitation would include:

- Aggregation of information on pipelines of infrastructure projects in roads, railways, power interconnections and transmission lines, bridges, ports and airports, and ICT networks that are at an advanced stage of project preparation, have relatively robust economic cases, and are likely to be able to substantially mitigate risks, including environmental and social risks.
- Follow-up information on the pipeline of projects where the economic case is reasonably strong but may need further substantiation and/or have risks that appear to be manageable.
- Project preparation facilities and technical assistance to increase the 'bankability' of project pipelines.
- Improving regulatory transparency and predictability – such as the publication/notification of investment-related measures, and enquiry points/single window.
- Streamlining and speeding up administrative procedures – such as the procedural aspects of investment applications, approval processes, licensing and qualifications, and formalities and documentation requirements – as one-stop shop/single window services.
- Enhancing international cooperation and addressing the needs of developing members – such as the exchange of information amongst competent authorities and technical assistance and capacity building for developing countries and least developed countries.
- Environmental and social assessments of projects.
- Debt sustainability and fiscal risk assessments of the projects.

Some important initiatives of multilateral cooperation are already taking shape, and each is unique to the strengths and requirements of the members and partners. The MCDF initiated by the AIIB, the AAGC, and the MPAC 2025 are following the multilateral or trilateral cooperation framework for all or some aspects of infrastructure financing, project preparation, information sharing, and capacity building.

Multilateral cooperation for investment facilitation will improve the speed, scale, and pricing with which private capital could flow into infrastructure investment. It will lead and complement the capital markets' response towards infrastructure investments through streamlining of policy and regulatory rules, institutional conduct, and agency factors. Multilateral cooperation, supported by the EU, the G20, and other similar groups of economies, will encourage governments and MDBs to provide an informed, predictable, and transparent investment environment for institutional investors and get capital to flow into projects.

Supply Chains: New Drivers of Connectivity Plans

ASEAN and East Asia are manufacturing hubs with close trade relations within the region, and with important markets in the EU and the US. Such trade integration has been achieved through supply chain efficiencies and market demands in which seamless connectivity plays an important role. Supply chains in ASEAN and East Asia rest on a stable foundation of trade and investment links. To the extent that there are risks, they are primarily at a micro level.

Four important events have brought the focus on new connectivity strategies that would help the supply chains in Asia remain resilient to changes in the international trade dynamics.

One, repeated natural disasters and the ongoing COVID-19 pandemic have reminded the world of the vulnerability of supply chains and risks to connectivity. In this context, the potential of connectivity plans such as the TLH lies in providing resilience to connectivity and supply chains, once it is well connected to other road networks (e.g. the GMS economic corridors) and the networks of other modes of transportation (e.g. railways, waterways, maritime, and air).

Two, the US–China trade tensions were forecast to affect supply chains, investments, and production locations in the region. International suppliers from the ASEAN region have remained resilient to such tensions. However, the China centrality of the supply chains in East Asia is driving new connectivity amongst Australia, Japan, India, and the US in the Quadrilateral Security Dialogue. Similar supply chain led connectivity plans are seen in South Asia. The AAGC is planned partly to provide alternative supply chain linkages in Asia. More recently, the India–Australia–Japan Supply Chain Resilience Initiative, signed on 27 April 2021, was launched to minimise supply chain disruptions and to diversify trade and investments, with a provision to expand the initiative to other regions (Ministry of Commerce & Industry, 2021). The renewed emphasis on the Mekong Subregion in these new supply chain initiatives is leading to new connectivity drives in Asia which have trade integration at the core.

Third, the advent of the digital economy has brought an urgency to digital connectivity plans in Asia. Investments in infrastructure for the digital economy and cybersecurity are the two most pressing needs in ASEAN and other parts of developing Asia for it to grow as a digital economy hub. However, the development of ICT-related infrastructure in individual Asian countries is uneven and gaps remain across and within countries (Chen, 2020). The digital economy could also allow less developed countries/regions to skip certain stages and leapfrog to a higher level of development. With an appropriate set of skills, the digital economy enables possible leapfrogging from the pre-globalised world to active participation in trade through technology and connectivity. Digital connectivity plans with trusted partners in Asia and Europe would fulfil the scope and need for value chains of the digital economy in Asia. EU–Asia connectivity has a strong focus on connectivity designed for the digital economy.

Fourth, the slowdown in trade in goods reflects capacity overhangs in investment and production. However, the growth in trade in services remains high. There is a pressing need to create new supply chains that can utilise the young demography and labour force and cater to new markets. Manufacturing will not diminish in the digital economy. The geographic span of the GVCs will expand, and their concentration may also shift from current locations. The production and consumption of goods and services will occur in new locations and platforms. The AAGC is a good example in this regard. Similarly, ASEAN–UK cooperation and ASEAN–EU connectivity address new supply chains for trade in services. Connectivity and cooperation – through market access, facilitation, and rules – can upgrade the existing value chains for trade in goods and services, and create new ones.

Can the Connectivity Plans Converge?

The ASEAN notions of connectedness and community building, despite some differences, are compatible with European and African thinking and can therefore be used effectively in pan-Asia, Asia–Africa, and Asia–Europe connectivity. However, in a global milieu, connectivity plans are competing for space, influence, and results (usually for the promoting country).

Seeking convergence amongst competing connectivity plans is based on the notion that all connectivity plans have similar objectives. The contours of the MPAC, AAGC, BRI, and other connectivity plans will show that this is not always the case. There are inherent differences in each of these plans, given their origins, partnerships, resources, and the political and economic priorities of the promoters. Given these competitive differences, a consensus amongst governments, businesses, and people is emerging to set up governance mechanisms that would place different connectivity plans behind globally agreed development goals. This will help to create common objectives and create synergies amongst the different connectivity plans.

The transformational changes in global governance, international relations, the aspirations of the young demography, technological connectivity, and the future of work are driving the current discourse on connectivity. For this reason, a free and open Indo-Pacific, ASEAN-India connectivity, the AAGC, the BRI, and EU–Asia connectivity are seeking greater emphasis on governance, standards, transparency, and accountability.

The apparent commonality of objectives in connectivity plans and mechanisms is deceptive because the principal agents in each plan choose different pathways towards apparently common goals. Therefore, the results differ amongst various connectivity plans. Primarily, the financing of connectivity plans, transparency in project preparation, and accountability in project execution are important global concerns emerging from the implementation of connectivity plans. The example of the BRI is important as it has drawn global attention towards issues of planning and project design, financing and debt sustainability, territorial integrity, and people's voices. Controversies in Pakistan, Sri Lanka, the Maldives, the Lao PDR, and Montenegro relate to debt sustainability and underline the disconnect between connectivity plans and development strategies. This emphasises the need for governance standards and processes which transcend bilateral arrangements and can be measured against generally accepted and globally agreed standards and norms for connectivity plans, especially infrastructure plans.

Finding the global standards for connectivity projects and activities is difficult but not impossible. Global development programmes and the impetus for multilateralism can provide a way to create greater interlinkages between connectivity plans through governments, and regional and multilateral institutions. The Bretton Woods framework monitored money and monetary institutions to foster peace and build growth in the post-war years. Similarly, with connectivity as the new international strategy for growth, it is essential that global governance reach and monitor its various aspects and actors. It is already evident in the MPAC, AAGC, and EU–Asia connectivity that triangular and multilateral cooperation on connectivity are producing more inclusive and sustainable plans due to greater oversight of project preparation processes and plan outcomes.

The practical aspects of trans-regional connectivity call for a unified or common regime for the carriage of goods and people across continents. Technical specifications, safety management frameworks, the social and economic well-being of workers in the sector, competition policy, and customs cooperation are some important beyond-the-border issues that require agreed standards and regulations, especially in rail and road transport. Air and sea connectivity have international rules but require calibration around new collaborations and routes. Digital connectivity is embedded in most plans, but promoting a peaceful, secure, and open ICT environment, including data protection, requires a coherent regulatory approach as well as policies and incentives to bridge the digital divide. Clearly, the synergy in different connectivity plans is incumbent on common rules and standards.

Global standards and governance rules for infrastructure-related connectivity plans can be drawn from the broad commitment to put people and their prosperity at the core of connectivity programmes. Employing good governance and accountability as drivers, the plans must work towards the goals of sustainable development and inclusive growth. When connectivity plans converge with regional, national, and global development priorities, monitoring of plans will likely become easier. Finally, the monitoring and regulatory mechanisms must ensure that connectivity plans are not used as a foil for regional leadership – nor can they be used to export debt problems in the promoter country or group of countries. Policymakers are working towards global standards on contemporary issues such as taxation, digital finance, the internet, data ownership and transfer, and artificial intelligence. A global consensus around climate change, the Sustainable Development Goals, multilateralism, and global trade is also being renewed. It is only logical that global (and regional) mechanisms for the monitoring and regulation of connectivity plans should ensure that these plans enhance economic and social well-being amongst people and create trust amongst partners.

Connectivity plans that cater to new supply chain linkages, whether for trade in goods or services, or for the digital economy, will be subject to efficiencies and markets. At the same time, the global discourse on balanced, sustainable, and inclusive growth shifts the emphasis on economic corridors that can stimulate two-way trade between economic agglomerations within Asia, and between Asia, Africa, and Europe. The ongoing COVID-19 pandemic has revealed the vulnerability of connectivity and GVCs. Connectivity between new production locations and markets will strengthen the resiliency of inter-regional connectivity and the GVCs, and improve trade integration. In the post-COVID-19 phase, it will also support restructuring and diversification of supply chains and markets. Asia has high stakes in the new supply chain led connectivity with other parts of the world. Restructuring, understanding, and preparing for a connected Asia will ensure stable and inclusive growth in the region.

References

ADB (2017), *Meeting Asia's Infrastructure Needs.* Manila: Asian Development Bank.

ADB (2018), *Review of Configuration of the Greater Mekong Subregion Economic Corridors*. Manila: Asian Development Bank.

AEI (2020), 'China Global Investment Tracker'. Washington, DC: American Enterprise Institute. https://www.aei.org/china-global-investment-tracker/ (accessed 30 June 2020).

AIIB (2019), 'Memorandum of Understanding on Collaboration on Matters to Establish the Multilateral Collaboration Center for Development Finance', 25 March. Beijing.

ASEAN (2011), *Master Plan on ASEAN Connectivity.* Jakarta: ASEAN Secretariat.

ASEAN (2016), *Master Plan on ASEAN Connectivity 2025*. Jakarta: ASEAN Secretariat.

Bielenberg, A., M. Kerlin, J. Oppenheim, and M. Roberts (2016), *Financing Change: How to Mobilize Private Sector Financing for Sustainable Infrastructure.* McKinsey Center for Business and Environment. McKinsey & Company. https://newclimateeconomy.report/workingpapers/wp-content/uploads/sites/5/2016/04/Financing_change_How_to_mobilize_private-sector_financing_for_sustainable-_infrastructure.pdf (accessed 26 March 2020).

CAPA Centre for Aviation (2018), 'China's Belt and Road Initiative and Aviation', 26 July. https://centreforaviation.com/analysis/airline-leader/chinas-belt-and-road-initiative-and-aviation-427350 (accessed 30 June 2020).

Chen, L. (2020), 'Improving Digital Connectivity for E-commerce: A Policy Framework and Empirical Note for ASEAN', *ERIA Discussion Paper Series*, No. ERIA-DP-2019-41. Jakarta: Economic Research Institute for ASEAN and East Asia.

Dulambazar, T. (2015), 'Mongolia's Cooperation in the GTI Transport Corridor', in *Blue Book: 20 Years in Greater Tumen Regional Cooperation*. Beijing: China Association of International Trade (CAIT).

EESC (2018), 'Connecting Europe and Asia – Building Blocks for an EU Strategy', Joint Communication to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions, and the European Investment Bank, September. Brussels: European Economic and Social Committee.

ERIA (2009), 'Mekong–India Economic Corridor Development', Concept Paper. Jakarta: Economic Research Institute for ASEAN and East Asia.

European Commission (2018a), 'A Credible Enlargement Perspective for and Enhanced EU Engagement with the Western Balkans', Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels: European Commission.

European Commission (2018b), 'Connecting Europe and Asia: Building Blocks for an EU Strategy', Communication to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank. Brussels: European Commission.

European Commission (2021a), 'Global Gateway: Up To €300 Billion for the European Union's Strategy to Boost Sustainable Links Around the World', Press release, 1 December. https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6433 (accessed 3 December 2021).

European Commission (2021b), 'State of the Union Address by President von der Leyen', Strasbourg, 15 September. https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_21_4701 (accessed 30 November 2021).

Green Finance and Development Center (2020), Countries of the Belt and Road Initiative (BRI). https://green-bri.org/countries-of-the-belt-and-road-initiative-bri (accessed 30 June 2020).

Hawke, G.R. (2007), 'Jusuf Wanandi, Always Thinking, Cajoling, Persuading', in H. Soesastro and C. Joewono (eds.) *The Inclusive Regionalist: A Festschrift Dedicated to Jusuf Wanandi*. Jakarta: Centre for Strategic and International Studies, pp.20–8.

Hawke, G.R. and A. Prakash (2016), 'Conceptualising Asia–Europe Connectivity: Imperatives, Current Status, and Potential for ASEM', in A. Prakash (ed.) *Asia–Europe Meeting (ASEM) Connectivity Vision 2025: Challenges and Opportunities*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA) and Government of Mongolia, pp.3–9.

Kimura, F., S. Umezaki, and A. Prakash, eds. (2020), *The India–Myanmar–Thailand Trilateral Highway and Its Possible Eastward Extension to Lao PDR, Cambodia, and Viet Nam: Challenges and Opportunities.* Jakarta: Economic Research Institute for ASEAN and East Asia.

Knowler, G. (2020), 'China-Europe Air Cargo Rates Hit New Highs on Medical Demand', 6 April, JOC. https://www.joc.com/air-cargo/china-europe-air-cargo-rates-hit-new-highs-medical-demand_20200406.html (accessed 30 June 2020).

Ministry of Commerce & Industry, India (2021), 'Australia–India–Japan Trade Ministers' Joint Statement on Launch of Supply Chain Resilience Initiative', Press release, 27 April. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1714362 (accessed 11 August 2021).

Ministry of Foreign Affairs, Japan (2019), 'The Partnership on Sustainable Connectivity and Quality Infrastructure between Japan and the European Union'. Tokyo: Government of Japan, Ministry of Foreign Affairs.

Prakash, A. (2018), 'The Asia–Africa Growth Corridor: Bringing Together Old Partnerships and New Initiatives', ORF Issue Brief, No. 239. New Delhi: Observer Research Foundation. https://www.orfonline.org/wp-content/uploads/2018/04/ORF_Issue_Brief_Asia_AfricaGrowth_Corridor.pdf

Prakash, A., ed. (2018), *Brussels Report on Strengthening Asia–Europe Connectivity: Drawing Synergy from Global Development and Governance Programmes*. Jakarta: Economic Research Institute for ASEAN and East Asia.

Prakash, A. (2020a), 'Connecting the Connectivities: It's Time for Regional Initiatives to Work Together', in A. Bodet, I. Krivaitė, Z. McGuinness, and A. Pauly (eds.) *Rethinking Global Governance*. Brussels: Friends of Europe, pp.18–21.

Prakash, A. (2020b), 'Multilateral Cooperation for Investment Can Mobilize Infrastructure Funds and Link Needs of Investors, Governments, and People', *Policy Brief,* Task Force 3: Infrastructure Investment and Financing. Riyadh: T 20.

Prakash, A., ed. (2021), *13th Asia Europe Meeting: Multilateral Cooperation for Resilient, Sustainable, and Rules-Based Future for ASEM.* Jakarta: Economic Research Institute for ASEAN and East Asia.

Prakash, A. and F-P. van der Putten (2021), 'Connectivity Plans for Asia and Europe: Public Goods and Collective Growth', in Prakash, A. (eds.), *13th Asia-Europe Meeting (ASEM) Summit: Multilateral Cooperation for a Resilient, Sustainable and Rules-Based Future for ASEM*, Jakarta: ERIA, Phnom Penh: ASEM13 and The Royal Government of Cambodia, pp.20-42.

Subhanij, T. (2018), 'Infrastructure Financing in Asia and the Pacific: Status and Modalities', Addressing the Transboundary Dimensions of the 2030 Agenda, Subregional Inception Meeting, 2–4 October, Almaty.
https://www.unescap.org/sites/default/files/Infrastructure%20Financing%20in%20Asia%20and%20the%20Pacific.pdf (accessed 3 November 2018).

Urata, S., G. Hawke, A. Prakash, and M.E. Pangestu (2019), 'Towards an Integrated and Connected Indo-East Asia', in S. Tay, S. Armstrong, P. Drysdale, and P. Intal (eds.) *Collective Leadership, ASEAN Centrality, and Strengthening the ASEAN Institutional Ecosystem*. Jakarta: Economic Research Institute for ASEAN and East Asia, pp.56–89.

World Bank (2020a), Air Transport, Freight (million ton-km) – China. https://data.worldbank.org/indicator/IS.AIR.GOOD.MT.K1?contextual=aggregate&locations=CN&start=2013 (accessed 30 June 2020).

World Bank (2020b), Air Transport, Passengers Carried – China. https://data.worldbank.org/indicator/IS.AIR.PSGR?locations=CN (accessed 30 June 2020).

Xinhua (2017), 'Full text: Vision for Maritime Cooperation under the Belt and Road Initiative', 20 June. http://english.www.gov.cn/archive/publications/2017/06/20/content_ 281475691873460.htm (accessed 30 June 2020).

Chapter 5

Digital Connectivity

Lurong Chen
Senior Economist, ERIA

Introduction

Digitalisation is transforming the global economy. Various factors have laid a solid foundation for economic digitalisation, such as high-speed Internet, the use of smartphones, the facilitation of online payments, changes in consumer behaviour, and service sector liberalisation. Digitalisation is disruptive to the traditional ways of doing business by introducing new digital tools, such as artificial intelligence (AI), cloud computing, big data, and machine learning, to the market (Chen and Kimura, 2019). For instance, digitalisation tends to lower market entry barriers and enable companies to tap into foreign markets that would otherwise be too difficult or too costly to access. This could be realised not only by reducing transaction and delivery costs, but more importantly, through greater international diffusion of information that allows firms to explore new markets globally.

In the literature, Baldwin (2016) has explained the economic logic of the way digitalisation – the development of information and communication technology (ICT) – could lead to a new pattern of globalisation (the 'third unbundling') characterised by a new type of international division of labour, which would create strategies for national development. Therefore, digital connectivity will significantly affect a nation's overall economic performance. Based on this, Kimura (2018) proposed a policy framework mapping the stages of technological progress and the possible choices of development strategies. Kimura and Chen (2018) applied this policy framework to an analysis of the development strategy of Indonesia's economy. Their findings show that for large countries such as Indonesia, given the existence of development gaps within the country, digitalisation could expand the policy space and allow policymakers to adopt diversified strategies to promote economic development. For regions with significant diversity, this sheds lights on regional development patterns.

In this regard, digitalisation will have important implications for Asia's development. The next Asian growth miracle could be born with the region's transformation to the new digital era, whose new ideas, technologies, mindset, tools, and businesses are changing the way people live, work, and study. For instance, the Association of Southeast Asian Nations (ASEAN) and East Asia has the world's fastest-growing online market, with an internet user base of more than 350 million and an overall market size of $72 billion in 2018. Google and Temasek (2019) projected that the regional e-commerce market would keep growing at an average rate of 25%–35% per year in the next 5–10 years. From 2017 to 2025, the market size of online business will increase by a factor of five (Statista, 2019). In ASEAN, the annual growth of e-commerce revenue relative to regional gross domestic product (GDP) growth is projected to be twice as much as the ratio of global e-commerce revenue growth to world GDP growth.

The ASEAN Economic Community (AEC) Blueprint 2025 (ASEAN, 2015) and ASEAN Socio-Cultural Community Blueprint 2025 (ASEAN, 2016) highlighted the importance of incorporating economic digitalisation in ASEAN's development. To realise the potential of fast growth, many tasks must be completed. A fundamental task for ASEAN is to improve digital connectivity, which, as the International Telecommunication Union (ITU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2019) argued, requires 'efforts to promote the benefits of online participation while mitigating the potential downsides' (ITU and UNESCO, 2019: ix).

For many developing countries, infrastructure remains one of the main barriers to the development of the digital economy. During the coronavirus disease (COVID-19) pandemic, when many countries implemented social distancing or lockdown measures to limit mobility and prevent the spread of the virus, digital solutions provided an effective backup to government policies and actions. In many areas, online solutions proved to be an efficient substitute for offline practices – from doing business online to working and studying from home.

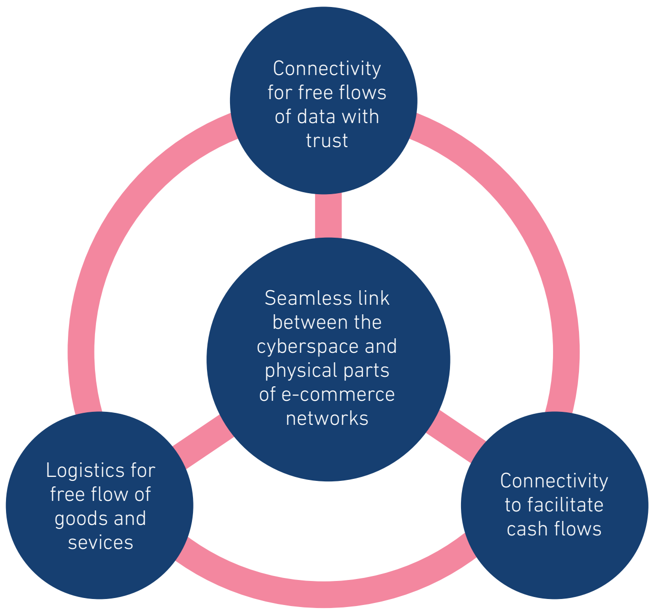
Let us take the growth of e-commerce as an example. Since 2015, e-commerce markets in ASEAN have grown at a compound annual growth rate of 20%. During the COVID-19 pandemic, the world's total e-commerce revenue was estimated to have increased 25% from 2019 to 2020, while that of ASEAN increased by more than 40%. In ASEAN, nearly 40 million new e-commerce users entered the market in 2020. Online services boomed quickly in the region. The online food delivery market was estimated to grow by more than one-third from 2019 to 2020, driven mainly by the Platform-to-Customer commerce.

As more offline activities switched online, the importance of digital connectivity was highlighted. For that reason, digital connectivity is a vital element of the Comprehensive Asia Development Plan 3.0. This chapter provides insights into digital connectivity by (i) examining the general development status of digital connectivity in the region, showing both the progress and the weaknesses; and (ii) discussing the importance of rules and regulations in facilitating digital connectivity, especially the vitality of free flow of data with trust within the region.

The Status of Digital Connectivity in ASEAN

According to Chen (2017, 2019), when considering digital connectivity, one needs to think of the following four types of links: (i) data connectivity, (ii) logistics, (iii) financial connectivity, and (iv) seamless links between the cyberspace and the physical parts of the network (Figure 5.1).

Figure 5.1 A Framework of Digital Connectivity



Source: Chen (2020: Figure 3).

First, the development of e-commerce demands more stable and affordable internet connections at higher speeds. Second, the digital society is a combination of physical space and cyberspace. For instance, while e-commerce allows people to do business online, logistics are still needed to deliver the traded products. Therefore, logistics is still a compulsory part of digital connectivity. In addition, obstacles posed by poor quality roads, incomplete road and railway networks, inadequate ports, and energy supply issues will hinder the development of the digital economy. Third, the financial sector will play an unreplaceable role in the resource allocation of the digital economy, even in a cashless society. Fourth, when thinking of digital connectivity as an integrated ecosystem, there is a need to link up different parts of the network and smoothen its overall function.

Data Connectivity

Compared with the world average, the general quality of regional internet infrastructure in ASEAN appears to be satisfactory. However, wide development gaps exist in ICT-related infrastructure across and within countries. For instance, the entry-level broadband connection in Singapore is much faster than that of the CLM countries – Cambodia, the Lao People's Democratic Republic (Lao PDR), and Myanmar. The average internet connection speeds in the region range from 20.3 megabits per second (Mbps) in Singapore, ranked seventh globally, to 5.5 Mbps in the Philippines, ranked 100th. The peak internet connection speed in the region ranges from over 180 Mbps in Singapore, the world's number 1, to 42 Mbps in the Philippines, number 97. In many countries, getting connected to the internet in rural areas or remote villages is not as easy as in urban areas. More insights can be gained from the following five aspects: (i) network coverage, (ii) speed of internet connection, (iii) affordability, (iv) content, and (v) cybersecurity.

Network coverage

According to World Bank (2019) data, the internet penetration in ASEAN Member States (AMS), measured as the number of internet users as a percentage of the total population, ranges from 22% in the Lao PDR to 81% in Singapore (Table 5.1), indicating gaps in internet access across countries. A large number of people/households in ASEAN, especially in the less developed countries, still do not have internet access.

Table 5.1 Internet Coverage

Country	**Internet penetration** (users as percentage of population)	**Fixed-line subscriber penetration** (per 100 inhabitants)	**Mobile subscriber penetration** (per 100 inhabitants)	**Mobile connections** (% of population)	
				3G	**4G**
Brunei	94.9	9.6	126.6	92.7	90.0
Cambodia	34.0	0.8	126.3	83.9	57.5
Indonesia	32.3	2.3	173.8	93.8	90.4
Lao PDR	25.5	0.4	54.1	78.0	9.0
Malaysia	80.1	8.5	133.9	96.2	92.0
Myanmar	30.7	0.2	89.8	90.5	75.1
Philippines	60.1	3.2	110.4	93.0	80.0
Singapore	84.4	25.8	148.2	100.0	100.0
Thailand	52.9	11.9	176.0	98.0	98.0
Viet Nam	49.6	10.8	125.6	95.0	95.0

Source: Author. Raw data from World Bank (n.d.), https://databank.worldbank.org/source/world-development-indicators (accessed 17 March 2020).

ASEAN's fixed-line broadband subscriptions are generally low. Even in Singapore, the number of subscriptions per 100 inhabitants to fixed-line broadband is lower than that of the Republic of Korea (42) or Japan (32). More people access the internet using their mobile phones, thanks to technological progress in wireless connections. In AMS, the 3G/4G network has already covered most of the population. With mobile phones supporting 3G technology (the minimum technical requirement for mobile internet use), more than 60% of people in the CLM can access the internet.[1] Despite this, however, some gaps in network construction remain. While most countries already have a 4G network with universal or almost universal coverage, i.e. 100% in Singapore and 98% in Thailand, the CLM countries will need to catch up more quickly with the construction of the 4G network.

An issue related to network coverage is electricity access. The coverage of internet access in a country is limited by the lower value of either network coverage or electricity access. The urban–rural gaps in electricity access seem even wider than those of internet access (Table 5.2). In Cambodia, although all urban residents have access to electricity, 80% of the population lives in rural areas where less than two-fifths have electricity access. A similarly wide urban–rural gap exists in Myanmar, which also needs to increase its urban electricity access. In these countries, including the Lao PDR, an urgent task is to resolve electricity supply problems in rural areas.

Table 5.2 Electricity Access

Country	Urban coverage (% of urban population)	Rural coverage (% of rural population)	Share of rural population
Brunei	100.0	100.0	22.5
Cambodia	100.0	36.5	79.1
Indonesia	100.0	94.8	45.5
Lao PDR	97.4	80.3	60.3
Malaysia	100.0	100.0	24.6
Myanmar	89.5	39.8	65.4
Philippines	96.9	86.3	55.7
Singapore	100.0	0.0	0.0
Thailand	99.9	100.0	48.5
Viet Nam	100.0	100.0	65.8

Source: Author. Raw data from ITU (2019).

[1] Based on the value of the 'mobile subscriber penetration (100%)' indicator (GSMA, 2019).

Speed of network connection

In addition to coverage, the quality of the network connection is an important factor of digital connectivity. To end users, good quality means faster, more stable, and more secure connection. Table 5.3 compares the network quality across AMS based on the bandwidth capacity and the average speed of the internet connection. This reveals large gaps in the countries' bandwidth capacity.

Table 5.3 Internet Connection Speed

Country	Bandwidth capacity		Fixed-line connection		Mobile connection	
	Total bandwidth (Gbps)[a]	Per internet user (Kbps)	Average upload speed (Mbps)	Average download speed (Mbps)	Average upload speed (Mbps)	Average download speed (Mbps)
Brunei	~44	~108.2	n.a.	n.a.	n.a.	n.a.
Cambodia	102 ~ 174	19 ~ 32	16.4	13.0	8.6	7.4
Indonesia	1,784 ~ 2,072	21 ~ 25	9.9	15.6	8.4	9.5
Lao PDR	~32.2	~18.4	n.a.	n.a.	n.a.	n.a.
Malaysia	1,078 ~ 1,424	43 ~ 56	15.2	21.9	9.1	16.7
Myanmar	83 ~ 92	6 ~ 7	9.6	8.8	14.4	22.7
Philippines	1,101 ~ 2,534	19 ~ 44	15.7	15.2	6.5	11.7
Singapore	4,522 ~ 4,544	954 ~ 959	170.9	132.2	31.7	76.0
Thailand	1,764 ~ 4,364	48 ~ 120	25.3	48.8	9.9	15.4
Viet Nam	4,038 ~ 6,100	91 ~ 137	31.9	29.5	7.7	14.3

Gbps = billion (giga) bits per second, Kbps = thousand (kilo) bits per second, Mbps = million (mega) bits per second, n.a. = data not available.

a Total bandwidth is calculated by per internet bandwidth per user multiple by the total number of internet users.

Source: Author. Based on EIU (2019), ITU (2019), and World Bank (2019).

While users in Singapore can get bandwidth of almost 1 million bits per second, the maximum quota for users in Myanmar is 6,200 bits per second. Accordingly, fixed-line connections in Singapore are 15–16 times faster than in Myanmar. When using the same phone to download information from the internet, the speed in Singapore is 10 times as fast as in Cambodia. Except for Singapore, the average speed of internet connections in ASEAN is slower than in China. Despite this, one should not deny the fast ICT development in the region. Nevertheless, the overall network speed already reaches a level that allows countries to use new ICT tools such as cloud computing. When using CISCO (2019) requirements[2] on internet speed for business and consumer cloud services as the benchmark, the internet speed in almost all AMS, including the CLM countries, has met the minimum requirements for advanced cloud applications (apps).

Affordability of internet access

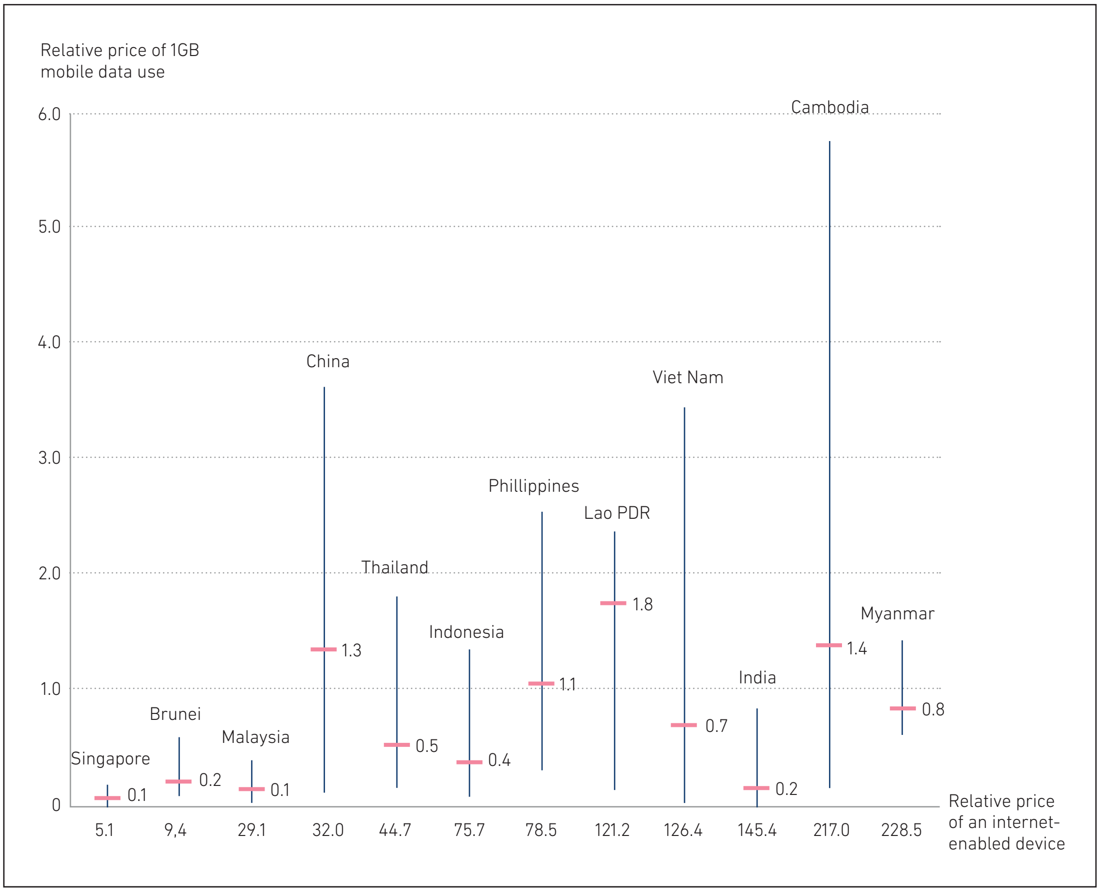
In ASEAN, smartphones and mobile apps have been widely used to access the internet. Both the price of the device and the cost of mobile data use have been driven down dramatically. The selling price of mobile phones does not vary significantly across countries. According to the International Data Corporation, the global average selling price of smartphones was about $235 (Statista, 2019). Buying a smartphone seems to be less burdensome for consumers in Singapore or Brunei since it only costs 5%–10% of their average monthly income. However, it is still a significant purchase for consumers in Cambodia or Myanmar, where the price of purchasing a new smartphone is equivalent to 2 months' income for most people.

The cost of internet access with a mobile connection has been dramatically driven down in recent years. Less developed countries in the region – the CLM countries – have made substantial improvements in the past 5 years. According to GSMA (2019), using a mobile connection to access the internet in Myanmar is now more affordable than in many other AMS. Region-wise, the gap across countries has been narrowed.

Figure 5.2 reveals more details on the price of 1 gigabyte (GB) of mobile data use relative to the country's monthly gross national income (GNI) per capita (indicated by the vertical axis) and the relative price of an android internet-enabled device (indicated by the horizontal axis). In countries like Malaysia or Singapore, the price of 1 GB of mobile data use is equivalent to only 0.01%–0.03% of monthly GNI per capita, while the cost of using the same amount of data in Cambodia, the Lao PDR, the Philippines, or Viet Nam is much higher. It is particularly expensive to access the internet via mobile phones in rural areas, partly because of the backlog in network building.

[2] CISCO (2019) categorised the internet speed requirements for business and consumer cloud services into (i) basic cloud apps (the low level), (ii) intermediate cloud apps (the middle level), and (iii) advanced cloud apps (the high level). For advanced cloud apps, the network download and upload speeds need to be higher than 2.5 Mbps and 1.0 Mbps, respectively, and the network latency must be less than 100 milliseconds (ms).

Figure 5.2 Relative Price of Smartphones and Mobile Data



Source: Chen (2020: Figure 5).

Content and services

To many users, access to the internet is indeed access to online resources. Very often, it is not the raw data or resources but the information that will be most useful. In this regard, online content and services are the determining factor of the quality of the internet. The outcome of the EIU (2019) survey provide some insights into the development of countries' e-finance, e-health, and e-commerce content (Table 5.4).

Table 5.4 Internet Content – Qualitative Rating and Score

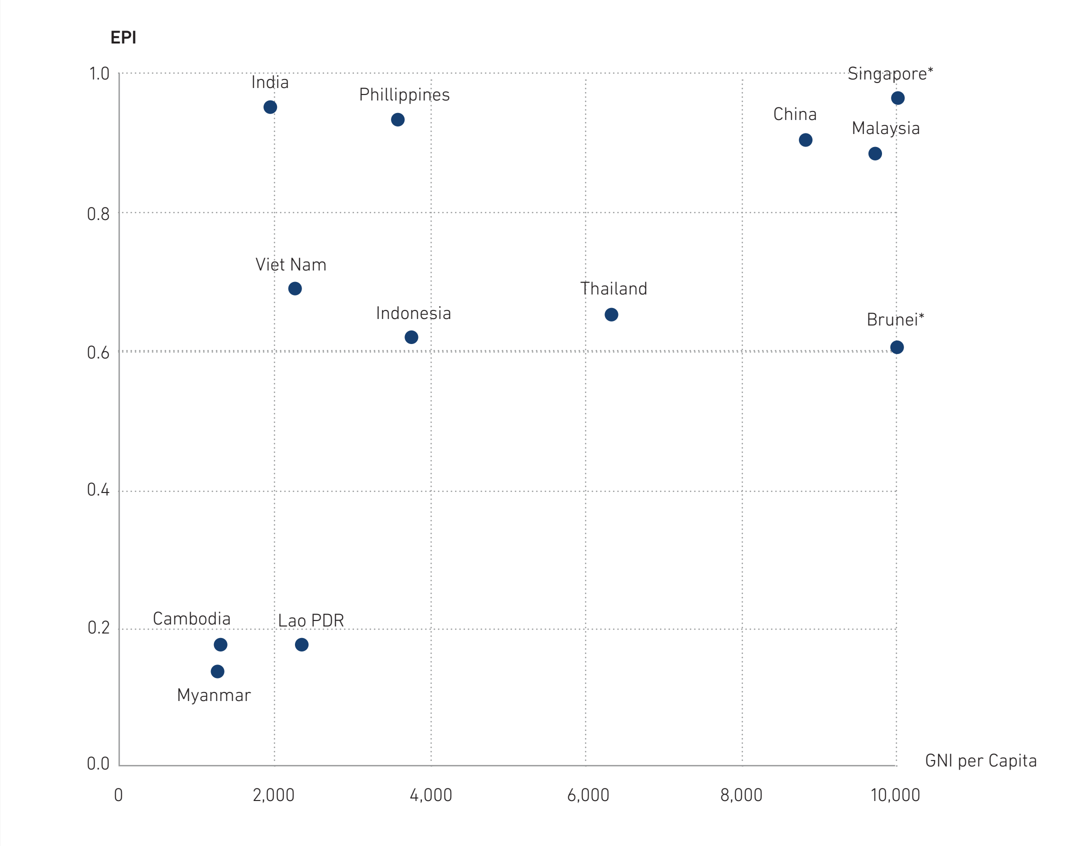
Country	Basic information in the local language (0–2, 2 = best)	E-finance content (0–2, 2 = best)	E-health content (0–3, 3 = best)	E-commerce content (0–100, 100 = best)
Cambodia	2	2	2	29
Indonesia	2	1	2	36
Malaysia	2	2	3	77
Myanmar	2	2	3	23
Philippines	2	2	2	40
Singapore	2	2	3	90
Thailand	2	2	3	68
Viet Nam	2	2	3	50

Source: EIU (2019).

The results of the survey show that basic information in the local language already exists in all countries. As for e-finance, there is not a significant difference across countries. Qualitatively, all obtain the highest rating of two (best) except Indonesia, which is rated one. In terms of e-health, five countries (Malaysia, Myanmar, Singapore, Thailand, and Viet Nam) obtain higher ratings than the others. As for e-commerce, Cambodia and Myanmar seem to lag, while Singapore and Malaysia have rich online content compared with other AMS.

Regarding e-government, the scores of the United Nations E-Participation Index show that the CLM countries still lag in promoting online public services and citizen engagement (Figure 5.3). The CLM countries' average E-Participation Index score is 0.15, lower than the world average value (0.57) and that of the other AMS (0.77). Therefore, it is rather urgent for the CLM countries to narrow the gap in providing information to their citizens, interacting with stakeholders, and engaging in decision-making processes (United Nations, 2019).

Figure 5.3 E-Participation



EPI = E-Participation Index, GNI = gross national income.

Notes: GNI per capita of Brunei = $30,057; GNI per capita of Singapore = $55,662.

Source: Author. Raw data from United Nations (2019) and World Bank (2019).

Security and reliability

Cybersecurity is also an important measure of digital connectivity. OECD (2012) pointed out that along with the development of the internet, the level of organisation and sophistication of cyberthreats has been increasing significantly. Possible cyberthreats include theft (of identity, personal data, and secrets); infringement of intellectual property rights; denial of service; leaks of private information; and the disruption of critical infrastructure.

Table 5.5 shows Asian emerging economies' scores and global rankings in the Global Cybersecurity Index and the National Cyber Security Index. The Global Cybersecurity Index indicates the level of cybersecurity commitment of countries with regard to legal measures, technical measures, organisational measures, capacity building, and cooperation. The National Cyber Security Index measures countries' preparedness to prevent cyberthreats and manage cyber incidents based on the security implemented by the central government on the aspects of legislation in force, established units, cooperation formats, and outcomes and products.

Table 5.5 Cybersecurity – Preparedness and Commitments

Country	NCSI		GCI		
	Score	Ranking (/100)	Score	Ranking (/175)	Level of commitment
Brunei	38.96	54	0.62	64	Medium
Cambodia	n.a.	n.a.	0.16	131	Low
Indonesia	19.48	83	0.78	41	High
Lao PDR	16.88	86	0.19	120	Low
Malaysia	72.73	11	0.89	8	High
Myanmar	n.a.	n.a.	0.17	128	Low
Philippines	31.17	63	0.64	58	Medium
Singapore	57.14	32	0.89	6	High
Thailand	n.a.	n.a.	0.79	35	High
Viet Nam	n.a.	n.a.	0.69	50	High

GCI = Global Cybersecurity Index, n.a. = not applicable, NCSI = National Cyber Security Index.

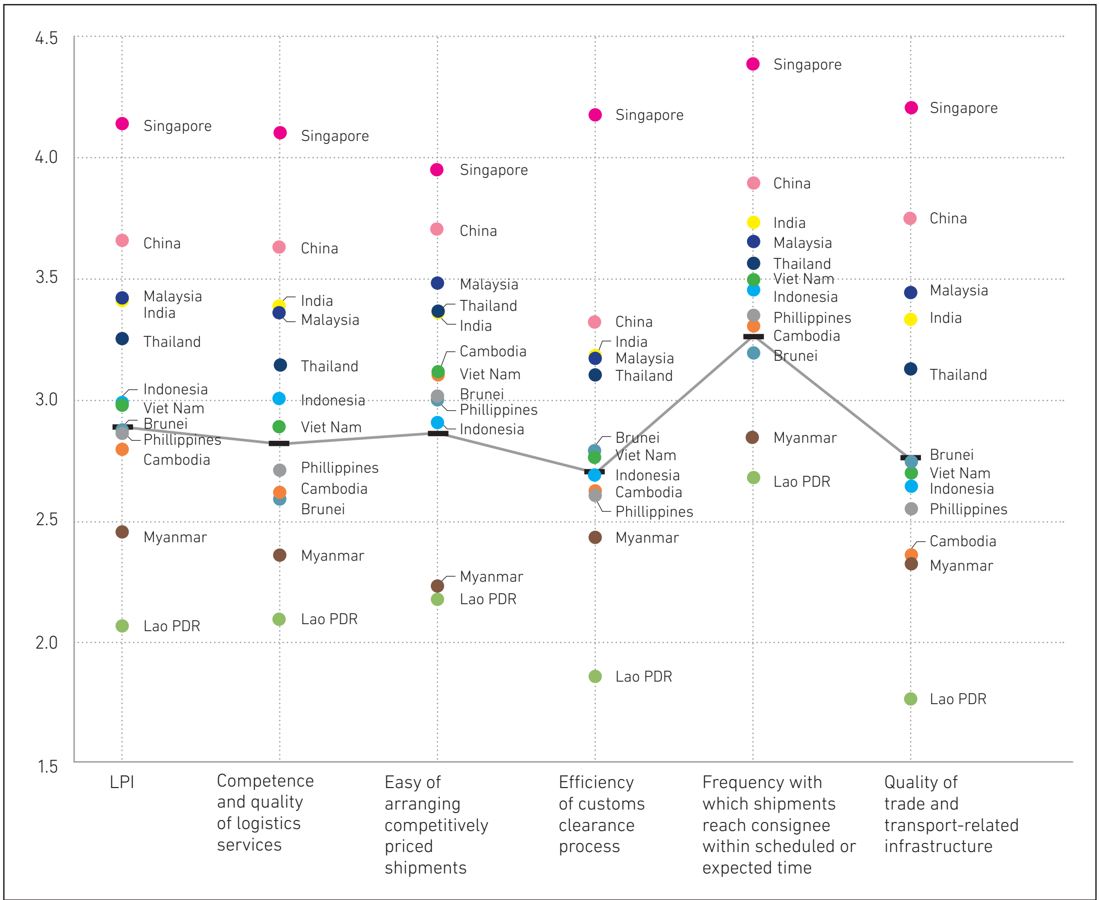
Source: Author. Based on ITU (2019) and e-Governance Academy (2019).

Based on the available data, Malaysia, Singapore, and India seem to be better prepared for cyberthreats than the other AMS. Most of the countries show a high level of commitment to implementing cybersecurity measures but again, the CLM countries are lagging. From a regional perspective, the unbalanced development of cybersecurity would hinder data flows region-wise and increase the cost and risk of doing business online. The improvement of national capabilities in the adoption and integration of cybersecurity will require efforts in law enforcement, education, intra-state cooperation, and public–private partnerships.

Logistics

The issue of logistics has long been a bottleneck in the economic development of emerging Asia. Using the World Bank's Logistics Performance Index, Figure 5.4 shows that the scores of the CLM countries and the Philippines are lower than the world average, while Singapore has the highest score worldwide. Except for the Lao PDR and Myanmar, AMS have made significant progress regarding the ease of arranging competitively priced shipments and the frequency with which shipments reach consignees within a scheduled or expected time.

Figure 5.4 Logistics Performance



LPI = Logistics Performance Index.

Source: Chen (2020: Figure 7).

According to a survey conducted by the World Economic Forum (2016), Singapore and Malaysia are amongst the countries with the highest quality of overall infrastructure, while others are either at or below the world average. Large gaps persist in logistics infrastructure across countries. As for the region, development still faces obstacles from poor quality of roads, incomplete road and railway networks, inadequate ports, and low service capability (Table 5.6).

Table 5.6 Quality of Logistics Infrastructure

Country	Overall infrastructure	Roads	Railways	Air transport	Ports
Brunei	4.14 (67)	4.70 (41)	2.07 (88)	4.08 (84)	3.67 (87)
Cambodia	3.43 (95)	3.38 (93)	1.62 (98)	3.85 (99)	3.85 (76)
Indonesia	3.79 (80)	3.86 (75)	3.82 (39)	4.52 (62)	3.91 (75)
Lao PDR	3.74 (81)	3.42 (91)	n.a.	3.77 (100)	2.01 (132)
Malaysia	5.48 (19)	5.46 (20)	5.06 (15)	5.70 (20)	5.44 (17)
Myanmar	2.42 (135)	2.33 (136)	1.79 (96)	2.62 (132)	2.62 (123)
Philippines	3.04 (112)	3.07 (107)	1.97 (89)	3.25 (116)	2.92 (113)
Singapore	6.39 (2)	6.28 (2)	5.74 (5)	6.85 (1)	6.66 (2)
Thailand	4.03 (72)	4.21 (60)	2.52 (77)	4.95 (42)	4.18 (65)
Viet Nam	3.63 (85)	3.47 (89)	3.15 (52)	4.06 (86)	3.84 (77)
China	4.55 (43)	4.77 (39)	5.07 (14)	4.81 (49)	4.59 (43)
India	4.45 (51)	4.43 (51)	4.48 (23)	4.49 (63)	4.53 (48)
World	4.06	4.05	3.38	4.41	4.04

n.a. = data not available.

Source: Author. Raw data from World Economic Forum (2016).

Relatively speaking, more problems exist in (i) the competence and quality of logistics services, (ii) the efficiency of customs clearance process, and (iii) the quality of trade and transport-related infrastructure. That is, compared with physical infrastructure, Asian countries need to pay more attention to developing the software of infrastructure – services. As Chen (2017, 2019) pointed out, in the digital economy, improving services is at least as important as building infrastructure in many aspects – from speed and accuracy to transparency and reliability. As consumers become more demanding of information on logistics services, facilitating online business requires not only the establishment of logistics facilities – such as mega e-fulfilment centres, parcel sorting centres (hubs), local parcel distribution centres for last-mile supply chains, local city logistics depots, and returns centres – but also service development, which is key to improving the efficiency of the regional distribution networks.

Financial Connectivity

Financial inclusiveness should also be considered in digital connectivity. According to the World Bank (2019), by the end of 2017, a significant number of adults aged 15 and above still do not have a bank account. Moreover, like other aspects of connectivity, wide gaps persist in countries' readiness to adopt and use digital payments. Table 5.7 shows the values of the Asia-Pacific Economic Cooperation (APEC) Fintech E-payment Readiness Index of AMS as well as their scores in each sub-index based on available data.[3] Singapore is the best positioned in e-payment development, with a value of 59.6, while Viet Nam scores 22.9 at the other end. The wide dispersion of e-payment readiness exists mainly in the regulatory and policy environment and in innovative products and services.

Table 5.7 E-payment Readiness

Cluster	Country	ERI	Regulatory and policy environment	Infra-structure	Demand	Innovative products and services
Cluster 1: Advanced e-payment ecosystems	Singapore	59.6	93.9	59.7	37.9	57.4
Cluster 2: Transitioning e-payment ecosystems	Malaysia	44.5	80.7	41.6	27.4	38.2
	Brunei	37.2	46.6	42.4	37.4	19.6
Cluster 3: Nascent e-payment ecosystems	Thailand	29.7	33.1	37.5	23.8	23.5
	Indonesia	28.8	43.4	29.2	17.8	29.9
	Philippines	26.4	32.8	31.4	20.5	21.2
	Viet Nam	22.9	28	28.3	20	14
(Degree of dispersion)		12.8	25.8	10.9	8.3	14.7

ERI = E-payment readiness indicator.

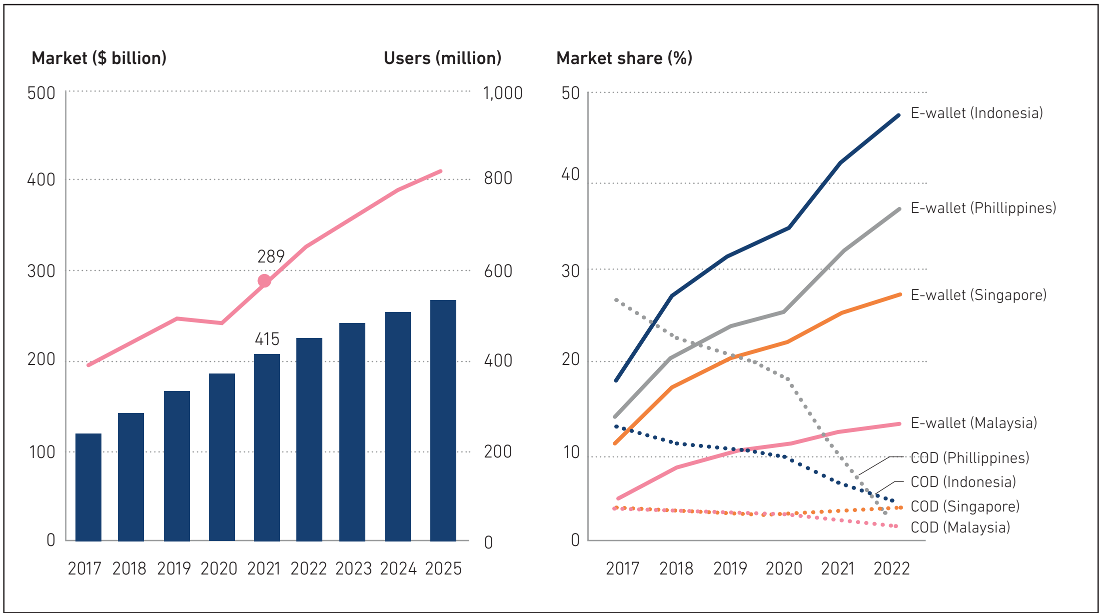
Source: RMIT and TRPC (2015).

Online transactions – payments for either online or offline business – is one of the most dynamic areas of the digital transformation. They can be made via various payment methods (credit cards, direct debit, invoices, or online payment providers such as PayPal and Alipay). As Figure 5.5 shows, both the size and the number of users of online transactions have grown over time. The COVID-19 pandemic has not interrupted this tendency despite the economic shocks it has caused. The online transactions market in

[3] No data available for Cambodia, the Lao PDR, and Myanmar.

ASEAN was projected to reach $290 billion by the end of 2021, with more than 400 million users (www.statista.com). The COVID-19 pandemic has caused a stark contrast through the boom in e-wallets and the rapid shrinking of cash on delivery, especially in populous countries like Indonesia and the Philippines.

Figure 5.5 ASEAN Online Transactions



ASEAN = Association of Southeast Asian Nations, CoD = cash on delivery.

Source: Author.

Internet financial innovations come with opportunities and challenges. In general, financial technology or fintech tends to be a market changer and creates new opportunities for leapfrogging development. The process of digital adoption in finance can be market-driven and self-enforced. Secure and reliable e-payment systems will increase financial inclusiveness and make digitalisation more beneficial to middle- and low-income households. Policy efforts at the regional level, such as establishing industrial standards and harmonising regulations, could help the economy realise economies of scale and support the market development (Chen, 2019; Kimura et al., 2019).

Integrating Connectivity

Seamless links between the virtual and physical parts of the digital ecosystem are critical to the functioning of the digital economy. The establishment of international rules and regulations could enhance market drivers and strengthen connectivity. This calls for multilayer cooperation, including public–private partnership, inter-institutional cooperation, subregional cooperation, and coordination amongst different government departments.

At the national level, many AMS have published strategic plans for digitalisation and have established special ministerial units to regulate its development (Chen, 2020). At the regional level, ASEAN leaders signed the e-ASEAN Framework Agreement in 2000 and announced the strategic goal to promote a productive ASEAN 'e-space' by (i) enhancing ICT sector competitiveness, (ii) reducing the digital divide within and amongst individual AMS, (iii) promoting partnership between the public and private sectors, and (iv) liberalising trade and investment in ICT goods and services (ASEAN, 2000: Article 3). The AEC Blueprint 2025 further highlights ICT development as 'a key driver in ASEAN's economic and social transformation' (ASEAN, 2015: Articles C2, C3, and D1). The ASEAN Digital Integration Framework and the ASEAN Agreement on Electronic Commerce[4] were signed in October and November 2018, respectively. In October 2019, during the 18th AEC meeting, ministers ratified the completion of the ASEAN Digital Integration Framework Action Plan, 2019–2025.[5]

Free Flow of Data with Trust

While internet service is the backbone of digital connectivity, free cross-border data flow is the basis and cornerstone of the digital economy. So far, AMS have no common position on regulating cross-border data flow, and are proceeding at different speeds in domestic rule setting. By the end of 2020, Indonesia, Malaysia, the Philippines, and Singapore have passed new laws; Thailand is considering such rules; and Brunei and the CLM countries have no personal data protection laws or regulations.

[4] The ASEAN Agreement on Electronic Commerce covers a wide range of topics and has 19 articles.

[5] The ASEAN Digital Integration Framework Action Plan emphasises (i) trade facilitation, (ii) data protection for digital trade, (iii) digital payments, (iv) a digital workforce, and (v) digital entrepreneurship.

When considering digital connectivity, a fundamental issue is how to govern data flows. Amongst all types of data, public and personal data are the most commonly discussed. Public data can be defined as information collected, produced, or paid for by public bodies. In principle, public data should be open to the public for free access. However, in certain circumstances, government officials have the right to limit access to data that is private or that should be kept secret for national security reasons. Definitions of personal data differ based on national laws. The three most representative opinions are:

(i) The European Union (EU) defines personal data as any information that relates to an identified or identifiable living individual. Personal data may be directly linked to a person, or indirectly linked to a person.

(ii) The United States (US) considers personal information data that can reasonably be used to contact or distinguish a person, including Internet Protocol (IP) addresses and device identifiers.

(iii) China sees data as a strategic resource that must be protected in the interest of national security and social stability. [6]

Although AMS have not yet agreed on a common definition of personal data, the 2018 ASEAN Agreement on Electronic Commerce uses 'personal information' (instead of 'personal data') in the final text, where it defines personal information as 'any information, including data, about an identified or identifiable individual' (ASEAN, 2018: 4). The scope of the definition seems to be wider than that of either the EU or the US. All AMS have agreed to work on eliminating or minimising barriers to data flow to facilitate cross-border e-commerce, given the importance of data safety as part of legitimate public policy objectives. This is in line with what countries agreed in the ASEAN Digital Integration Framework, one of whose six priority areas – protect data while supporting digital trade and innovation – requires governments and industry to 'ensure that data is protected and secured' (ASEAN, 2012: 1). This means that AMS have reached a consensus on supporting free flow of data in principle, and they seem to prioritise data safety, trust, and security in practice.

The policy regime of data governance is underdeveloped and fragmented across countries; and a fundamental problem is that the logic of economic justification for policies is not well established (Kimura et al., 2019). In ASEAN, the positions of the 10 Member States are so different that the 2018 ASEAN Agreement on Electronic Commerce had to leave it open for AMS to choose how to regulate the use of computing facilities and ensure the safety of communications. Countries' paces in domestic rule setting differ widely. At the time of

[6] This explains why China applies regulations such as the 'Measures for Security Assessment of Cross-border Transfer of Personal Information and Important Data' and 'Guidelines for Data Cross-Border Transfer Security Assessment' to any company that is a network operator engaged in domestic operations.

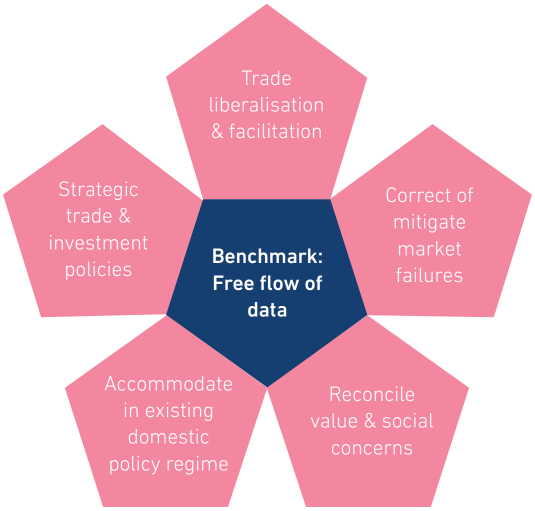
writing, the CLM countries have not yet formulated laws and regulations on personal data protection; others (e.g. Indonesia, Malaysia, the Philippines, and Singapore) have passed new laws; and Thailand is considering such rules. As for the content, while Singapore is strongly against data localisation, many others (e.g. Brunei, Indonesia, Malaysia, and Viet Nam) have adopted or are considering laws that require data generated locally on their citizens and residents to be kept within their geographical boundaries and to remain subject to domestic law. Some de facto requirements on data localisation are already in place in these countries. For instance, the cybersecurity law that came into effect in Viet Nam in early 2019 allows the government to regulate the data processing methods of technology companies that operate in the country and to restrict the internet connections of users who post ‘prohibited’ content.

Reaching consensus on data governance to facilitate ASEAN digital connectivity is difficult, but not impossible. Cross-border data flows and cross-border flows of goods and services share some common features: (i) both are produced in one place but sent to be used in others, (ii) both are subject to regulations at and beyond borders, and (iii) the two flows are closely related and mutually encourage each other. For that reason, the policy regime on free trade in goods could be a good reference for that of free flow of data.

Policy Framework

Kimura et al. (2019) proposed a policy framework in which free flow of data with trust is the benchmark, supported by five ‘pillars’ of policy instruments (Figure 5.6). First, policies for trade liberalisation and facilitation. In addition to tariff elimination, more efforts on the removal of non-tariff measures, service liberalisation, and trade facilitation will be needed to facilitate international trade in the digital era.

Figure 5.6 **Policy Framework for Free Flow of Data with Trust**



Source: Author. Based on Kimura et al. (2019).

Second, policies to correct or mitigate market failure. In the data-driven economy, potential market failures may come from network externalities, economies of scale, information asymmetry, or any combination of these conditions.[7] To correct the consequent market distortion, we will need policy efforts – especially in competition policy, consumer protection, and intellectual property rights protection. All these will require international cooperation in rule setting plus domestic efforts in enforcement.

Third, digitalisation will have extensive impacts on society, especially when massive data are moving across national borders with the internet of things. To avoid regulatory segmentation, the establishment and implementation of international norms on related issues need to reconcile values and social concerns with economic efficiency, especially from the aspect of data privacy protection and cybersecurity.

Fourth, data governance requires international as well as domestic policy efforts to accommodate data flows and data-related affairs. Challenges in this area are related not only to the incorporation of new technologies (e.g. AI and fintech) in the economy and society, but also to policy that balances market efficiency and fairness, such as firms' information disclosure and due process in government access to privacy or industry

[7] For example, when the world's giant digital platformers apply big data and AI, they could exercise market power, exploit users, and monopolise innovation capability by generating network externalities or economies of scale.

data. When considering taxation on the digital economy, harmonised nexus and profit allocation concepts should be applied to ensure fair competition between online and offline businesses as well as non-discriminatory and national treatment of both domestic and international market players.

Fifth, as Kimura and Chen (2018) pointed out, the digital economy provides a novel framework for inclusive growth, and strategic trade and investment policies should allow developing countries to leapfrog to a new paradigm of globalisation ('the third unbundling'). Each AMS should have the space to develop national strategic policies to nurture their own industries in new data-related business; and the related rules and regulations should not lead to any hidden forms of protectionism. In this regard, Mill's criterion[8] and Bastable's criterion,[9] which have been applied to justify the infant industry protection argument in free trade, could be very useful references.

International Rule Setting for Data Flows

Globally, there are multiple approaches to data connectivity. Multilateralism is the best option for rule setting. Some related terms can be seen in the existing World Trade Organization (WTO) agreements.[10] However, a multilateral agreement on governing cross-border data flows is not yet in place. Asian countries are active in pushing forward WTO talks on digital trade. At the initiative of Australia, Japan, and Singapore, 70 WTO members launched the E-Commerce Joint Statement Initiative at the 11th WTO Ministerial Conference in Buenos Aires in December 2017 and 76 WTO members agreed to start e-commerce talks on 25 January 2018.

Multilateral trade talks are progressing slowly because of significant differences amongst WTO members. For instance, while the EU and Singapore focus on establishing an e-commerce enabling environment, other countries (e.g. Japan, Brazil, and the US) want more extensive discussions on the enabling environment for various flows related to digital trade. As for the goals of the talks, some countries want clear rules governing the exchange of data, while others think about how to facilitate data-driven growth, and still others are more focused on bolstering e-commerce.

[8] Mill's criterion is that protection should be temporary, and the protected industry should be able to become self-sufficient within or after the period of protection.

[9] Bastable's criterion is that the total benefits of protecting one particular industry should outweigh the net costs to society.

[10] These include the General Agreement on Tariffs and Trade (GATT), the General Agreement on Trade in Services (GATS), the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), the Agreement on Technical Barriers to Trade, and the Information Technology Agreement (ITA and ITA2).

Free trade agreement (FTA) approaches seem to be proceeding at a faster pace. In addition to the ASEAN Agreement on Electronic Commerce, which contains non-binding provisions on cross-border data issues, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), EU-Japan Economic Partnership Agreement, and Singapore-EU FTA all include binding provisions on cross-border data flows. The CPTPP makes the free flow of data a default and requires member states to establish rules to protect the privacy of individuals and firms. It bans data localisation (requirements that data be produced or stored on local servers) and prohibits forced sharing of source code. In the EU-Japan Economic Partnership Agreement, both sides agreed to recognise each other's data protection systems as 'equivalent', which allows data to flow safely between the EU and Japan. In the Singapore–EU FTA, cross-border data flow is treated as part of cross-border services. Each party has made commitments on protecting privacy and personal data, including individual records and accounts, with appropriate safeguard measures. Most recently, in January 2020, Singapore, Chile, and New Zealand concluded the Digital Economy Partnership Agreement, aiming for best practice to support and promote digital trade.[11]

All the FTAs mentioned above contain exceptions that allow governments to achieve legitimate domestic policy objectives, including rules to protect public morals, public order, public health, public safety, and privacy related to data processing and dissemination. However, governments can only take advantage of the exceptions if they are necessary, performed in the least trade-distorting manner possible, and do not impose greater restrictions on the transfer of information than what is needed to achieve the respective government's objectives.

[11] The Digital Economy Partnership Agreement text drew heavily on the e-commerce chapter of the CPTPP.

Concluding Remarks

Digital infrastructure – both hardware and software – is the key to connectivity. In terms of digital connectivity, the region needs to make substantial efforts on (i) improving connectivity infrastructure in both the physical world and cyberspace, (ii) rule setting to support a development-friendly ecosystem for digitalisation, and (iii) combining countries' national strategies and regional collaboration to eliminate institutional barriers.

Given the wide development gaps amongst AMS, it is critical to support latecomers to catch up faster. In this regard, the issue of capacity building needs particular attention. Digital infrastructure obstacles may come from capacity and resource limits – either capital or technology or both. The public sector may still need to take the lead to initiate and drive the increase in the supply of public goods in both quantity and quality. Private sector involvement will be equally important to make the development sustainable.

Regarding the establishment of a regulatory system to support the development of the digital economy, the most critical step is to realise free flow of data with trust. Since restrictions on data flows could harm international trade in a similar way to trade protectionism, ASEAN needs to eliminate this threat to free trade and collaborate in promoting digital adoption to sustain regional development. The related rules and regulations should cover traditional trade issues (e.g. tariffs and non-tariff measures, trade facilitation, consumer protection, and intellectual property rights) as well as new issues (e.g. cross-border information flow, privacy protection, data localisation, and source code disclosure).

The ongoing Regional Comprehensive Economic Partnership (RCEP) negotiations touch upon a wide range of issues related to digital connectivity. Reaching agreements on these issues will require countries to balance the interests of the economy, society, and national security, as well as the long-term gains and short-term costs. This, again, calls for collaboration amongst governments and private sector involvement.

References

Anandan, R., R. Sipahimalani, A. Bharadwaj, J. Jhangiani, D. Kim, and S. Ramesh (2017), 'E-conomy SEA: Unlocking the $200B Digital Opportunity in Southeast Asia', Think with Google. http://apac.thinkwithgoogle.com/research-studies/e-conomy-sea-unlocking-200b-digital-opportunity.html (accessed 16 August 2020).

ASEAN (2000), '2000 e-ASEAN Framework Agreement'. Jakarta: ASEAN Secretariat. http://agreement.asean.org/media/download/20140119121135.pdf (accessed 16 August 2020).

ASEAN (2012), *The ASEAN Digital Integration Framework.* Jakarta: ASEAN Secretariat.

ASEAN (2015), *ASEAN Economic Community Blueprint 2025.* Jakarta: ASEAN Secretariat.

ASEAN (2016), *ASEAN Socio-Cultural Community Blueprint 2025.* Jakarta: ASEAN Secretariat. https://asean.org/storage/2016/01/ASCC-Blueprint-2025.pdf (accessed 16 August 2020).

ASEAN (2018), The ASEAN Agreement on E-commerce. Jakarta: ASEAN Secretariat.

Baldwin, R. (2016), *The Great Convergence: Information Technology and the New Globalization*. Cambridge, MA: The Belknap Press of Harvard University Press.

Chen, L. (2017), 'Developing Asia in the Era of Cross-Border E-Commerce', *ERIA Discussion Paper Series,* No. DP-2017-11. https://www.eria.org/research/developing-asia-in-the-era-of-cross-border-e-commerce/ (accessed 16 August 2020).

Chen, L. (2019), 'ASEAN in the Digital Era: Enabling Cross-Border E-Commerce', in L. Chen and F. Kimura (eds.) *Developing the Digital Economy in ASEAN*. Abingdon and New York: Routledge, pp.259–75.

Chen, L. (2020), 'Improving Digital Connectivity for E-Commerce: A Policy Framework and Empirical Note for ASEAN', *ERIA Discussion Paper Series*, No. DP-2019-41. https://www.eria.org/publications/improving-digital-connectivity-for-e-commerce-a-policy-framework-and-empirical-note-for-asean/ (accessed 16 August 2020).

Chen, L. and F. Kimura (2019), 'Introduction: ASEAN Development in the Digital Economy', in L. Chen and F. Kimura (eds.) *Developing the Digital Economy in ASEAN*. Abingdon and New York: Routledge, pp.3–13.

CISCO (2019), 'Cisco Global Cloud Index 2018'. www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-gci/white-paper-c11-738085.html (accessed 20 March 2019).

Demirgüç-Kunt, A., L. Klapper, D. Singer, S. Ansar, and J. Hess (2018), *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. Washington, DC: World Bank.

e-Governance Academy (2019), *E-Governance Academy Yearbook 2019.* Tallinn: e-Governance Academy. https://fega.ee/wp-content/uploads/2019/03/E-gov_yearbook_2019_ENG.pdf (accessed 16 December 2019).

EIU (2014), *The ICT Globalisation Index.* London: Economist Intelligence Unit. https://eiuperspectives.economist.com/sites/default/files/EIU_The ICT Globalisaton Index_0.pdf (accessed 29 September 2019).

EIU (2019), The Inclusive Internet Index. https://theinclusiveinternet.eiu.com/ (accessed 16 December 2019).

Google and Temasek (2019), *Google, Temasek, Bain & Company e-Conomy SEA 2019 Report*. https://www.temasek.com.sg/en/news-and-views/subscribe/google-temasek-e-conomy-sea-2019 (accessed 16 December 2019).

GSMA (2019), *The State of Mobile Internet Connectivity Report 2019*. https://www.gsma.com/mobilefordevelopment/resources/the-state-of-mobile-internet-connectivity-report-2019 (accessed 16 December 2019).

Inbound Logistics (2014), 'Adapting Your Supply Chain for the Future...Now'. http://www.inboundlogistics.com/cms/article/adapting-your-supply-chain-for-the-futurenow/ (accessed 24 October 2016).

ITU (2018), *Measuring the Information Society Report 2018 – Volume 2*. Geneva: International Telecommunication Union.

ITU (2019), 'Broadband Strategies, Policies and Plans, 2019'. Geneva: International Telecommunication Union.

ITU and UNESCO Broadband Commission for Sustainable Development (2019), *The State of Broadband: Broadband as a Foundation for Sustainable Development*. Geneva: International Telecommunication Union and United Nations Educational, Scientific and Cultural Organization.

Kimura, F. (2018), '"Unbundlings" and Development Strategies in ASEAN: Old Issues and New Challenges', *Journal of Southeast Asian Economies*, 35(1), pp.13–21.

Kimura, F. and L. Chen (2018), 'Value Chain Connectivity in Indonesia: The Evolution of Unbundlings,' *Bulletin of Indonesian Economic Studies,* 54(2), pp.165–92.

Kimura, F., L. Chen, W. Cheng, D. Ciuriak, J. Nakagawa, R. Pomfret, G. Rigoni, and J. Schwarzer (2019), 'The Digital Economy for Economic Development: Free Flow of Data and Supporting Policies', *Policy Brief for T20 Summit 2019*. Tokyo: Think20 (T20). www.g20-insights.org/wp-content/2019/05/t20-japan-tf8-4-digital-economy-economic-development.pdf (accessed 15 November 2019).

OECD (2012), 'Cybersecurity Policy Making at a Turning Point: Analysing a New Generation of National Cybersecurity Strategies for the Internet Economy', *OECD Digital Economy Papers,* No. 211. Paris: Organisation for Economic Co-operation and Development. https://www.oecd.org/sti/ieconomy/cybersecurity%20policy%20making.pdf (accessed 12 March 2017).

RMIT and TRPC (2015), *APEC E-Payment Readiness Index: Ecosystem Assessment and Status Report*. https://trpc.biz/old_archive/wp-content/uploads/APEC-E-Payment-Readines-Index-Report_wPreface.pdf (accessed 12 March 2018).

Statista (2019), *Digital Economy Compass 2019*. https://www.statista.com/study/52194/digital-economy-compass/ (accessed 16 December 2019).

Think with Google (2016), 'How People Shop on their Phones'. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0a-hUKEwiKrpG38snVAhXEuI8KHZdRCfYQFgglMAA&url=https%3A%2F%2Fwww.think-withgoogle.com%2F_qs%2Fdocuments%2F322%2Fapp-marketing-mobile-shopping.pdf&usg=AFQjCNEJ5wt1Dm7MHC1_BKRxpzgAlCMsGw (accessed 12 March 2018).

United Nations (2019), *United Nations E-Government Survey 2018: Gearing E-Government to Support Transformation Towards Sustainable and Resilient Societies*. New York: United Nations.

Walsh, J. (2019), 'Internet Services and the Potential for Market Access for Rural Agricultural Households in Myanmar and Viet Nam', in L. Chen and F. Kimura (eds.), *Developing the Digital Economy in ASEAN. Abingdon and New York*: Routledge, pp.232–55.

World Bank (2009), *2009 Information and Communications for Development: Extending Reach and Increasing Impact*. Washington, DC: World Bank.

World Bank (2019), *World Development Indicators 2019*. Washington, DC: World Bank.

World Economic Forum (2016), *The Global Competitiveness Report 2016–2017*. Geneva: World Economic Forum. https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1 (accessed 25 February 2019).

Chapter 6

Hard Infrastructure Development

Masahito Ambashi
Research Fellow, ERIA

Takuya Fujita
Senior Policy Advisor, ERIA

Hiroshi Suzuki
CEO and Chief Economist, Business Research Institute for Cambodia (BRIC)

This chapter examines the hard infrastructure development needed for the Association of Southeast Asian Nations (ASEAN). Section 1 provides an overview and assesses the progress of the infrastructure projects covered under the previous Comprehensive Asian Development Plan (CADP 2.0) in 2015 (ERIA, 2015). Section 2, the key section of this chapter, provides a concise description of the new characteristics of necessary infrastructure and prospective projects, which are highlighted in the CADP 3.0. Section 3 concludes, followed by an appendix that lists every concrete infrastructure project as a reference for readers. Finally, Box 6.1 shows a concrete example of hard infrastructure development – the Southern Economic Corridor in Cambodia.

Overview of the CADP 2.0 Infrastructure List

This chapter first describes the progress of infrastructure projects listed in the CADP 2.0 by following the latest comprehensive survey of Fujisawa et al. (2019). According to the degree of participation in production networks, the CADP 2.0 highlighted the importance of infrastructure quality and presented 761 concrete projects, mainly comprised of hard infrastructure development. The CADP 2.0 was submitted to the East Asia Summit in 2015, along with the Master Plan on ASEAN Connectivity 2025, to continue efforts to improve the East–West, Southern, and North–South Economic Corridors as well as to strengthen other regional and country-level connectivity.

The 761 projects cover 11 sectors: roads/bridges, railways, ports/maritime, airports, other transportation, industrial estates/special economic zones (SEZs), energy/power, water supply/sanitation, telecommunications, urban development, and others. The assessment of infrastructure was conducted in 12 countries (ASEAN, China, and India) and three subregions in financial year (FY) 2018 (April 2018–March 2019).

Overall Progress

Generally, infrastructure development takes many years from the conceptual stage through the construction stage to the operation stage. While some of the projects listed in 2015 have been completed, there have also been some changes and discontinuations due to the policy changes taking place. We report on the state of infrastructure development that is expected to contribute to the improvement of ASEAN connectivity and innovation. We first summarise the progress of the CADP 2.0 projects during FY2018, and subsequently show the progress of all 761 projects from 2015 by region.[1]

The 761 infrastructure projects in the region focus on physical and economic infrastructure that is vital for both rural and urban development and innovation. When selecting a project for evaluation, the CADP 2.0 considered the following points:

(i) the impact on the project area;
(ii) the medium- and long-term plans of each country, priority projects, and projects related to neighbouring countries; and
(iii) the project's feasibility and ability to implement and/or construct the project.

Project progress has been classified into four stages: (i) conceptual, (ii) feasibility study, (iii) construction, and (iv) operation. These classification criteria have been utilised since FY2015. The progress of each project was determined through interviews with government officials, researchers' reports, consultant analyses, inspections of the project site, and reading various media reports within each country.

Although the CADP 2.0 covered projects in 11 sectors, progress can be tracked primarily within four sectors, i.e. roads/bridges, railways, energy/power, and industrial estates/SEZs. Compared with the road sector, which is steadily progressing to the construction and operation stages, progress in the railway sector requires more time for land acquisition and financing. Moreover, railway infrastructure takes longer to construct and often stagnates at the feasibility study stage. The progress of power-generation projects and SEZ projects has mostly focused on private enterprises. All seven projects in the SEZ sector are conducted by private enterprises at the operation stage. In addition, 43 projects in the power sector are at the operation stage, and 19 of the 30 power-generation projects are private or under public–private partnerships.[2]

The number of operation stage projects increased from 7 (1% of all projects) in 2015 to 161 (21%) in 2018, while projects in the construction stage increased from 219 (29%) in 2015 to 264 (35%) in 2018. Conversely, the total number of projects in the feasibility study stage decreased from 431 (57%) in 2015 to 292 (38%) in 2018, and projects in the conceptual stage decreased from 104 (14%) in 2015 to 44 (6%) in 2018 (this includes no change during FY2016–FY2018). Most conceptual stage projects are unlikely to progress to the feasibility study stage.

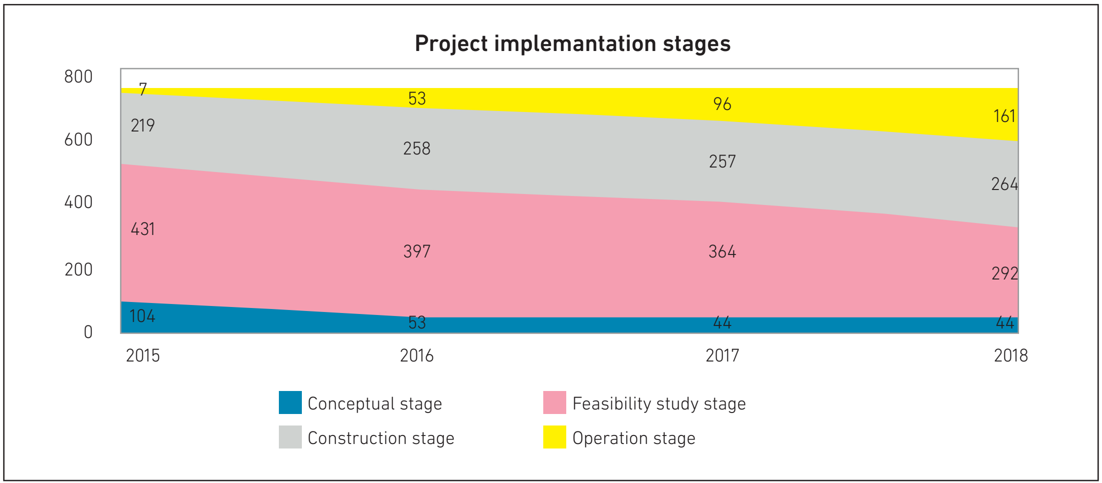
[1] Although the survey as of 2018 may be obsolete, this is the latest comprehensive progress survey of the CADP 2.0 infrastructure projects for reasons such as difficulty in repeating similar surveys due to the coronavirus disease (COVID-19) pandemic.

[2] Projects that incorporate an element of private funding are considered private finance incentives.

In addition, as of 2018, 24 projects have been discontinued or postponed: 7 in Indonesia, 3 in Malaysia, 6 in Myanmar, 6 in Thailand, and 2 in Viet Nam. By sector, 3 of the projects concern roads, 4 ports, 2 airports, 13 power, 1 urban development, and 1 water supply. The power sector, which accounts for the largest number of cancelled projects, included 5 thermal power projects in Myanmar; 3 hydropower projects, 1 transmission line project, and 2 nuclear power projects in Viet Nam; and 2 hydropower projects in Malaysia.

Some 70 projects (9% of the total, including 46 projects in the conceptual stage that have not been advanced) have no prospect of execution. Land acquisition and finance composition are the most important factors in determining when construction can begin on a project. Land acquisition often poses the most trouble due to higher land prices than initially anticipated, budget shortages due to price increases (including wages), and local regulatory barriers. In addition, events such as construction interruption due to payment delays from the order side have also occurred. However, although some projects have stagnated or been discontinued or postponed, development has begun for many of the projects (161) that conducted a feasibility study during 2015–2018. A total of 425 projects (56%) have been completed or are moving toward realisation, and some are under construction (Figure 6.1).

Figure 6.1 CADP 2.0 Progress, 2015-2018



CADP = Comprehensive Asian Development Plan.

Source: Fujisawa et al. (2019).

Progress by Subregion

The CADP 2.0 infrastructure projects have been classified into three subregions to follow up on their regional progress: (i) Mekong Subregion, (ii) Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth ERIA and surrounding regions (BIMP+), and (iii) Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions (IMT+).[3]

Mekong

There are 517 infrastructure projects in the Mekong Subregion, accounting for about 68% of all projects. During 2015–2018, the number of projects in the operation stage increased from 1 (0% of all projects) to 107 (21%), while that of projects in the construction stage also increased from 149 (29%) to 172 (33%). Conversely, the number of projects in the feasibility study stage decreased from 297 (57%) to 214 (41%), and that of projects in the conceptual stage decreased from 70 (14%) to 24 (5%).

The East–West Economic Corridor (EWEC) – connecting Yangon to Da Nang through the Lao People's Democratic Republic (Lao PDR) and Thailand – was fully opened in 2016, while several development projects are still in progress to stimulate the Mekong economies. The EWEC includes the development of a port and other facilities in Da Nang, which will act as the gateway to the Viet Nam side of the border. This project will be advanced in conjunction with the development of National Road No. 9 crossing the Lao PDR, and the Friendship Bridge across the Mekong River to Thailand. Single-stop and single-window operations have begun across several of these border crossings to reduce non-tariff barriers. On the Myanmar side, the Second Thai–Myanmar Friendship Bridge with Thailand was completed in 2018, and the road from Thailand to Yangon has been improved. Construction of the Thilawa Industrial Park and other areas near Yangon have also been completed, indicating that preparations for industrial development centred on the EWEC are in place. In 2017, the Long Binh (Long An)–Chory Thom Bridge over the Mekong River between Viet Nam and Cambodia opened with the cooperation of both countries. The Fifth Friendship Bridge between Thailand and the Lao PDR will also be completed in 2023 as it is currently under construction.

Moreover, infrastructure development of the Southern Economic Corridor (SEC) – connecting Ho Chi Minh City to Phnom Penh, Bangkok, and Dawei – must be continued to strengthen the whole connectivity of the Mekong region. The improvement of the SEC will not only facilitate logistics between Bangkok and Ho Chi Minh City, the two biggest mercantile cities of the region, but also encourage the land transit to Dawei, which is expected to open the economic gateway to the Indian Ocean as an export basis. This bypath,

[3] The regional categories of BIMP+ and IMT+ were introduced in ERIA (2010).

using land transit, circumvents ocean transit via the Malacca Strait; and will drastically reduce the amount of time required for logistics from Bangkok to India, Europe, and the Middle East. However, the road development around Dawei has not progressed much, while that of Cambodia (a so-called land-link country in the SEC) has been progressing smoothly (Box 6.1 discusses the SEC from the viewpoint of Cambodia).

There are still several unfinished plans for infrastructure development in the Mekong Subregion to continue to promote economic revitalisation in the future. These plans include evaluating high-standard roads (including express ways) from Vientiane in the Lao PDR to Hanoi in Viet Nam, and the consistent development of the international power grid to make it possible to share power generated in the Lao PDR across the region economically. Thus far, these developments have been primarily supported by neighbouring countries based on bilateral contracts to encourage Thailand, Viet Nam, and Cambodia to import energy from the Lao PDR.

Brunei Darussalam–Indonesia–Myanmar–Philippines+

There are 172 infrastructure projects in the BIMP+ region, including 82 in Indonesia and 77 in the Philippines. From 2015 to 2018, these projects advanced as follows: the number of projects in the operation stage increased from 6 (3% of the total) to 34 (20%); projects in the construction stage increased from 47 (27%) to 64 (37%); projects in the feasibility study stage decreased from 97 (56%) to 65 (38%); and projects in the conceptual stage decreased from 22 (13%) to 9 (5%). Amongst the BIMP+ countries, Indonesia's achievements are remarkable, and as of 2018 the country had 60 projects (73%) in either the operation or construction stage: 23 (28%) in the operation stage and 37 (45%) in the construction stage.

Indonesia–Malaysia–Thailand+

There are 72 infrastructure projects in the IMT+ region. From 2015 to 2018, the number of projects in the operation stage increased from 0 (0%) to 18 (25%), while projects in the construction stage increased from 23 (32%) to 30 (42%). Meanwhile, projects in the feasibility study stage decreased from 37 (51%) to 21 (29%); and projects in the conceptual stage decreased from 12 (17%) to 3 (4%). In the IMT+ region, 33 projects (67%) are in either the construction or operation stage, more than in all the other subregions under consideration.

Infrastructure Projects in CADP 3.0

The choice of prospective infrastructure development projects in the CADP 2.0 was based on the concepts of both the first and second unbundlings,[4] which reduce the cost of transporting goods through physical infrastructure and of transmitting ideas through information and communication technology (ICT), respectively. Nevertheless, the CADP 2.0 still places emphasis on hard infrastructure development projects that can facilitate the movement of goods and people, while paying some attention to investment in ICT.

Since the publication of the CADP 2.0, new globalisation and industrialisation – enabled by the third unbundling – have been rapidly approaching owing to the advancement of ICT. This third unbundling is highly likely to lead to a reduction in face-to-face costs and to drastically change our economy, industry, and society. It is also notable that the third unbundling has rapidly accelerated between 2020 and 2021 due to the coronavirus disease (COVID-19) pandemic, by increasing the application of ICT to replace face-to-face physical contacts with virtual contacts via online devices. Given the recent advancement of the third unbundling, the CADP 3.0 attempts to shed light on a broader range of hard infrastructure projects that contribute to the new economy and society.

Unbundling Concept and Infrastructure in the CADP 3.0

The CADP 3.0 uses the concept of 'unbundlings' instead of 'tiers' – a concept developed in the CADP 1.0 and CADP 2.0 to illustrate the demand for infrastructure in ASEAN and East Asia in accordance with each globalisation stage.

Based on this conceptual framework of unbundlings defined by the level of progress of globalisation, we set criteria to classify the hard infrastructure required at each unbundling stage, as indicated in Table 6.1. This table demonstrates that hard infrastructure arrangements can vary with the representative industries and industrial characteristics installed at each unbundling stage. While the second unbundling calls for physical connectivity such as large-scale transport infrastructure (e.g. ports, airports, and multimodal infrastructure) and (sub)urban development (e.g. logistics and economic infrastructure services) mainly for manufacturing activities, the third unbundling needs to encourage the promotion of urban amenities such as urban transport (e.g. light rail transit (LRT) and subways), living environments (e.g. children's education and medical services), and others (e.g. variety of consumption) based on ICT. The backdrop to the change in

[4] See Chapter 1 for a detailed explanation of 'unbundlings'.

necessary infrastructure from the second to the third unbundling is 'servitisation' of economic activities (i.e. goods and products are served jointly with relevant services), in which digital and service industries emerge as a key sector.

Table 6.2 classifies infrastructure into 'physical' and 'economic' infrastructure for analytical purposes. While physical infrastructure (i.e. roads/bridges, railways, ports/maritime, and airports) enhance connectivity with distant regions and facilitate the movement of goods and people, economic infrastructure (i.e. industrial estates/SEZs, energy/power, water supply/ sanitisation, and ICT) play a role in supporting economic activities by providing various services for industries and firms. As might be expected, the third unbundling requires more advanced infrastructure – both physical and economic – than the second unbundling. When it comes to roads and highways, for example, the third unbundling demands better access to and within cities to enhance urban amenities and attract urban residents, while the second unbundling focuses on access to industrial zones. In addition, with respect to industrial estates in the third unbundling, the establishment of high-tech parks is necessary to promote product and service innovation. Physical and economic infrastructure at the stage of the second unbundling has not been fully established yet, but ASEAN needs to move towards new industrial development by creating such third-unbundling infrastructure.

Finally, Table 6.3 highlights the 'social' aspects of infrastructure by providing specific project categories and concrete examples. While such infrastructure is, in principle, included in either physical or economic infrastructure, its social aspects are much more conspicuous in the third unbundling in terms of raising the living standards of urban residents, preserving the natural environment and resources, and creating unique innovations. In this regard, the key is the use of ICT – resolving social challenges by establishing infrastructure based on that technology. Notably, agriculture, which was the main sector in the first unbundling, can become an advanced high-tech sector in the third unbundling if it creates appropriate infrastructure such as special agricultural zones. Additionally, infrastructure related to academia–industry collaborations such as high-tech parks can promote innovation. Therefore, these infrastructure projects are indispensable for ASEAN to achieve the next development stage through new industrialisation.

Table 6.1 Characteristics of Hard Infrastructure by Unbundling

	Before globalisation (0)	First unbundling (1)	Second unbundling (2)	Third unbundling (3)
Type of unbundling	**None**	**Production/consumption**	**Within industries**	**Tasks**
Representative industry	Traditional agriculture	Plantation agriculture Mining Labour-intensive industry Tourism	Machinery industry Automobile industry	Digital industry Service industry
Industrial characteristics	Autarky	Initial industrialisation: import substitution	Manufacturing: export orientation	Servitisation
Basic technology	Self-subsistence	Mass production	Supply chain management	ICT
Concept of hard Infrastructure	None	**Basic infrastructure** Middle-grade connectivity: - roads - ports - airports Infrastructure services (e.g. electricity, energy, water)	**Advanced infrastructure** High-quality connectivity: - large-scale ports - full-scale airports - multimodal (e.g. cargo, passengers) Urban and suburban development for industrial agglomeration: - logistics (e.g. highway system) - large-scale economic infrastructure services (e.g. industrial estates, electricity, energy, water)	Highly advanced infrastructure ICT connectivity: - internet connection - bridging connectivity Urban development for urban amenities: - urban transport (e.g. LRT, subways, airport access, access to resorts) - living environment (e.g. children's education, medical services, urban safety) - other urban amenities (e.g. variety of consumer products)

ICT = information and communication technology, LRT = light rail transit.

Source: Authors.

Table 6.2 Sector Classification for Physical and Economic Infrastructure

Sector		First unbundling	Second unbundling	Third unbundling
Physical infrastructure	Roads/bridges	Long-distance road connections for industrial development Regional road networks	Medium-distance roads to industrial parks and logistic hubs Suburban roads for congestion alleviation	Highways, bridges, and bypasses in and around cities Airport access roads
	Railways	Railways for transporting resourc-es	Main railway network connecting areas	Urban public transportation (e.g. subways, LRT, and MRT) High-speed trains connecting cities with suburbs
	Ports/maritime	Local port improvement	Major port improvement for expansion of handling capacity	Port facilities with large-scale containers Modernisation of ports (e.g. procedures and loading equipment)
	Airports	Local airport establishment and improvement	Major airport improvement for passengers and cargos	Airport facilities that can cope with large passenger and cargo flows
Economic infrastructure	Industrial estates/ SEZs	Industrial estates/SEZs in rural areas	Industrial estates/SEZs in border areas and highly populated areas	High-tech parks and industrial estates
	Energy/power	Power plant development with favourable locations Regional electricity and energy supply	Stable and sufficient supply of electricity and energy to industries	Stable and sufficient supply of electricity and energy to both industries and residential areas
	Urban development	Minimum development of urban functions and city services	Urban and suburban development to support surrounding industrial activities	Urban development to enhance amenities for urban residents
	Water supply/ sanitisation	Regional water supply and sanitisation	Enhanced water supply and sanitisation for industries	High-quality clean water supply and sanitisation for cities
	ICT	Regional communication network	Development and improvement of communication network	High-speed communication network

ICT = information and communication technology, LRT = light rail transit, MRT = mass rapid transit, SEZ = special economic zone.

Source: Authors.

Table 6.3 Social Aspects of Infrastructure in the Third Unbundling

Project category	Examples
Agriculture	High-tech agriculture Special agricultural zones
Basic living standards	Water and sewage Medical care Environment and resource circulation (recycling) Disaster prevention and management
Urban consolidation	Smart city Transit-oriented development Congestion control system
Innovation	Academia–industry collaboration University for industry-oriented human resources and skills development

Source: Authors.

Infrastructure Project List

This section describes the list of infrastructure projects in the appendix. To compile this list, the Economic Research Institute for ASEAN and East Asia (ERIA) conducted an infrastructure survey in FY2019 with the support of local consultants in each ASEAN Member State (AMS) excluding Singapore. The consultants compiled a draft infrastructure project list in-country, and ERIA held a workshop in Jakarta on 24 April 2019 to share the concept of the CADP 3.0 with them. The authors (Masahito Ambashi and Takuya Fujita) visited the countries to discuss the draft with the consultants and to perform field research to observe the progress of major infrastructure construction sites.

Three criteria were applied to select the infrastructure projects in each country. First, to remove small-scale projects, the threshold of the (planned) budget was set at $5 million. Second, infrastructure projects to which governments attach great importance, such as national flagship projects or long-term development plans, were prioritised, even if their budget was below the threshold. Third, and most importantly, the selection was based on (i) the impact on the focused region (both quantitative and qualitative), (ii) connectivity with neighbouring regions, and (iii) feasibility. The second and third criteria basically replicated those set by the CADP 2.0 for selecting its infrastructure projects. The authors and consultants made extra efforts to investigate the third criteria by interviewing officials and responsible companies, analysing think tank and aid agency reports, and reading mass media news reports.

According to these criteria, as well as the categories shown in Tables 6.1–6.3, the authors not only gathered physical and economic infrastructure projects suitable for the first and second unbundlings, but also searched for projects with social aspects necessary for the third unbundling. As a result, the infrastructure project list is not merely revised from the CADP 2.0, but is a truly new list – building on the concept of unbundlings – that encompasses a broader range of infrastructure such as that related to ICT. [5]

After examining projects in each country with the consultants, the authors selected 779 representative and prospective projects (Table 6.4). [6] Figures 6.2–6.4 map out the representative projects. Most of the projects belong to the first (43) and second (542) unbundlings, indicating that conventional economic and physical infrastructure is still planned and required in response to local demand. Nevertheless, about a quarter of the infrastructure projects (192) cater to the third unbundling. This finding implies that AMS acknowledge the importance of developing highly advanced infrastructure that underpins the technology- and innovation-led economy.

By sector, the projects are classified into the following categories: roads/bridges (176 projects), railways (121), ports/maritime (68), airports (58), other transportation (7), industrial estates/SEZs (62), ICT (19), energy/power (135), urban development (39), water/sanitation (63), and others (31). The infrastructure distribution by sector is still biased towards transportation, energy, and industrial infrastructure, reflecting the regional aspiration to manufacturing connectivity across and within countries and subregions, while urban development and others (including infrastructure related to medical and academia–industry collaboration) for the third unbundling are being promoted.

Next, although the authors admit that the number of infrastructure projects is not necessarily balanced across countries, possibly due to different interpretations of the criteria, the project list reveals that all AMS need a variety of infrastructure according to the size of their economy and their development stage (Figures 6.2-6.4). It is also notable that 13 cross-border infrastructure projects (e.g. the Sixth Friendship Bridge between Thailand and the Lao PDR) are under way involving multiple countries. With respect to subregional aggregation, while 396 projects (half of the total) are planned in the Mekong subregion, 361 are in the BIMP+ and 19 are in the IMT+. Therefore, we have to say that the infrastructure development initiatives in the IMT+ are delayed or weak compared with those in the Mekong subregion and BIMP+.

To sum up, we can see from this infrastructure project list that demand for hard infrastructure in ASEAN continues to be very high and that concrete projects for the third unbundling have emerged in this region. The important thing is to step up the steady

[5] The new list also follows up on important projects listed in the CADP 2.0 that have not been completed.

[6] See the appendix for details of project names, countries/regions, and unbundling stages.

implementation of such projects, going beyond the conceptual or study phases (Chapter 7 attempts to evaluate the economic impacts on the geographical simulation model by assuming that these infrastructure projects are implemented). AMS should strengthen their cooperation with other states to enhance regional connectivity because all states can benefit from it through the production and service networks that have been thus far developed in ASEAN. As an example of regional infrastructure development, Box 6.1 illustrates the progress, challenges, and benefits of the SEC from the viewpoint of Cambodia, which is located in the central Mekong region. Furthermore, given that the East Asian countries (China, Japan, and the Republic of Korea) have established their industrial bases in ASEAN, they are strongly expected to make further contributions to implementing the infrastructure projects listed in the CADP 3.0.

Conclusion

This chapter has reviewed the progress of and plans for hard infrastructure development in ASEAN based on the project list compiled by ERIA. By assessing the previous project list in the CADP 2.0, we make it clear that ASEAN and AMS have steadily carried out hard infrastructure development from the conceptual and feasibility study stages to the construction and operation stages. Meanwhile, as is shown throughout this book, a new style of globalisation and industrialisation has emerged in recent years, with the advent of the third unbundling in which connectivity amongst regions and people can be enhanced using ICT. At this unbundling stage, alternative hard infrastructure development – with a focus on social aspects such as urban amenity improvement – is essential for ASEAN to spur innovation-driven economies. The revised infrastructure project list in the CADP 3.0 reflects the new characteristics of the third unbundling in addition to those in the first and second unbundlings. For hard infrastructure development to fulfil its purpose, ASEAN and AMS are expected to make cooperative efforts to carry infrastructure development plans into implementation.

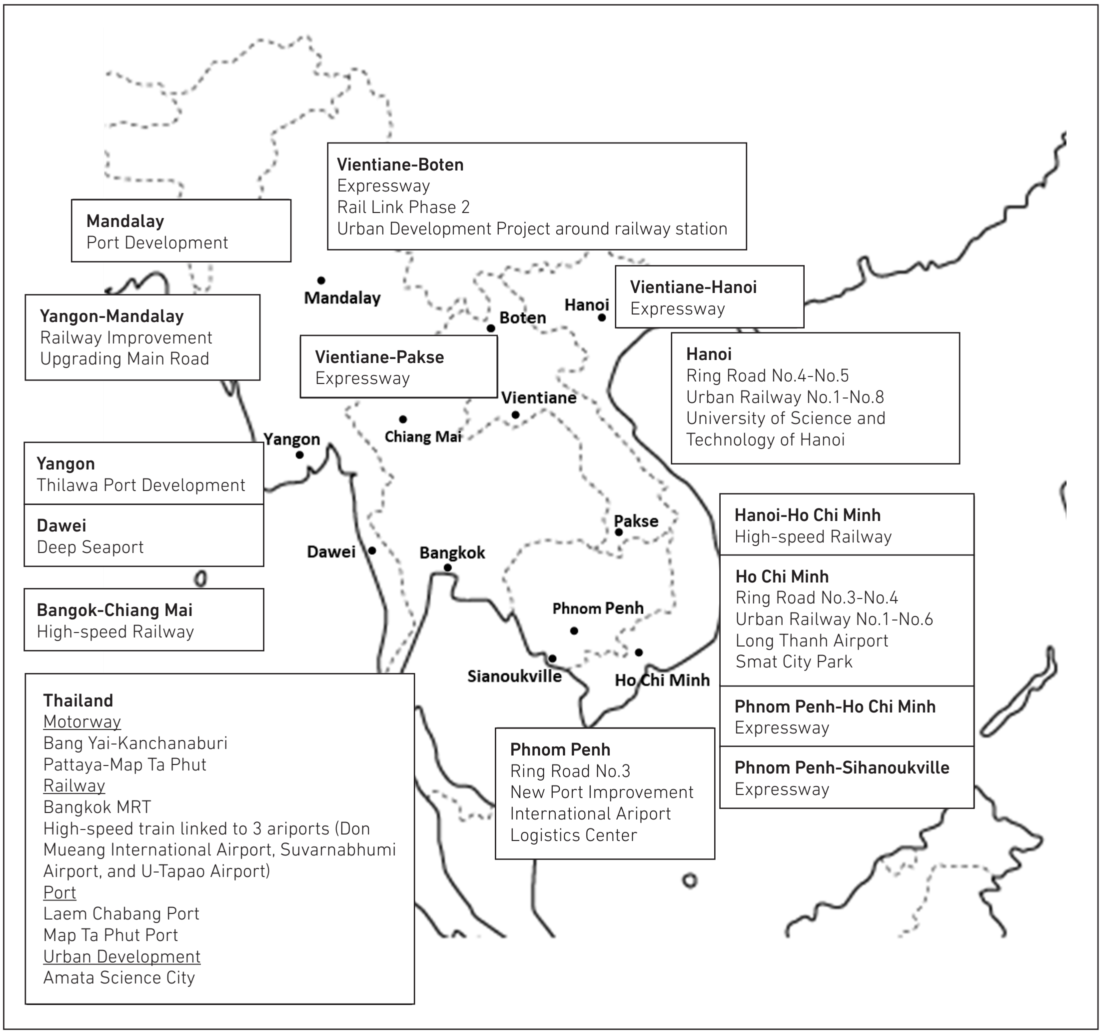
Table 6.4 Summary of the Representative Prospective Project List in the Appendix, by Subregion and by Country

		Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	Viet Nam	Cross-Border	Mekong	BIMP+	IMT+	ASEAN	Total
Unbundlings	The first unbundling				1		8	20	4	8	2	22	20	1		43
	The second unbundling	31	37	84	64	59	37	88	67	67	10	265	208	71		544
	The third unbundling	1	3	31	6	15	3	32	58	40	3	111	64	16	1	192
Sectors	Roads/Bridges	3	11	14	9	12	6	57	25	32	7	86	73	17		176
	Railways		2	12	5	10	4	21	45	22		73	33	15		121
	Ports/Maritime		2	7	14	6	7	9	14	9		43	16	9		68
	Airports		4	10	2	8	4	14	8	8		25	25	8		58
	Other transportation						2	5				2	5			7
	Industrial estates/SEZs	25		8	5	4			11	9		22	33	7		62
	ICT		2	4		3	1	5	2		2	6	9	3	1	19
	Energy/Power	3	15	21	30	14	11	11	15	10	5	83	39	13		135
	Urban development	1		2	6	12	4	1	2	11		23	5	11		39
	Water supply/sanitation		1	24		5	6	16	5	6		18	40	5		63
	Others		3	13			3	1	2	8	1	17	14			31
	Total	**32**	**40**	**115**	**71**	**74**	**48**	**140**	**129**	**115**	**15**	**398**	**292**	**88**	**1**	**779**

ASEAN = Association of Southeast Asian Nations, BIMP+ = Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth ERIA and surrounding regions, ICT = information and communication technology, IMT+ = Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions, SEZ = special economic zone.

Source: Authors' compilation.

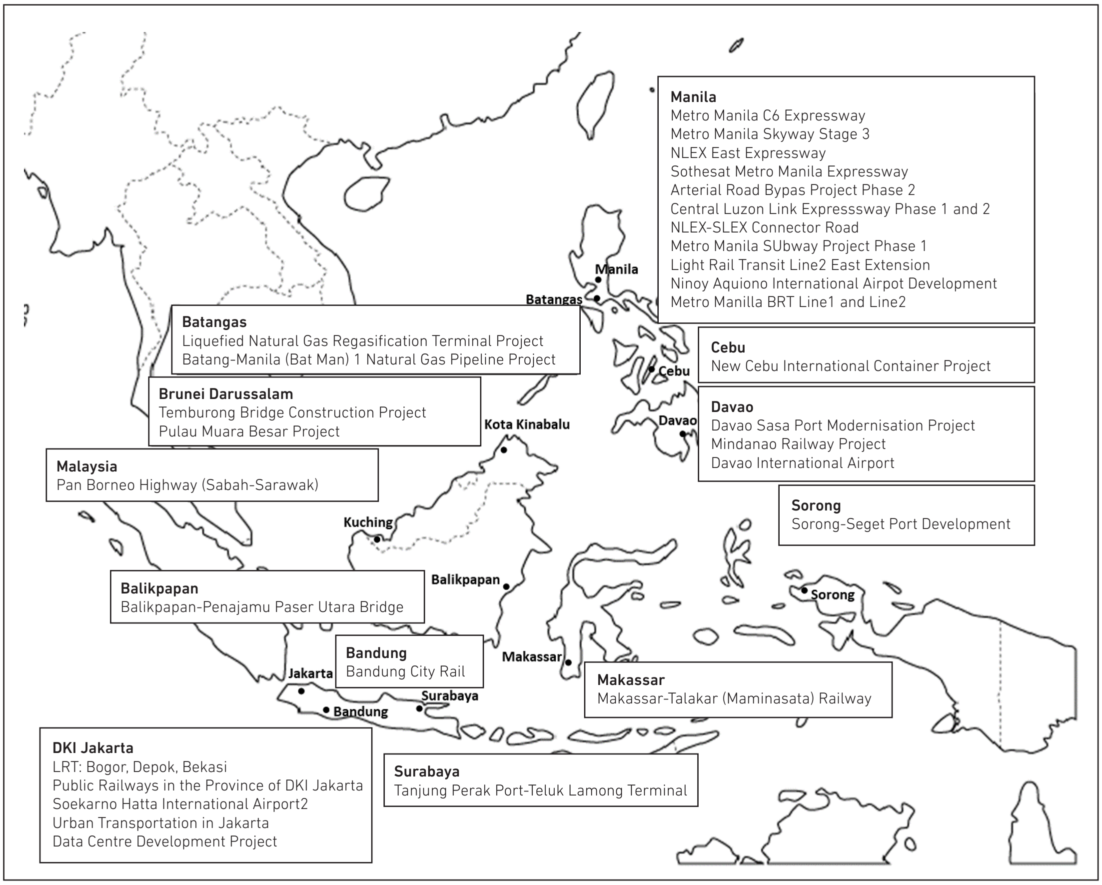
Figure 6.2 Selected Representative Infrastructure Projects in the Mekong Subregion



EWEC = East–West Economic Corridor, MRT = mass rapid transit.

Source: Authors' compilation.

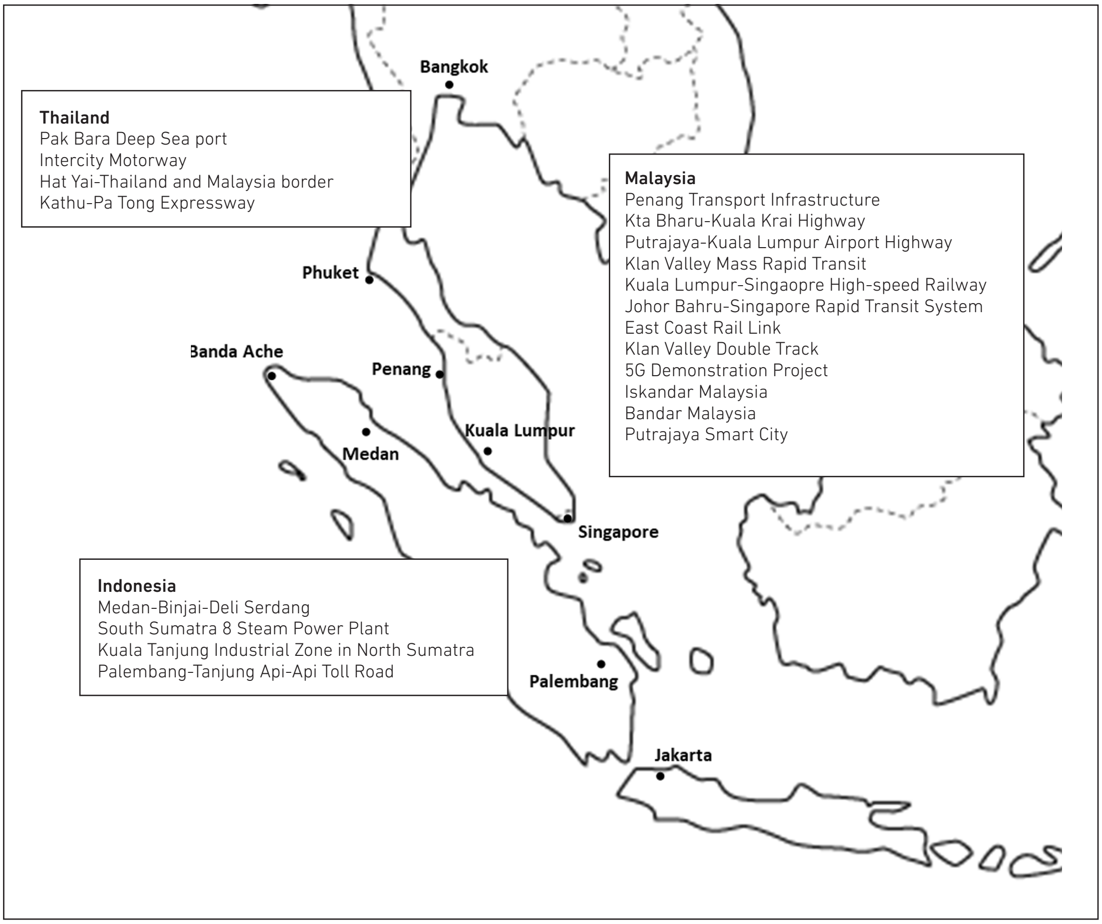
Figure 6.3 Selected Representative Infrastructure Projects in the BIMP+ Subregion



BIMP+ = Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth ERIA and surrounding regions, BRT = bus rapid transit, LRT = light rail transit, NLEX = North Luzon Expressway, SLEX = South Luzon Expressway.

Source: Authors' compilation.

Figure 6.4 Selected Representative Infrastructure Projects in the IMT+ Subregion



IMT+ = Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions.

Source: Authors' compilation.

Box 6.1 Southern Economic Corridor – From the Viewpoint of Cambodia

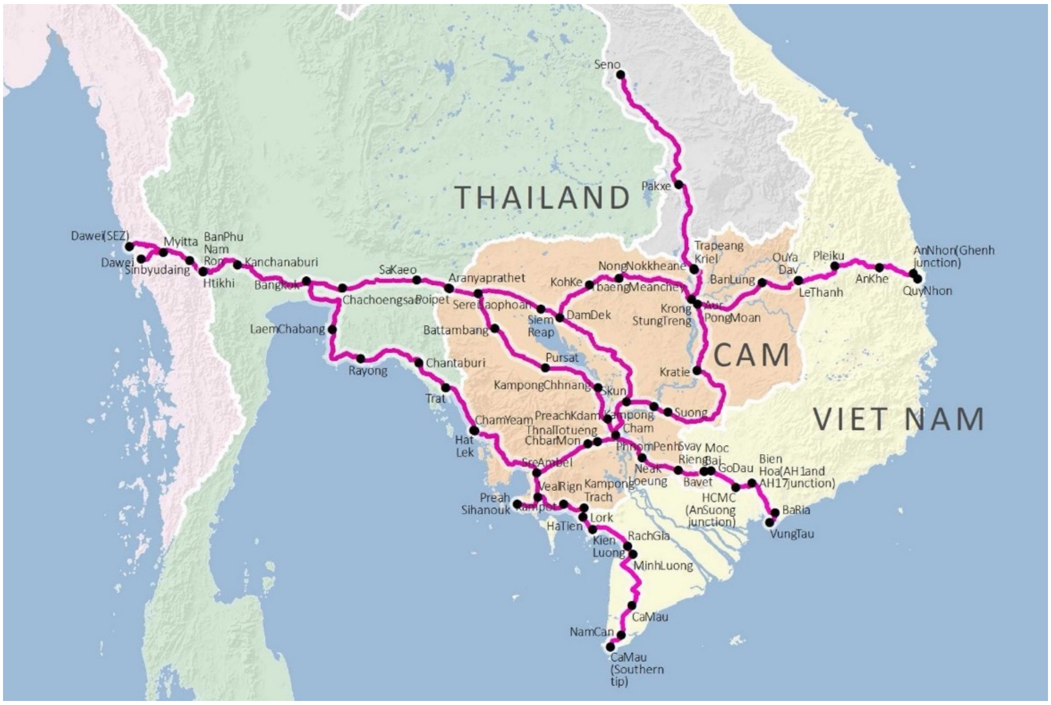
1. Background and Need for the Southern Economic Corridor

The Eighth Greater Mekong Subregion (GMS) Ministerial Conference, held in Manila in 1998, identified the Southern Economic Corridor (SEC) as one of three priority GMS economic corridors. The other two corridors were the East–West Economic Corridor and the North–South Economic Corridor. The meeting expected the role of economic corridors in GMS development to be as follows:

> GMS member countries will create economic corridors linking the subregion to major markets; nodal points within these economic corridors will serve as centers for enterprise development; economic corridors will be an expansion of key transport corridors so as to enhance economic activities and benefits, and over the longer term to build on the potential of the subregion as a land bridge serving the People's Republic of China (PRC), Southeast Asia, South Asia, and East Asia (ADB, 2010: 1).

The economic corridors are necessary to help achieve the vision of the GMS as a prosperous, harmonious, and integrated subregion by providing increased connectivity, enhanced competitiveness, and a greater sense of community (ADB, 2010). The Central Subcorridor – connecting Bangkok (Thailand)–Phnom Penh (Cambodia)–Ho Chi Minh City (Viet Nam)–Vung Tau (Viet Nam) – was identified as the main corridor of the SEC. Two subcorridors and an interlink were identified. The Central Subcorridor, from Bangkok, traverses Sa Kaeo Province in Thailand and crosses into Cambodia through the Aranyaprathet–Poipet border gate. In Cambodia, it passes through Sisophon and goes to Phnom Penh via two routes. The first is via National Road No. 5, which crosses the provinces of Banteay Meanchey, Battambang, Pursat, Kampong Chhnang, and Kandal before reaching Phnom Penh. The second is via National Road No. 6, which passes through Siem Reap, Kompong Thom, Kompong Cham, and Kandal provinces before reaching Phnom Penh. From Phnom Penh, this subcorridor follows National Road No. 1 and goes through Svay Rieng Province down to the Bavet–Moc Bai border gate between Cambodia and Viet Nam. From Moc Bai, this subcorridor goes to Ho Chi Minh City via National Road No. 22, after which it connects with National Road No. 51, passing through four provinces in Viet Nam: Tay Ninh, Ho Chi Minh City, Dong Nai, and Ba Ria–Vung Tau. In addition to this route, the SEC can be extended from Bangkok to the deep seaport in Dawei on the western coast of Myanmar.

Map of Southern Economic Corridor



Source: Greater Mekong Subregion (n.d.).

2. Recent Improvement of the SEC

After the identification of economic corridors, all the GMS member countries made great improvements in (i) strengthening infrastructure links; (ii) facilitating cross-border trade, investment, and tourism; (iii) enhancing private sector participation and competitiveness; (iv) protecting the environment and promoting the sustainable use of shared natural resources; and (v) developing human resources and skills competencies. Examples of recent improvements in Cambodia are detailed in section 2.1.

2.1 Improvement of Road Infrastructure

2.1.1 National Road No. 1 and Tsubasa Bridge

Cambodia's National Road No. 1 connecting Phnom Penh and Bavet, which is the border city with Viet Nam, is one of the most important arterial roads for the SEC as well as Cambodia's economy. The eastern part of this road was improved with a concessional loan from the Asian Development Bank. The western part and the bridge over the Mekong River were constructed with grant assistance from the Government of Japan. The bridge, completed in 2015, was named 'Tsubasa Bridge' by the prime minister of Cambodia, Hun Sen ('Tsubasa' means wing in Japanese). Until the completion of this bridge, National Road No. 1 was interrupted by the Mekong River in Neak Loeung, and a ferry was the only way to cross the river. The waiting time for a ferry was usually about 30 minutes, but during busy times, even with all three ferries running on full schedules, passengers were forced to wait 7–8 hours. Further, the ferries did not operate at night. For users of National Road No. 1, this spot was a large bottleneck. The completed main bridge of Tsubasa Bridge is 640 metres long, the entire bridge is 2,215 metres long, and the total length (including the attached road section) is 5,400 metres (JICA, 2015). This bridge is indispensable to facilitate exports from Cambodia to major destination countries including the United States, Japan, and China through Viet Nam's ports.

Tsubasa Bridge

Source: Authors.

2.1.2 National Road No. 5 Connecting Phnom Penh to the Thai Border

Linking Phnom Penh and the border with Thailand, National Road No. 5 serves as a trunk road for Cambodia, as well as composing a portion of the Asian Highway and the SEC, and is expected to function as a major industrial artery for the Mekong region.

Improvements to National Road No. 5 include widening of the road from two lanes to four lanes along 309 kilometres; construction of bypass roads for four major cities (59 kilometres in total); and bridge renovation (JICA, 2020). This improvement is financed by Japanese ODA loans totalling ¥81,610 million ($750 million equivalent). The first portion (Battanbang–Sisophon) has been completed in 2021. Upon completion of all the projects (scheduled for 2023), the transportation capacity is expected to increase and the number of traffic accidents is projected to decrease (JICA, 2019).

2.2 Improvement of Border Checkpoints

2.2.1 Cambodia–Thailand Border

To mitigate the congestion of border facilities at the Poipet border with Thailand, a new border checkpoint for freight trucks was planned at Stung Bot, Cambodia. The loan agreement for the construction of Stung Bot Cross Border Facilities and Access Road to National Road No. 5 was signed on 19 February 2016 between Cambodia and the Neighbouring Countries Economic Development Cooperation Agency (NEDA), Thailand. The loan amount is 928,110,681 ($26.34 million equivalent). The loan covers border control facilities, roads, a dormitory, a cross dock warehouse, a container yard, improvement of existing roads, flood mitigation, and consulting services. Construction of the new Cambodia–Thailand border checkpoint was expected to be completed by 2019. Although Thailand has completed the new border bridge, the construction of border facilities has been delayed because of procurement issues in Thailand.

Completed Border Bridge at Stung Bot

Source: Authors.

2.2.2 Cambodia–Viet Nam Border

The border between Bavet (Cambodia) and Moc Bai (Viet Nam) is one of the most important borders for both countries. For exports from Cambodia to major export destination countries (e.g. the United States, Canada, Japan, and China), one of the major routes is Phnom Penh–Bavet–Moc Bai–Ho Chi Minh to large-scale container ports such as Cai Mep and Thi Vai ports. From the viewpoint of Cambodia, this border is important infrastructure to promote exports not only to Viet Nam but also other destinations through Viet Nam's ports.

Increased traffic via this route was causing severe congestion at this border checkpoint. The longer waiting time of container tracks was identified as one of the biggest bottlenecks for logistics on this route. To mitigate this challenge, the Government of Cambodia started improvements such as a priority lane, longer customs operation periods, and the abolition of the Cambodia Import–Export Inspection and Fraud Repression Directorate General (Camcontrol) border inspections. Cambodia is now preparing the improvement of checkpoint facilities and infrastructure with assistance from the Government of Japan. Both governments are considering constructing the checkpoint based on the ASEAN Single Window (ASW).

2.3 Improvement of Soft Infrastructure

2.3.1 Facilitation of the ASEAN Single Window

The ASW is a regional initiative that connects and integrates the National Single Windows (NSWs) of ASEAN Member States (AMS). The ASW objective is to expedite cargo clearance and promote ASEAN economic integration by enabling the electronic exchange of border trade-related documents amongst AMS.

In June 2019, Cambodia launched its NSW to facilitate import and export activities. The NSW connects the Automated Systems for Customs Data (ASYCUDA) System of the General Department of Customs and Excise and the e-Certificate of Origin (e-CO) System of the Ministry of Commerce to the ASW, through which the ASEAN Trade in Goods Agreement electronic Certificate of Origin (ATIGA e-Form D) can be issued (Vannak, 2019).

In December 2019, Cambodia and the other AMS joined the ASW Live Operation, which allowed the granting of preferential tariff treatment based on the ATIGA e-Form D exchanged through the ASW.

In December 2020, Cambodia, Myanmar, and Singapore started the exchange of the ASEAN Customs Declaration Document through the ASW, followed by Malaysia and Thailand from 31 March 2021 (ASEAN Single Window, n.d.).

2.3.2 Cambodia–Japan Public–Private Sector Meeting

The Cambodia–Japan Public–Private Sector Meeting is Cambodia's only bilateral dialogue mechanism, created under the framework of the Bilateral Investment Treaty between Cambodia and Japan signed on 14 June 2007. Since 2009, annual or semiannual meetings have been held periodically. This bilateral meeting is part of the aftercare service mechanism, which gives Japanese investors the opportunity to address challenges and make requests to representatives of Cambodian ministries and agencies to review and take action to promote Japanese investment in Cambodia, as well as to improve the investment and business environment in Cambodia. At the meeting in 2020, Japan started the submission of a formal policy recommendation report to Cambodia that includes issues to be discussed and those already solved.

Many issues and challenges have been solved through this dialogue mechanism, with requests and proposals based on the actual experiences of Japanese companies. One of the biggest examples is the abolition of border inspections by Camcontrol. The Japanese side pointed out that the Camcontrol inspections were redundant, given the customs inspections, and were inefficient in terms of both cost and time. On 1 February 2019, the prime minister issued a sub-decree to abolish Camcontrol inspections at the border checkpoint (JBAC, 2021).

3. Expected Impact, Effects, and Challenges of the SEC

3.1 Expected Impact and Effects of the SEC

The expected impact and effects of the SEC development are (i) the promotion of the investment environment through the improvement of physical connectivity amongst Thailand, Cambodia, Viet Nam, and Myanmar; (ii) strengthening of connectivity and the promotion of regional integration; and (iii) an increase in the transportation capacity and improvement of the logistics efficiency.

The best examples of these effects are investments in Cambodia by the Japanese parts manufacturing industry. Based on the improved connectivity through the SEC, with heavy accumulation of industries in neighbouring countries such as Thailand and Viet Nam, Cambodia has become an attractive location for labour-intensive parts manufacturing, taking advantage of the lower labour costs in Cambodia. Some large-scale Japanese parts manufacturers (including MinebeaMitsumi, Sumitomo Wiring System, Yazaki, DENSO, and Nidec) have shifted the labour-intensive manufacturing of some automobile and electronics parts to Cambodia, given the increasing cost of labour in Thailand, China, and Viet Nam. This type of investment could be regarded as an authentic and typical example of the theory of fragmentation.

Through these investments, Cambodia enjoys the benefits of increasing employment, rising exports, higher value addition, and diversification of export items and destinations. The improvement of both hard and soft infrastructure in the SEC is indispensable for attracting foreign direct investment and for the 'way of kings' development of Cambodia, following the neighbouring AMS.

3.2 Challenges of the SEC

The SEC faces challenges in achieving its expected impact and effects (section 3.1). Regarding hard infrastructure, the biggest issue is the delay in the construction of the Stung Bot Cross Border Facilities between Cambodia and Thailand. This issue was discussed at the 13th Dialogue between the Secretary General of ASEAN and the Federation of Japanese Chambers of Commerce and Industry in ASEAN on 7 July 2021 (Mission of Japan to ASEAN, 2021). It is envisaged that the volume of freight will increase following the recovery of economies in this region after the coronavirus disease (COVID-19) pandemic. It is necessary to expedite the construction of the Stung Bot Cross Border Facilities.

Regarding soft infrastructure, streamlining the procedures for cross-border logistics is crucial. Based on the World Bank Logistics Performance Index (2018), Cambodia was ranked 98 out of 160 countries because of low performance in customs procedures (World Bank, 2018). Improvements towards single window procedures, facilitation of online procedures, and human development will be necessary.

References

ADB (2010), *Sharing Growth and Prosperity: Strategy and Action Plan for the Greater Mekong Subregion Southern Economic Corridor*. Manila: Asian Development Bank. https://www.adb.org/publications/sharing-growth-and-prosperity-strategy-and-action-plan-greater-mekong-subregion (accessed 31 July 2021).

ASEAN Single Window (n.d.), https://asw.asean.org/ (accessed 31 July 2021).

ERIA (2010), *The Comprehensive Asia Development Plan*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/publications/the-comprehensive-asia-development-plan/ (accessed 8 December 2021).

ERIA (2015), *The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/publications/the-comprehensive-asian-development-plan-20-cadp-20-infrastructure-for-connectivity-and-innovation/ (accessed 8 December 2021).

Fujisawa, T., K. Yamamoto, J. Wada, and M. LoCastro, eds. (2019), '2018 Progress Survey Report of Infrastructure Projects in the Comprehensive Asian Development Plan 2.0'. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/publications/2018-progress-survey-report-of-infrastructure-projects-in-the-comprehensive-asian-development-plan-20/ (accessed 8 December 2021).

Greater Mekong Subregion (n.d.), GMS Economic Corridors – Southern Economic Corridor (SEC). https://www.greatermekong.org/gms-economic-corridors-southern-economic-corridor-sec (accessed 31 July 2021).

JBAC (2020), *Annual Report 2019*. Phnom Penh: Japanese Business Association of Cambodia. https://jbac.info/activity-report/ (accessed 31 July 2021).

JBAC (2021), 'Record of Discussion of 21st Cambodia Japan Public and Private Sector Meeting'. Phnom Penh: Japanese Business Association of Cambodia. https://jbac.info/news/%e7%ac%ac21%e5%9b%9e%e5%ae%98%e6%b0%91%e5%90%88%e5%90%8c%e4%bc%9a%e8%ad%b0%e8%ad%b0%e4%ba%8b%e9%8c%b2/ (accessed 31 July 2021).

JICA (2015), 'Tsubasa Bridge Opens in Cambodia, connecting Vietnam, Cambodia and Thailand with a Single Road'. Error! Hyperlink reference not valid. https://web.facebook.com/jicapreng/photos/news-tsubasa-bridge-opens-in-cambodia-connecting-vietnam-cambodia-and-thailand-w/572019786273102/?_rdc=1&_rdr (accessed 26 December 2021).

JICA (2019), 'Development of the Major Artery of the Southern Economic Corridor of the Mekong Region: The National Road No. 5 Improvement Project is Underway in Cambodia—This Year is "Mekong–Japan Exchange Year 2019"', News release, 14 August.

https://www.jica.go.jp/english/news/field/2019/20190814_01.html (accessed 31 July 2021).

JICA (2020), 'Ex-Ante Evaluation (for Japanese ODA Loan): National Road No. 5 Improvement Project (Prek Kdam–Thlea Ma'am Section) (III)'.

https://www.jica.go.jp/english/our_work/evaluation/oda_loan/economic_cooperation/c8h0vm000001rdjt-att/cambodia_200324_02.pdf (accessed 31 July 2021).

Mission of Japan to ASEAN (2021), 'The 13th Dialogue Between the Secretary General of ASEAN and the Federation of Japanese Chambers of Commerce and Industry in ASEAN (FJCCIA)', News release, 12 July. https://www.asean.emb-japan.go.jp/itpr_en/pr21_0712en.html (accessed 31 July 2021).

Urata Shujiro and Ushiyama Ryuichi (2017), 'Yakudo Riku no ASEAN, Nanbu keizai kairou no senzairyoku Mekong keizaiken no sintenkai' (Moving Land ASEAN, Potential of Southern Economic Corridor, New Development of Mekong Economic Region), Bunshindou. http://www.bunshin-do.co.jp/catalogue/book4915.html (accessed 31 July 2021).

Vannak, C. (2019), 'Cambodia Launches National Single Window', *Khmer Times*, 1 July.

https://www.khmertimeskh.com/619318/cambodia-launches-national-single-window/ (accessed 31 July 2021).

World Bank (2018), 'From Parts to Products: Why Trade Logistics Matter'. News feature, 24 July. http://www.worldbank.org/en/news/feature/2018/07/24/from-parts-to-products-why-trade-logistics-matter (accessed 31 July 2021).

Appendix. List of Prospective Projects

Country	Sector	Project name	Region	UB
Brunei Darussalam	Road/Bridge	Temburong Bridge Construction Project	BIMP+	UB2
Brunei Darussalam	Road/Bridge	Pulau Muara Besar Bridge Project	BIMP+	UB2
Brunei Darussalam	Road/Bridge	Construction of Telisai–Lumut Highway	BIMP+	UB2
Brunei Darussalam	Energy/Power	Pulau Muara Besar Oil Refinery Project	BIMP+	UB2
Brunei Darussalam	Energy/Power	Ammonia and Urea Plant Project	BIMP+	UB2
Brunei Darussalam	Energy/Power	Hydrogen Demonstration Plant Project	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Sungai Duhon Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Pekan Belait Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Mumong Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Sungai Bera Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial Estate/ SEZ	Sungai Liang Industrial Park (SPARK)	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Telisai Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Serambangun Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Bukit Panggal Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Kuala Lurah Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Mulaut Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Bengkurong Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Lumapas Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Beribi Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Bio-Innovation Corridor Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Digital Junction Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Terunjing Industrial Park	BIMP+	UB2

Country	Sector	Project name	Region	UB
Brunei Darussalam	Industrial estate/ SEZ	Lambak Kanan West Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Lambak Industrial Site	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Anggerek Desa Tech Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Tanjong Kajar Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Salambigar Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Salar Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Serasa Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Pulau Muara Besar Industrial Park	BIMP+	UB2
Brunei Darussalam	Industrial estate/ SEZ	Batu Apoi Industrial Park	BIMP+	UB2
Brunei Darussalam	Urban development	Temburong Eco Town Smart Community Project	BIMP+	UB3
Cambodia	Road/Bridge	Phnom Penh–Ho Chi Minh City Expressway (E-1)	Mekong	UB2
Cambodia	Road/Bridge	Phnom Penh–Sihanoukville Expressway (E-4)	Mekong	UB2
Cambodia	Road/Bridge	Road Network Improvement Project (National Road No. 1)	Mekong	UB2
Cambodia	Road/Bridge	National Road No. 2 and No. 22 Improvement Project	Mekong	UB2
Cambodia	Road/Bridge	National Road No. 3 Improvement Project	Mekong	UB2
Cambodia	Road/Bridge	Road Asset Management Project II Additional Financing (National Road No. 4)	Mekong	UB2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Battambang–Sri Sophorn Section)	Mekong	UB2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Thlea Ma'Am–Battambang and Sri Sophorn–Poipet sections)	Mekong	UB2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Prek Kdam–Thlea Ma'Am section)	Mekong	UB2
Cambodia	Road/Bridge	Road Network Improvement Project (National Road No. 6)	Mekong	UB2
Cambodia	Road/Bridge	Phnom Penh Ring Road No. 3	Mekong	UB2
Cambodia	Railway	Phnom Penh City Rail Transit Project	Mekong	UB3
Cambodia	Railway	Missing link of Singapore–Kunming Railway Link: Bat Deng–Loc Ninh	Mekong	UB2
Cambodia	Port/Maritime	Phnom Penh New Port Improvement Project	Mekong	UB2
Cambodia	Port/Maritime	Sihanoukville Port New Container Terminal Development Project	Mekong	UB2
Cambodia	Airport	Expansion of Sihanoukville International Airport	Mekong	UB2
Cambodia	Airport	New Phnom Penh International Airport	Mekong	UB2
Cambodia	Airport	New Siem Reap International Airport	Mekong	UB2

Country	Sector	Project name	Region	UB
Cambodia	Airport	New Koh Kong International Airport (Botum Sakor)	Mekong	UB2
Cambodia	Energy/Power	Coal Power Plant II-2	Mekong	UB2
Cambodia	Energy/Power	Coal Power Plant II-3	Mekong	UB2
Cambodia	Energy/Power	Coal Power Plant III-1	Mekong	UB2
Cambodia	Energy/Power	Coal Power Plant III-2	Mekong	UB2
Cambodia	Energy/Power	Stung Sala Mum Thun Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Middle Stung Russey Chrum Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Veal Thmor Kambot Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Prek Laang Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Stung Battambang II Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Stung Pursat I Hydroelectric Project	Mekong	UB2
Cambodia	Energy/Power	Emergency Project of Thermal Power Plant	Mekong	UB2
Cambodia	Energy/Power	Solar Park Project	Mekong	UB2
Cambodia	Energy/Power	Transmission Line Phnom Penh–Sihanoukville along National Road No. 4	Mekong	UB2
Cambodia	Energy/Power	Phnom Penh City Transmission and Distribution System Expansion Project	Mekong	UB2
Cambodia	Energy/Power	Transmission Line Phnom Penh–Stung Treng–Lao PDR	Mekong	UB2
Cambodia	ICT	5G Network	Mekong	UB3
Cambodia	ICT	Submarine Fibre-Optic Cable between Sihanoukville and Hong Kong	Mekong	UB3
Cambodia	Water/Sanitation	Bakheng Water Treatment Facility	Mekong	UB2
Cambodia	Others	Cross-border facilities at Moc Bai–Bavet	Mekong	UB2
Cambodia	Others	New cross-border facilities at Poipet	Mekong	UB2
Cambodia	Others	Phnom Penh Logistics Centre	Mekong	UB2
Indonesia	Road/Bridge	Serang–Panimbang Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Yogyakarta–Bawen Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Probolinggo–Banyuwangi Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Semanan–Balaraja Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Kamal–Taluk Naga–Rajeg Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Patimban Port Access Project	BIMP+	UB2
Indonesia	Road/Bridge	Gedebage–Tasikmalaya–Cilacap Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Balikpapan–Penajam Paser Utara Bridge	BIMP+	UB2
Indonesia	Road/Bridge	Tol Solo–Yogyakarta–NYIA–Kulon Progo	BIMP+	UB2
Indonesia	Road/Bridge	Palembang–Tanjung Api-Api Toll Road	IMT+	UB2
Indonesia	Road/Bridge	Binjai–Langsa Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Langsa–Lhokseumawe Toll Road	BIMP+	UB2
Indonesia	Road/Bridge	Pekanbaru–Bangkinang–Payakumbuh–Bukittinggi Toll Road	IMT+	UB2
Indonesia	Road/Bridge	Sigli–Banda Aceh Toll Road	BIMP+	UB2
Indonesia	Railway	Makassar–Parepare Railway	BIMP+	UB2

Country	Sector	Project name	Region	UB
Indonesia	Railway	Kalimantan Timur Railway	BIMP+	UB2
Indonesia	Railway	Integrated LRT: Bogor, Depok, and Bekasi	BIMP+	UB2
Indonesia	Railway	Public Railways in the Province of DKI Jakarta	BIMP+	UB3
Indonesia	Railway	Lahat–Tarahan Line Railway	BIMP+	UB2
Indonesia	Railway	Makassar–Maros–Sungguminasa–Takalar (Maminasata) Railway	BIMP+	UB2
Indonesia	Railway	Medan–Binjai–Deli Serdang (Mebidang) Railway	IMT+	UB2
Indonesia	Railway	Tanjung–Banjarmasin Railway	BIMP+	UB2
Indonesia	Railway	Kertajati Airport Railway	BIMP+	UB2
Indonesia	Railway	Bandung City Railroad	BIMP+	UB3
Indonesia	Railway	LRT of Cibubur–Bogor	BIMP+	UB3
Indonesia	Railway	Cibungur–Tanjungrasa Line Shortcut	BIMP+	UB2
Indonesia	Port/Maritime	Patimban Port	BIMP+	UB2
Indonesia	Port/Maritime	Inland Waterways: Cikarang Bekasi Laut Development Project	BIMP+	UB2
Indonesia	Port/Maritime	Pantoloan Port Development	BIMP+	UB2
Indonesia	Port/Maritime	Anggrek Port	BIMP+	UB2
Indonesia	Port/Maritime	Depapre Port	BIMP+	UB2
Indonesia	Port/Maritime	Tanjung Perak Port–Teluk Lamong Terminal	BIMP+	UB2
Indonesia	Port/Maritime	Sorong–Seget Port Development	BIMP+	UB2
Indonesia	Airport	Kediri Airport	BIMP+	UB2
Indonesia	Airport	Buntu Kunik Airport in South Sulawesi	BIMP+	UB2
Indonesia	Airport	Bukit Malintang Airport in Mandaling Natal	BIMP+	UB2
Indonesia	Airport	Singkawang Airport	BIMP+	UB2
Indonesia	Airport	Siboru Airport	BIMP+	UB2
Indonesia	Airport	Weda Airport	BIMP+	UB2
Indonesia	Airport	Wasior Baru Airport	BIMP+	UB2
Indonesia	Airport	Gorom Airport	BIMP+	UB2
Indonesia	Airport	Lombok International Airport	BIMP+	UB2
Indonesia	Airport	Soekarno Hatta International Airport 2	BIMP+	UB2
Indonesia	Energy/Power	Dieng Small Scale Steam Power Plant	BIMP+	UB2
Indonesia	Energy/Power	Tanjung Steam Power Plant in Tabalong Regency	BIMP+	UB2
Indonesia	Energy/Power	Poso Hydroelectric Power Plant	BIMP+	UB2
Indonesia	Energy/Power	South Sumatra 8 Steam Power Plant	IMT+	UB2
Indonesia	Energy/Power	Java–1 Steam and Gas Power Plant	BIMP+	UB2
Indonesia	Energy/Power	Java–3 Steam Power Plant	BIMP+	UB2
Indonesia	Energy/Power	Java–9 and 10 Steam Power Plant	BIMP+	UB2
Indonesia	Energy/Power	Asahan III Hydropower Project	BIMP+	UB2
Indonesia	Energy/Power	Poso Peaker Hydropower Project	BIMP+	UB2
Indonesia	Energy/Power	Patuha Geothermal Power Project	BIMP+	UB2

Country	Sector	Project name	Region	UB
Indonesia	Energy/Power	Waste-Based Power Plant in Bekasi	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Jakarta	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Surakarta	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Denpasar	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Palembang	IMT+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Tangerang	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Bandung	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Semarang	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Makassar	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Manado	BIMP+	UB3
Indonesia	Energy/Power	Waste-Based Power Plant in Surabaya	BIMP+	UB3
Indonesia	Water/Sanitation	West Semarang Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Jatigede Regional Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Umbulan Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Bandar Lampung City Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Mamminasata Regional Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Jatiluhur Regional Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Wasusokas Regional Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Dumai Water Supply Project	IMT+	UB2
Indonesia	Water/Sanitation	Sarbagikung Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Ciawi District Bogor Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Tangerang City Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Karian–Serpong Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Kamijoro Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Pekanbaru City Water Supply Project	IMT+	UB2
Indonesia	Water/Sanitation	Kabupaten Gresik Water Supply Project	BIMP+	UB2
Indonesia	Water/Sanitation	Way Sekampung Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Kuwil Kawangkoan Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Leuwikeris Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Temef Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Pamukkulu Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Sadawarna Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Way Apu Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Bener Dam	BIMP+	UB2
Indonesia	Water/Sanitation	Jenelata Dam	BIMP+	UB2
Indonesia	ICT	Palapa Ring Broadband (Eastern part)	BIMP+	UB3
Indonesia	ICT	Multifunction Satellite Project	BIMP+	UB3
Indonesia	ICT	Base Transceiver Station Blank Spot Project	BIMP+	UB3
Indonesia	ICT	Data Centre Development Project	BIMP+	UB3

Country	Sector	Project name	Region	UB
Indonesia	Industrial Estate/ SEZ	Kuala Tanjung Industrial Zone in North Sumatera	IMT+	UB2
Indonesia	Industrial Estate/ SEZ	Batulicin Industrial Zone in South Sulawesi	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Jorong Industrial Zone in South Kalimantan	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Bantaeng Industrial Zone in South Sulawesi	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Morowali Industrial Zone in Middle Sulawesi	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Buli Industrial Zone in North Maluku	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Teluk Bintuni Industrial Zone in West Papua	BIMP+	UB2
Indonesia	Industrial Estate/ SEZ	Tanah Kuning Industrial Zone in North Kalimantan	BIMP+	UB2
Indonesia	Urban development	Urban Transportation in Jakarta	BIMP+	UB3
Indonesia	Urban development	Transit Oriented Development in Poris-Plawad Tangerang	BIMP+	UB3
Indonesia	Others	Development of Indonesian International Islamic University Campus	BIMP+	UB3
Indonesia	Others	N-245 Medium Range Aircraft Industry Program	BIMP+	UB2
Indonesia	Others	R80 Medium Distance Aircraft Industry Program	BIMP+	UB2
Indonesia	Others	Indonesia National Cancer Centre, Dharmais Hospital	BIMP+	UB3
Indonesia	Others	Pirngadi Hospital	BIMP+	UB3
Indonesia	Others	Zainoel Abidin General Hospital	BIMP+	UB3
Indonesia	Others	Relocation of Salemba Correctional Facility	BIMP+	UB3
Indonesia	Others	University of Sam Ratulangi Teaching Hospital	BIMP+	UB3
Indonesia	Others	Cirebon Campus Development of Institut Teknologi Bandung	BIMP+	UB3
Indonesia	Others	Legok Nangka Regional Waste Treatment	BIMP+	UB3
Indonesia	Others	Sidoarjo General Hospital	BIMP+	UB3
Indonesia	Others	Gorontalo Regional Hospital	BIMP+	UB3
Indonesia	Others	Nambo Regional Waste Management	BIMP+	UB3
Lao PDR	Road/Bridge	Xelamphao Bridge (Lao PDR–Cambodia)	Mekong	UB2
Lao PDR	Road/Bridge	Vientiane–Hanoi Expressway Project	Mekong	UB2
Lao PDR	Road/Bridge	Vientiane–Boten Expressway Project (Phase II and III)	Mekong	UB2
Lao PDR	Road/Bridge	Vientiane–Pakse Expressway Project	Mekong	UB2
Lao PDR	Road/Bridge	Upgrade of three main national roads (vertical lines): No. 1, 3, 11	Mekong	UB2
Lao PDR	Road/Bridge	Upgrade of National Road No. 11 (Nam Sang River–Khaodor-Nonsavanh)	Mekong	UB2
Lao PDR	Road/Bridge	Vang Tao border crossing point	Mekong	UB2

Country	Sector	Project name	Region	UB
Lao PDR	Road/Bridge	Upgrade of eight national roads (horizontal lines): No. 3, 4, 6, 8, 9, 15, 16, and 18	Mekong	UB2
Lao PDR	Road/Bridge	Upgrade of road corridor links: No. 24, 5A, 25, 23, 7, 5B, 10, 26, 22, 21, 16A, 17, and 19	Mekong	UB1
Lao PDR	Railway	SKRL Spur Line: Vientiane–Thakhak–Mu Gia	Mekong	UB2
Lao PDR	Railway	Savannakhet–Lao Bao Railway	Mekong	UB2
Lao PDR	Railway	Thakhek–Pakse–Vantao Railway	Mekong	UB2
Lao PDR	Railway	Thakhek–Savannakhet–Champasak Railway	Mekong	UB2
Lao PDR	Railway	Boten–Vientiane Rail Link (Phase II)	Mekong	UB2
Lao PDR	Port/Maritime	Khammouan Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Thanaleng Logistics Hub and Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Champasak Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Bolikhamxay Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Huayxay Logistics Hub Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Luang Prabang Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Udomxay Dry Port Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Jo Bounmy Inland Container Depot Development Project	Mekong	UB2
Lao PDR	Port/Maritime	Xieng Kok River Port (Luang Namtha)	Mekong	UB2
Lao PDR	Port/Maritime	Pakbeng River Port (Udomxay)	Mekong	UB2
Lao PDR	Port/Maritime	Kokchong River Port (Luang Prabang)	Mekong	UB2
Lao PDR	Port/Maritime	Savannakhet River Port	Mekong	UB2
Lao PDR	Port/Maritime	Khammouan River Port	Mekong	UB2
Lao PDR	Port/Maritime	Hatkhuaydang River Port	Mekong	UB2
Lao PDR	Airport	New Vientiane International Airport	Mekong	UB2
Lao PDR	Airport	New Pakse International Airport	Mekong	UB2
Lao PDR	Energy/Power	Pakbeng Hydropower on Mekong River	Mekong	UB2
Lao PDR	Energy/Power	Sanakham Hydropower on Mekong River	Mekong	UB2
Lao PDR	Energy/Power	Pou Ngoy Hydropower on Mekong River	Mekong	UB2
Lao PDR	Energy/Power	Luang Prabang Hydropower on Mekong River	Mekong	UB2
Lao PDR	Energy/Power	Bankhoum Hydropower on Mekong River	Mekong	UB2
Lao PDR	Energy/Power	Xelanong 3 Dam (Savannakhet)	Mekong	UB2
Lao PDR	Energy/Power	Nam Ngum 4 Hydropower (Xiengkhouang)	Mekong	UB2
Lao PDR	Energy/Power	Nam Moun Dam (Bolikhamxay)	Mekong	UB2
Lao PDR	Energy/Power	Sekong 5 Dam	Mekong	UB2
Lao PDR	Energy/Power	Sekong 3A and 3B Dam	Mekong	UB2
Lao PDR	Energy/Power	Nam Ma 1 2 3 Dam (Houaphanh)	Mekong	UB2
Lao PDR	Energy/Power	Nam Sum 3 Dam (Houaphanh)	Mekong	UB2
Lao PDR	Energy/Power	Nam Pha Gnai Dam (Luang Namtha)	Mekong	UB2
Lao PDR	Energy/Power	Nam Phouan Dam (Xaysomboun)	Mekong	UB2

Country	Sector	Project name	Region	UB
Lao PDR	Energy/Power	Nam Neun 1 Dam (Houaphanh)	Mekong	UB2
Lao PDR	Energy/Power	Nam Emoon Dam (Sekong)	Mekong	UB2
Lao PDR	Energy/Power	Monsoon Wind Farm Project	Mekong	UB2
Lao PDR	Energy/Power	Nam Seuang Hydropower (Luang Prabang)	Mekong	UB2
Lao PDR	Energy/Power	Kalum Lignite Unit 1	Mekong	UB2
Lao PDR	Energy/Power	Coal Power Project (Savannakhet)	Mekong	UB2
Lao PDR	Energy/Power	Coal Power Project (Bolikhamxay and Khammouan)	Mekong	UB2
Lao PDR	Energy/Power	Sekong 4A and 4B Dam	Mekong	UB2
Lao PDR	Energy/Power	Coal Power Project (Houaphanh)	Mekong	UB2
Lao PDR	Energy/Power	Namphak Dam (Champasak)	Mekong	UB2
Lao PDR	Energy/Power	Wind Power Project (Savannakhet, Attapeu, Salavan, Bolikhamxay, and Khammouan)	Mekong	UB2
Lao PDR	Energy/Power	Solar Power Project (Vientiane Capital)	Mekong	UB2
Lao PDR	Energy/Power	East–West Corridor Power Transmission and Distribution Project (Savannakhet and Salavan Provinces)	Mekong	UB2
Lao PDR	Energy/Power	Transmission Line Project (Stung Treng–Lao PDR)	Mekong	UB2
Lao PDR	Energy/Power	Solar Power Plant Development in Thakhek SEZ	Mekong	UB2
Lao PDR	Energy/Power	Transmission Line Interconnection (Hat Xan–Pleiku)	Mekong	UB2
Lao PDR	Industrial estate/ SEZ	Mahanathy Siphandone SEZ	Mekong	UB2
Lao PDR	Industrial estate/ SEZ	Amata Smart and Eco Cities Development Project	Mekong	UB2
Lao PDR	Industrial estate/ SEZ	Bokeo SEZ	Mekong	UB2
Lao PDR	Industrial estate/ SEZ	Xiengkhouang SEZ	Mekong	UB2
Lao PDR	Industrial estate/ SEZ	Nongkang SEZ	Mekong	UB2
Lao PDR	Urban development	New Urban Development Project in Luang Prabang Province	Mekong	UB3
Lao PDR	Urban development	New Urban Development Project in Savannakhet Province	Mekong	UB3
Lao PDR	Urban development	New Urban Development Project in Champasak Province	Mekong	UB3
Lao PDR	Urban development	Urban Development Project in the Lao PDR–Thailand border areas	Mekong	UB3
Lao PDR	Urban development	New Urban Development Project in Vientiane (Vientiane Smart City)	Mekong	UB3
Lao PDR	Urban development	Urban Development Project around the Lao PDR–China railway stations	Mekong	UB3
Malaysia	Road/Bridge	East Coast Expressway (Phase 3)	IMT+	UB2
Malaysia	Road/Bridge	Pan-Borneo Highway (Sabah–Sarawak)	BIMP+	UB2
Malaysia	Road/Bridge	West Coast Expressway (Banting–Taiping)	IMT+	UB2

Country	Sector	Project name	Region	UB
Malaysia	Road/Bridge	Penang Transport Infrastructure Project (Part of the Penang Transport Master Plan)	IMT+	UB2
Malaysia	Road/Bridge	Duta–Ulu Kelang Expressway (Phase 2)	IMT+	UB2
Malaysia	Road/Bridge	Setiawangsa–Pantai Expressway	IMT+	UB2
Malaysia	Road/Bridge	Central Spine Road Project	IMT+	UB2
Malaysia	Road/Bridge	Kota Bharu–Kuala Krai Highway Project	IMT+	UB2
Malaysia	Road/Bridge	Sungai Besi–Ulu Kelang Elevated Expressway	IMT+	UB2
Malaysia	Road/Bridge	Damansara–Shah Alam Highway	IMT+	UB2
Malaysia	Road/Bridge	Putrajaya–Kuala Lumpur International Airport (KLIA) Highway (MEX II)	IMT+	UB2
Malaysia	Road/Bridge	Pan-Island Link 1 (part of the Penang Transport Master Plan)	IMT+	UB2
Malaysia	Railway	Klang Valley Mass Rapid Transit	IMT+	UB2
Malaysia	Railway	Gemas–Johor Bahru Electrified Double Track	IMT+	UB2
Malaysia	Railway	Kuala Lumpur–Singapore High-Speed Rail	IMT+	UB2
Malaysia	Railway	Johor Bahru–Singapore Rapid Transit System Link	IMT+	UB2
Malaysia	Railway	Bayan Lepas LRT (part of the Penang Transport Master Plan)	IMT+	UB2
Malaysia	Railway	LRT Line 2 (Kelana Jaya and Sri Petaling to Putra Heights)	IMT+	UB2
Malaysia	Railway	East Coast Rail Link	IMT+	UB2
Malaysia	Railway	Klang Valley Double Track Project	IMT+	UB2
Malaysia	Railway	LRT Line 3 (Bandar Utama to Klang)	IMT+	UB2
Malaysia	Railway	Sarawak Automated Rail Transit Project	BIMP+	UB2
Malaysia	Airport	Expansion of Langkawi International Airport	IMT+	UB2
Malaysia	Airport	Kuala Lumpur Air Traffic Control Centre, Kuala Lumpur International Airport	IMT+	UB2
Malaysia	Airport	Expansion of Sultan Ismail Petra Airport	IMT+	UB2
Malaysia	Airport	Kulim International Airport	IMT+	UB2
Malaysia	Airport	Mukah Airport	BIMP+	UB2
Malaysia	Airport	Seri Iskandar Airport	IMT+	UB2
Malaysia	Airport	Expansion of Penang Airport	IMT+	UB2
Malaysia	Airport	Air Cargo Terminal 1 (KACT1), Kuala Lumpur International Airport	IMT+	UB2
Malaysia	Energy/Power	Hulu Terengganu Hydroelectric Project	IMT+	UB2
Malaysia	Energy/Power	Tanjung Bin Energy Power Plant	IMT+	UB2
Malaysia	Energy/Power	Prai Combined-Cycle Gas Turbine Power Project	IMT+	UB2
Malaysia	Energy/Power	Manjung 5 Ultra-Super Critical Coal-Fired Power Plant	IMT+	UB2
Malaysia	Energy/Power	Ulu Jelai New Hydroelectric Power Plant	IMT+	UB2
Malaysia	Energy/Power	Balingian Power Plant Project	BIMP+	UB2
Malaysia	Energy/Power	Jimah East Power (Project 3B)	IMT+	UB2
Malaysia	Energy/Power	Baleh Hydroelectric Dam	BIMP+	UB2

Country	Sector	Project name	Region	UB
Malaysia	Energy/Power	Sarawak–Peninsular Malaysia HVDC Transmission Project	BIMP+	UB2
Malaysia	Energy/Power	Trans-Borneo Power Grid Project	BIMP+	UB2
Malaysia	Energy/Power	Baram Hydroelectric Dam	BIMP+	UB2
Malaysia	Energy/Power	Pengerang Integrated Petroleum Complex	IMT+	UB2
Malaysia	Energy/Power	Trans-Sabah Gas Pipeline	BIMP+	UB2
Malaysia	Energy/Power	Multi-Product Pipeline (Melaka and Port Dickson to Jitra, Kedah)	IMT+	UB2
Malaysia	Water/Sanitation	Langat 2 Water Treatment Plant (Selangor)	BIMP+	UB2
Malaysia	Water/Sanitation	Kaiduan Dam and Water Treatment Plant (Sabah)	BIMP+	UB2
Malaysia	Water/Sanitation	Sungai Muda Flood Mitigation Project	IMT+	UB2
Malaysia	Water/Sanitation	Sungai Kedah and Sungai Anak Bukit Flood Mitigation Plan	IMT+	UB2
Malaysia	Water/Sanitation	Sungai Golok and Sungai Kelantan Integrated River Basin Development Project	IMT+	UB2
Malaysia	Industrial estate/ SEZ	Green Technology Park (Phase 2 and 3) (Pekan, Pahang)	IMT+	UB2
Malaysia	Industrial estate/ SEZ	Sarawak Steel and Iron Industry Park	BIMP+	UB2
Malaysia	Industrial estate/ SEZ	Nusajaya Tech Park	IMT+	UB3
Malaysia	Industrial estate/ SEZ	Malaysia–China Kuantan Industrial Park	IMT+	UB3
Malaysia	Port/Maritime	Expansion of Northport, Port Klang	IMT+	UB2
Malaysia	Port/Maritime	Expansion of Westport, Port Klang	IMT+	UB2
Malaysia	Port/Maritime	Kuala Linggi International Port (Melaka)	IMT+	UB2
Malaysia	Port/Maritime	Carey Island Port Development (Port Klang Expansion)	IMT+	UB2
Malaysia	Port/Maritime	Expansion of Kuantan Port New Deep Water Terminal	IMT+	UB2
Malaysia	Port/Maritime	Tok Bali Development Area	IMT+	UB2
Malaysia	ICT	National Fiberisation and Connectivity Plan	IMT+	UB3
Malaysia	ICT	5G Demonstration Project	IMT+	UB3
Malaysia	ICT	Maxis–Huawei 5G Collaboration	IMT+	UB3
Malaysia	Urban development	Iskandar Malaysia	IMT+	UB3
Malaysia	Urban development	River of Life	IMT+	UB3
Malaysia	Urban development	Bandar Malaysia	IMT+	UB3
Malaysia	Urban development	PNB 118 Tower	IMT+	UB3
Malaysia	Urban development	Melaka Gateway	IMT+	UB2
Malaysia	Urban development	Malaysia City Brain	IMT+	UB3

Country	Sector	Project name	Region	UB
Malaysia	Urban development	Penang South Reclamation Project	IMT+	UB2
Malaysia	Urban Development	Forest City	IMT+	UB3
Malaysia	Urban Development	Smart Selangor	IMT+	UB3
Malaysia	Urban Development	Putrajaya Smart City	IMT+	UB3
Malaysia	Urban Development	KLIA Aeropolis Digital Free Trade Zone Park	IMT+	UB3
Malaysia	Urban Development	Kota Kinabalu Smart City Initiatives	BIMP+	UB3
Myanmar	Road/Bridge	Ruili–Kyaukpyu Expressway	Mekong	UB2
Myanmar	Road/Bridge	Kyaing Tong–Monglar Road (part of Daluo–Tachileik Highway)	Mekong	UB2
Myanmar	Road/Bridge	Construction of Yangon Inner Ring Road, Outer Ring Road, and Arterial Road	Mekong	UB2
Myanmar	Road/Bridge	Rural Road Development Project	Mekong	UB1
Myanmar	Road/Bridge	Upgrading Yangon–Mandalay Main Line	Mekong	UB2
Myanmar	Road/Bridge	Upgrading of Bago–Mawlamyine, Yangon–Pyay, and Mandalay–Myitkyina	Mekong	UB2
Myanmar	Railway	Muse–Kyaukpyu Rail Transportation System	Mekong	UB2
Myanmar	Railway	Thanbyuzayat–Three Pagoda Pass (SKRL missing link)	Mekong	UB1
Myanmar	Railway	Freight Railway Station in Yangon and Mandalay	Mekong	UB2
Myanmar	Railway	Yangon–Mandalay Railway Improvement Project (Phase I and II)	Mekong	UB2
Myanmar	Port/Maritime	Mandalay Port Development	Mekong	UB2
Myanmar	Port/Maritime	Navigation channel improvement of Ayeyarwady, Chindwin, and Yangon	Mekong	UB2
Myanmar	Port/Maritime	Modernisation of Dalla Dockyard	Mekong	UB2
Myanmar	Port/Maritime	Thilawa Port Development	Mekong	UB2
Myanmar	Port/Maritime	Mandalay Container Port Development Project	Mekong	UB2
Myanmar	Port/Maritime	Container-based multipurpose port terminal construction project in Thilawa Area	Mekong	UB2
Myanmar	Port/Maritime	Dawei Deep Seaport	Mekong	UB2
Myanmar	Airport	Hanthawaddy Airport Development	Mekong	UB2
Myanmar	Airport	Implementation of ASR System at Yangon International Airport and ATC Simulator	Mekong	UB2
Myanmar	Airport	PSR/SSR at Nay Pyi Taw International Airport and SSR at Mandalay International Airport	Mekong	UB2
Myanmar	Airport	Project of radar application and maintenance (airport project)	Mekong	UB2
Myanmar	Other transportation	Ayeyarwady Integrated River Basin Management Project: Inland water transport facilities improvement and development	Mekong	UB2

Country	Sector	Project name	Region	UB
Myanmar	Other transportation	Truck terminal development in Yangon	Mekong	UB2
Myanmar	Energy/Power	Power Sector Improvement Project in the Greater Yangon (Phase I)	Mekong	UB2
Myanmar	Energy/Power	Southern Myanmar Development Company	Mekong	UB2
Myanmar	Energy/Power	Construction of Electrification for Rural Area National Electrification Project (Sagaing)	Mekong	UB2
Myanmar	Energy/Power	Construction of 230 kV transmission line between Bhamo, Na Ba, and Ohn Daw	Mekong	UB2
Myanmar	Energy/Power	Construction of 66 kV transmission line between Kalaywa and Maw Lite	Mekong	UB2
Myanmar	Energy/Power	Construction of 230 kV transmission line between Namsam, Mine Pyin, and Kyaing Ton	Mekong	UB2
Myanmar	Energy/Power	Upper Kyaing Taung Hydropower Project (Shan)	Mekong	UB2
Myanmar	Energy/Power	Phyu Chaung Hydropower Project (Bago)	Mekong	UB2
Myanmar	Energy/Power	Mone Chaung Hydropower Project (Magway)	Mekong	UB2
Myanmar	Energy/Power	Mandalay Rural Area Electrification Project	Mekong	UB1
Myanmar	Energy/Power	Urgent Rehabilitation and Upgrade Project (Yangon)	Mekong	UB2
Myanmar	Water/Sanitation	Urgent Expansion of Water Supply System in Mandalay City	Mekong	UB2
Myanmar	Water/Sanitation	Megala Dam Project	Mekong	UB1
Myanmar	Water/Sanitation	Sewage System Improvement Project in Yangon City (C1 + part W1 Area)	Mekong	UB2
Myanmar	Water/Sanitation	Reconstruction of North Yama Irrigation System (Sagaing)	Mekong	UB1
Myanmar	Water/Sanitation	Project of Water Supply for Irrigation (North Yama Dam, Sagaing)	Mekong	UB1
Myanmar	Water/Sanitation	Reconstruction of Nat Taung Dam (Mandalay)	Mekong	UB1
Myanmar	ICT	Expansion of Community ICT Centre activities in Myanmar	Mekong	UB2
Myanmar	Urban development	Low-Cost Housing Project in Yangon	Mekong	UB2
Myanmar	Urban development	Yangon Mapping Project	Mekong	UB3
Myanmar	Urban development	Project for improving Yangon's bus service	Mekong	UB3
Myanmar	Urban development	Project for enhancing the urban development capacity in Yangon (Phase I)	Mekong	UB3
Myanmar	Others	Development of cross-border trade facility	Mekong	UB2
Myanmar	Others	Construction of Agriculture Income Improvement Project (Mandalay)	Mekong	UB1
Myanmar	Others	Construction of Building for Myanmar Japan Technical Development Centre 1 and 2	Mekong	UB2
Philippines	Road/Bridge	Mindoro–Batangas Super Bridge	BIMP+	UB2
Philippines	Road/Bridge	Cavite–Laguna Expressway (CALAX) Project (CALA East–West National Road Project)	BIMP+	UB2

Country	Sector	Project name	Region	UB
Philippines	Road/Bridge	Cebu North Coastal Road (Mandaue–Consolacion–Liloan Bypass Project)	BIMP+	UB2
Philippines	Road/Bridge	Davao City Bypass Construction Project (Phase I and II)	BIMP+	UB1
Philippines	Road/Bridge	Metro Manila C6 Expressway Project	BIMP+	UB2
Philippines	Road/Bridge	Metro Manila Skyway Stage 3	BIMP+	UB2
Philippines	Road/Bridge	North Luzon East Expressway	BIMP+	UB2
Philippines	Road/Bridge	Samal Bridge Project	BIMP+	UB2
Philippines	Road/Bridge	Camarines–Catanduanes Friendship Bridge (Nationwide Island Provinces Link Bridges)	BIMP+	UB2
Philippines	Road/Bridge	Bohol–Leyte Link Bridge (included in Nationwide Island Provinces Link Bridges)	BIMP+	UB2
Philippines	Road/Bridge	Cebu–Bohol Link Bridge (Nationwide Island Link Bridges)	BIMP+	UB2
Philippines	Road/Bridge	Luzon–Samar Link Bridge (Nationwide Island Provinces Link Bridges)	BIMP+	UB2
Philippines	Road/Bridge	Leyte–Surigao Link Bridge (Nationwide Island Link Bridges)	BIMP+	UB2
Philippines	Road/Bridge	Davao City Coastal Road Project including Bucana Bridge	BIMP+	UB1
Philippines	Road/Bridge	Metro Cebu Circumferential Road (Metro Cebu Expressway Project)	BIMP+	UB2
Philippines	Road/Bridge	Southeast Metro Manila Expressway Project	BIMP+	UB2
Philippines	Road/Bridge	Panay–Guimaras Negros Bridge	BIMP+	UB2
Philippines	Road/Bridge	Bataan–Cavite Interlink Bridge	BIMP+	UB2
Philippines	Road/Bridge	Quezon–Bicol Expressway	BIMP+	UB2
Philippines	Road/Bridge	Arterial Road Bypass Project (Phase II)	BIMP+	UB2
Philippines	Road/Bridge	Circumferential Road 3 (C3) Missing Link Project	BIMP+	UB2
Philippines	Road/Bridge	Camarines Sur Expressway Project (San Fernando–Pili Section)	BIMP+	UB2
Philippines	Road/Bridge	Sheridan–J.P. Rizal Bridge	BIMP+	UB1
Philippines	Road/Bridge	Cebu BRT Project	BIMP+	UB3
Philippines	Road/Bridge	Central Luzon Link Expressway (Phase I) (Tarlac–Cabanatuan, Nueva Ecija)	BIMP+	UB2
Philippines	Road/Bridge	Central Luzon Link Expressway (Phase II) and operation and maintenance of Phases I and II	BIMP+	UB2
Philippines	Road/Bridge	Dalton Pass East Alignment Alternative Road Project (East Dalton Bypass Project)	BIMP+	UB1
Philippines	Road/Bridge	Bonifacio Global City to Ortigas Center Road Link Project (Phase I, IIA, and IIB)	BIMP+	UB2
Philippines	Road/Bridge	Iba–Tarlac Road (Capas–Botolan Road) Project	BIMP+	UB2
Philippines	Road/Bridge	Improvement, operation, and maintenance of Kennon Road and Marcos Highway	BIMP+	UB1
Philippines	Road/Bridge	Palanca–Villegas (2nd Ayala) (initially submitted as Ayala Bridge)	BIMP+	UB2

Country	Sector	Project name	Region	UB
Philippines	Road/Bridge	Beata–F.Y. Manalo Bridge (initially submitted as Pandacan–Sta. Ana Bridge)	BIMP+	UB2
Philippines	Road/Bridge	Blumentritt–Antipolo Bridge	BIMP+	UB2
Philippines	Road/Bridge	Marikina–Vista Real Bridge (initially submitted as Kabayani–Katipunani Bridge)	BIMP+	UB2
Philippines	Road/Bridge	J.P. Rizal–Lopez Jaena Bridge (initially submitted as Reposo–Guatemala Bridge)	BIMP+	UB2
Philippines	Road/Bridge	J.P. Rizal–St. Mary Bridge (initially submitted as J.P. Rizal–Yale Bridge)	BIMP+	UB2
Philippines	Road/Bridge	Mercury–Evangelista Bridge (initially submitted as G. Gabriel Mercury Ave. Bridge)	BIMP+	UB2
Philippines	Road/Bridge	East–West Bank Bridge 1	BIMP+	UB2
Philippines	Road/Bridge	East–West Bank Bridge 2	BIMP+	UB2
Philippines	Road/Bridge	North–South Harbor Bridge (initially submitted as Robinson Bridge)	BIMP+	UB2
Philippines	Road/Bridge	Binondo–Intramuros Bridge	BIMP+	UB2
Philippines	Road/Bridge	Estrella–Pantaleon Bridge	BIMP+	UB2
Philippines	Road/Bridge	Metro Manila Interchange Construction Project (Phase VI)	BIMP+	UB2
Philippines	Road/Bridge	Metro Manila Priority Bridges Seismic Improvement Project	BIMP+	UB3
Philippines	Road/Bridge	NAIA Expressway Project (Phase II)	BIMP+	UB2
Philippines	Road/Bridge	NLEX–SLEX Connector Road Project	BIMP+	UB2
Philippines	Road/Bridge	Road Network Development Project in conflict-affected areas of Mindanao	BIMP+	UB2
Philippines	Road/Bridge	Davao City Expressway Project	BIMP+	UB2
Philippines	Road/Bridge	Quezon–Bicol Expressway	BIMP+	UB2
Philippines	Road/Bridge	Aqueduct No.7 (AQ–7)	BIMP+	UB2
Philippines	Road/Bridge	R–7 Expressway	BIMP+	UB2
Philippines	Road/Bridge	Samal Bridge Project	BIMP+	UB2
Philippines	Road/Bridge	Sen. Gil Puyat Ave.–Makati Ave.–Paseo de Roxas Underpass Project	BIMP+	UB1
Philippines	Road/Bridge	South Luzon Expressway Toll Road 4 (Sto. Tomas to Lucena Toll Road)	BIMP+	UB2
Philippines	Road/Bridge	Tagum–Davao–General Santos High Standard Highway	BIMP+	UB2
Philippines	Road/Bridge	Pasacao–Balatan Tourism Coastal Highway	BIMP+	UB2
Philippines	Road/Bridge	Cebu–Negros Link Bridge (Nationwide Island Provinces Link Bridges)	BIMP+	UB2
Philippines	Railway	PNR North 2 (Malolos–Clark International Airport–New Clark City)	BIMP+	UB3
Philippines	Railway	Mindanao Rail Project (Phase 1), Tagum–Davao–Digos Segment	BIMP+	UB3
Philippines	Railway	Mindanao Railway Project (Phase 2)	BIMP+	UB3
Philippines	Railway	LRT Line 1 Cavite extension, operation, and maintenance	BIMP+	UB3

Country	Sector	Project name	Region	UB
Philippines	Railway	Modified LRT 6 Project (Phase I)	BIMP+	UB3
Philippines	Railway	Subic–Clark Railway Project	BIMP+	UB3
Philippines	Railway	Metro Manila Subway Project (Phase I)	BIMP+	UB3
Philippines	Railway	MRT Line 7	BIMP+	UB3
Philippines	Railway	North–South Commuter Railway (formerly Manila–Malolos Commuter Line)	BIMP+	UB2
Philippines	Railway	PNR South Commuter Line (Tutuban–Los Baños)	BIMP+	UB2
Philippines	Railway	PNR South Long-haul (Manila–Bicol)	BIMP+	UB2
Philippines	Railway	Ortigas–Taytay LRT Line 4 Project	BIMP+	UB3
Philippines	Railway	C5 MRT 10 Project	BIMP+	UB3
Philippines	Railway	MRT 11	BIMP+	UB3
Philippines	Railway	Cebu Monorail System	BIMP+	UB3
Philippines	Railway	MRT 4	BIMP+	UB3
Philippines	Railway	LRT Line 2 East Extension (Manila LRT: 2nd line extension)	BIMP+	UB3
Philippines	Railway	LRT Line 2 West Extension Projects	BIMP+	UB3
Philippines	Railway	Metro Manila Central Business District Transit System Project	BIMP+	UB3
Philippines	Railway	MRT 3 Capacity Expansion Project	BIMP+	UB3
Philippines	Railway	Mindanao Railway Project (Phase 3)	BIMP+	UB3
Philippines	Port/Maritime	Cagayan de Oro Port Development Project	BIMP+	UB1
Philippines	Port/Maritime	Rehabilitation/Improvement of the Zamboanga Fish Port Complex	BIMP+	UB1
Philippines	Port/Maritime	Nationwide Fish Ports Project Package III	BIMP+	UB2
Philippines	Port/Maritime	Central Spine Roll-on/Roll-off (RoRo)	BIMP+	UB2
Philippines	Port/Maritime	Davao Sasa Port Modernization Project	BIMP+	UB2
Philippines	Port/Maritime	New Cebu International Container Port	BIMP+	UB2
Philippines	Port/Maritime	General Santos City Port (Makar Wharf Expansion) Project	BIMP+	UB2
Philippines	Port/Maritime	Regional Fish Port Project for Greater Capital Region (Upgrading/Rehabilitation of Navotas Fish Port Complex)	BIMP+	UB1
Philippines	Port/Maritime	Maritime Safety Capability Improvement Project for the Philippine Coast Guard	BIMP+	UB2
Philippines	Airport	Davao International Airport Project	BIMP+	UB2
Philippines	Airport	Iloilo International Airport Project	BIMP+	UB2
Philippines	Airport	NAIA Development Project	BIMP+	UB1
Philippines	Airport	Bulacan International Airport Project (New Manila International Airport)	BIMP+	UB2
Philippines	Airport	Sangley International Airport	BIMP+	UB2
Philippines	Airport	Laguindingan Airport	BIMP+	UB1
Philippines	Airport	Busuanga Airport Development Project	BIMP+	UB2
Philippines	Airport	Clark International Airport Expansion Project	BIMP+	UB1
Philippines	Airport	Bacolod–Silay International Airport Project	BIMP+	UB1

Country	Sector	Project name	Region	UB
Philippines	Airport	Laguindingan International Airport Project	BIMP+	UB1
Philippines	Airport	New Bohol Airport operation and management concession	BIMP+	UB1
Philippines	Airport	Mactan–Cebu International Airport Passenger Terminal Building Project	BIMP+	UB1
Philippines	Airport	Puerto Princesa Airport Development Project	BIMP+	UB1
Philippines	Airport	San Fernando Airport	BIMP+	UB1
Philippines	Other transportation	C-5 Modern Bus Transit System Project	BIMP+	UB3
Philippines	Other transportation	Metro Manila BRT Line 1 (Quezon Ave.)	BIMP+	UB3
Philippines	Other transportation	Metro Manila BRT Line 2 (EDSA/Central)	BIMP+	UB3
Philippines	Other transportation	Road Transport Information Technology Infrastructure Project (Phase II)	BIMP+	UB3
Philippines	Other transportation	Davao Public Transport Modernization Project	BIMP+	UB3
Philippines	Energy/Power	600 MW Mariveles Coal-Fired Power Plant Expansion Project (known as Dinginin Power Station)	BIMP+	UB2
Philippines	Energy/Power	Batangas Liquefied Natural Gas Regasification Terminal Project	BIMP+	UB2
Philippines	Energy/Power	Pagbilao LNG Hub Terminal Project	BIMP+	UB2
Philippines	Energy/Power	AG&P Energy City Project	BIMP+	UB2
Philippines	Energy/Power	Batangas–Manila (BatMan) 1 Natural Gas Pipeline Project	BIMP+	UB2
Philippines	Energy/Power	Pulangi 4 Selective Dredging (Phase 3)	BIMP+	UB1
Philippines	Energy/Power	Chiller Energy Efficiency Project	BIMP+	UB2
Philippines	Energy/Power	Integrated Bataan LNG Terminal, Power Plants, and Bataan–Manila Gas Pipeline Project (BatMan 2)	BIMP+	UB2
Philippines	Energy/Power	Rehabilitation of all Agus–Pulangi Hydroelectric Plant Units	BIMP+	UB2
Philippines	Energy/Power	Bohol Northeast Basin Multipurpose Project	BIMP+	UB2
Philippines	Energy/Power	Rehabilitation, Operation, and Maintenance of the Angat Hydro Electric Power Plant (AHEPP) Auxiliary Turbines 4 and 5	BIMP+	UB2
Philippines	Water/Sanitation	Bulacan Bulk Water Supply Project	BIMP+	UB2
Philippines	Water/Sanitation	Ambal–Simuay River and Rio Grande de Mindanao River Flood Control Projects	BIMP+	UB2
Philippines	Water/Sanitation	Kanan Dam Project	BIMP+	UB2
Philippines	Water/Sanitation	Kabulnan-2 Multipurpose Irrigation and Power Project	BIMP+	UB2
Philippines	Water/Sanitation	Pasig–Marikina River Channel Improvement (Phase IV)	BIMP+	UB2
Philippines	Water/Sanitation	Angat Water Transmission Improvement Project	BIMP+	UB2
Philippines	Water/Sanitation	Design and Construction of Parañaque Water Reclamation Facility 1	BIMP+	UB2
Philippines	Water/Sanitation	Cavite Industrial Area Flood Management Project	BIMP+	UB3
Philippines	Water/Sanitation	Chico River Pump Irrigation Project	BIMP+	UB2

Country	Sector	Project name	Region	UB
Philippines	Water/Sanitation	Malitubog–Maridagao Irrigation Project (Phase II)	BIMP+	UB2
Philippines	Water/Sanitation	New Centennial Water Supply Source (Kaliwa Dam Project)	BIMP+	UB2
Philippines	Water/Sanitation	Ipo Dam No. 3	BIMP+	UB2
Philippines	Water/Sanitation	Ilocos Norte Irrigation Project, Stage 2	BIMP+	UB2
Philippines	Water/Sanitation	Asbang Small Reservoir Irrigation Project	BIMP+	UB2
Philippines	Water/Sanitation	Water Supply and Wastewater Project in Boracay Island	BIMP+	UB2
Philippines	Water/Sanitation	Integrated Disaster Risk Reduction and Climate Change Adaptation Measures in the Low-Lying Areas of Pampanga Bay	BIMP+	UB2
Philippines	ICT	Philippine Identification System	BIMP+	UB3
Philippines	ICT	National Government Data Center	BIMP+	UB3
Philippines	ICT	Luzon Bypass Infrastructure Project	BIMP+	UB3
Philippines	ICT	Automated Fare Collection Clearing House	BIMP+	UB3
Philippines	ICT	Safe Philippines Project (Phase 1)	BIMP+	UB3
Philippines	Urban development	Clark Green City Project (including Government Center, Commercial Center, and Mixed-Income Housing)	BIMP+	UB3
Philippines	Others	Improvement of remaining sections along Pasig River from Delpan Bridge to Napindan Channel	BIMP+	UB1
Thailand	Road/Bridge	Motorway M6: Bang Pa-in–Saraburi–Nakhon Ratchasima	Mekong	UB2
Thailand	Road/Bridge	Motorway: Bang Yai–Ban Pong–Kanchanaburi	Mekong	UB3
Thailand	Road/Bridge	Motorway: Pattaya–Map Ta Phut	Mekong	UB3
Thailand	Road/Bridge	Motorway M8: Nakhon Pathom–Cha Um	Mekong	UB2
Thailand	Road/Bridge	Motorway: Bang Pa-in –Nakhon Sawan	Mekong	UB2
Thailand	Road/Bridge	Road network to support 2nd Moei Bridge	Mekong	UB2
Thailand	Road/Bridge	Road network to support Mukdahan border, Highway No. 12 (Kalasin–Baan Nakrai), sections 1 and 2	Mekong	UB2
Thailand	Road/Bridge	Road network to support Khlong Yai border, Highway No. 3 (Trat–Hat Lek), section 1	Mekong	UB2
Thailand	Road/Bridge	Highway improvement: Highway No. 4 (Krabi–Huai Yot), No. 12 (Kalasin–Somdet), No. 314 (Bang Pakong–Chachoengsao), and No. 3138 (Ban Bueng–Ban Khai)	IMT+	UB2
Thailand	Road/Bridge	Project to develop highway along East–West Economic Corridor (EWEC)	Mekong	UB2
Thailand	Road/Bridge	Inter-City Motorway: Hat Yai–Thai–Malaysia border	IMT+	UB2
Thailand	Road/Bridge	Highway improvement: Lom Sak–Phetchabun	Mekong	UB2
Thailand	Road/Bridge	Four-lane road construction and border checkpoint at Aranyaprathet–Poipet	Mekong	UB2
Thailand	Road/Bridge	Si Rat–Bangkok Outer Ring Road Expressway Project	Mekong	UB3
Thailand	Road/Bridge	Third-Stage Expressway System, North Sections	Mekong	UB3
Thailand	Road/Bridge	Rama III–Western Outer Ring Road Expressway Project	Mekong	UB3
Thailand	Road/Bridge	Kathu–Patong Expressway Project, Phuket Province	IMT+	UB2
Thailand	Road/Bridge	Burapha Withi–Pattaya Expressway Project	Mekong	UB3

Country	Sector	Project name	Region	UB
Thailand	Road/Bridge	Udon Rattaya–Ayutthaya Expressway Project	Mekong	UB3
Thailand	Road/Bridge	Chalongrat–Nakhon Nayok–Saraburi Expressway Project	Mekong	UB3
Thailand	Road/Bridge	Hat Yai–Sadao Intercity Motorway Project	IMT+	UB2
Thailand	Road/Bridge	Don Muang Tollway: Rangsit–Bang Pa-in	Mekong	UB3
Thailand	Road/Bridge	Motorway: Mahachai–Ban Paew	Mekong	UB3
Thailand	Road/Bridge	Motorway: Srinakarin–Suwannaphum Airport	Mekong	UB3
Thailand	Road/Bridge	Coastal Road Project (or Thailand Riviera)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Extension Blue line (Hualumpong–Bangkae and Bang Sue–Tha Phra)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Extension Blue line (Bang Khae–Phutthamonthon Sai 4)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Green Line (Morchit–Saphan Mai–Kukot)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Green Line (Kukot–Kam Luk Ka)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Green Line (Bearing–Samut Prakan)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Green Line (Samut Prakan–Bang Pu)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Orange Line (Taling Chan–Cultural Center)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Orange Line (Cultural Center–Min Buri)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Purple Line (Bang Yai–Bang Sue)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Purple Line (Taopoon–Rat Burana)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Pink Line (Khae Rai–Min Buri)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Yellow Line (Lat Phrao–Samrong)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Red Line (Bang Sue–Rangsit)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Red Line (Rangsit–Thammasat)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Light Red Line (Bang Sue–Taling Chan)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Light Red Line (Bang Sue–Hua Mak) and Dark Red Line (Bang Sue–Hualampong)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Light Red Line (Taling Chan–Salaya)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Light Red Line (Taling Chan–Sirirat)	Mekong	UB3
Thailand	Railway	Bangkok MRT: Dark Red line (Hualampong–Mahachai)	Mekong	UB3
Thailand	Railway	High-speed train rail project linked to 3 airports (Don Mueang International Airport, Suvarnabhumi Airport, and U-Tapao Airport)	Mekong	UB3
Thailand	Railway	Railway: Den Chai–Chiang Rai–Chiang Khong	Mekong	UB2
Thailand	Railway	Double-track railway: Jira, Nakhon Ratchasima–Khon Kaen	Mekong	UB2
Thailand	Railway	Double-track railway: Prachuap Khiri Khan–Chumporn	IMT+	UB2
Thailand	Railway	Double-track railway: Nakhon Pathom–Hua Hin	Mekong	UB2
Thailand	Railway	Double-track railway: Lopburi–Paknampho	Mekong	UB2
Thailand	Railway	Double-track railway: Mabkabao–Jira junction, Nakhon Ratchasima	Mekong	UB2
Thailand	Railway	Double-track railway: Hua Hin–Prachuap Khiri Khan	Mekong	UB2

Country	Sector	Project name	Region	UB
Thailand	Railway	Double-track railway: Chachoengsao–Klong Sibkao–Kaeng Khoi	Mekong	UB2
Thailand	Railway	Railway: Baan Pai–Nakhon Phanom	Mekong	UB2
Thailand	Railway	High-speed railway: Bangkok–Pattaya–Rayong	Mekong	UB3
Thailand	Railway	Double-track railway: Surat Thani–Phang Nga (Thanoon)	IMT+	UB2
Thailand	Railway	Railway: Nong Khai–Kaeng Khoi–Map Ta Phut–Bangkok	Mekong	UB3
Thailand	Railway	Double-track railway: Ban Phu Nam Ron–Kanchanaburi–Bangkok–Chachoengsao–Laem Chabang and Bangkok–Chachoengsao–Aranyaprathet	Mekong	UB3
Thailand	Railway	High-speed train project: Bangkok–Chiang Mai	Mekong	UB3
Thailand	Railway	High-speed train: Bangkok–Hua Hin	Mekong	UB3
Thailand	Railway	High-speed railway: Chiang Khong–Den Chai–Ban Pachi	Mekong	UB2
Thailand	Railway	Double-track railway: Songkla–Satun	IMT+	UB2
Thailand	Railway	Light railway: Phuket Airport–Chalong Intersection	IMT+	UB2
Thailand	Railway	Brown Line (monorail): Khae Rai–Lam Sali (Bueng Kum)	Mekong	UB3
Thailand	Railway	Bangkok–Nong Khai Double-Track High-Speed Railway	Mekong	UB3
Thailand	Railway	Purchase of 50 diesel locomotives	Mekong	UB3
Thailand	Railway	Lease of 50 locomotives	Mekong	UB3
Thailand	Railway	Double-track railway: Ban Pai–Mukdahan–Nakhon Phanom	Mekong	UB3
Thailand	Railway	Thailand–China train: 6–7 contracts	Mekong	UB3
Thailand	Railway	Railway: Chumporn–Ranong	IMT+	UB3
Thailand	Port/Maritime	Pak Bara Deep Sea Port Construction	IMT+	UB2
Thailand	Port/Maritime	Songkla Deep Sea Port 2 Construction	IMT+	UB2
Thailand	Port/Maritime	Deep Sea Port Construction in Chumporn	IMT+	UB2
Thailand	Port/Maritime	Construction of water freight transport station in Ang Thong	Mekong	UB2
Thailand	Port/Maritime	Freight optimisation project in Pa Sak River	Mekong	UB2
Thailand	Port/Maritime	Construction of lift dam for navigation in Chao Phraya River and Nan River	Mekong	UB2
Thailand	Port/Maritime	Samut Sakhon Port Construction	Mekong	UB2
Thailand	Port/Maritime	Multipurpose port in Khlong Yai, Trat	Mekong	UB2
Thailand	Port/Maritime	Transportation capacity improvement in Saen Saep Canal and Chao Phraya River	Mekong	UB2
Thailand	Port/Maritime	Coastal Terminal Development Project of Bangkok Port	Mekong	UB3
Thailand	Port/Maritime	Coastal Terminal Development Project (A) of Laem Chabang Port	Mekong	UB3
Thailand	Port/Maritime	Single Rail Transfer Operator at Laem Chabang Port (Phase 1)	Mekong	UB3
Thailand	Port/Maritime	Laem Chabang Port (Phase 3)	Mekong	UB3
Thailand	Port/Maritime	Map Ta Phut Port Project (Phase 3)	Mekong	UB3
Thailand	Airport	Project to develop U-Tapao Airport into a commercial airport	Mekong	UB3

Country	Sector	Project name	Region	UB
Thailand	Airport	Suvarnabhumi Airport (Phase 2)	Mekong	UB3
Thailand	Airport	Don Mueang Airport Terminal 2 renovation	Mekong	UB3
Thailand	Airport	Phuket Airport expansion	IMT+	UB2
Thailand	Airport	Chiang Mai Airport expansion	Mekong	UB2
Thailand	Airport	Mae Sot Airport expansion	Mekong	UB2
Thailand	Airport	U-Tapao Airport and Eastern Airport City PPP Project	Mekong	UB2
Thailand	Airport	U-Tapao Maintenance Repair and Overhaul (TG MRO Phase 1)	Mekong	UB2
Thailand	Energy/Power	Krabi coal power plant	IMT+	UB2
Thailand	Energy/Power	New power plant to replace Mae Moh Power Plant Unit 4-7	Mekong	UB2
Thailand	Energy/Power	Coal power plant in Tepa, Songkla	IMT+	UB2
Thailand	Energy/Power	Construction of underwater cable and distribution system to Koh Kood Island and Koh Mak Island in Trat Province	Mekong	UB1
Thailand	Energy/Power	Construction of underwater cable to Tao Island in Surat Thani Province	IMT+	UB1
Thailand	Energy/Power	Development of electricity generated system by renewable energy in Kut Island and Mak Island in Trat Province	Mekong	UB1
Thailand	Energy/Power	Development project of transmission line and distribution system (Phase 1)	Mekong	UB2
Thailand	Energy/Power	Development project of micro-grid in Mae Sariang, Mae Hong Son Province	Mekong	UB1
Thailand	Energy/Power	Transmission line and distribution system development (Phase 1)	Mekong	UB3
Thailand	Energy/Power	Power plant construction from waste of the Nonthaburi Provincial Administration Organization	Mekong	UB3
Thailand	Energy/Power	Power plant construction using waste of Nakhon Ratchasima Municipality	Mekong	UB2
Thailand	Energy/Power	Natural Gas Pipeline Network (Phase 1)	Mekong	UB2
Thailand	Energy/Power	4th Natural Gas Transmission Pipeline (Rayong–Kaeng Khoi)	Mekong	UB2
Thailand	Energy/Power	Nakhon Sawan On-shore Natural Gas Pipeline (Phase 1 and 2)	Mekong	UB2
Thailand	Energy/Power	Nakhon Ratchasima Waste Energy	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Southern Region Cargo Distribution Center at Thung Song	IMT+	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Mae Sot, Tak	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Mukdahan	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Aranyaprathet, Sa Kaeo	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Had Lek, Trat	Mekong	UB2

Country	Sector	Project name	Region	UB
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Sadao, Songkla	IMT+	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Nong Khai	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Chiang Rai (Phase 2)	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Kanchanaburi (Phase 2)	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Nakhon Phanom (Phase 2)	Mekong	UB2
Thailand	Industrial Estate/ SEZ	Establishment of SEZ in Narathiwat (Phase 2)	IMT+	UB2
Thailand	Water/Sanitation	Wastewater treatment plant projects in Min Buri, Thonburi, Bueng Nong Bon, and Klong Toey	Mekong	UB3
Thailand	Water/Sanitation	Water diversion from Yuam River to the Bhumibol Dam in Tak	Mekong	UB2
Thailand	Water/Sanitation	Water diversion from Mekong River to Khong, Loey, Chi, Moon Rivers	Mekong	UB2
Thailand	Water/Sanitation	Toxic Industrial Waste Disposal Management Master Plan, 2015–2019	Mekong	UB2
Thailand	Water/Sanitation	Establishment of industrial waste disposal sites	Mekong	UB2
Thailand	ICT	International submarine cable system	Mekong	UB2
Thailand	ICT	2 million ports broadband project for 2015–2019	Mekong	UB2
Thailand	Urban development	Smart city pilot project of Saensuk Municipality in Chon Buri's Muang District	Mekong	UB3
Thailand	Urban development	Amata Science City in Chon Buri's Nakhon District	Mekong	UB3
Thailand	Others	Development of Thailand Earth Observation System	Mekong	UB2
Thailand	Others	Development of Global Navigation Satellite System continuously operating reference stations and creation of new service by Quasi-Zenith Satellite System	Mekong	UB3
Viet Nam	Road/Bridge	Cao Bo–Mai Son Highway	Mekong	UB2
Viet Nam	Road/Bridge	Mai Son–NH 45 Highway	Mekong	UB2
Viet Nam	Road/Bridge	NH 45–Nghi Son Highway	Mekong	UB2
Viet Nam	Road/Bridge	Nghi Son–Dien Chau Highway	Mekong	UB2
Viet Nam	Road/Bridge	Dien Chau–Bai Vot Highway	Mekong	UB2
Viet Nam	Road/Bridge	Cam Lo–La Son Highway	Mekong	UB2
Viet Nam	Road/Bridge	Nha Trang–Cam Lam Highway	Mekong	UB2
Viet Nam	Road/Bridge	Cam Lam–Vinh Hao Highway	Mekong	UB2
Viet Nam	Road/Bridge	Vinh Hao–Phan Thiet Highway	Mekong	UB2
Viet Nam	Road/Bridge	Phan Thiet–Dau Giay Highway	Mekong	UB2
Viet Nam	Road/Bridge	Dau Giay–Lien Khuong Highway	Mekong	UB2
Viet Nam	Road/Bridge	Trung Luong–My Thuan Highway	Mekong	UB2
Viet Nam	Road/Bridge	My Thuan–Can Tho Highway	Mekong	UB2

Country	Sector	Project name	Region	UB
Viet Nam	Road/Bridge	Can Tho–Chau Doc–Soc Trang Highway	Mekong	UB2
Viet Nam	Road/Bridge	Ha Tien–Rach Gia–Bac Lieu Highway	Mekong	UB2
Viet Nam	Road/Bridge	Ho Chi Minh–Moc Bai Highway	Mekong	UB2
Viet Nam	Road/Bridge	Bien Hoa–Vung Tau Highway	Mekong	UB2
Viet Nam	Road/Bridge	My Thuan 2 Bridge	Mekong	UB2
Viet Nam	Road/Bridge	Van Don–Mong Cai Highway	Mekong	UB2
Viet Nam	Road/Bridge	Coastal road in Thai Binh Province	Mekong	UB1
Viet Nam	Road/Bridge	Coastal road in Hoang Hoa–Sam Son and Quang Xuong–Tinh Gia sections	Mekong	UB1
Viet Nam	Road/Bridge	Nghi Son–Cua Lo coastal road	Mekong	UB1
Viet Nam	Road/Bridge	Tra Khuc–Sa Huynh coastal road	Mekong	UB1
Viet Nam	Road/Bridge	Cat Tien–De Gi coastal road	Mekong	UB1
Viet Nam	Road/Bridge	Southern Coastal Corridor Project Phase 2	Mekong	UB1
Viet Nam	Road/Bridge	Hanoi Ring Road No. 4 (including Hong Ha Bridge and Duong Bridge)	Mekong	UB2
Viet Nam	Road/Bridge	Hanoi Ring Road No. 5	Mekong	UB2
Viet Nam	Road/Bridge	Ho Chi Minh City Ring Road No. 3	Mekong	UB2
Viet Nam	Road/Bridge	Ho Chi Minh City Ring Road No. 4	Mekong	UB2
Viet Nam	Road/Bridge	Highway from Thanh Thuy International Border Gate, Vi Xuyen District, Ha Giang Province to Noi Bai–Lao Cai Highway	Mekong	UB2
Viet Nam	Road/Bridge	Dong Dang (Lang Son)–Tra Linh (Cao Bang) Highway	Mekong	UB2
Viet Nam	Road/Bridge	Highway from Tuyen Quang (connecting with Noi Bai–Lao Cai Highway)	Mekong	UB2
Viet Nam	Railway	North–South High-Speed railway	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway: Route No. 1 (Ngoc Hoi–Yen Vien, Nhu Quynh)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 2 (Noi Bai–Downtown–Thuong Dinh)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 3 (Nhon–Hanoi Railway Station–Hoang Mai)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 4 (Dong Anh–Sai Dong–Vinh Tuy/Hoang Mai–Thanh Xuan–Tu Liem–Thuong Cat–Me Linh)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 5 (South of Westlake–Ngoc Khanh–Lang Hoa Lac)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 6 (Noi Bai– Ngoc Hoi)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 7 (Ha Dong–Me Linh–Duong Noi)	Mekong	UB3
Viet Nam	Railway	Hanoi Urban Railway Route No. 8 (My Dinh–Son Dong; Mai Yi Duong Xa)	Mekong	UB3
Viet Nam	Railway	Project to consolidate weak tunnels, open new stations, and improve the architecture in Vinh–Nha Trang section	Mekong	UB2

Country	Sector	Project name	Region	UB
Viet Nam	Railway	Project to renovate and upgrade essential works in Nha Trang–Saigon section	Mekong	UB2
Viet Nam	Railway	Lao Cai–Hanoi–Hai Phong Railway	Mekong	UB2
Viet Nam	Railway	Bien Hoa–Vung Tau Railway	Mekong	UB2
Viet Nam	Railway	Ho Chi Minh City–Can Tho Railway	Mekong	UB2
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 1 (Ben Thanh–Suoi Tien)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 2 (Ben Thanh–Tham Luong)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 3a (Ben Thanh Market–Tan Kien)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 3b (Cong Hoa Roundabout–Nguyen Thi Minh Khai–Xo Viet Nghe Tinh–Highway No. 13–Hiep Binh Phuoc)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 4 (Nguyen Van Linh Street–Ben Cat)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 5 (Saigon Bridge–Can Giuoc Coach Station)	Mekong	UB3
Viet Nam	Railway	Ho Chi Minh City Urban Railway No. 6 (Ba Queo–Au Co–Luy Ban Bich–Tan Hoa Dong–Phu Lam Roundabout)	Mekong	UB3
Viet Nam	Railway	Loc Ninh–Ho Chi Minh City Railway	Mekong	UB2
Viet Nam	Port/Maritime	Tran De Seaport	Mekong	UB2
Viet Nam	Port/Maritime	Cai Mep Ha Logistics Center and Cai Mep Ha Terminal	Mekong	UB2
Viet Nam	Port/Maritime	Long Phu Thermal Power Centre Port	Mekong	UB2
Viet Nam	Port/Maritime	My Thuy Port Area	Mekong	UB2
Viet Nam	Port/Maritime	Expansion of Chu Lai Port	Mekong	UB2
Viet Nam	Port/Maritime	Gemalink Port	Mekong	UB2
Viet Nam	Port/Maritime	Nam Dinh Vu Port Cluster Phase 2	Mekong	UB2
Viet Nam	Port/Maritime	Lien Chieu Port	Mekong	UB2
Viet Nam	Port/Maritime	Hoa Phat Dung Quat General Container Port	Mekong	UB2
Viet Nam	Airport	Long Thanh International Airport	Mekong	UB2
Viet Nam	Airport	Construction of passenger terminal T2, aircraft parking yard, and cargo terminal construction in Cat Bi Airport	Mekong	UB2
Viet Nam	Airport	Construction of passenger terminal T2 in Vinh International Airport	Mekong	UB2
Viet Nam	Airport	Building of passenger terminal T2 in Phu Bai International Airport	Mekong	UB2
Viet Nam	Airport	Sa Pa Airport	Mekong	UB1
Viet Nam	Airport	Construction of passenger terminal T3 in Tan Son Nhat International Airport	Mekong	UB3
Viet Nam	Airport	Dien Bien Phu Airport Expansion	Mekong	UB1
Viet Nam	Airport	Chu Lai International Airport Upgrade	Mekong	UB2
Viet Nam	Energy/Power	LNG gas power project in Binh Thuan Province	Mekong	UB2

Country	Sector	Project name	Region	UB
Viet Nam	Energy/Power	Hai Duong Thermal Power Project	Mekong	UB2
Viet Nam	Energy/Power	Quang Trach 1 Thermal Power Plant	Mekong	UB2
Viet Nam	Energy/Power	O Mon III Combined Cycle Power Plant	Mekong	UB2
Viet Nam	Energy/Power	Long Phu Power Plant I, No. 1 and No. 2	Mekong	UB2
Viet Nam	Energy/Power	Expansion of Hoa Binh Hydropower Project	Mekong	UB2
Viet Nam	Energy/Power	Expansion of Tri An Hydroelectric Plant	Mekong	UB2
Viet Nam	Energy/Power	Thang Long Wind Power Project	Mekong	UB2
Viet Nam	Energy/Power	Ba Tri Wind Power Plant No. 7	Mekong	UB2
Viet Nam	Energy/Power	Solar Power Plant in Thien Nghiep Commune	Mekong	UB2
Viet Nam	Water/Sanitation	Ho Chi Minh City Flood Protection Project	Mekong	UB3
Viet Nam	Water/Sanitation	Song Hong Water Supply Plant	Mekong	UB2
Viet Nam	Water/Sanitation	Hoa Lien Water Supply Plant in Da Nang	Mekong	UB2
Viet Nam	Water/Sanitation	Yen Xa Wastewater Treatment Plant in Hanoi	Mekong	UB3
Viet Nam	Water/Sanitation	Nieu Loc Thi Nghe Wastewater Treatment Plant in Ho Chi Minh City	Mekong	UB3
Viet Nam	Water/Sanitation	Drainage Treatment Plan in Da Nang city	Mekong	UB3
Viet Nam	Industrial Estate/ SEZ	Nam Pleiku Industrial Park Infrastructure Construction and Business Investment Project	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Investing and trading in infrastructure of industrial park in Thu Thua Town	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Dong Van III Supporting Industrial Park Infrastructure Construction and Business Project	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Thang Long II Industrial Park	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Investment project – constructing and trading industrial park infrastructure in Hemaraj Urban Area of Southeast Economic Zone	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Investment project – commercial operation of infrastructure in Dong Binh Industrial Park	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Soc Son Clean Industrial Park Project	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Ly Thuong Kiet Industrial Zone and Service Urban Development Project	Mekong	UB2
Viet Nam	Industrial Estate/ SEZ	Industrial Park Project specialised in serving Northern Delta agriculture	Mekong	UB3
Viet Nam	Urban development	Smart urban area in Dong Anh, Hanoi	Mekong	UB3
Viet Nam	Urban development	Smart city development of Da Nang	Mekong	UB3
Viet Nam	Urban development	Smart city plan of Binh Duong	Mekong	UB3
Viet Nam	Urban development	Smart City Park: Vinhomes Grand Park, Ho Chi Minh City	Mekong	UB3

Country	Sector	Project name	Region	UB
Viet Nam	Urban development	VinCity Ocean Park, Hanoi	Mekong	UB3
Viet Nam	Urban development	Dai Kim New Urban Area, Hanoi	Mekong	UB3
Viet Nam	Urban development	Ecopark Hung Yen Project	Mekong	UB3
Viet Nam	Urban development	Thu Thiem Eco Smart City	Mekong	UB3
Viet Nam	Urban development	Ha Long Xanh Urban Complex Project	Mekong	UB3
Viet Nam	Urban development	Project of industrial urban area and deepwater port in Hon Net-Con Ong, Van Don	Mekong	UB2
Viet Nam	Urban development	FLC Ngoc Vung Beach and Golf Resort Project	Mekong	UB3
Viet Nam	Others	Bach Mai 2 Hospital	Mekong	UB3
Viet Nam	Others	Viet Duc 2 Hospital	Mekong	UB3
Viet Nam	Others	Cho Ray 2 Hospital	Mekong	UB3
Viet Nam	Others	Relocation of National University of Hanoi to Lang Hoa Lac	Mekong	UB3
Viet Nam	Others	Project of disaster and climate change countermeasures using earth observation satellite	Mekong	UB3
Viet Nam	Others	Can Tho Oncology Hospital	Mekong	UB3
Viet Nam	Others	Hai Phong General Hospital (Phase I)	Mekong	UB3
Viet Nam	Others	University of Science and Technology of Hanoi	Mekong	UB3
Lao PDR, Thailand	Road/Bridge	Fifth Thai–Lao Friendship Bridge: Bueng Kan and Pakxan	Mekong	UB1
Lao PDR, Thailand	Road/Bridge	Sixth Thai–Lao Friendship Bridge: Ubon Ratchathani and Saravan	Mekong	UB1
Lao PDR, Thailand	Road/Bridge	Lao PDR–Thai Mekong Friendship Bridge (Sanakham–Loei Province)	Mekong	UB2
Lao PDR, Thailand	Road/Bridge	Lao PDR–Thai Mekong Bridge for high-speed train (Vientiane–Nong Khai)	Mekong	UB2
Lao PDR, Thailand	Energy/Power	Nabong 500 kV Substation Transmission Facility	Mekong	UB2
Cambodia, Lao PDR, Thailand	Energy/Power	South Power Transmission Interconnection: - Ban Na (Seno)–Nathone (Saravan) (230 kV 189 km) (TBD) - Nathone (Saravan)–Xekong (230 kV 58 km) (TBD) - Muang Mai (Attapu)–Xekong (2 30 kV 69 km) (TBD) - Lak 25–Muang Mai (Attapu) (230 kV 121 km) (TBD) - Lak 25–Veun Kham (Cambodia border) (230 kV 125 km) (TBD) - Lak 25–Ban Vangtao (Thailand border) (500 kV 72 km) (TBD)	Mekong	UB2
China, Lao PDR, Thailand	Energy/Power	North Power Transmission Interconnection: Boun Tai–Na Mo 2–Pakmong–Luang Prabang 2 (230 kV); China–Na mo 2–M. Houn–Thailand; M. Houn–M. Nan–Napia	Mekong	UB2

Country	Sector	Project name	Region	UB
India, Myanmar, Thailand	Road/Bridge	Trilateral Highway	Mekong	UB2
Myanmar, Thailand	Energy/Power	Myanmar–Thailand power transmission	Mekong	UB2
China, Lao PDR, Thailand	Energy/Power	China–Lao PDR–Thailand 600 HVDC Interconnection	Mekong	UB2
Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam	ICT	ASEAN Smart Network Projects	Mekong	UB3
Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam	Others	Cooperation in Cybersecurity	Mekong	UB3
ASEAN	ICT	ASEAN Digital Hub	ASEAN	UB3

ASEAN = Association of Southeast Asian Nations; ASR = Airport Surveillance Radar; ATC = air traffic control; Ave. = Avenue; BIMP+ = Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area and surrounding regions; BRT = bus rapid transit; CALA = Cavite–Laguna; DKI = Daerah Khusus Ibukota (capital special region); EDSA = Epifanio de los Santos Ave.; HVDC = high-voltage direct current; ICT = information and communication technology; IMT+ = Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions; KLIA = Kuala Lumpur International Airport; km = kilometre; kV = kilovolt; LNG = liquefied natural gas; LRT = light rail transit; MRT = mass rapid transit; MW = megawatt; NAIA = Ninoy Aquino International Airport; NH = National Highway; NLEX = The North Luzon Expressway; NYIA = New Yogyakarta International Airport; PNB = Permodalan Nasional Berhad; PNR = Philippine National Railways; PPP = public–private partnership; PSR = Primary Surveillance Radar; SEZ = special economic zone; SKRL = Singapore Kunming Rail Link; SLEX = South Luzon Expressway; SSR = Secondary Surveillance Radar; TG MRO = maintenance, repair, and overhaul facilities for Thai Airways International; UB = unbundling.

Source: Authors.

Chapter 7

Geographical Simulation Analysis

Satoru Kumagai
Director, IDE-JETRO, Economic Geographical Studies Group, Development Studies Centre

Ikumo Isono
Senior Economist, ERIA

Introduction

The Economic Research Institute for ASEAN and East Asia (ERIA), in collaboration with the Institute of Developing Economies of the Japan External Trade Organization (IDE-JETRO), has conducted an economic impact analysis of infrastructure improvements and institutional reforms in the Association of Southeast Asian Nations (ASEAN) and neighbouring countries for the Comprehensive Asian Development Plan (CADP) (ERIA, 2010) and CADP 2.0 (ERIA, 2015). This chapter uses the latest IDE/ERIA-Geographical Simulation Model (IDE/ERIA-GSM) to provide economic impact analyses on infrastructure improvements and institutional reforms for the CADP 3.0.

The two major changes in the situation in ASEAN and East Asia are as follows. The first is the relative decline in importance of new physical interregional transportation infrastructure projects. In 2010 and 2015, a number of toll roads and other important infrastructure projects connecting major cities needed to be developed as soon as possible. As a result of the progress made in the construction of these motorways with regard to densely populated areas, infrastructure projects connecting cities have become less of a priority. At the same time, unlike when the CADP and CADP 2.0 were being developed, the number of remaining intercity toll road infrastructure projects with a significant impact on a country's economy is decreasing. The policy interest in transportation infrastructure projects has been shifting to urban transportation, rural infrastructure, and the expansion of existing infrastructure. In addition, many infrastructure projects that are not economically feasible remain in place, and some of them have been designated regional priority projects. New projects such as high-speed rail have been proposed, but progress has been slow due to the huge construction costs. A rapid expansion of the high-speed rail network, as seen in China, has not occurred in ASEAN or in other countries.

ASEAN Member States (AMS) are at varying levels of development, with some countries still urgently needing to improve their core transport infrastructure to link cities and towns. On the other hand, countries that are nearing completion of their core transport infrastructure need to tackle more difficult challenges to reap additional economic benefits, such as the effective deployment of information and communication technology (ICT) infrastructure and the introduction of new technologies to save energy.

The second is the coronavirus disease (COVID-19). How COVID-19 will change the shape of economic activity is not yet certain at the time of writing, but some trends can already be observed. There will be a decline in cross-country tourism and business travel opportunities, with some business travel being replaced by ICT-enabled teleconferences. As the airline industry has fallen on hard times, airfares have become more expensive, and the shift from relatively expensive air freight transport to cheaper land transport may become a long-term trend in the future.

This chapter is based on awareness of these issues. We build scenarios and run simulations. The scenarios include infrastructure in the CADP 3.0; the deployment of ICTs, especially 5G-enabled services; and progress in energy conservation. An overview of the IDE/ERIA-GSM and the differences between the latest IDE/ERIA-GSM and the versions used in the CADP/CADP 2.0 are presented in section 2. The scenarios and results are discussed in section 3. Conclusions are given in section 4.

What Is the 2020 Version of the IDE/ERIA-GSM?

The IDE/ERIA-GSM has been developed and extended since 2007 as a joint research project between ERIA and IDE-JETRO. The IDE/ERIA-GSM is an applied general equilibrium model based on spatial economics, which is similar to Puga and Venables (1996). The most significant feature is that the model is not based on country-level data, but on province- or district-level data. This allows us to calculate the economic impacts at the province or district level. The model also includes a logistics network of roads, railways, seaways, and airways.

The model can calculate not only the economic impact on the region or country where the transport infrastructure to be developed is located, but also the impact on the surrounding regions or countries. For example, if a road is developed to connect two cities, not only the people and companies in those two cities and in the cities and towns along the way, but also the people and companies in cities located beyond an end point city will benefit from occasional use of the road. This indirect impact is not confined to the country but extends to neighbouring countries and entire regions. Therefore, it is suitable for the analysis of international transportation infrastructure projects. The model also makes it possible to analyse the economic impacts of free trade agreements (FTAs), which are examined using country-level data. This means that the economic impact analysis of FTAs and province-to-province road projects can be calculated with the same tool, i.e. the IDE/ERIA-GSM. It is also possible to conduct an economic impact analysis of those combinations. The model includes agriculture; mining; five manufacturing industries (automotive, electronics and electrical appliances, textile and garments, food processing, and other manufacturing); and service industries. For more details on the model, see Kumagai et al. (2013).

How is the IDE/ERIA-GSM for the CADP 3.0 characterised? Table 7.1 shows a comparison of the 2010 and 2015 versions. In ERIA (2010), the economic impact of CADP infrastructure projects was presented as a cumulative effect for 2011–2020. In the 2010 version, the regional scope was the 10 AMS,[1] Bangladesh, and parts of China and India. In ERIA (2015), the economic impact of CADP 2.0 infrastructure projects, special economic zones (SEZs), and institutional reforms was presented in terms of the cumulative effect over 2021–2030.

[1] The 10 AMS are Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam.

The regional coverage includes the 10 AMS, all of China and India, Japan, the Republic of Korea, Bangladesh, Sri Lanka, Bhutan, and Nepal. In addition, 65 countries outside Asia are incorporated using country-specific data to represent the 'rest of the world'.

In 2010, time and costs for the trade across borders – for customs clearance, quarantine, tariffs, and non-tariff barriers, etc. – were all shown in a single integrated parameter. The analysis in 2010 showed that reducing this broadly defined border barrier could bring the greatest economic benefits to Myanmar. The 2015 version, as well as the current version, separated the costs at the border, transaction time at the border, tariffs, and non-tariff barriers in the data and analyses. This permits economic impact analysis of policy interventions on each item. In addition, the IDE/ERIA-GSM deals with productivity parameters. This is used to look at the impact analysis of SEZs and disasters on the economy.

Table 7.1 Comparison of the IDE/ERIA-GSM in the CADP (2010), CADP 2.0 (2015), and CADP 3.0

Item	CADP	CADP 2.0	CADP 3.0
	2010	2015	2021
Number of economies in East and South Asia	15	21	23
Number of regions	956	1,818	3,262
Number of nodes	1,676	5,833	11,076
Number of routes	2,691	10,906	20,067
Rest of the world (province-level data)	-	-	83 economies
Rest of the world (country-level data)	-	65 economies	63 economies
Number of transport modes	Road, sea, and air	Road, sea, air, and rail	Road, sea, air, rail, and HSR
Number of industries	7	7	8
Intermediate goods	Yes	Yes	Yes
Non-tariff barriers	No	Yes	Yes
Tariff data	No	Yes	Yes
SEZ/disaster analysis	No	Yes	Yes

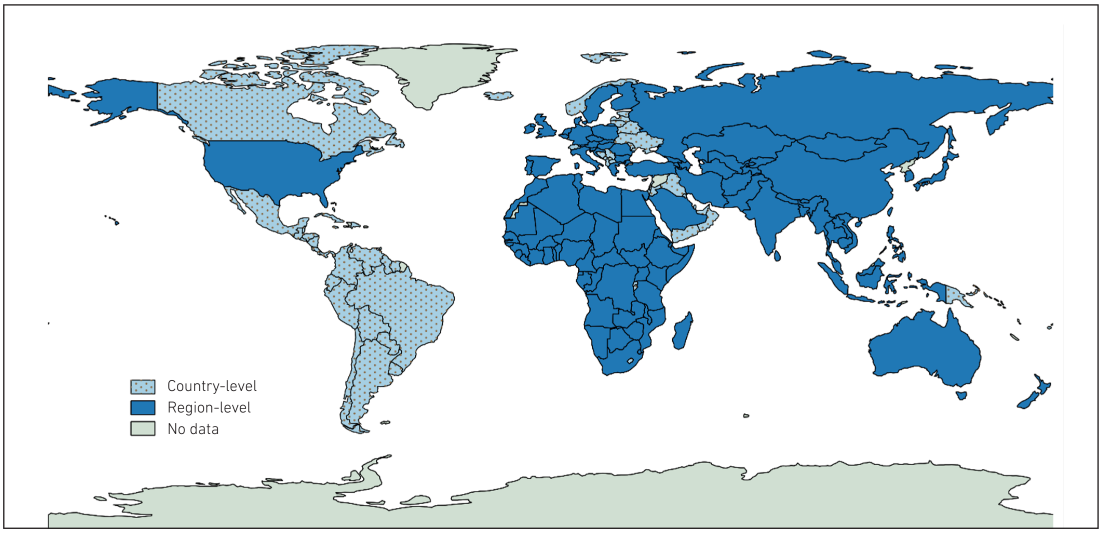
CADP = Comprehensive Asian Development Plan, ERIA = Economic Research Institute for ASEAN and East Asia, GSM = Geographical Simulation Model, HSR = high-speed rail, IDE = Institute of Developing Economies, SEZ = special economic zone.

Source: Authors.

The most important feature of the 2020 version is the extension of the geographic scope. In fact, the model has data at the subnational level for many countries and economies (Figure 7.1). Mining is also added to the industry category. The gross regional domestic product (GRDP) in 2010 for agriculture, mining, five manufacturing sectors, and the services sector is calculated mainly based on official statistics. In many cases, the GRDP is subdivided using data from industrial statistics and censuses.

In this study, following Keola and Kumagai (2016), we used night-time satellite imagery and land use data to construct a geo-economic data set for countries that do not have national level economic data. The number of mines by mineral resources and mineral export data for each country are used to further refine the interpolation method of GRDP for the mining sector.

Figure 7.1 Data Coverage in the IDE/ERIA-GSM
(as of 30 June 2020)



ERIA = Economic Research Institute for ASEAN and East Asia, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: Authors.

High-speed rail is a new mode of transport in the model. High-speed rail handles passengers only and will mainly contribute to the development of the services sector by stimulating the movement of people. The development of high-speed rail will help the labour and industry structure shift from agriculture and manufacturing to the services sector. In addition, countries will be divided into areas where the concentration of service industries is accelerating and areas where it is not.

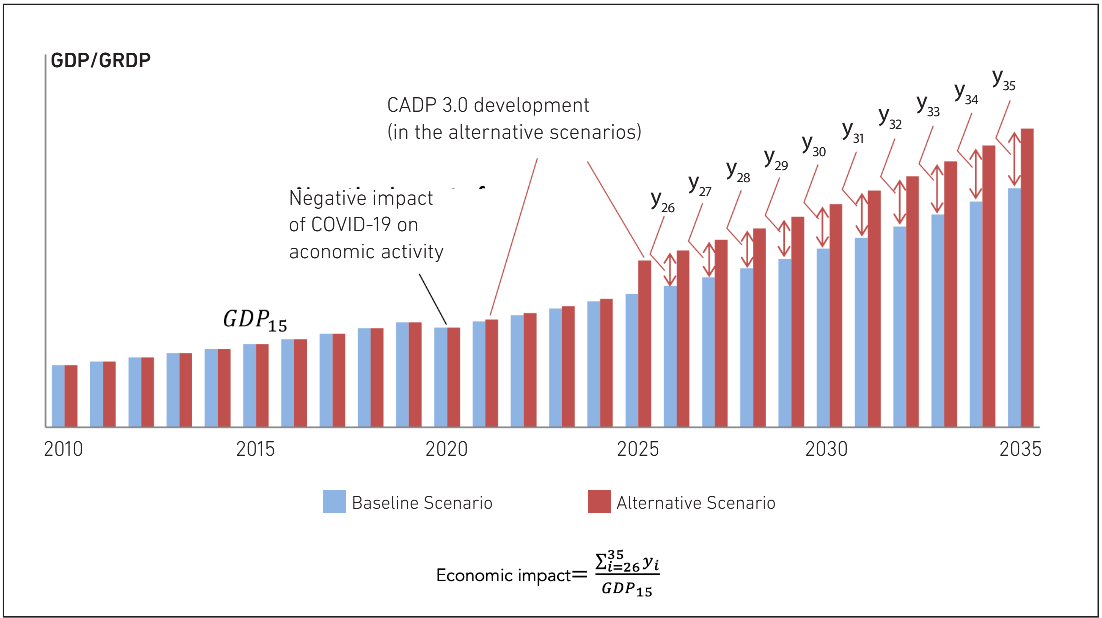
The simulation covers 20,067 routes: 12,859 land routes, 1,341 sea and inland waterways, 2,673 air routes, and 3,194 railroad routes (including high-speed railways). Route data consist of starting and ending cities, intercity distances, and speeds of vehicles travelling along the route. The land routes between the cities are constructed based on the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Asian Highway Database (UNESCAP, n.d.) as a benchmark, and routes on various maps were added. Actual road distances between cities were used for intercity road distances, and where road distances were not available, straight-line distances were used. The data for air and sea routes are mainly from the Japan Maritime Research Institute (Nihon Kaiun Shukaijo, 1983) and a team from the Logistics Institute – Asia Pacific. The railway data were adopted from various sources, including maps and the official websites of the relevant railway companies.

Scenarios and Results

Economic impact

The impact assessment is done by comparing results from different scenarios. There are two major scenarios: one is the baseline scenario, which assumes no specific infrastructure development. It follows the same development pattern as before, according to International Monetary Fund (IMF) estimates, etc.; and includes the achievements of ASEAN so far, such as the implementation of the ASEAN Economic Community (AEC), ASEAN Single Window (ASW), ASEAN Trade in Services Agreement (ATISA), etc., and future developments from these achievements. The other is that additional infrastructure development or policy initiatives take place. This is called the development scenario. The difference between the baseline scenario and the development scenario is then defined as the economic impact. The economic impact is shown cumulatively over 2026–2035 in Figure 7.2.

Figure 7.2 Image of Economic Impact



CADP = Comprehensive Asian Development Plan, COVID-19 = coronavirus disease, GDP = gross domestic product, GRDP = gross regional domestic product.

Source: Authors.

The economic impacts of different scenarios in this analysis are summarised in Table 7.2.

Table 7.2 Cumulative 10-Year Economic Impacts, 2026–2035

Economy	Compared with the baseline scenario				Combined	All
	Physical infrastructure	IT	CT	Energy conservation		
Brunei Darussalam	0.5	0.3	30.3	21.7	53.3	54.1
Cambodia	6.7	23.9	6.0	48.6	85.9	138.5
Indonesia	19.5	11.3	1.2	40.4	73.2	129.9
Lao PDR	110.5	0.5	1.5	48.3	163.0	193.8
Malaysia	13.3	19.9	2.1	37.9	73.5	77.0
Myanmar	8.9	0.6	1.0	41.0	51.7	111.0
Philippines	36.8	32.1	1.3	40.3	112.9	130.8
Singapore	0.3	30.7	30.0	30.1	90.1	93.3
Thailand	0.8	14.5	4.6	29.0	49.3	68.9
Viet Nam	31.6	14.6	3.2	47.6	98.1	136.9
Japan	0.1	0.0	-0.1	0.1	0.1	0.2

Economy	Compared with the baseline scenario				Combined	All
	Physical infrastructure	IT	CT	Energy conservation		
Korea	0.1	0.1	-0.2	0.1	0.1	0.6
China	0.2	0.1	0.4	0.5	1.2	1.9
Australia	0.0	0.1	-0.1	0.2	0.2	1.1
New Zealand	0.0	0.0	-0.1	0.2	0.1	0.9
India	-0.1	0.5	0.5	0.7	1.6	3.7
United States	0.0	0.0	-0.1	-0.1	-0.2	0.0
Russia	0.0	0.0	-0.1	0.0	0.0	0.0
EU	0.0	0.0	-0.1	0.0	0.0	0.1
ASEAN10	16.2	17.4	5.6	37.6	77.4	109.0
EAS16	1.9	2.1	0.8	4.5	9.4	13.5
World	0.6	0.6	0.2	1.3	2.8	4.1

ASEAN = Association of Southeast Asian Nations, CT = communication technology, EAS = East Asia Summit, ERIA = Economic Research Institute for ASEAN and East Asia, EU = European Union, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies, IT = information technology.

Source: IDE/ERIA-GSM simulation results.

Baseline scenario

COVID-19 was confirmed to have occurred in China at the end of December 2019, and since then, as of January 2022, a total of 300 million people have been infected and 5.5 million have died. Economic activities, the movement of people, and logistics are restricted in many countries, seriously damaging the global economy. A detailed estimate of the magnitude of the impact of COVID-19 is constantly changing.

In both the baseline scenario and the development scenario described below, we calibrate the growth rates of technical parameter A for each country to replicate the actual and projected gross domestic product (GDP) growth rates in the IMF's World Economic Outlook (IMF, 2021). As the actual and forecast GDP growth rates in the World Economic Outlook reflect the impact of COVID-19, this allows us to capture the wider impact of COVID-19 in the simulation. The following assumptions for the aviation industry, according to Kumagai et al. (2020), are included in the calibration:

- The frequency of flights in the model was reduced to reflect the less frequent international/domestic flights across the world from 2020 to 2021.

- The airfare per kilometre (km) was doubled to reflect the increased costs of air freight caused by limited capacity.
- Barriers to trade in the services sector between countries are assumed to be 20% more to reflect the impact of mutually imposed immigration/visiting restrictions.[2]

Even within the model, COVID-19 has negative economic effects on the economy. The negative impact on the services sector is significant, as it is assumed to be constrained by the aviation industry, but the manufacturing sector is also negatively affected, reflecting the reduced demand due to the overall economic downturn. The severity appears to be influenced by the degree of dependence on foreign trade. In other words, countries with large domestic economies have relatively small negative economic impacts. Indonesia, the Lao People's Democratic Republic (Lao PDR), and the Philippines have a relatively small impact, while Malaysia, Singapore, and Viet Nam have a relatively large impact.

Physical infrastructure scenario

We selected key projects from the CADP 3.0 project list (see Appendix of Chapter 6) to create this physical infrastructure scenario. Of the CADP 3.0 project list, it is assumed that the projects which are scheduled to be completed and start operating by 2025 are completed in 2025 in the model. The major projects in the scenario include the following:

Cambodia
- Phnom Penh–Sihanoukville expressway

Indonesia
- Serang–Panimbang toll road
- Yogyakarta–Bawen toll road
- Probolinggo–Banyuwangi toll road
- Patimban Port access
- Gedebage–Tasikmalaya–Cilacap road project
- Pekanbaru–Bangkinang–Payakumbuh–Bukittinggi road project
- Makassar–Parepare railway
- Kertajati Airport railway
- Patimban Port
- Depapre Port
- Development of Kediri Airport
- Construction of New Nabire Airport
- Construction of Bolaang Mongondow Airport
- Sukabumi Airport

[2] Barriers to trade in services between each country are tariff-equivalent data estimated by authors.

- Singkawang Airport
- Siboru Airport
- Banggai Laut Airport

Lao PDR
- Vientiane–Boten high-speed railway project
- 5th Lao–Thai Mekong Friendship Bridge (Bolikhamxay–Bueng Kan)
- Lao–Thai Mekong Bridge for high-speed train (Vientiane–Nong Khai)
- Vientiane–Hanoi expressway project (portion from Vientiane to Nam On)
- Vientiane–Boten expressway project

Malaysia
- Pan-Borneo highway (Sabah–Sarawak)
- Central spine road project
- Gemas–Johor Bahru electrified double track
- Johor Bahru–Singapore Rapid Transit System (RTS Link)
- East Coast Rail Link (ECRL)

Myanmar
- Muse–Kyaukphyu railway

Philippines
- North Luzon East Expressway (NLEX)
- Mindanao railway project: Tagum–Davao–Digos segment
- Subic–Clark Railway Project
- PNR South Long-Haul (Manila–Bicol) railway

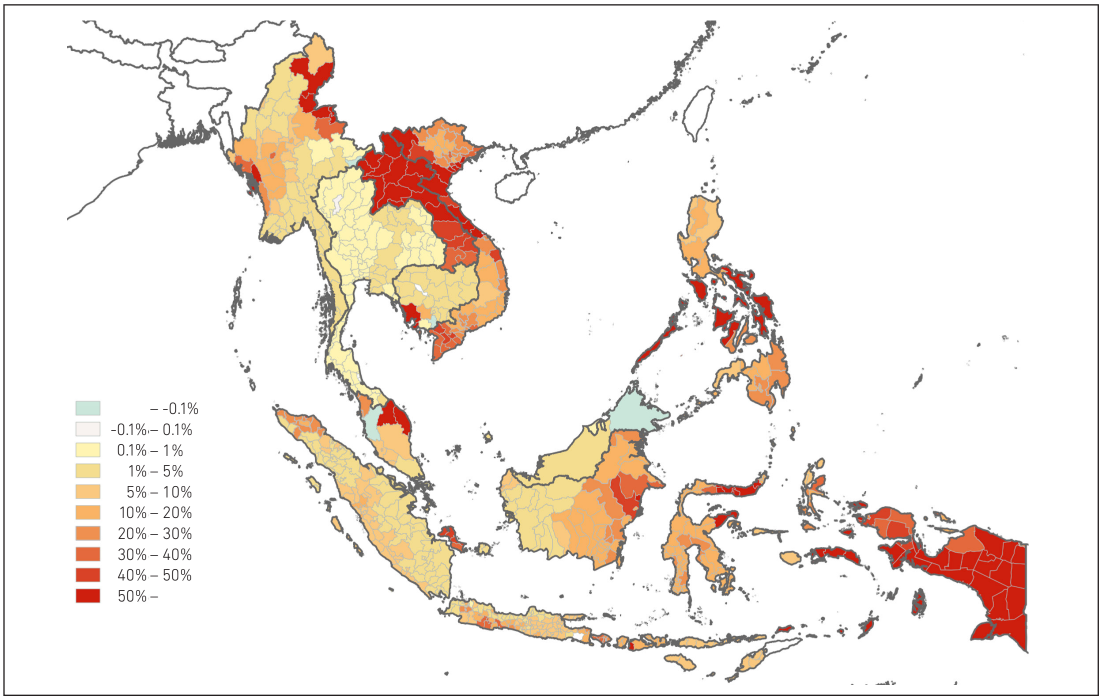
Thailand
- Bangkok–Nakhon Ratchasima high-speed railway
- Double track: Prachuab Khiri Khan–Chumphon
- Double track: Nakhon Pathom–Hua Hin
- Double track: Lopburi–Paknampho

Viet Nam
- Cam Lo–La Son highway
- Trung Luong–My Thuan highway
- My Thuan–Can Tho highway
- Van Don–Mong Cai highway
- Construction of passenger terminal T2 project – Cat Bi International Airport
- Construction of passenger terminal T2 – Vinh International Airport
- Building passenger terminal T2 – Phu Bai International Airport
- Dien Bien Phu Airport

CADP 3.0 infrastructure projects will give the Lao PDR the most significant cumulative economic impact (110.5%), with the Philippines gaining 36.8%, Viet Nam 31.6%, and Indonesia 19.5%. With a maximum speed of 160 km per hour (km/h) for passenger trains and 120 km/h for goods trains, the opening of the Lao High-Speed Railway will have a high economic impact on northern Lao PDR by significantly reducing the freight transport time. In the Philippines, Viet Nam, and Indonesia, much of the trunk interregional transportation infrastructure is composed of highways rather than expressways. Therefore, the economic impact of the new expressway project becomes large. On the other hand, in Viet Nam, it is not assumed that the expressway between Hanoi and Ho Chi Minh City will be fully completed by 2025. Further, in Indonesia, the highway connecting Sumatra to the north and south will only be partially completed. Even after this scenario is implemented, there is still a lot of ground left for the interregional transport infrastructure to yield larger economic impacts.

By region, the New Nabire Airport project in Indonesia will give Nabire the largest economic impact (Figure 7.3 and Table 7.3). Banggai and Fakfak will also gain significant economic impacts from the Banggai Laut Airport and Siboru Airport projects, respectively. In the Lao PDR, the northern part of the country (e.g. Bokeo, Luang Namtha, and Oudomxai provinces) receive a relatively high economic impact. There are also several regions with high economic benefits in northwest Viet Nam, central Philippines, and Papua Island. This confirms the statement in the introduction to this chapter that the policy interest of the AMS is shifting towards infrastructure in the peripheral regions.

Figure 7.3 Economic Impacts of the Physical Infrastructure Scenario on ASEAN
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.3 Top 10 Gainers Under Physical Infrastructure Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Nabire	Indonesia	6,432
Banggai	Indonesia	748
Fakfak	Indonesia	616
Maluku Tengah	Indonesia	424
Maluku Tenggara	Indonesia	402
Kaimana	Indonesia	369
Seram Bagian Timur	Indonesia	357
Seram Bagian Barat	Indonesia	334
Bokeo	Lao PDR	300
Oudomxai	Lao PDR	296

ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

ICT development

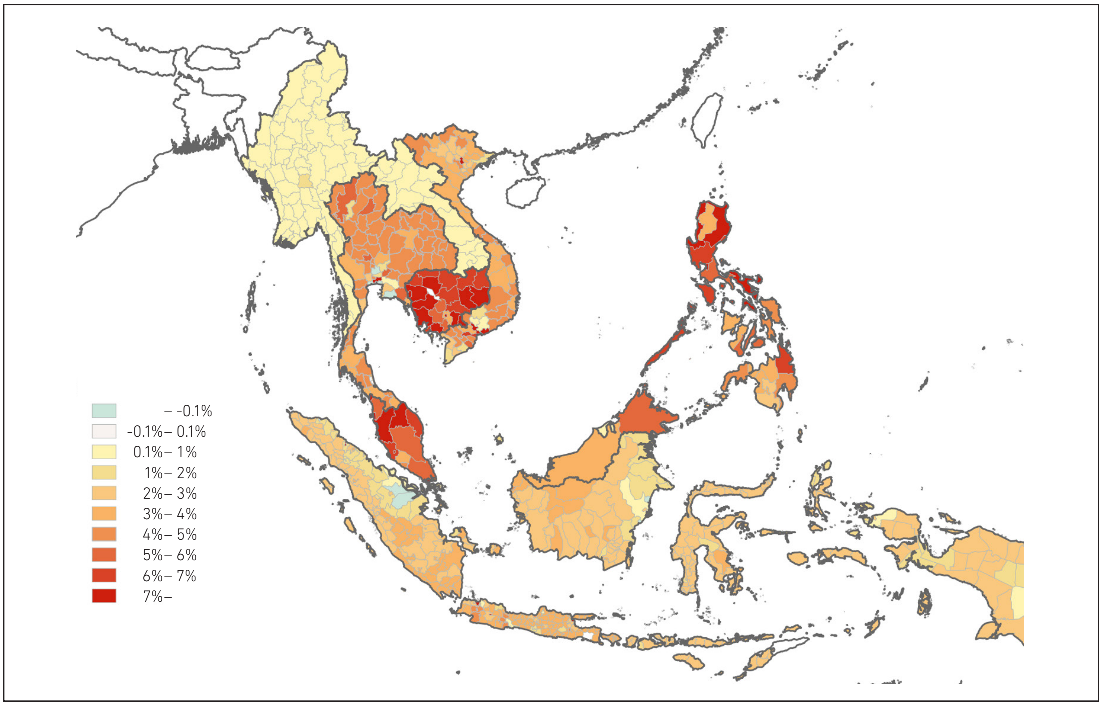
The development of ICT, in particular the diffusion of 5G technology and the emergence of new services triggered by it, is expected to lead to economic development through various channels. The future development of ICT, which has been ongoing since previous economic developments, is already included in the baseline scenario. In this chapter, we assume that additional information technology (IT) developments will lead to an intensive build-up of facilities in selected large cities. Although some attempts have been made to establish data centres and other facilities farther from cities to mitigate risks such as disasters, in practice the concentration of facilities in large cities continues due to their proximity to technicians, customers, and related services. Twelve ASEAN cities – Bandung, Bangkok, George Town, Hanoi, Ho Chi Minh City, Jakarta, Kuala Lumpur, Manila, Medan, Phnom Penh, Singapore, and Surabaya – will see a 1% increase in technical parameters in the services sector. This is called the IT effect.

The diffusion of 5G and related services in communication technology (CT) is assumed to be a reduction of transport costs and a reduction of trade barriers in the services sector, as CT can be seen as a technology that facilitates trade in goods and services and assumes the possibility of changing the way goods and services are traded. The barriers to trade in the services sector will be lowered at a fixed annual rate between 2021 and 2025 for all regions in the 10 AMS. The reductions in the services sector are as follows:

- Singapore, Brunei, Malaysia, and Thailand: 2% per year
- Indonesia, the Philippines, and Viet Nam: 4% per year
- Cambodia, Lao PDR, and Myanmar: 6% per year

The results are summarised in Figures 7.4 and 7.5 and Tables 7.4 and 7.5. In the IT scenario, countries with cities that experience large IT build-ups experience high economic impacts, while AMS that do not experience such build-ups experience little economic impact. The benefits of IT are not limited to the city where the IT buildout takes place, but extend to the entire country in which the city is located. Large-scale IT buildouts are strongly dependent on the size of the current market and the potential for future development, as the location must be chosen by the private sector, despite government incentives and environmental improvements.

Figure 7.4 Economic Impacts of IT Scenario on ASEAN
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies, IT = information technology.

Source: IDE/ERIA-GSM simulation results.

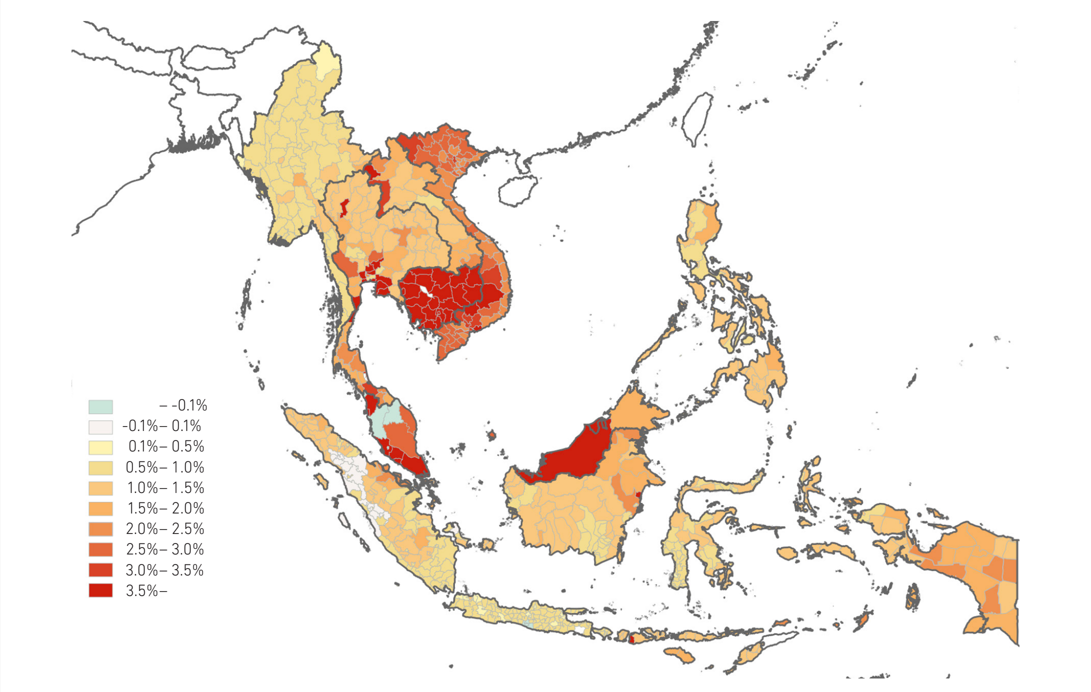
Table 7.4 Top 10 Gainers Under IT Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Kuala Lumpur	Malaysia	78
Phnom Penh	Cambodia	64
National Capital Region	Philippines	57
Ho Chi Minh City	Viet Nam	56
Bangkok	Thailand	43
Ha Noi City	Viet Nam	42
Jakarta	Indonesia	31
Singapore	Singapore	31
Pulau Pinang	Malaysia	27
Kota Surabaya	Indonesia	26

ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies, IT = information technology.

Source: IDE/ERIA-GSM simulation results.

Figure 7.5 Economic Impacts of CT Scenario on ASEAN
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, CT = communication technology, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.5 Top 10 Gainers Under CT Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Brunei Darussalam	Brunei Darussalam	30
Singapore	Singapore	30
Samut Sakhon	Thailand	14
Pailin	Cambodia	14
Pulau Pinang	Malaysia	14
Rayong	Thailand	12
Samut Prakarn	Thailand	12
Phra Nakhon Si Ayudhya	Thailand	11
Mondulkiri	Cambodia	9
Negeri Sembilan	Malaysia	8

CT = communication technology, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

In the CT scenario, most regions in the AMS reap positive economic impacts. The city states of Singapore and Brunei reap particularly high economic impacts. Some large cities that have a high economic impact in the IT scenario have little economic impact in the CT scenario. The CT scenario tends to have higher economic impacts on the periphery of large cities and on major regional cities. For this reason, the CT scenario is complementary to the IT scenario.

Cambodia is next, with a relatively high economic impact of 6%. As Cambodia is also projected to have a high economic impact in the IT scenario, many regions show high figures in both Figures 7.4 and 7.5. This can be interpreted as the prosperity of the Cambodian service industry and the low level of external barriers to the service industry, which has also had a positive impact on the introduction of ICT.

In the roll-out of 5G, there is a trade-off between cost efficiency and cross-regional service deployment. Based on the GDP impact and cost efficiency alone, only these densely populated cities should deploy 5G and develop their service industries. This can be achieved at a much lower cost than deploying a nationwide 5G network and developing a new services industry that can be deployed in the same way throughout the country. This partial roll-out would be the preferred scenario for the private sector, including telecoms operators. On the other hand, deploying 5G only in the most populous cities and leaving the rest of the country without assistance would be contrary to balanced and equitable development. Rural areas would be even more gentrified. To achieve full-scale deployment of 5G across the country, regulations such as universal service obligations are needed to ensure equal service provision throughout the country.

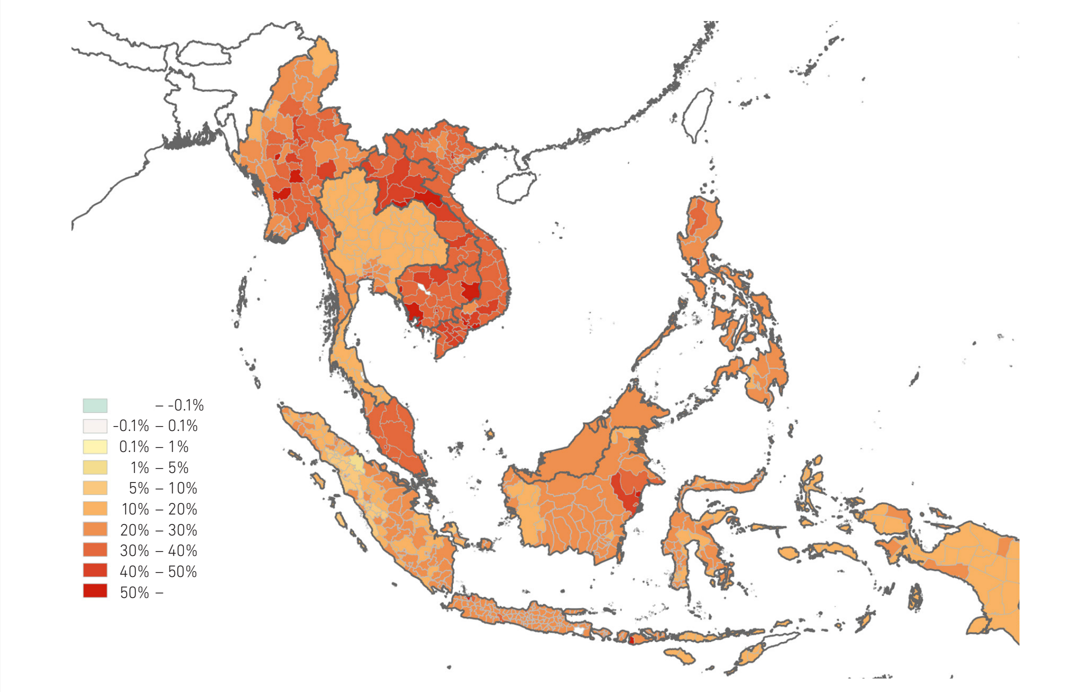
In addition, regulation should be imposed not only on telecoms operators but also on start-ups that provide new services combining internet and real services. Regulation of start-ups would be difficult to implement as it would have a direct negative impact on the profitability of private start-ups. A possible solution would be to mandate large companies with market dominance to roll out and operate their services in more than one city or region.

Energy conservation

In the energy conservation scenario, we assume the rise of energy saving technologies in ASEAN. Following Pollitt et al. (2017), we replicate the positive impact of active energy saving technology adoption on GDP in a macro pathway, with rising technology parameters on the IDE/ERIA-GSM (Figure 7.6 and Table 7.6). For the level of progress in energy efficiency and conservation, we use Kimura and Han (2021).[3]

[3] Whereas Kimura and Han (2021) assumed how ambitious energy efficiency and conservation could be achieved with a constant level of GDP, Pollitt et al. (2017) discussed the increase in GDP due to the introduction of energy saving technologies. The simulation in this chapter uses only the level of energy conservation in the alternative scenario of Kimura and Han (2021) and assumes that GDP could rise with the introduction of technology as in Pollitt et al. (2017).

Figure 7.6 Economic Impacts of Energy Conservation Scenario on ASEAN
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.6 Top 10 Gainers Under Energy Conservation Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Kota Bontang	Indonesia	161
Pailin	Cambodia	101
Nay Pyi Taw	Myanmar	98
Sumbawa Barat	Indonesia	76
Ba Ria–Vung Tau	Viet Nam	75
Nyaung-U	Myanmar	74
Phnom Penh	Cambodia	70
Vientiane Capital	Lao PDR	64
Mondulkiri	Cambodia	64
Kuala Lumpur	Malaysia	62

CT = communication technology, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

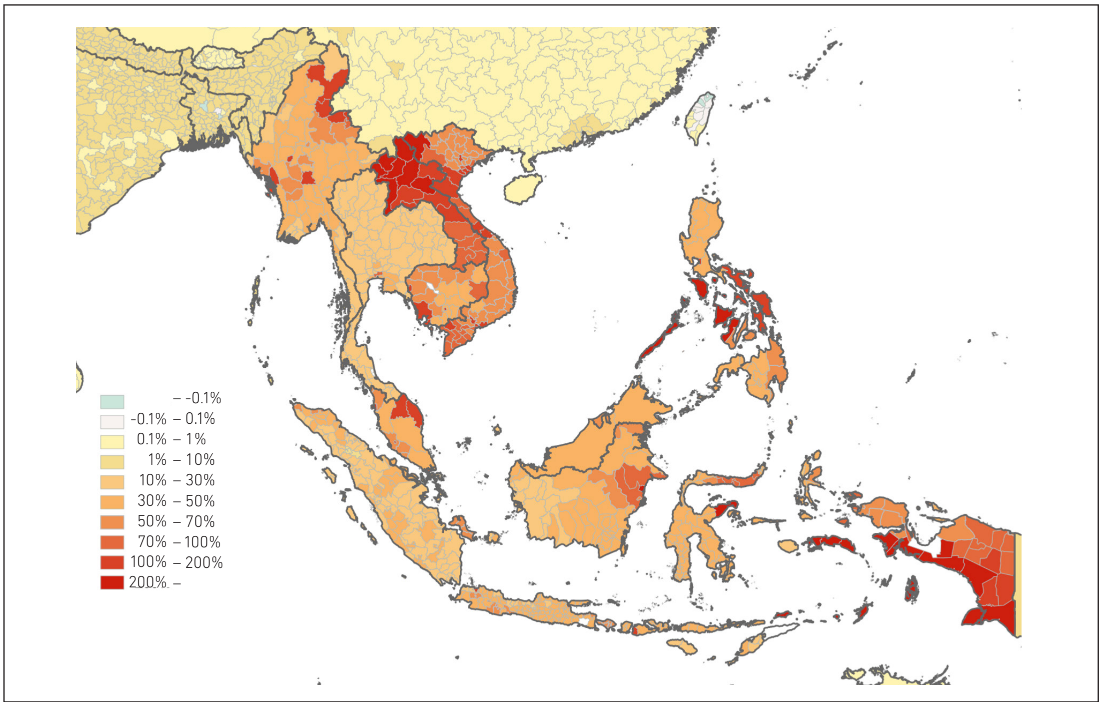
Source: IDE/ERIA-GSM simulation results.

The introduction of new technologies to achieve energy efficiency and conservation will have a significant economic impact on AMS. Regionally, Cambodia, the Lao PDR, Myanmar, and Viet Nam are the countries with the highest economic impact.

All' scenario

The results of the combined scenario of physical infrastructure, IT, CT, and the introduction of new technologies to achieve energy conservation are shown in Figure 7.7 and Table 7.7. For the nine AMS excluding Singapore, the economic impact of the combined scenario is higher than the sum of the economic impacts of the four scenarios. This indicates that there are synergies between the scenarios.

Figure 7.7 Economic Impacts of the Combined Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.7 Top 10 Gainers Under Combined Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Nabire	Indonesia	6,618
Banggai	Indonesia	790
Fak-fak	Indonesia	658
Maluku Tengah	Indonesia	458
Maluku Tenggara	Indonesia	435
Kaimana	Indonesia	399
Seram Bagian Timur	Indonesia	386
Seram Bagian Barat	Indonesia	362
Bokeo	Lao PDR	353
Oudomxai	Lao PDR	344

ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

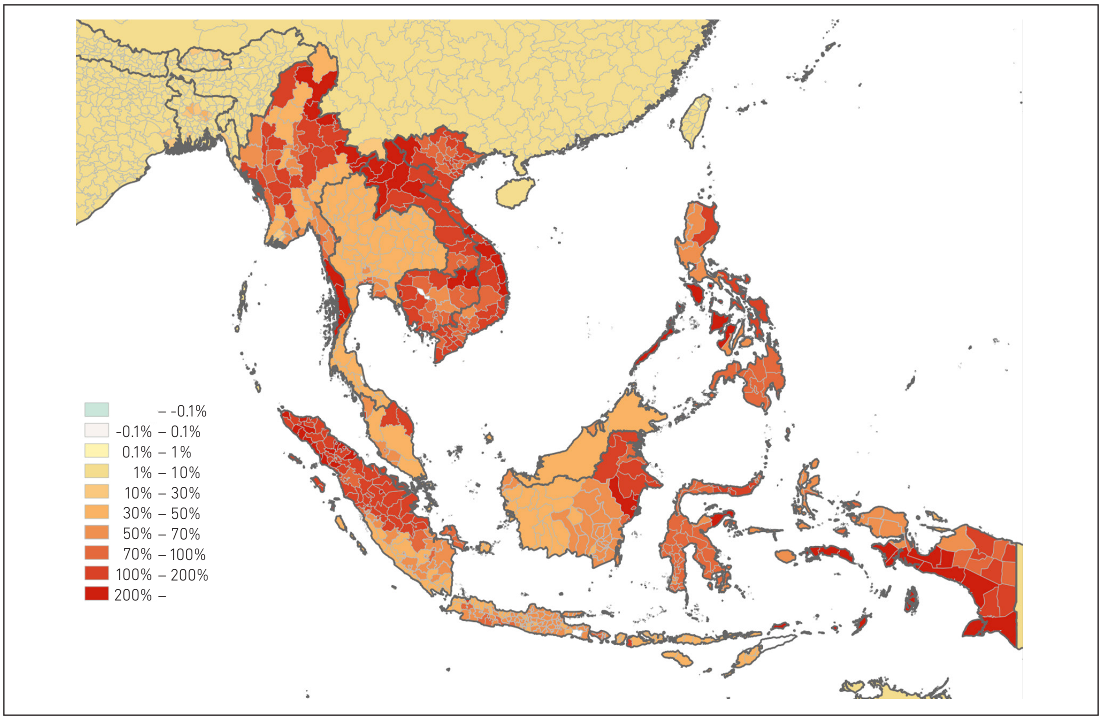
In addition to the combined scenario, the remaining key transport infrastructure projects that have a significant economic impact on the region are included in the 'all' scenario. These include:

- Completion of the Hanoi–Ho Chi Minh City expressway (AH1)
- Completion of the Manila–Davao expressway network (AH26)
- Completion of the Trans-Sumatran Highway
- Upgrading the backbone road network in Myanmar
- Upgrade of the Cambodian road section of the Mekong–India Economic Corridor
- Sea route improvement for specific sea corridor routes in ASEAN and surrounding countries
- Completion of deep sea port projects in Dawei and Kyaukphyu at the level of major feeder ports

Many of these are the projects that the 2015 CADP 2.0 analysis recommended to policymakers for early completion.

The economic impacts of the 'all' scenario are shown in Figure 7.8 and Table 7.8. Almost all the regions of ASEAN will gain positive economic impacts. Northern, northeastern, and southern Myanmar; northern Lao PDR; northern and northwestern Viet Nam; central Philippines; northeastern Cambodia; northern Sumatra; northern Sulawesi; and Papua are the regions with high economic impacts. For this to happen, it will need to be driven by policymakers. The remaining major projects must be completed, and 5G and new services must be rolled out across the country in an appropriate manner.

Figure 7.8 Economic Impacts of the 'All' Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)



ASEAN = Association of Southeast Asian Nations, ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.8 Top 10 Gainers Under 'All' Scenario
(%, cumulative impact during 2026–2035/GDP in 2015)

Region	Country	Impact
Nabire	Indonesia	6,640
Kawthoung	Myanmar	1,939
Dawei	Myanmar	1,834
Myeik	Myanmar	1,478
Banggai	Indonesia	830
Fakfak	Indonesia	665
Tachileik	Myanmar	643
Bokeo	Lao PDR	625
Kota Bontang	Indonesia	543
Maluku Tengah	Indonesia	465

ERIA = Economic Research Institute for ASEAN and East Asia, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies.

Source: IDE/ERIA-GSM simulation results.

Table 7.9 shows the economic impacts by industry in each country for the combined and 'all' scenarios. In both scenarios, agriculture and mining have positive economic impacts, but manufacturing and services have much higher economic impacts than agriculture and mining. This is because the number of workers in agriculture falls compared with the baseline scenario, and more workers are employed in manufacturing and services. In fact, the food processing sector has grown significantly in many AMS. This indicates that more workers will be employed in food processing, which is expected to add more value to agricultural production.

Table 7.9 Economic Impacts of Combined and All Scenarios on ASEAN by Industry
(%, cumulative impact during 2026–2035/GDP in 2015)

Country	Agricul-ture		Automo-tive		E&E		Textile		Food Proc.		Oth. Mfg.		Services		Mining	
	CB	All	CB	All	CB	All	CB	All	CB	All	CB	All	CB	All	CB	All
Brunei Darussalam	15	19	219	217	133	134	118	122	113	126	164	165	57	58	10	10
Cambodia	13	21	202	250	107	140	42	70	33	64	76	96	125	202	17	18
Indonesia	35	66	64	103	29	34	30	54	22	54	25	52	113	199	8	11
Lao PDR	23	28	324	275	202	195	141	159	130	147	124	120	224	268	22	28
Malaysia	11	15	77	85	65	68	53	86	40	60	50	55	93	95	9	12
Myanmar	12	9	199	559	90	328	68	-74	43	1	69	194	78	210	21	-15
Philippines	23	35	84	129	40	32	46	197	49	119	43	49	167	178	6	8
Singapore	6	8	132	144	147	157	130	147	80	94	125	133	67	67	7	8
Thailand	10	25	41	84	30	32	31	103	23	63	27	47	72	84	7	9
Viet Nam	19	29	99	133	56	80	62	110	68	111	46	62	161	221	16	17

ASEAN = Association of Southeast Asian Nations, CB = combined, E&E = electronics and electric appliances, ERIA = Economic Research Institute for ASEAN and East Asia, Food Proc. = food processing, GDP = gross domestic product, GSM = Geographical Simulation Model, IDE = Institute of Developing Economies, Oth. Mfg. = other manufacturing.

Source: IDE/ERIA-GSM simulation results.

Furthermore, the services sector has a higher economic impact than the manufacturing sector, indicating that although developments such as IT and CT will have a positive impact on the manufacturing sector as well as the services sector, there is still room for ASEAN to grow further in the services sector, including healthcare and pharmaceuticals. Compared with the combined scenario, the 'all' scenario generates higher economic impacts in many industries in many countries. In the 'all' scenario, the services sector will grow further. This shows again that ASEAN has large potential in the services sector.

On the other hand, the 'all' scenario will bring about different changes in the Lao PDR and Myanmar than in the other countries. The Lao PDR will see strong growth in the automotive and electrical and electronics industries under the combined scenario, but this growth will be constrained under the 'all' scenario, and the services sector will grow strongly instead. In Myanmar, the textile industry will have a negative impact under the 'all' scenario, and the food processing industry will have a smaller impact than under the combined scenario. Instead, the automotive, electrical and electronics, and services industries will be much higher than in the combined scenario.

The negative economic impact of Myanmar's textile industry in the 'all' scenario is compared with the baseline scenario. This does not mean that the industry will be smaller than it is in 2022, but rather that it will not have to specialise in the textile industry, as other manufacturing and service sectors will grow significantly, whereas it would have had to in the baseline scenario.

Myanmar's greater share of the automotive and electrical and electronic industries within ASEAN will result in a lower share for the Lao PDR compared with the combined scenario, but this will be offset by further growth in the services sector, and the Lao PDR will reap higher economic benefits than in the combined scenario.

Conclusions

We have run a new simulation in response to the changing situation in ASEAN and East Asia. COVID-19 may impede the movement of people, especially with respect to international passenger traffic. In the simulation, a shift from air to land transport is evident.

Given this new normal situation with COVID-19, mitigation of the negative impacts by ICT becomes more important. The simulation results show that if infrastructure projects, ICT development, and the introduction of new technologies to achieve energy efficiency are successfully combined – as in the 'all' scenario – many regions located in peripheral areas of the AMS can develop to a greater extent.

References

ERIA (2010), *The Comprehensive Asia Development Plan*, ERIA Project Research Report 2009, No. 7-1. Jakarta: Economic Research Institute for ASEAN and East Asia.

ERIA (2015), *The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*. Jakarta: Economic Research Institute for ASEAN and East Asia.

IMF (2021), World Economic Outlook Data: April 2021 Edition. https://www.imf.org/en/Publications/WEO/weo-database/2021/April (accessed 1 August 2021).

Isono, I. and S. Kumagai *(2020), '(Re)defining Economic Corridors', IDE–JETRO Discussion Papers*, No. 774. Tokyo: Institute of Developing Economies, Japan External Trade Organization.

Keola, S. and S. Kumagai (2016), 'Measuring Population Mobility Speed from Space', *IDE–JETRO Discussion Papers*, No. 574. Tokyo: Institute of Developing Economies, Japan External Trade Organization.

Kimura, S. and P. Han, eds. (2021), *Energy Outlook and Energy Saving Potential in East Asia 2020*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Kumagai, S., T. Gokan, K. Tsubota, I. Isono, K. Hayakawa, and S. Keola (2020), 'Impact of the 2019 Novel Coronavirus on Global Economy: Analysis Using Mobility Data from Mobile Phones', *IDE Policy Brief*, No. 11. Tokyo: Institute of Developing Economies, Japan External Trade Organization.

Kumagai, S., K. Hayakawa, I. Isono, S. Keola, and K. Tsubota (2013), 'Geographical Simulation Analysis for Logistics Enhancement in Asia', *Economic Modelling*, 34, pp.145–53.

Nihon Kaiun Shukaijo (1983), *Distance Tables for World Shipping*, 8th edition. Tokyo: Nihon Kaiun Shukaijo.

Pollitt, H. et al. (2017), *The Macro-Level and Sectoral Impacts of Energy Efficiency Policies*. Brussels: European Commission.

Puga, D. and A.J. Venables (1996), 'The Spread of Industry: Spatial Agglomeration in Economic Development', *Journal of the Japanese and International Economies*, 10(4), pp.440–64.

UNESCAP (n.d.), Asian Highway Database. https://www.unescap.org/our-work/transport/asian-highway/database (accessed 1 February 2022).

PART 2
Innovation

Chapter 8

Innovation Systems and Digital Transformation[1]

Keita Oikawa
Economist, ERIA

[1] I am grateful for valuable suggestions from Lili Yan Ing, Lead Advisor (Southeast Asia Region) of the Economic Research Institute for ASEAN and East Asia (ERIA).

Introduction

When you hear the word 'innovative', what comes to mind? You may think of a firm providing products or services by making full use of state-of-the-art technologies such as artificial intelligence (AI) or a firm producing such technologies. Innovation is a key growth factor not only for firms but also for nations. Innovative firms generate more value added than non-innovative firms. The more innovative firms there are in an economy, the more qualitative products and services are provided to the market with a more efficient method of production, which means the better the living standards (income levels) the people living in the economy enjoy. An innovative nation or economy has an environment conductive to generating innovative firms. It has highly competitive universities attracting talented people. It generates many start-ups, and venture capitalists gather there. When looking at innovative economies, we find that systematic linkages exist between universities, firms, investors, and related organisations. This finding applies not only to established developed countries like the G7 members, but also to newly developed countries like the Asian Miracles – the Republic of Korea (henceforth, Korea), Taiwan, Singapore, and Hong Kong.

This chapter discusses optimal innovation systems at the macroeconomic level for middle-income Association of Southeast Asian Nations (ASEAN) Member States (AMS). As an introduction, we give a brief overview of the discussion. Many AMS are middle-income countries, and their technology utilisation levels are much lower than those of high-income advanced countries such as the United States (US). Economic growth theory implies that closing this technology utilisation gap is a primary way of turning middle-income countries into high-income countries as quickly as possible. For middle-income AMS to improve their technology utilisation levels, they need to understand the mechanism of technology adoption – both at the firm level and at the macroeconomic level – and build their innovation systems by harnessing digital transformation.

Many AMS have advanced to middle-income status by participating in global value chains, based on their comparative advantage in labour costs amid globalisation. More precisely, AMS have improved their income levels by attracting foreign direct investment (FDI) to manufacturing plants through competitive multinational enterprises by providing low-cost labour resources. Moreover, indigenous firms that trade with global firms have improved their productivity through learning effects. It may appear that this growth model is sufficient for economies to grow to high-income levels since advanced technologies are likely to flow to AMS through FDI, typically in the manufacturing sector. However, what we have observed is the middle-income AMS struggling with overcoming the 'middle-income trap'. In examining the differences between Asian Miracles cases and economies that remain at middle-income levels, it is difficult to find economies that have reached high-income levels through FDI alone. All the Asian Miracles that succeeded in establishing innovation systems, building innovation capabilities, and fostering competitive private firms in their countries did so by developing a healthy competitive market environment.

For middle-income AMS to develop innovation-friendly markets, they need to keep in mind the lessons from empirical studies regarding technology diffusion from global frontier firms to national firms. First, promoting global-level firms in a country benefits other national firms – although national laggers seem to have difficulty adopting technologies directly from global frontier firms. Second, fostering global-level firms requires encouraging entrepreneurship, FDI for global innovative enterprises, an improved educational system, research and development (R&D) activities, industry–university R&D partnership, and an effective intellectual property rights system. Third, minimising inefficient and incapable firms contributes to improvements in macro-level innovation capabilities. To do so, it is necessary to balance the benefits of employment protection and costs of employment allocation inefficiency regulations and to reduce administrative costs for businesses. Last, to help national laggers catch up, product market laws and employment protection must be relaxed and industry–university R&D cooperation must be encouraged.

From the perspective of indigenous firms or start-ups hoping to be global-level innovative firms in their economies, it is difficult for them to avoid competing with global frontier firms in high-tech industries, such as electronics, machinery, pharmaceuticals, aerospace, transport equipment, software, information technology (IT), and science and technical services. Competitive firms in both the Asian Miracles – Hong Kong, Korea, Singapore, and Taiwan – and China undertook creative imitation innovation strategies, and can provide lessons for latecomer firms competing with advanced firms in high-tech industry markets. Creative imitation is an innovative activity in which latecomers try to partly imitate and adapt new products and services from abroad to satisfy local market demands or to create lower-cost versions to compete in price-sensitive markets. It is an important option for firms in the middle-income AMS.

Another important point in the promotion of innovative firms is full utilisation of digital transformation. The Asian Miracles succeeded in reaching the technological frontier before or around the 1990s, before the information and communication technology (ICT) revolution started in full swing. The current digital transformation trend has changed the importance of start-ups relative to incumbent firms in innovation compared with the Asian Miracle era. The significance of start-ups has been a major driver of innovation, especially in sectors such as e-commerce, mobile applications, finance, and the internet of things.

ICT, or digital technology, has a property of general-purpose technology (GPT): it will be deployed in all sectors – both manufacturing and non-manufacturing – and make current business models obsolete. The digitalisation tide never turns, so both the private and public sectors in AMS economies must advance by shifting weight from accumulated 'incremental' innovation (typically in the manufacturing sector) to 'disruptive' digital innovation (adopted in all sectors). Technology utilisation gaps embody the potential to grow quickly by catching up with and even leapfrogging to a higher development stage – through the 'advantage of backwardness'.

To do this, AMS governments must keep in mind that supporting firms arbitrarily will not help to create innovative firms. Such industrial policies are not justified either theoretically or empirically. Pro-innovation industrial policies should keep the market competitive and impose strict accountability. In addition, AMS governments should establish innovation systems in which a government organisation oversees and coordinates the formulation and implementation of innovation policies across several government departments. They should also provide monetary incentives to the private sector, including local and international firms, to invest in R&D for innovation. Moreover, they should promote university–industry cooperation (UIC), which is an important component of innovation ecosystems that foster technological diffusion and knowledge spillover.

This chapter is organised as follows. Section 2 breaks down productivity gaps into three factors – reproducible capital, human capital, and total factor productivity (TFP) – amongst AMS, East Asian countries, and the US. Section 3 claims the importance of TFP in economic growth by using macroeconomic models. Section 4 shows the movements of TFP of AMS and East Asian countries in recent decades. Section 5 explains the relationship between TFP and innovation capability, and shows what the 'advantage of backwardness' is via macroeconomic modelling. Section 6 presents a mathematical expression of macro-level innovation capability as the aggregation of individual firm-level innovation capability, and discusses empirical findings on technology diffusion from global frontier firms and national firms. Section 7 explains that digital technology has the nature of GPT and discusses empirical findings regarding the relationship amongst digital technology adoption, firms' capability, and market incentives. Section 8 discusses optimal innovation systems, harnessing digital transformation, for middle-income AMS to conclude this chapter.

Breakdown of Productivity Gaps Amongst AMS and East Asian Economies

A firm's innovativeness and productivity are closely interrelated. Let us consider two business firms: an innovative firm and a less innovative firm. It is easy to imagine that the innovative firm providing attractive goods and services at affordable costs can sell or produce more than the less innovative firm, even using the same capital and labour inputs. In this case, the innovative firm is more productive than the less innovative firm – meaning that the former's output (sales or production) is larger than the latter's using the same amount of inputs. At the macroeconomic level, similar things happen. An innovative economy is more productive than a less innovative economy. This section sees the history and current state of productivity gaps amongst AMS and East Asian economies at the macroeconomic level. The interpretation of productivity as innovativeness will be discussed later.

'Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker' (Krugman, 1997: 3). This quotation is by Paul Krugman, the Nobel Prize-winning economist, in 2008. Economic researchers often quote it to summarise the importance of productivity growth in a nation's economic development. Here, we break down the labour productivity of AMS into several factors by conducting a development accounting exercise. We show that productivity comprises the following three factors: TFP, physical capital to human capital ratio, and human capital per worker. We also discuss the implications of economic growth theory on how middle-income countries can grow to high-income countries.

Economic growth theory often models gross domestic product (GDP) as the following production function:

$$Y = AF(K, H) = AK^{\alpha}H^{1-\alpha}, \quad (1)$$

where Y is output (GDP), A is TFP, K is physical capital (e.g. production machinery), H is human capital, and α is a parameter that takes a value more than zero and less than one. This parameter equals the share of capital compensation under the competitive market assumption. This production function is intuitive. An economy produces output by inputting reproducible capital and human capital. These two types of inputs are aggregated through the Cobb-Douglas type function F. The aggregation multiplied by TFP is the economy's final output. One can interpret TFP as a productivity parameter in terms of using both physical and human capital. That is why it is called 'total factor' productivity. Human capital covers a broad kind of inputs provided by humans, consisting not only of hours worked but also of workers' skills obtained through education or training. Human capital is modelled as the product of the average skills of workers obtained through education and the total hours worked. Rearranging Equation 1, one has

$$\frac{Y}{L} = A\left(\frac{K}{H}\right)^{\alpha}\frac{H}{L},$$

where L is labour input measured in total hours worked. This equation means that labour productivity (Y/L) is composed of TFP, the physical to human capital ratio to the power of capital share, and the human capital per labour unit. We assume the capital share parameter is one-third, following Jones (2016). TFP itself is not observable. Therefore, TFP is calculated by dividing labour productivity by the physical to human capital ratio to the power of capital share and by the human capital per labour unit.

Table 8.1 reports the results of the development accounting exercise for the AMS and East Asian countries in 2019 based on the associated data from the Penn World Table version 10.0 (University of Groningen, Groningen Growth and Development Centre, n.d.).[2] All the figures represent the values relative to those of the US. For instance, in the labour productivity (Y/L) column, Cambodia has a value of 0.047, which means that Cambodia's labour productivity is 4.7% that of the US. In the research on economic growth, the US is considered to have grown for the past century at the production frontier (Jones, 2016). Therefore, one can interpret the values in the table as each economy's gap from the global production frontier.

As claimed by Paul Krugman, each country's relative labour productivity level is associated with its income level, or GDP per capita (Krugman, 1997). The World Bank classifies countries into low-income, lower-middle-income, upper-middle-income, and high-income economies.[3] According to the classification list of the World Bank (n.d.), Cambodia, India, the Lao People's Democratic Republic (Lao PDR), Myanmar, the Philippines, and Viet Nam are classified as lower-middle-income economies. China, Indonesia, Malaysia, and Thailand are ranked as upper-middle-income economies. Brunei Darussalam, Japan, Korea, and Singapore are classified as high-income economies. It is evident that a country's income level is correlated with its labour productivity. We use low- (high-) income economies and low- (high-) labour productivity economies interchangeably.

[2] Table 8.1 reports two types of productivity measures. TFP is based on hours worked. Because of data limitations, the table does not report Brunei Darussalam or the Lao People's Democratic Republic (Lao PDR). TFPE is based on workers. The main text only discusses TFP. TFPE is reported for interested readers.

[3] See World Bank (n.d.).

One of the notable findings from Table 8.1 is that the range of TFP is wider than the other two factors. The smallest value in the TFP column is Cambodia's (0.212). The smallest value of physical to human capital ratio to the power of α is also Cambodia's (0.422). The smallest value of human capital per unit of labour is Myanmar's (0.472). Another finding is that if a country is a low-income economy, it tends to have low TFP, a low physical to human capital ratio, and low human capital per unit of labour. In other words, there are no observations that have the combination of a high TFP, a low physical to human capital ratio, and a low human capital per unit of labour. Lower-income countries, such as Cambodia, Myanmar, and Viet Nam, have a significantly low TFP, physical to human capital ratio, and human capital per labour unit. Conversely, high-income countries, such as Singapore, Japan, and Korea, have high values of these three factors.

Table 8.1 Development Accounting for the AMS and East Asian Countries (US = 1, 2019)

Country	Y/L	TFP	$(K/H)^{\alpha}$	H/L	Y/L_E	TFP_E	$(K/H_E)^{\alpha}$
Brunei	.	.	.	0.746	1.075	1.026	1.404
Cambodia	0.047	0.212	0.422	0.524	0.066	0.265	0.472
Indonesia	0.160	0.341	0.769	0.610	0.183	0.373	0.804
Lao PDR	.	.	.	0.518	0.116	0.362	0.616
Malaysia	0.335	0.502	0.811	0.821	0.417	0.581	0.873
Myanmar	0.070	0.284	0.500	0.492	0.097	0.353	0.558
Philippines	0.135	0.338	0.551	0.724	0.166	0.388	0.590
Singapore	0.740	0.672	0.949	1.161	0.977	0.808	1.041
Thailand	0.206	0.378	0.729	0.748	0.244	0.423	0.772
Viet Nam	0.091	0.258	0.462	0.765	0.110	0.293	0.492
China	0.158	0.341	0.642	0.720	0.194	0.392	0.688
India	0.118	0.330	0.616	0.579	0.141	0.373	0.655
Japan	0.578	0.617	0.977	0.959	0.553	0.600	0.963
Rep. of Korea	0.552	0.581	0.947	1.004	0.620	0.627	0.983
US	1.000	1.000	1.000	1.000	1.000	1.000	1.000

AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations, GDP = gross domestic product, TFP = total factor productivity, US = United States.

Notes: H/L = human capital per hours worked, $(K/H)^{\alpha}$= reproducible capital–human capital ratio to the power of capital share, $(K/H_E)^{\alpha}$ = reproducible capital–human capital ratio to the power of capital share by using only the number of workers, TFP_E = TFP calculated by using only the number of workers, Y/L = GDP per hours worked, Y/L_E= GDP per worker.

Source: University of Groningen, Groningen Growth and Development Centre (n.d.).

Why an Economy's Capital Stock Level and its TFP Move Together in a Correlated Way

The theory of economic growth accounts for these two findings with a simple dynamic macroeconomic model called the Solow or Solow–Swan growth model (Solow, 1956; Swan, 1956). This growth model (hereafter the Solow growth model) suggests that if an economy has low TFP, it also has a low physical to human capital ratio. In other words, low levels of TFP are the potential root cause of low living standards for low-income countries. Further, an extended Solow growth model can show that a low TFP economy also has a low human capital per labour unit. Here, we describe the model and solve it to explain the mechanism whereby TFP determines the physical to human capital ratio. Readers who are not interested in the mechanism can skip the rest of this section.

The Solow growth model has a simple setting, with no trade with foreign countries and a constant saving rate. It specifies the macro-level physical capital accumulation as follows:

$$K_{t+1} = I_{K,t} + (1 - \delta_K)K_t, \tag{2}$$

where K_t is the physical capital stock at time t, $I_{K,t}$ is the gross investment in physical capital at time t, and δ_K is the depreciation rate of physical capital. Further, the model assumes that the amount of gross investment at time t is determined by the constant fraction (saving rate) of output (GDP) as follows:

$$I_{K,t} = s_K Y_t = s K_t^{\alpha} (AH)^{1-\alpha}, \tag{3}$$

where s_K is the constant saving (investment) rate for physical capital. Note that we slightly modify the production function (1) with TFP placed inside the parentheses of labour input to obtain a simple solution for the model. Additionally, we assume that TFP and human capital grow exogenously at a constant rate. Solving the dynamic model composed of Equations 2 and 3 for K_t, one has the following steady-state ratio of physical to human capital multiplied by TFP:

$$k_t^* \equiv \left(\frac{K_t}{AH}\right)^* = \left(\frac{s_K}{\delta_K}\right)^{\frac{1}{1-\alpha}}. \tag{4}$$

As seen in the above solution, k^*_t is determined solely by the saving rate, depreciation rate, and the capital share parameter. Accordingly, when the TFP is low, the physical to human capital ratio is also low. Conversely, when the TFP is high, the physical to human capital ratio is also high. Thus, the solution of the Solow growth model implies that the TFP is the root cause of the low capital stock level.

The Solow growth model can be easily extended to a growth model with endogenous human capital. We replace the production function with the following:

$$Y_t = K_t^{\alpha} H_t^{\beta} (AL)^{1-\alpha-\beta}, \tag{5}$$

where β is a parameter that satisfies $0<\beta<1$ and $\alpha+\beta<1$. We assume that human capital accumulates in a similar way to reproducible capital (Equation 2), as follows:

$$H_{t+1} = I_{H,t} + (1-\delta_H)H_t, \tag{6}$$

where $I_{H,t}$ is the gross investment in human capital at time t, and δ_H is the depreciation rate of human capital. Gross investment in human capital is also determined in a similar way to physical capital investment, as follows:

$$I_{H,t} = s_H Y_t \tag{7}$$

where s_K is the constant saving (investment) rate for human capital. Now, the growth model with endogenous human capital comprises Equations 2, 3, 5, 6, and 7. Solving this model, one has the following solutions for the ratio of reproducible capital to hours worked multiplied by TFP and the ratio of human capital to hours worked multiplied by TFP:

$$k_t^{**} \equiv \left(\frac{K_t}{AL}\right)^{**} = \left(\frac{s_K}{\delta_K}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{s_H}{\delta_H}\right)^{\frac{\beta}{1-\alpha-\beta}},$$
$$h_t^{**} \equiv \left(\frac{H_t}{AL}\right)^{**} = \left(\frac{s_K}{\delta_K}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{s_H}{\delta_H}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}.$$

It is evident that if TFP is low, the steady-state human capital per labour unit is also low. Therefore, the growth model with endogenous human capital indicates that if an economy has low TFP, it has a low reproducible capital per labour unit and a low human capital per labour unit.

Does international trade change the result? The answer is 'no' if we disregard the role of international trade in helping economies to improve their TFP. Suppose there are two economies: one is North, and the other is South. We assume that North's TFP is higher than South's. The condition of free trade and capital flows across these countries equalises the return on physical capital in North and South. In a competitive market, the return on physical capital equals the marginal productivity of physical capital (MPK). When considering the production function in Equation 3, one has the following equalisation condition:

$$MPK^N = MPK^S \Leftrightarrow \alpha\left(\frac{K^N}{A^N H^N}\right)^{\alpha-1} = \alpha\left(\frac{K^S}{A^S H^S}\right)^{\alpha-1} \Leftrightarrow \frac{K^N}{A^N H^N} = \frac{K^S}{A^S H^S}.$$

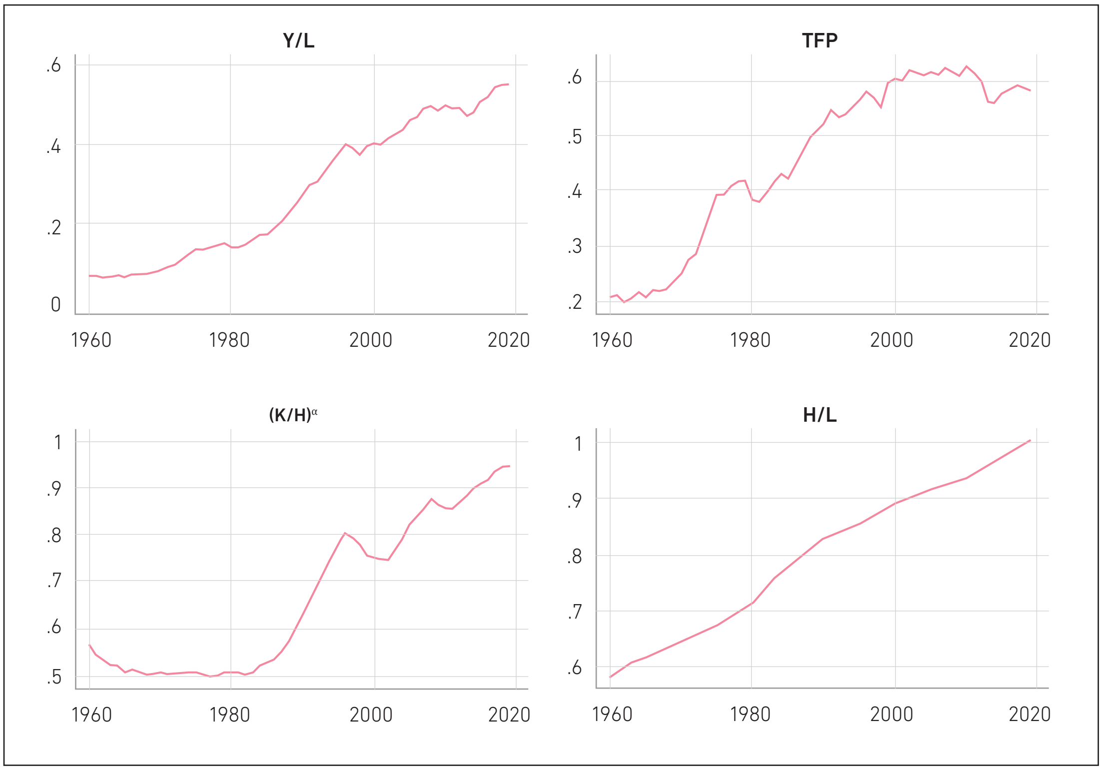
This equation clearly shows that North's physical to human capital ratio is larger than South's. Therefore, low-income economies with low TFP cannot accumulate capital stock to the level of high-income countries, or improve their living standards solely by depending on resources from foreign countries.

It should be noted that the discussion here does not deny that a small, less industrialised economy can improve its living standards by changing its industrial structure through incorporation in the global economy. As Ventura (1997) discussed, based on his economic growth model incorporating the Heckscher-Ohlin model of international trade, a small, less industrialised country can develop its economy by accumulating capital stock and changing its industrial structure from labour-intensive to capital-intensive. The country is small, so it can export as many capital-intensive goods as possible at a price determined in the global market.[4] This is a good way of describing the high economic growth of small export-oriented East Asian countries after World War II. However, it can only apply to such transition economies. If the economy's scale reaches a non-negligible level in terms of influence on global supply, the economy can no longer enjoy the non-decreasing international price.[5] Further, as seen in Figure 8.1, even Korea (a representative country of the East Asian Miracles) caught up towards the production frontier not only in capital stock accumulation but also TFP and human capital accumulation. Therefore, improvement in TFP is still essential for low- and middle-income economies to improve their living standards towards high-income economies.

[4] If the economy is closed, it will face diminishing returns on capital-intensive goods as it accumulates capital stock. In an economy with no international trade, accumulation of reproducible capital means that its scarcity value decreases relative to labour.

[5] See Acemoglu (2009: 648–91).

Figure 8.1 Republic of Korea's Productivity Gap and Its Breakdown Since 1960 (US = 1)



GDP = gross domestic product, TFP = total factor productivity, US = United States.

Notes: H/L = human capital per hours worked, (K/H)$^{\alpha}$ = reproducible capital–human capital ratio to the power of capital share, Y/L = GDP per hours worked.

Source: University of Groningen, Groningen Growth and Development Centre (n.d.).

TFP of AMS and East Asian Countries in Recent Decades

As shown above, Korea is representative of the countries that succeeded in turning low-income economies into high-income economies. It succeeded in turning the trend towards the frontier around the beginning of the 1970s. After that, its physical to human capital ratio began to move towards the US level around 1990. Human capital was constantly moving towards the US level from 1960 and caught up with and surpassed the US in 2019.

Let us examine the movement of other countries' TFP since 1985 (Figure 8.2). Singapore has experienced fluctuating movement of the TFP gap, but its overall level has remained closer to the frontier than that of the lower-income countries since 1985. The other high-income countries – Japan and Korea – have also experienced higher TFP movements than lower-income countries since 1985.

Malaysia, one of the higher middle-income countries, has experienced TFP movements at about 50% of the US level since 1985. It is evident that Malaysia's TFP distance from the frontier is farther than that of the high-income countries.

The TFP gap of Indonesia, another higher middle-income country, was relatively close to the frontier (like Malaysia) before 1998. However, its TFP level dropped suddenly in 1998, and the widened TFP gap has not shrunk significantly since then. Thailand is also categorised as a higher middle-income country, and experienced a similar movement of TFP to Indonesia, even though the drop in the TFP level was more moderate than that of Indonesia.

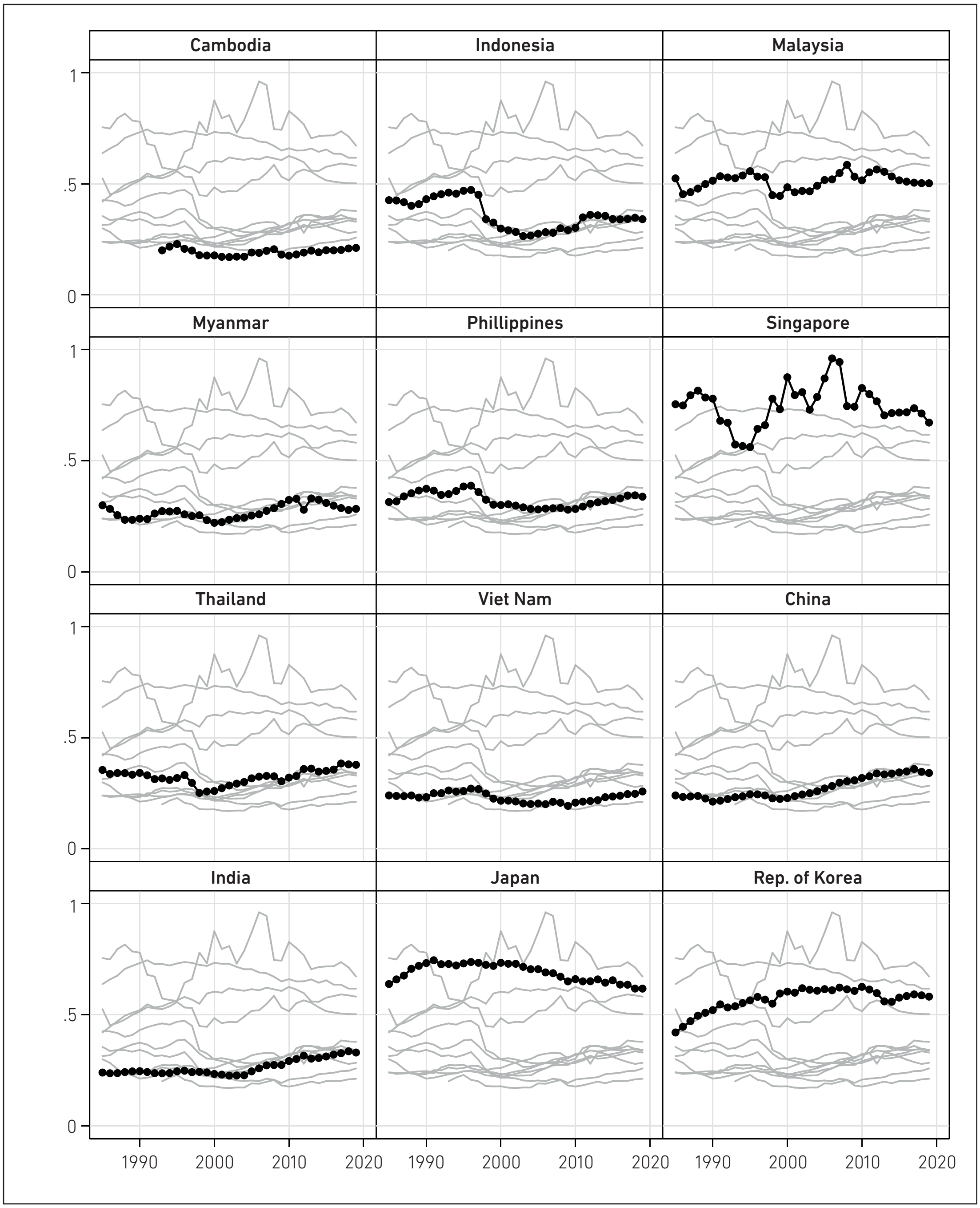
China, the last higher middle-income country, was a low TFP country in East Asia. However, the TFP level started moving towards the frontier around 2000. The current TFP level is close to the frontier, at almost the same level as Indonesia and Thailand.

India experienced a similar movement pattern of the TFP gap to that of China. India's TFP remained at a very low level before 2005. However, TFP started moving towards the frontier in 2006, and the TFP level is slightly lower than that of the higher middle-income countries.

Myanmar follows India in terms of the recent distance of TFP from the frontier. Viet Nam follows Myanmar – its TFP level is low, but the recent movement of the distance to the frontier has started shrinking steadily. Cambodia's TFP remains the lowest amongst the countries examined here since the 1990s.

Taken together, while some of the lower and higher middle-income countries show signs of a trend towards a decreasing TFP gap, many of them remain at a significantly lower level.

Figure 8.2 TFP Level at Current PPP Since 1985 (US = 1)



PPP = purchasing power parity, TFP = total factor productivity, US = United States.

Source: University of Groningen, Groningen Growth and Development Centre (n.d.).

TFP, Innovation Capability, and the Advantage of Backwardness

So far, we have explained the importance of TFP for improving economies' living standards. We defined TFP as a productivity parameter in terms of using both physical and human capital. As we mentioned, TFP is not observable. In the growth theory context, TFP is a 'measure of our ignorance' (Abramovitz, 1956: 11) in the sense that a large portion of economic growth and income level cannot be accounted for by directly measurable physical and human capital inputs. Although it is impossible to measure directly, growth theory provides a way to gain economic insights from TFP – the stock of technology available to produce output with physical and human capital inputs. Now, the production function (Equation 1) implies that products and services are generated by a combination of technology, physical capital, and human capital.

In the economic growth theory context, the stock of technology is also called the stock of codified knowledge or ideas. A typical example is scientific knowledge. Product blueprints and food recipes are familiar examples. People can access and use technology without preventing other people from using it.[6] In contrast, human capital is implicit knowledge because it can only be used by the person who has (learned) it in their brain, and other people cannot use it. Technology at its frontier is the worldwide stock of codified knowledge.

Technology is codified knowledge. It follows that technology would be available anywhere in the world because of its nature. However, as seen above, there are significant differences in TFP levels between low- and high-income countries. Moreover, some countries have caught up or moved towards the frontier, while others are far from the global frontier. These results imply that the existence of technology is different from the utilisation of technology. In other words, an economy's available technology stock can be different from the technology frontier. Additionally, its capability of adopting or adapting to the stock of technology can be different amongst economies.

Innovation, the theme of this chapter, is an increment in the utilisation of technology. More concretely, a particular economy's innovation is defined as implementing the technology stock that the economy has not utilised to provide new products and services (product innovation) or improve productivity in providing existing goods and services (process innovation).[7] Thus, the innovation capability of a particular economy refers to the capability

[6] In economics terms, it is called non-rivalry.

[7] The Oslo Manual (OECD/Eurostat, 2018: 20) defined it thus: 'an innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)'. Note that the Oslo Manual is an international reference guide for national statistics organisations in charge of measuring innovation or people interested in innovation study.

of implementing new technology. It should be noted that generating new technology (codified knowledge) is an invention, not innovation.[8] Innovation is the implementation or deployment of new technology in the economy.

The capability for innovation determines the technology level available in an economy. Further, there is an 'advantage of backwardness' for less advanced economies. We show the reason for those claims by using a mathematical model of technology differences across economies.[9] Suppose there is a particular economy, country i, with its technology stock less than the frontier.

$$\Delta A_{i,t} = \sigma_i(A_t - A_{i,t}) + \lambda_i A_{i,t}\,, \tag{8}$$

where A_t is the stock of technology at the global frontier, $A_{i,t}$ is the stock of technology available in country i (national frontier), and $\Delta A_{i,t}$ is an increment in country i's technology from t to $t+1$. The technology absorption parameter σ_i takes a positive value and stands for country i's capability of absorbing advanced technology that exists outside the country but which the country did not have. Meanwhile, the country can innovate on its own based on its stock of technology at the rate λ_i. The term $\lambda_i A_{i,t}$ can be interpreted as completely new technologies that go to part of the next-period global technology stock,[10] A_{t+1}, or already existing technologies in the global stock, A_t. We assume that λ_i takes a positive value that is less than the technology growth rate at the frontier, g. Rearranging Equation 8, one has

$$(1+g)\Delta a_{i,t} = \sigma_i - (\sigma_i + g - \lambda_i)a_{i,t}\,,$$

where $a_{i,t}$ is the ratio of country i's technology stock to the frontier technology stock, $A_{i,t}/A_t$. This dynamic equation implies that there exists a steady state of country i's relative technology ratio, such that

$$a_i^* = \frac{\sigma_i}{\sigma_i + g - \lambda_i}\,. \tag{9}$$

This solution shows that even if a particular economy cannot increase its technology stock by itself, or $\lambda_i=0$, only if the absorption parameter is positive, the economy's technology grows at the frontier growth rate g. Further, Equation 9 indicates that a particular economy's technology stock ratio compared with the frontier technology stock depends on its capability of absorbing advanced technology from outside the economy

8 It should also be noted that for advanced economies producing at the frontier, the creation of new technology means innovation since the implementation of the created new technology is interpreted to happen simultaneously.

9 See Acemoglu (2009: 611–47) for more details on this model.

10 In this simple model, even in that case, $\lambda_i A_{i,t}$ will not affect the dynamism of A_t (the global technology stock is assumed to be exogenous).

and its capability of innovation by itself based on its technology stock. This finding also shows that even if $\lambda_i=0$, when σ_i is large, the relative technology stock ratio can be close to one. These phenomena can be called the advantage of backwardness, which cannot be expected for advanced economies producing at the global frontier.

As we have seen above, most AMS have significant gaps with the global technology frontier. Generating completely new technologies and implementing them is important to reduce the gap. However, if AMS cannot leverage the advantage of backwardness, it is almost impossible for them to catch up with the global frontier quickly. The next section discusses possible determinants of innovation capability, mainly through technology adoption.

Macro-Level Innovation Capability as an Aggregation of Firm-Level Innovativeness

Until the previous section, we depicted an economy as one large firm that produces output (GDP) by using the whole economy's physical capital and human capital resources. Here, we break down the macro-level innovation capability into an aggregation of individual firms' innovativeness. Not unexpectedly, firms are diverse in terms of available technology and innovativeness. To make the story simple, products and services (Y) are created by combining available technology (A) and labour input (L). As shown below, the macro-level available technology can be expressed as the weighted average of an individual firm's available technology (A_j): [11]

$$A = \frac{Y}{L} = \frac{\sum_j Y_j}{\sum_j L_j} = \sum_j \left(\frac{L_j}{\sum_j L_j}\right)\frac{Y_j}{L_j} = \sum_j w_j A_j \text{, where } \sum_j w_j = 1 \,. \tag{10}$$

Further, for simplification, we assume that there are two types of firms: national frontier firms (NF) with higher available technology and national lagger firms (NL) with lower available technology. Equation 10 becomes

$$A = w_{NF}A_{NF} + w_{NL}A_{NL}\text{, where } A_{NF} > A_{NL} \text{ and } w_{NF} + w_{NL} = 1. \tag{11}$$

Equation 11 implies that there are two ways to increase the macro-level available technology: a rise in an individual firm's available technology (a rise in A_{NF} or A_{NL} or both) and a rise in the weight of the NF firm (a rise in w_{NF}). The former is called a within-firm effect, and the latter a composition effect (Bartelsman and Dhrymes, 1998). The latter effect is important in the sense that the discussion based on the macro production

[11] This input-based weighted average of individual productivity (available technology) is adopted by Bartelsman and Dhrymes (1998), although it is not exactly the same definition. The output-based weighted average is also often used in the literature (e.g. Foster, Haltiwanger, and Krizan, 2001).

function until the previous section did not explicitly deal with the effect. The composition effect can be considered as the extent to which an economy efficiently allocates its economic resources across firms in the economy.

Similar to the macro-level technology adoption modelling in the previous section, we introduce globally innovative firms, called global frontier firms (GF), which run businesses at the global frontier by fully utilising the globally available stock of technology. Then, from GF to NF and/or NL, technology diffusion (or transfer) can occur through the NF and NL learning and/or imitating activities to catch up to the frontier. The empirical literature regarding technology diffusion has studied the extent of the within-firm and composition effects for countries; and Andrews, Criscuolo, and Gal (2015) showed the following findings based on a cross-country firm-level data set for the Organisation for Economic Co-operation and Development (OECD) countries:[12]

1. There tends to be an order of technology diffusion amongst GF (the highest firm group in productivity in the data set), NF, and NL. First, advanced technologies diffuse from GF to NF. After that, the technologies transfer from NF to NL.
2. The macro-level productivity gap between countries tends to be accounted for by not the within-firm effect but the composition effect. Specifically, the gap between GF and NF is relatively small, but the weight (or scale) of NF, compared with GF, is small in lower productivity countries.
3. GF, compared with non-GF, tend to have the characteristics of operating on a larger scale, generating more profits, having a younger age, being part of multinational conglomerates, and being more patent-intensive. GF selection is very competitive. Around half of them drop from the GF group after a year, and less than 15% can keep the GF position after 5 years.
4. The within-firm productivity gap between GF and NF tends to decrease when the quality of education systems is higher, R&D tax subsidies for small and medium-sized enterprises (SMEs) are more generous, and there is more R&D collaboration with universities. The gap also tends to decrease when venture capital is abundant. Regarding patent protection, there is non-linearity between its extent and the gap. The stronger the protection, the smaller the gap when the industry is more R&D intensive. Meanwhile, stronger intellectual property rights protection leads to a larger GF–NF gap when the industry is more entrepreneurial (having a higher firm turnover rate).
5. The composition (scale) gap between GF and NF tends to decrease when employment protection is less strict, administrative burdens on start-ups are lower, business closing (bankruptcy) costs are lower, and R&D tax subsidies for SMEs are not more generous.
6. The within-firm productivity gap between NF and NL tends to decrease when product market regulations are less strict, employment protection is less strict, and R&D collaboration with universities is higher.

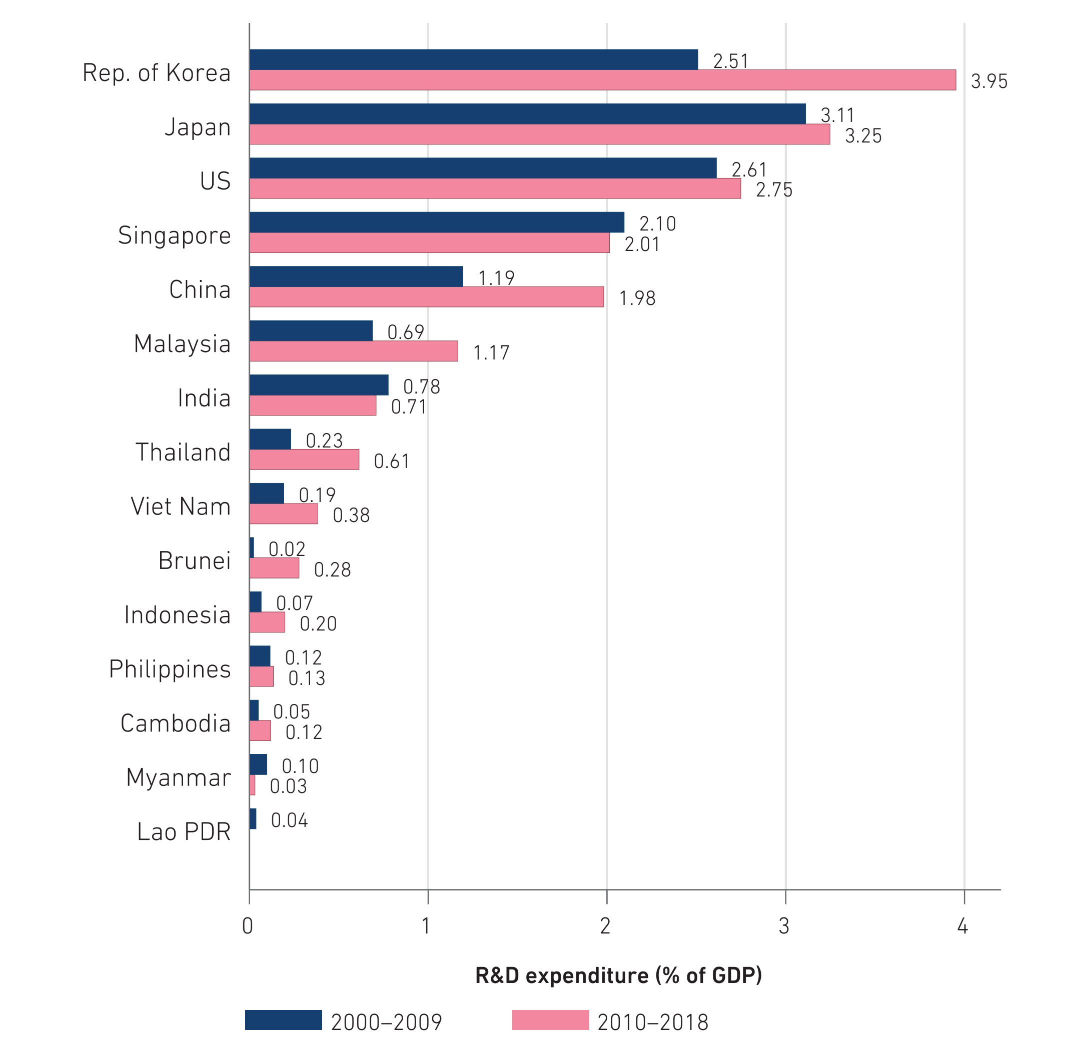
[12] The data set covered non-farm to non-financial industries from 2001 to 2009.

Note that these findings are based on OECD countries – high-income countries – but there are similar findings in the literature. For example, Iacovone and Crespi (2010) used firm-level data for Mexico, a middle-income country, and found that Mexican firms tend to catch up with the national frontier more quickly than the global frontier.

We can take many lessons from the above findings. First, if we want to improve the innovation capability of NL, we should take measures to increase NF innovativeness at the same time (Finding 1). In other words, fostering global-level firms in a country, even if there are not many, can positively affect other national firms. Second, to cultivate global-level firms, we should prioritise stimulating entrepreneurship, attracting FDI for global innovative firms, improving the education system, promoting R&D activities, encouraging UIC in R&D, and setting up an appropriate intellectual property rights system (Findings 3 and 4). Third, we need to reduce the share of inefficient, incapable firms to gain macro-level innovation capability (Finding 2). To do so, we should balance employment regulations with lower administrative burdens on entrepreneurs (Finding 5). Last, to help less capable national firms to catch up, we should keep product market regulations and employment protection lenient and promote UIC in R&D (Finding 6). We need to keep these findings in mind when planning innovation policies.

Several findings of Andrews, Criscuolo, and Gal (2015) have indicated that R&D activities play an important role for national firms in catching up to more innovative firms. R&D activities are considered to contribute not only to discovering completely new knowledge or the technology and innovation based on it, but also imitating or adopting technologies generated by others (Griffith, Redding, and Van Reenen, 2004). Even for imitation, some tacit knowledge is required, and it is difficult to be codified or obtained without investigation. Let us examine some data to see the status of AMS R&D activities. Figure 8.3 shows R&D expenditures as a percentage of GDP for AMS and East Asian countries. According to the figure, the R&D expenditures of many AMS have been very small, even taking into consideration the small size of their economies. AMS R&D expenditures as a percentage of GDP have been less than 1% on average since 2000. Although most AMS increased their scale of R&D from the 2000s to the 2010s, the scale of R&D in AMS except Singapore and Malaysia was significantly smaller than that of advanced economies. Of course, firms' innovation activities are not limited to R&D, and R&D tax incentives for SMEs may cause a negative impact on national innovation capability through composition effects (Finding 5). However, we should keep in mind that all AMS struggling with the middle-income trap have significantly lower R&D expenditure rates than high-income countries.

Figure 8.3 R&D Expenditures by AMS and East Asian Countries
(periodic average, % of GDP)



AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations, GDP = gross domestic product, R&D = research and development, US = United States.

Source: World Bank (2022), World Development Indicators. https://databank.worldbank.org/source/world-development-indicators (accessed 23 February 2022).

To conclude this section, we underscore the significant potential impact of reducing the number of inefficient firms. In fact, there is a significant capability gap between large-scale companies and SMEs in middle-income AMS compared with advanced economies (OECD, 2021). Additionally, OECD (2021) pointed out that one of the explanatory factors for the productivity gap is the FDI in large firms in AMS from advanced economies. More concretely, the FDI enables large firms to access productivity-enhancing technology and resources. These facts suggest that for middle-income AMS to catch up to advanced economies in terms of technology, they need to enhance the innovation capability of indigenous firms. Furthermore, while increasing entry and exit rates, incubating innovative entrepreneurs, or start-ups, is significant.

Characteristics and Adoption of Digital Technology

In the previous section, we discussed macro-level innovation capability through the lens of the adoption of non-specific technologies – technologies in general terms. Here we focus on digital technology adoption. As pointed out by Kretschmer (2012), digital technology, or ICT, has a unique property compared with other technologies as it impacts a wide range of industries and economic activities. Due to these characteristics of digital technology, it is considered a GPT, coined by Bresnahan and Trajtenberg (1995). Bresnahan and Trajtenberg set forth three more concrete characteristics that GPTs need to have:

1. Pervasiveness – GPTs must be utilised in almost all sectors.
2. Improvement – the cost of GPTs must continuously decrease as time passes.
3. Innovation spawning – GPTs must promote product and process innovations.

In the context of this chapter, the first and third properties – pervasiveness and innovation spawning – are important. As Kretschmer (2012) illustrated by taking an ICT user firm's case, firms leveraging ICT can improve their productivity by communicating speedier than before with suppliers and distributors, streamlining business processes, and reducing inventories. Further, firms can make better decisions, cut more coordination costs, and reduce the number of supervisors, through more prompt and extensive conveyance of information. In the sector of information goods (e.g. books, music, and computer software), decreased communication and replication costs have brought disruptive business model innovation to the market.

One of the reasons that the economic growth literature focuses on ICT is the macro-level productivity growth gap between the US and Europe after the mid-1990s. Both economies experienced almost the same productivity gains in the ICT-producing sectors (e.g. semiconductors and computers), but the US experienced significantly larger productivity gains than Europe in the ICT-using sectors – mainly market services, including distribution, financial, and business services (van Ark, O'Mahoney, and Timmer, 2008). Regarding these findings, Bloom et al. (2012) showed that the ICT intensity (ICT capital stock per hours worked) of the US is also significantly larger than that of the Europe, and asserted that the US firms' flexible people management practices, which are complementary to ICT capital, contribute to the ICT-using productivity gains.

Andrews, Nicoletti, and Timiliotis (2018) studied if there were significant differences in digital technology (cloud computing, enterprise resource planning, and customer relationship management) adoption rates at the industry level caused by firms' capabilities and the market environment (incentives) by using cross-country industry-level data for OECD countries. They found:

1. There is a statistically significant positive relationship between the penetration of high-speed broadband and digital technology adoption.
2. In knowledge-intensive sectors, more organisational capital such as management abilities is linked with higher levels of digital technology adoption.
3. The ICT competence level of the working-age population, the provision of ICT training (on the job or during the job), and the efficient matching of workers' skills to jobs contribute to higher digital technology adoption.
4. Three market incentives – a flexible labour market, competitive pressures, and risk capital availability – have positive effects on digital technology adoption.

From the perspective of the policymakers responsible for innovation policy, Andrews, Nicoletti, and Timiliotis (2018) gave us important insights. The first finding suggests that digital infrastructure needs to be well developed to promote digital technology adoption. While AMS continue to improve their digital connectivity, the development is uneven – with large gaps between and within countries (Chen and Ruddy, 2020). Improving digital connectivity is indispensable for AMS to leverage digital technology. The second and third findings imply that firms' internal managerial resources (management skills) and external human capital resources (ICT-skilled labour) are essential for digital transformation. Digital technology is complementary to management skills and ICT-skilled labour, so improving the quality of education from the elementary to university level is essential. The fourth finding suggests that AMS should keep developing a healthy market competition environment.

Innovation Systems Harnessing Digital Transformation

In the above sections, we saw the innovation capability gap between advanced economies and AMS which struggle with the middle-income trap, and discussed the significance of the adoption of technology from the global frontier and the essential factors for promoting the adoption of technologies, especially digital technology. In the last section, we discussed policy implications from a systematic view of innovation at a macro level (country or economy) by considering several actors related to innovation activities in the economy – incumbent firms, start-ups, universities, and public research institutes.

In the literature, the systematic view of innovation at the macro level is called a 'national' innovation system (Freeman, 1987).[13] However, as Soete, Verspagen, and ter Weel (2010) pointed out, the 'national' concept may have been undermined because an innovation

[13] The concept of a national innovation system was established in the late 1980s by Christopher Freeman based on a study of Japan's miraculous post-war growth (Soete, Verspagen, and ter Weel, 2010).

system is shifting from a national one to an international one.[14] In contrast to each nation's domestic efforts in research and knowledge accumulation, worldwide economic growth since the 1990s has been brought about by an acceleration in technology diffusion across countries. The rapid spread of ICT globally has undoubtedly contributed to more rapid penetration of leading technologies. Although we consider that a 'national' factor still plays a significant role in macro-level innovation capability, we are also of the opinion that the point raised by Soete, Verspagen, and ter Weel is reasonable. Thus, to avoid giving an impression of exaggerating 'national' borders in innovation activities, we call what the existing literature calls a national innovation system simply an 'innovation system'.

The word 'system' implies networks or structured processes for accomplishing a particular purpose where several actors interact with each other. Accordingly, an innovation system is composed of networks or structured processes promoting innovation at an aggregate level where many actors at a micro level interact. In this chapter, we follow the definition of an innovation system presented by Kimura, Wong, and Ambashi (2019: 33): an innovation system is 'a continuous process of systemic change facilitated by government policies (at central and local levels), where institutions, learning processes, and networks play a central role in generating technological advancement and innovation via the intentional, systemic interactions between various components such as universities, institutions, the private sector, and investors'.

Kimura, Wong, and Ambashi (2019) illustrated the interactions between actors in an innovation system (Figure 8.4). As the figure shows, universities and public research institutes (PRIs) play an important role in innovation implemented by incumbent firms and start-ups. They provide trained R&D personnel and technologies to incumbent firms. They also carry out joint R&D with incumbent firms. In addition, they transfer technologies and technology talent to start-ups. Universities and PRIs advance technology and knowledge diffusion in an innovation system.

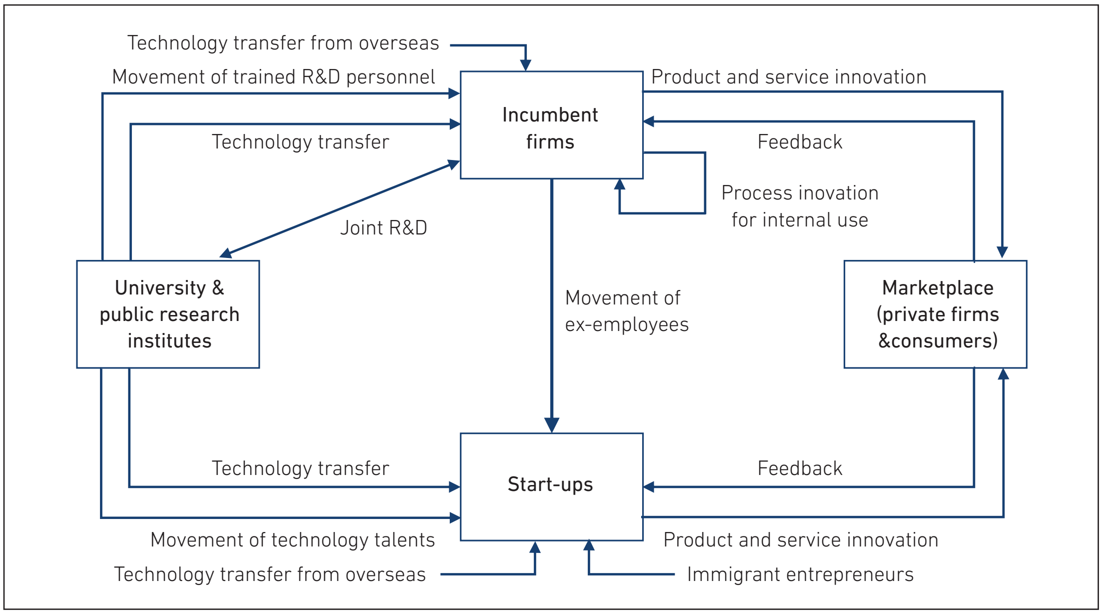
As mentioned in Box 1, during the second unbundling of globalisation, technology transfer from overseas is an important source for incumbent firms to improve their innovation capability. This improvement channel is not only through FDI but also through transactions with advanced foreign firms. Ueki (2020) showed that multinational firms brought technology transfer to Southeast Asian countries both through their subsidiaries and through inter-firm relationships between multinational firms and local firms (e.g. customer–supplier relationships). In addition to the external technology transfer, incumbent firms can carry out process innovation for internal use through learning

[14] As another reason that the national concept has been challenged, Soete, Verspagen, and ter Weel, (2010) asserted the increasing importance of innovation without industrial research, typically in the knowledge service sectors. The old view of innovation systems was based on a simple dichotomy – innovation happens in professional R&D laboratories via R&D and/or learning activities, while production and distribution activities are not relevant to innovation and play a simple role of cost minimisation and sales maximisation. In contrast, what is happening now is more digital-based efficiency improvements and more service-related activities, such as in the financial sector, wholesale/retail sectors, healthcare, education, government services, and business operations.

by doing. Product innovation by incumbent firms is brought about both through R&D activities directed by management and through 'intrapreneurship' – activities performed by employees, motivated by employee entrepreneurship.[15] New products and services created by incumbent firms are provided to consumers through the marketplace, and the incumbent firms build innovation capabilities through success or failure in the market and consumer feedback.

For start-ups, in addition to universities and PRIs, domestic incumbent firms and overseas entities are parts of knowledge and human resources of innovation. A new start-up is founded by university scientists (university channel), ex-employees (incumbent firm channel), or immigrants (overseas channel). Of course, unemployed people may also establish a start-up. A start-up founded by ex-employees can be independent from their ex-employer (independent start-ups) or dependent (spin-offs). Start-ups play a very important role in product innovation: not only do they discover business opportunities through scientific advancement, but they also do so through internal information (e.g. successes or failures in the market and customer feedback) as well as exogenous changes (e.g. demographic transitions, shifts in consumer perceptions, and changes in government regulations or market conditions) (Fukugawa, 2018).

Figure 8.4 Illustration of Interaction Between Actors in an Innovation System



R&D = research and development.

Source: Authors based on Kimura, Wong, and Ambashi (2019).

[15] Fukugawa (2018) gave the following examples of intrapreneurship: SR-71 (Lockheed Martin), the Post-It (3M), Elixir (Gore), the VHS (JVC), autofocus (Konica), the digital camera (Casio), the plasma display panel (Fujitsu), and the PlayStation (Sony).

Although the role of the government is not shown in the figure, as mentioned in the definition of an innovation system, the government organises the entire system of innovation and facilitates dynamic and interactive innovation processes through policies. The remainder of this section discusses important recommendations and the role of government in an innovation system, harnessing digital transformation in emerging AMS economies.

Shift some weight from 'incremental innovation' to 'disruptive innovation' and leverage the 'advantage of backwardness'

An important recommendation drawn from the discussion about the third unbundling and latecomer advantages and disadvantages in Box 1 is that AMS should shift some weight from 'incremental innovation' to 'disruptive innovation', and leverage the 'advantage of backwardness'. The discussion of the third unbundling in Baldwin (2016) implies that digital transformation will dramatically decrease the cost of the movement of people via virtual means. Further, this digital transformation has the potential to drastically change existing products and services.

The third unbundling is brought about by further advancement in ICT than we saw in the second unbundling. ICT comprises IT and communication technology (CT) (Kimura, Shrestha, and Narjoko, 2019). AI, robots, data processing, and machine learning are examples of IT that can be used for everything from marketing, research, design, and industrial processing to inventory management.[16] CT refers to technologies that connect people even if they are far away from each other – exemplified by the internet, smartphones, and the 5G network. CT promotes the local and international division of labour as well as the dispersion of economic activities. Significant decreases in business-to-consumer (B2C) and consumer-to-consumer (C2C) transaction and communication costs create new businesses. Accordingly, IT and CT will be adopted in and spread to most sectors.

For instance, Kimura, Shrestha, and Narjoko (2019) pointed out that advancement of the adoption of ICT may change traditional sectors, including the agricultural sector. Using smartphones, farmers can obtain accurate information about markets, soil quality, and weather, as well as use sensors to monitor their crops and sell directly to customers over the internet. By reducing waste, improved inventory management will reduce the cost of manufacturing and distributing perishable agricultural goods. Self-driving tractors may also be used by farmers to harvest crops more swiftly and effectively. This example tells us that the advancement of ICT adoption in the third unbundling will bring about intrinsically more 'disruptive' than 'incremental' innovation as ICT adoption completely

[16] Box 2 summarises the introduction to Ing and Grossman (forthcoming).

transforms existing industries. Taking the same agricultural example, farmers, firms that produce agricultural equipment, or start-ups that provide ICT solution services to other sectors may create a new agricultural production system. Consequently, AMS need to acknowledge that it is inevitable to shift some weight to 'disruptive innovation' from 'incremental innovation', which had been carried out through FDI and learning through transactions with advanced firms. Many AMS still have technology utilisation gaps, but this means that there is ample room for exploring the 'advantage of backwardness', which enables economies to grow quickly by catching up with and even leapfrogging to a higher development stage.

Regarding disruptive innovation for emerging economies as latecomers, Kimura, Wong and Ambashi (2019) asserted that 'creative imitation' is increasingly important. Creative imitation is an innovative activity whereby latecomers attempt to partially imitate and adapt new goods and services from abroad to meet the needs of the local market, or to produce lower-cost variants to be competitive in price-conscious markets. This innovation strategy is efficient since latecomers do not need to compete directly with first movers, as described in Box 1. This kind of innovative imitation is what China accomplished during most of its catch-up period, even though observers from developed countries have often referred to copycats or intellectual property pirates. However, they are not necessarily exact replicas and often include some degree of originality. For instance, Baidu, a Chinese search engine, did not just replicate Google by offering better internet search tools in the Chinese language. It modified them to search Chinese chat sites rather than just websites. As an additional advantage, creative imitation activities require minimal R&D or patenting. Ideally, as emerging markets climb up the technological ladder, the proportion of creative components relative to imitation components will rise. Middle-income AMS should recognise the importance of creative imitation and take measures to promote it. Creative innovation is mentioned again below.

In encouraging disruptive innovation, it is notable that start-ups play an important role. Sauermann (2018) showed that based on a survey of US R&D employees, start-up employees are more productive in patent applications (a measure of innovation) than incumbent firm employees. Additionally, start-up employees are more motivated, especially in terms of taking risks. Kimura, Wong, and Ambashi (2019) referred to a study showing that the significance of start-ups has been the primary engine of innovation, particularly in areas such as e-commerce mobile apps, fintech, and the internet of things. To foster start-ups, entrepreneurship education programs have a substantial positive effect on students' entrepreneurial involvement (Ho, Low, and Wong, 2014). Therefore, strengthening university education, especially computer engineering and entrepreneurship management programmes, is recommended for many AMS.

Further, one of the policy tools to promote innovative start-ups is the US Small Business Innovation Research (SBIR) program. The SBIR program started in 1982 to generate innovative start-ups by subsidising R&D from the conceptual stage and fostering start-ups by supporting commercialisation. The SBIR program comprises three phases. In the first phase, the government bodies participating in the SBIR, such as the Department of Defense and the Department of Health and Human Services, grant or contract with start-ups for concept development or an early stage of R&D. Each start-up granted SBIR funds will receive $50,000–$250,000 for 6 months to 1 year to support R&D. In the second phase, the government bodies subsidise the start-ups that succeeded in their conceptual research to proceed to the next stage of prototype development. The start-ups generally receive $750,000 for 2 years. In the third phase, the government bodies no longer fund start-ups that succeeded in the second phase, but they support their commercialisation and contracting government bodies procure new products or services from them.[17] Lerner (1999) showed that the start-ups awarded SBIR subsidies experienced higher growth than other firms and more of them attracted venture financing. Additionally, Siegel and Wessner (2012) revealed that the university-based SBIR start-ups experienced better performance than the other start-ups. Amongst AMS, Singapore has a similar programme – Startup SG.[18] For the other AMS, the SBIR program is helpful in considering how to promote innovation by start-ups.[19]

Strategically compete with existing advanced digital platforms

As discussed in Box 1, the current global digital platforms (e.g. Apple, Google, Facebook, and Amazon) enjoy first-mover advantages in a winner-takes-all game. In the context of economics, a platform business such as those digital platforms is called an intermediary in two-sided markets. 'Two-sided' means that the intermediary (platform) has two (or more) groups of users, and when the number of one group increases, the value of the platform to the other group increases (positive externality or network effects), and vice versa (Rysman, 2009). What are the differences between one-sided (non-platform business) markets and two-sided markets? Here is an example of retail businesses. In the case of traditional retail businesses, consumers buy goods directly from a brick-and-mortar retailer (the retailer purchases and stocks goods and sells them to consumers). This is a one-sided market. Meanwhile, in the case of e-commerce platform businesses (e.g. Amazon), consumers purchase goods from suppliers through a virtual marketplace provided by a platform. When the number of consumers increases, the platform becomes

[17] For readers interested in more detail on this subject, see SBIR (n.d.).

[18] See Startup SG (n.d.).

[19] The Government of Japan introduced an R&D subsidiary program for SMEs in 1999, but unfortunately positive policy effects such as speeding up SME growth were not observed (Inoue and Yamaguchi, 2017). Reviewing the program, the government found that there was not enough support for investment in technological seeds and supporting commercialisation, including utilising public procurement. Based on that, the government introduced a new SBIR program reinforming those problems in June 2021. Japan's experience could also be helpful for AMS.

more valuable to suppliers because they can sell their goods to more people through the markets, and vice versa. This case represents two-sided markets.[20] An intermediary of two-sided markets can be considered a monopolist because the intermediary can block the access to its members from other industries, and it competes with other platforms aggressively to enjoy the monopolistic position. Considering the above example, the e-commerce platform businesses compete by imposing no costs on consumers. The winning platform can enjoy a monopolistic position against suppliers and imposes high costs on suppliers to use the platform.

In addition to two-sidedness, economies of scope and scale in data intensify the monopolistic position of first-mover platform firms. Intrinsically, two-sided markets play a role of matching two groups, exemplified by a marketplace matching consumers and suppliers. In digitalised economies, how efficiently platforms can utilise data – in the retail example, how efficiently they can match consumers and suppliers – determines who will win the game. To maximise network effects, platforms require and invest in ambiguous and probabilistic matching technology (Martens, 2020).[21] Economies of scope in data – meaning more variables of data (e.g. consumer profiles and locations) – lead to more efficiency in probability matching. Economies of scale in data – meaning more observations (e.g. the number of consumers collected) – lead to more efficiency in probability matching. Economies of scope and scale in data intensify the monopolistic positions of existing platforms that have already collected a large number of observations and variables. Further, Marten pointed out that algorithms enhance the value of data through a feedback mechanism based on improved predictions and learning by doing. Using these data-driven network effects, global platforms expand their business to new sectors. Simply put, global platforms are incredibly powerful competitors for latecomers. For incumbent firms and start-ups in emerging economies to enter and grow in the markets, AMS need strategies.

To foster local firms in the digital economy, AMS should take into consideration the above first-mover advantages of existing platforms. To this end, it is necessary to support local firms, but governments should not simply help underperforming local firms. It is not rare that local firms fail to improve their market performance despite government assistance. When governments support local firms, they should keep in mind that the market discipline and autonomy of the public sector are important for the success of innovation policies (Cherif and Hasanov, 2019). This point is related to the next recommendation. For local firms and start-ups, creative imitation is an effective strategy to compete with advanced

[20] Readers may think that a traditional brick-and-mortar retailer also has two-sided market properties because a greater number of consumers makes a retailer more attractive to suppliers, and vice versa. Regarding this point, Rysman (2009) said that although all markets have two-sided properties to some extent, whether a market is two-sided is determined by how important the market's two-sidedness (cross-group network effect) is. In the case of a traditional retailer, potential consumers are usually limited to the local area, and the network effect benefitting suppliers is limited. Meanwhile, an online shopping site does not exclude consumers living far from the firm providing the service within the range of logistics availability. In this case, its network effect is significant.

[21] Meanwhile, unambiguous matching requires neither a various nor a large number of observations. For example, matching a consumer who wants a particular product and a supplier that produces the product does not require other consumers' purchasing data.

platforms. For AMS governments, it is essential to support local firms by building the ICT capacity of workers and strengthening the technology diffusion function of universities and PRIs. Further, the governments should develop and maintain a healthy market environment with a flexible labour market, competitive pressures, and the availability of risk capital.

Foster frontier firms in 'sophisticated' industries through 'competition-friendly' policies

In the previous recommendation, we referred to Cherif and Hasanov (2019), who studied the industrial strategies of the Asian Miracles compared with those of the middle-income countries. They concluded that the success of the Asian Miracles is not due to luck, but is the result of implementing a Technology and Innovation Policy (TIP). As a result, the Asian Miracles achieved sustainable high growth by working on an ambitious TIP for decades.

Cherif and Hasanov (2019) presented three approaches to a TIP: (i) the highest gear is the moonshot approach, where governments intervene to remove obstacles to domestic firms investing in 'sophisticated' industries for sustained long-term growth (correction of market failure); (ii) the middle gear is the leapfrog approach, which refers to industrial policies to attract FDI based on comparative advantages; and (iii) the low gear is the snail crawl approach, which is limited to the correction of government failures such as high inflation, unnecessary regulations, uncertain property rights, and other economic distortions by governments. They defined 'sophisticated' products or services as ones that have positive effects on the tradable sector in terms of productivity gains by using them and spillovers through a feedback loop between the two sectors. Sophisticated industries are R&D and patent intensive, exemplified by electronics, machinery, pharmaceuticals, aerospace, transport equipment, software, IT, and science and technical services.

Cherif and Hasanov asserted that the governments of the Asian Miracles set extremely ambitious goals to catch up quickly with advanced economies in terms of both technology and the economy. They summarised the four governments' TIP characteristics as follows: (i) interventions to build new capabilities in sophisticated and tradable industries beyond their current capabilities; (ii) emphasis on export promotion; and (iii) fierce competition in domestic and foreign markets and strict accountability (no unconditional government assistance and no support without fierce competition amongst domestic and foreign firms). Based on the above considerations, Cherif and Hasanov claimed that the economic success of the Asian Miracles was dependent on their moonshot approach. They also argued that the reason that Malaysia has not moved into the high-income country group is because it implemented the snail crawl and leapfrog approaches rather than the moonshot approach.

What we can draw from their study is that AMS governments should take actions to create firms in sophisticated industries to overcome the middle-income trap and to accomplish sustained long-run growth. To this end, governments should be careful about not depending on the unconditional support of local firms and start-ups, but should keep the market competitive and impose strict accountability. Studies other than Cherif and Hasanov (2019) have also claimed that industrial policies that prevent competition and pick winners (and select losers) to support infant industries are inefficient both theoretically and empirically. Aghion et al. (2015) advocated for 'competition-friendly' industrial policies – providing subsidies or tax holidays to competitive sectors (not picking up winners) and strengthening market competition by encouraging the entry of young firms.

Other recommendations for building innovation systems

We conclude this chapter by mentioning other recommendations to build innovation systems by referring to the policy options presented by Ambashi (2018).

The first one is establishing a government organisation to oversee and coordinate the formulation and implementation of innovation policies across several government departments. Even though some AMS have a government organisation responsible for innovation policies, most of them are not comprehensive or systematic. Singapore is an exception. The Government of Singapore's Economic Development Board has consistently promoted technical development, infrastructure, public services, and the provision of incentives and subsidies for FDI. The Economic Development Board's effective management and coordination, in cooperation with the Agency for Science, Technology, and Research (A*STAR), led in the establishment of the biomedical sciences cluster. International pharmaceutical firms, biomedical local firms, start-ups, and venture capital have been promoted. R&D collaboration between universities and the healthcare services sector has been stimulated. AMS should review their own government organisations and move towards establishing ones that can control and coordinate innovation policies.

Second, AMS governments should encourage the private sector, including local and international firms, to spend on R&D for innovation via suitable monetary incentives. To promote R&D via incentives, AMS governments need to assist private firms and PRIs in commercialising their innovations. It is an attractive option to establish specialised PRIs whose primary mission is to conduct R&D and provide technical assistance for commercialising various types of innovation. Local firms often face barriers at the commercialisation stage because of lack of knowledge and expertise. A*STAR in Singapore and Fraunhofer-Gesellschaft in Germany may serve as models.

Last, AMS governments should establish a conductive innovation ecosystem which includes universities, government research institutions, and the business sector. UIC is an important component of innovation ecosystems that foster technological diffusion and knowledge spillovers, and it plays a critical role in many industrialised nations' innovation systems. UIC happens when universities offer consultancy services and licence their technology to industry, collaborate on research projects with them, and foster academic entrepreneurship such as spin-offs and start-ups in exchange for getting research funding from them. As mentioned above, the SBIR program in the US has created university-based start-ups which grow faster than other start-ups. It is worth mentioning that UIC may contribute to regional development efforts spearheaded by local governments. As such, AMS must foster UIC as a viable tool capable of not only enhancing university-based discoveries but also disseminating and commercialising them for the private sector via close regional collaboration. To seize these possibilities, rules and procedures to accelerate UIC must be developed, such as those found in Japan's Basic Law for Science and Technology (1995), Japan's Technology Licensing Organization Law (1998), and the US Bayh-Dole Act (1980). AMS should use these legislative and institutional changes to spread UIC best practices.

Box 1 Latecomer Advantages and Disadvantages in Digital Transformation

For firms in late-industrialising economies to catch up rapidly through innovation, it is not enough to know about the innovation resources such as human capital and accumulated knowledge stocks. It is necessary to know their advantages and disadvantages as latecomers. Compared with early movers (leading companies in industries), latecomers have the following advantages and disadvantages (Wong, 1999). Wong's study was based on the experience of Japan and newly industrialised economies in East Asia, but the concept is still useful as a starting point to discuss what will be changed by the current trend of digitalisation.

The first advantage is that latecomers do not incur the sunk costs that first movers do. When first movers invest in an asset to serve existing customers, they suffer from switching costs in adapting to significant shifts in consumer taste, whereas latecomers have no switching costs to serve new customers.* The second advantage is the same as the first, replacing consumer taste with technology. When a shift in the technology used to supply goods or services renders the first movers' assets obsolete, the first movers incur switching costs. The first and second disadvantages are intensified when first movers have significant organisational inertia. The third advantage is the information externality generated by first movers. Latecomers can learn from the first movers' experience. They can avoid trial-and-error costs, enjoy educated consumers, and learn from existing knowledge and expertise, which lowers latecomers' imitation costs. The fourth advantage is the asymmetric information between latecomers and first movers. Latecomers can observe and study first movers' behaviour, while the opposite is difficult.

Late-industrialising economies give latecomers the following additional advantages. The first additional advantage is the lower cost – at least initially – of a broad variety of resources for providing goods or services, such as labour and labour-intensive inputs. The second additional advantage is that the market is sheltered to some extent from firms in advanced economies. Markets in late-industrialising economies tend to be protected via government regulation or specialised local needs. These obstacles for firms in advanced economies to enter local markets enable local firms to develop their skills without being pressured by advanced firms. The third additional advantage is the amplified information asymmetry between first movers in advanced economies and latecomers in late-industrialising economies. It is likely that advanced firms outside the late-industrialising economies have difficulty gathering information on local adversary firms and their technology sources.

Latecomer Disadvantages

Next are latecomer disadvantages (or first mover advantages). The first disadvantage is the existence of consumer switching costs. First movers capture consumers at an early stage of the market. Subsequently, consumers incur costs by switching from the products or services of first movers to those of latecomers, exemplified by brand recognition and user sunk costs (the time and cost of learning about a new brand). The second disadvantage is that first movers can take pre-emptive actions. Pre-emption is an offensive action by first movers to prevent latecomers from threatening the first movers' position in the market. First movers have a competitive advantage in terms of pre-emptive strategies, exemplified by locking in key resources and predatory investment in capacity. The third disadvantage is the existence of experience or the learning curve effect. First movers have more experience providing goods and services than latecomers. Accordingly, when experience has significant positive effects on productivity (e.g. a market where cumulative research and development (R&D) or the learning-by-doing effect is crucial), first movers have competitive advantages over latecomers. The fourth disadvantage is that first movers are winners in the winner-takes-all race, exemplified in the patent race.

In addition to the generic disadvantages above, the following latecomer disadvantages are present in late-industrialising economies. The first additional disadvantage is the distance from lead users, who have a strong need for new products or services, which indicates the general demand of the future market.** Lead users typically locate in advanced economies. The second additional disadvantage is the distance from the leading sources of technology. The leading technology sources are typically advanced firms, universities, or public institutions in advanced economies. The third additional disadvantage is the scarcity of competitive advanced factors, following Porter (1990). A nation's industrial competitiveness depends on specialised factors (e.g. specific skilled personnel, infrastructure, and knowledge bases) rather than generalised factors (e.g. a highway system and general employees). An advanced private sector is considered significant in building specialised factors. For example, advanced private firms are good at investment in R&D for commercial innovation in new fields or for the needs of particular industries. These advanced private firms are typically located in advanced economies.

The table summarises the discussion above.

Generic and Economy-Specific Advantages and Disadvantages of Latecomers and Late-industrialising Economies Based on Wong (1999)

Advantages	Description
Generic latecomer advantages	
1. Sunk costs for existing consumers	When first movers invest in an asset to serve existing customers, they suffer from switching costs in adapting to significant changes in consumer tastes.
2. Sunk costs for existing technology	When a shift in technology to supply goods or services renders the first movers' assets obsolete, they incur switching costs.
3. Information externality	Latecomers can observe and study first movers' behaviour, while the opposite is difficult.
Latecomer advantages specific to late-industrialising economies	
1. Lower costs for resources	Late-industrialising economies usually have lower costs of resources, such as labour and labour-intensive inputs.
2. Sheltered local markets	Firms in advanced economies find it difficult to enter the markets of late-industrialising economies because they tend to be protected via government regulation or specialised local needs.

Advantages	Description
3. Amplified information asymmetry	Advanced firms outside the late-industrialising economies are likely to have difficulty gathering information on local adversary firms and their technology sources.
Generic latecomer disadvantages	
1. Consumers' switching costs	First movers capture consumers at an early stage of the market. Subsequently, consumers incur costs by switching from the products or services of first movers to those of latecomers (e.g. brand recognition).
2. Leaders' pre-emptive actions	Pre-emption is an offensive action by first movers to prevent latecomers from taking action to threaten the first movers' position in the market. First movers have a competitive advantage to take pre-emptive strategies.
3. Leaders' learning curve effects	First movers have more experience providing goods and services than latecomers (e.g. in a market where cumulative R&D or the learning-by-doing effect is crucial).
4. Winner-takes-all case	First movers are winners in the winner-takes-all race (e.g. patent race).
Latecomer disadvantages specific to late-industrialising economies	
1. Distance from lead users	Lead users have a strong need for new products or services, which indicates the general demand of the future market. Lead users typically locate in advanced economies.
2. Distance from advanced technology sources	Leading technology sources are typically advanced firms, universities, or public institutions in advanced economies.
3. Scarcity of competitive advanced factors	A nation's industrial competitiveness depends on specialised factors (e.g. specific skilled personnel, infrastructure, and knowledge bases). Advanced private firms, which are typically in advanced economies, are important in building specialised factors.

Source: Authors, based on Wong (1999).

What Happened to Innovation in Late-industrialising Economies from the 1990s to the mid-2010s – Globalisation and the Second Unbundling

Baldwin (2016) described how the current late-industrialising economies, many of which are AMS, have succeeded in innovation by using the concept of 'unbundling' in the context of globalisation. According to Baldwin (2016), we experienced two waves of globalisation and have been in the third wave of globalisation. The first one began in the 1820s and continued to the 1980s, characterised by significant decreases in the cost of moving goods and unbundling the combination of production and consumption. The advent of steam, diesel, gas, and electric engines significantly decreased the cost of moving goods via land and sea transportation. Before the significant decrease in transportation costs, producing and consuming goods happened at a close distance. The continuous fall in transportation costs unbundled this combination and enabled firms in one country to sell their goods in a faraway country. This 'first unbundling' globalisation provides global markets for final goods and raw materials, but for very limited intermediate parts.

The second wave of globalisation started in the 1990s and carried on to the mid-2010s, characterised by decreases in the cost of moving ideas and unbundling factories or production stages. Before the second unbundling, high communication costs prevented firms in a given country from fragmenting their production processes across other countries even if they were low-wage countries. High communication costs provided relative efficiency of industrial agglomeration, or production units gathering spatially. This agglomeration induced innovation, followed by intensified industrial competitiveness and increases in exports. That industrial competitiveness promoted agglomeration. This virtuous cycle worked well in countries that industrialised early, or G7 countries. However, the information and communication technology (ICT) revolution in the 1990s stopped this virtuous circle. The improvement in ICT significantly reduced communication costs and enabled firms in developed countries to manage and control production units in far-flung low-wage countries (e.g. efficient supply chain management). Competitive firms in developed countries moved or established production units in low-wage countries. Typically, firms went from Germany to Central and Eastern Europe, from the United States to South and Central America, and from Japan to East and Southeast Asia. Accordingly, many AMS took advantage of the second unbundling through technology transfers (innovation) from developed countries. In other words, AMS late-industrialising economies have grown by participating in international production networks – the task-wise international division of labour (Kimura, 2020) – through the comparative advantages of lower costs of labour and by accumulating a stock of advanced production technologies.

Countries that developed their economies to a high-income level before 1990 – such as the Republic of Korea (henceforth, Korea), Hong Kong, Taiwan, and Singapore – are different from other late-industrialising economies in terms of the growth path. These East Asian high-income countries built their industrial competitiveness during the first unbundling. Although they started their development with low-income advantages, they established sufficient industrial competitiveness to compete with industries in advanced economies by building agglomeration and innovation capability. For example, Korea's automobile industry entered a low-price market segment based on its low labour cost advantage. After that, the firms invested intensively in imitative R&D (Wong, 1999) and built automobile industry agglomeration in the country (Baldwin, 2016). Further, automobile firms shifted their market positions towards leading-edge segments, and some finally overtook existing leading firms by surpassing their level of R&D investment to build product and process innovation capabilities (Wong, 1999). These East Asian high-income countries are in a position, like the G7 countries, to transfer their advanced technologies to other middle-income late-industrialising countries.

Latecomers in late-industrialising economies have been able to enjoy economic growth without competing with leaders in advanced economies. As seen in the latecomer advantages and disadvantages discussion above, latecomers must endeavour not to compete directly with leading firms in advanced economies before the second unbundling. As was the case with Korea's automobile industry, latecomers have to find a market segment in which they can run their businesses without competing directly with leading firms. Meanwhile, during the second unbundling, firms in late-industrialising markets did not have to do the same things as firms did previously. Significant decreases in the cost of moving ideas allow firms in both advanced economies and late-industrialising economies to build a win–win relationship, where the former provide production technologies and the latter provide low labour costs.

Impacts of Digital Transformation on Advantages and Disadvantages in Innovation for Latecomers and Late-industrialising Economies – Future Globalisation and the Third Unbundling

Baldwin's unbundling concept asserts that we are at the beginning of the third wave of globalisation, characterised by a decrease in the cost of the movement of people. This does not mean that people move physically across borders, but that the technology of telepresence enables people to communicate as if they were present in one place. Further, telerobotics allow people in one country to inspect or repair machinery in a factory located in another country. Currently, the costs of telepresence and telerobotics are high, but they will start decreasing soon. This decrease in face-to-face costs will unbundle individual tasks performed by a group of people in a fixed location into subdivided work performed by individual people in different locations , and will bring about a people-wise international division of labour (Kimura, 2018) or the third unbundling. In this unbundled world, people's human capital is digitalised and moves easily across borders, which Baldwin calls 'virtual immigration' or 'international telecommuting'. In this digitally connected world, distance is almost nothing. We have already experienced this to some extent because of the use of telework as a social distancing measure during the coronavirus disease (COVID-19) pandemic. This teleworking experience worldwide will not change our work styles entirely, but has changed people's minds about the necessity of face-to-face communication. The experience of the COVID-19 pandemic will encourage us to move forward towards the third unbundling.

Will the digitalisation trend and the person-wise international division of labour change late-industrialising economies' advantages and disadvantages in terms of the innovation capabilities described above? Generic advantages will not change because the discussion does not depend on digitalisation or the international division of labour. What about the advantages specific to late-industrialising economies? These advantages do not appear to change, and some of them may even be intensified. Various kinds of labour in late-industrialising markets may be embedded in global value chains. At least until late-industrialising economies catch up in terms of wage levels, the cost of labour remains lower than in advanced economies. Accordingly, decreases in the cost of (virtually) moving people may strengthen the competitiveness of indigenous firms, including self-employed people, in terms of labour costs. Regarding the sheltered local market advantages, local firms are likely to retain their advantageous position at least until local markets are significantly digitally transformed. Regarding the e-commerce market in the Association of Southeast Asian Nations (ASEAN) region, for example, Chen and Ruddy (2020) pointed out that the region's internet infrastructure seems to be at a satisfactory level compared with the world average, but the internet infrastructure levels are uneven between more developed countries and less developed countries as well as between urban and rural areas. A less digitalised market makes the market less accessible for firms located far from it. Accordingly, local firms can enjoy the advantage of being first movers and can grow their business in local markets. Moreover, for the same reason, the advantage of amplified information asymmetry seems to remain.

Next, what about late-industrialising economies' disadvantages? The generic disadvantages will not be changed by digital transformation in general. However, digital transformation will intensify winner-takes-all advantages. This is evident, as famous giant digital platforms (e.g. Apple, Google, Facebook, and Amazon) are typical businesses enjoying winner-takes-all advantages. Further, Chinese platforms (e.g. Alibaba) that have been fostered in a sheltered large-scale market are now extending their businesses globally, including in the ASEAN region. Digital transformation will mitigate the disadvantages specific to late-industrialising markets. Advanced economies have a more sophisticated level of digitalisation in terms of ICT infrastructure, data security, etc. than many ASEAN Member States. This means that the disadvantages of distance from lead users and distance from advanced technology sources will no longer be problems. People or firms located in the ASEAN region can now easily access the advanced economy advantages. Of course, they need to be located in a relatively developed area in terms of ICT. Although these areas may be limited at present, digital transformation has a significant positive impact on the ASEAN region in terms of reducing late-industrialising economies' specific advantages.

Overall, the third unbundling or digital transformation provides both positives and negatives to late-industrialising economies in terms of innovation capabilities. For people and firms in late-industrialising economies, digital transformation will intensify the advantages of lower labour costs and sheltered markets. Further, it will mitigate the disadvantages of accessing advanced technology and knowledge. Meanwhile, although it is not limited to late-industrialising economies, the current first movers of advanced economies (typically US internet platforms) are more likely than ever to enjoy first mover advantages in the winner-takes-all digital economy.

* If the change in taste occurs amongst all consumers at once, first movers will quickly abandon their existing assets since these assets become useless after the change. However, if the taste changes start in a particular section of consumers, the decision to abandon the assets is difficult for first movers.
** The concept of 'lead users' was originated by von Hippel (1986).

Source: Authors.

Box 2 Robots and AI – A New Economic Era

Over the past 3 centuries, we have witnessed various technological advances that have revolutionised production methods, business organisation, and the way people work and live. More recently, we have seen remarkable advances in the availability and uses of industrial robots and artificial intelligence (AI).

Starting from the invention of industrial robots in the late 1950s, they were traded in Europe by the 1960s, in Japan and the Republic of Korea by the 1970s, and internationally afterwards. As the technology developed, faster and more sophisticated robots began to be used for a range of manufacturing processes. Likewise, the most advanced technology invention – AI – is used to describe computations that mimic human cognitive functions such as learning or problem solving. AI has improved massively in the last decade, primarily due to the invention of machine learning techniques that enable computers to have superior predictive power at substantially reduced costs.

Industrial robots, especially those that apply AI, offer perhaps the greatest scope for technological improvement and productivity gains in the modern industrial era. The potential for robots and AI to improve the quality of life is enormous. At the same time, new technologies almost always carry unintended consequences. Industrial robots, run by AI, are bound to take over a range of tasks in production and thereby displace workers in the labour market. Workers who perform tasks that can be done more efficiently by robots may see a fall in wages and a need to change jobs. Moreover, industrial robots and AI will tend to widen income inequality.

Early research on the benefits of industrial robots and AI has emphasised two potential sources of gain. First, these technological advances reduce production and operational costs. Robots can perform many tasks faster than humans and with greater precision and accuracy. AI can be used to predict problems along the production line and to leverage computation as an input to production. Second, and perhaps less obvious, industrial robots and AI can help markets to function more efficiently. Industrial robots and AI can facilitate not only trade in goods, but also trade in services.

Source: Ing and Grossman (forthcoming)

References

Abramovitz, M. (1956), 'Resource and Output Trends in the United States Since 1870', *Occasional Paper*, No. 52. Cambridge, MA: National Bureau of Economic Research.

Acemoglu, D. (2009), *Introduction to Modern Economic Growth*. Princeton, NJ: Princeton University Press.

Aghion, P., J. Cai, M. Dewatripont, L. Du, A. Harrison, and P. Legros (2015), 'Industrial Policy and Competition', *American Economic Journal: Macroeconomics,* 7(4), pp.1–32.

Ambashi, M. (2018), 'Conclusion and Policy Recommendations', in M. Ambashi (ed.) *Innovation Policy in ASEAN*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.321–30.

Andrews, D., C. Criscuolo, and P.N. Gal (2015), 'Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries', *The Future of Productivity: Main Background Papers*. Paris: Organisation for Economic Co-operation and Development (OECD).

Andrews, D., G. Nicoletti, and C. Timiliotis (2018), 'Digital Technology Diffusion: A Matter of Capabilities, Incentives or Both?', *OECD Economics Department Working Papers*, No. 1476. Paris: Organisation for Economic Co-operation and Development (OECD).

van Ark, B., M. O'Mahoney, and M.P. Timmer (2008), 'The Productivity Gap Between Europe and the United States: Trends and Causes,' *Journal of Economic Perspectives*, 22(1), pp.25–44.

Baldwin, R. (2016), *The Great Convergence: Information Technology and the New Globalization*. Cambridge, MA: Belknap Press of Harvard University Press.

Bartelsman, E.J. and P.J. Dhrymes (1998), 'Productivity Dynamics: US Manufacturing Plants, 1972–1986', *Journal of Productivity Analysis,* 9, pp.5–34.

Bloom, N., R. Sadun, and J. Van Reenen (2012), 'Americans Do IT Better: US Multinationals and the Productivity Miracle', *American Economic Review,* 102(1), pp.167–201.

Bresnahan, T.F. and M. Trajtenberg (1995), 'General Purpose Technologies "Engines of Growth"?' *Journal of Econometrics*, 65(1), pp.83–108.

Chen, L. and L. Ruddy (2020), 'Improving Digital Connectivity: Policy Priority for ASEAN Digital Transformation', *Policy Brief*, No. 2020-07. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Cherif, R. and F. Hasanov (2019), 'Principles of True Industrial Policy', *Journal of Globalization and Development*, 10(1), 20190034.

Foster, L., J.C. Haltiwanger, and C.J. Krizan (2001), 'Aggregate Productivity Growth: Lessons from Microeconomic Evidence', in C.R. Hulten, E.R. Dean, M.J. Harper (eds.) *New Developments in Productivity Analysis*. Chicago: University of Chicago Press, pp.303–72.

Freeman, C. (1987), Technology Policy and Economic Performance: Lessons from Japan, Pinter: London.

Fukugawa, N. (2018), 'Division of Labor between Innovation Intermediaries for SMEs: Productivity Effects of Interfirm Organizations in Japan', *Journal of Small Business Management,* 56(S1), pp. 297–322.

Griffith, R., S. Redding, and J. Van Reenen (2004), 'Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries', *Review of Economics and Statistics*, 86(4), pp.883–95.

von Hippel, E. (1986), 'Lead Users: A Source of Novel Product Concepts', *Management Science*, 32(7), pp.791–805.

Ho, Y.-P., P.-C. Low, and P.-K. Wong (2014), 'Do University Entrepreneurship Programs Influence Students' Entrepreneurial Behavior? An Empirical Analysis of University Students in Singapore', *Innovative Pathways for University Entrepreneurship in the 21st Century*, Advances in the Study of Entrepreneurship, Innovation and Economic Growth, Volume 24. Bingley, UK: Emerald Group Publishing Limited, pp.65–87.

Iacovone, L. and G.A. Crespi (2010), 'Catching Up with the Technological Frontier: Micro-level Evidence on Growth and Convergence', Industrial and Corporate Change, 19(6), pp.2073–96.

Ing, L.Y. and G.M. Grossman, eds. (forthcoming), *Robots and AI: A New Economic Era*. New York and Oxon: Routledge.

Inoue, H. and E. Yamaguchi (2017), 'Evaluation of the Small Business Innovation Research Program in Japan', *SAGE Open,* January–March, pp.1–9.

Jones, C.I. (2016), 'The Facts of Economic Growth', in J.B. Taylor and H. Uhlig (eds.) *Handbook of Macroeconomics*, Volume 2A. Amsterdam: North-Holland (Elsevier), pp.3–69.

Kimura, F. (2018), '"Unbundlings" and Development Strategies in ASEAN: Old Issues and New Challenges', *ERIA Discussion Paper Series,* ERIA-DP-2017-14. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Kimura, F. (2020), 'Exit Strategies for ASEAN Member States: Keeping Production Networks Alive Despite the Impending Demand Shock', *Policy Brief,* No. 2020-03. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Kimura, F., R. Shrestha, and D. Narjoko (2019), 'The Digital and Fourth Industrial Revolution and ASEAN Economic Transformation', in F. Kimura, V. Anbumozhi, and H. Nishimura. (eds.) *Transforming and Deepening the ASEAN Community.* Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.1–23.

Kimura, F., P.K. Wong, and M. Ambashi (2019), 'Innovation for ASEAN 2040', in F. Kimura, V. Anbumozhi, and H. Nishimura. (eds.) *Transforming and Deepening the ASEAN Community*, Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.24–49.

Kretschmer, T. (2012), 'Information and Communication Technologies and Productivity Growth: A Survey of the Literature', *OECD Digital Economy Papers,* No. 195, Paris: Organisation for Economic Co-operation and Development (OECD).

Krugman, P.R. (1997), *The Age of Diminished Expectations: US Economic Policy in the 1990s*. Cambridge, MA: MIT Press.

Lerner, J. (1999), 'The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program', *The Journal of Business*, 72(3), pp.285–318.

OECD (2021), *Promoting the Productivity of SMEs in ASEAN Countries – Strengthening Capabilities, Enabling Business Dynamics*. Paris: Organisation for Economic Co-operation and Development (OECD).

OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities*. Paris and Luxembourg: Organisation for Economic Co-operation and Development (OECD) and Eurostat.

Martens, B. (2020), 'An Economic Perspective on Data and Platform Market Power', *JRC Digital Economy Working Paper*, No. 2020-09. Brussels: European Commission Joint Research Centre.

Porter, M.E. (1990), *The Competitive Advantage of Nations.* New York: The Free Press.

Rysman, M. (2009), 'The Economics of Two-Sided Markets', *Journal of Economic Perspectives*, 23(3), pp.125–43.

Sauermann, H. (2018), 'Fire in the Belly? Employee Motives and Innovative Performance in Start-Ups Versus Established Firms', *Strategic Entrepreneurship Journal,* 12(4), pp.423–54.

SBIR (n.d.), Small Business Innovation Research. https://www.sbir.gov/ (accessed 26 October 2021).

Siegel, D.S. and C. Wessner (2012), 'Universities and the Success of Entrepreneurial Ventures: Evidence from the Small Business Innovation Research Program', *Journal of Technology Transfer,* 37(4), pp.404–15.

Soete, L., B. Verspagen, and B. ter Weel (2010), 'Systems of Innovation', in B.H. Hall and N. Rosenberg (eds.) *Handbook of The Economics of Innovation*, Volume 2. Amsterdam: Elsevier, pp.1160–79.

Solow, R.M. (1956), 'A Contribution to the Theory of Economic Growth', *The Quarterly Journal of Economics*, 70(1), pp.65–94.

Startup SG (n.d.), https://www.startupsg.gov.sg/ (accessed 26 October 2021).

Swan, T.W. (1956), 'Economic Growth and Capital Accumulation', *Economic Record,* 32(2), pp.334–61.

Ueki, Y. (2020), 'Production Networks and Technology Transfer: –Empirical Analysis Based on Survey Data for Companies in Southeast Asia–', *Public Policy Review*, 16(1), pp.95–120.

University of Groningen, Groningen Growth and Development Centre (n.d.), Penn World Table version 10.0. https://www.rug.nl/ggdc/productivity/pwt/ (accessed 20 June 2021).

Ventura, J. (1997), 'Growth and Interdependence', *The Quarterly Journal of Economics,* 112(1), pp.57–84.

Wong, P.K. (1999), 'National Innovation Systems for Rapid Technological Catch-Up: An Analytical Framework and a Comparative Analysis of Korea, Taiwan and Singapore', Paper Presented at the DRUID Summer Conference on National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebild, Denmark, 9–12 June.

Wong, P.K. (2014a), 'Catching Up or Breaking Out? Capability Development Strategy of Latecomer Firms and Nations', Presentation at the Technology and Management Centre for Development Seminar, Oxford Department of International Development, University of Oxford, 13 March. https://www.oxfordtmcd.org/sites/default/files/attachments/Oxford%20TMCD%20Seminar.pdf

Wong, P.K. (2014b), 'Innovation and Inclusive Growth in Emerging Economies', Presentation at the Symposium on Innovation and Inclusive Growth, OECD, Paris, 20–21 March. https://www.oecd.org/sti/inno/Session_1_Poh%20Kam%20Wong.pdf

World Bank (n.d.), World Bank Country and Lending Groups. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed 8 August 2021).

Chapter 9

Skills Development System: Soft Infrastructure for Leapfrogging and Feedback

Rashesh Shrestha
Research Fellow, ERIA

The Need for a Skills Development System in the Era of the Third Unbundling

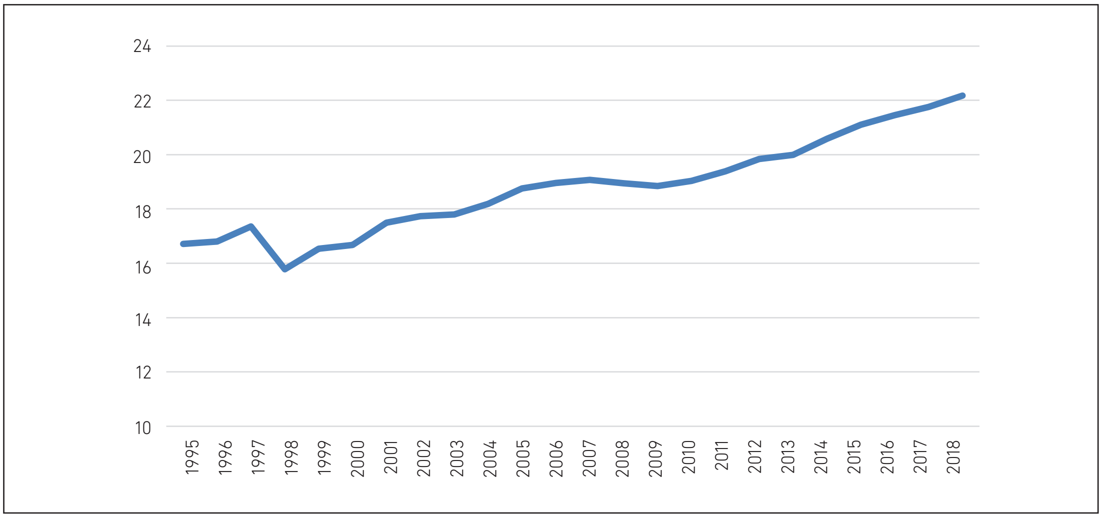
In the modern economy, a skilled workforce plays a central role. The expanding use of technology will transform traditional sectors and create high demand for a workforce with complementary skills. Technology could make the production process more capital-intensive by automating labour-intensive tasks. As firms reorganise their production activities around digital technology and automation, skilled human resources will determine the growth and competitiveness of the Association of Southeast Asian Nations (ASEAN) economies. Therefore, ASEAN economies need to create a system that will equip workers with the necessary skills.

While technology is transforming economies, it is directly competing with human labour in doing many routine tasks. Essentially, jobs that mainly comprise tasks that can be routinised and automated will no longer be available for humans (ADB, 2018). When computers became commonplace in the United States, many tasks requiring mid-level skills went to the machines (Autor, Katz, and Kearney, 2006). Today, even highly skilled professional tasks are not immune – artificial intelligence (AI) is now better at recognising lung cancer than human doctors (Grady, 2020). Many workers in ASEAN are employed in jobs that have a high likelihood of automation (Chang and Huynh, 2016). Individuals, businesses, and policymakers – worried that increasing automation will make human labour obsolete – are seeking ways to avoid a future where machines displace humans in completing routine and non-cognitive tasks. To ensure this, it is essential for workers to develop skills that cannot easily be automated.

Technology also plays a crucial role in the services sector, which is a large employer in itself and supports the modern manufacturing and agricultural sector. It is now widely understood that a thriving tradable sector requires efficient local services such as transportation and logistics (Findlay and Pangestu, 2016). However, it is uncertain whether the services sector can engender improvements in the living standards of unskilled workers without a substantial increase in the skills of service providers. The low-skilled services sector is not known for a rapid increase in productivity, although improvements in technology may be transforming this sector. Thus, workers in this sector will quickly need to develop the skills to work with new technology.

While technology creates new economic activities and opportunities for growth during the era of the third unbundling, human capital will be necessary to spread the benefits widely and to foster inclusive growth. During the first and second unbundlings, ASEAN enjoyed growth and structural transformation through the creation of relatively well-paid, low-skilled jobs that could be relied upon to drive growth and poverty reduction. Figure 9.1 shows ASEAN's employment rate in the manufacturing sector. These jobs made intensive use of the large labour force to carry out highly labour-intensive but simple manufacturing tasks that could easily be accomplished by the existing workforce. During this period, Asia became a haven for the production of intermediate goods and assembly, making this region the world's factory. In 1990, Asia produced about a quarter of the world's manufacturing output; by 2015, led by China, that share has risen to almost 50% (The Economist, 2015). A more important achievement was the rapid reduction in poverty and improvement in living standards.

Figure 9.1 ASEAN Manufacturing Employment, 1995–2018 (%)



ASEAN = Association of Southeast Asian Nations.

Note: The figure shows the trend in the manufacturing employment share in ASEAN, which is calculated as the population-weighted average of the 10 ASEAN Member States.

Source: Author's compilation from World Bank (n.d.), World Development Indicators. http://datatopics.worldbank.org/world-development-indicators/ (accessed 13 August 2021).

During the first and second unbundlings, human resources development took place organically – skills development was not a strategic priority. Such complacency in human resources development was less of an issue when low-skilled jobs were plentiful, but it must be given high priority during the current era of the third unbundling to ensure inclusive growth. As Chinese wages increase and businesses look for new production locations, ASEAN Member States (AMS) cannot rely solely on attracting low-skilled jobs through offshoring by developed countries. The availability of cheaper production technology – data processing, AI, robotics, and machine learning – means that building complementary skills is essential. Skills are in greater demand, which means that human resources development is an important economic growth strategy. These developments are likely to leave low-skilled workers behind if adequate investment in human capital is not prioritised.

Given the importance of human capital, it is essential to build a skills development system that can produce a highly skilled workforce. Such a system can be considered as important 'soft infrastructure' that comprises formal education, training, reskilling, and upskilling opportunities for all workers. Building such infrastructure requires a deep understanding of the various dimensions of skills and how they are produced. Furthermore, the level of human capital depends on decisions made by a large number of individuals, rather than centralised decisions of policymakers. So, an effective skills development system needs to not only address the supply side (e.g. educational institutions), but also offer the right incentives and enabling environment to invest in personal growth.

Dimensions of Human Capital

The key idea behind human capital is that skills are like any other durable investible good that can be acquired at a cost. It formalises the notion that human capabilities are not immutable. Becker (1962) noted that any activity that increases physical and mental abilities, and thus improves people's income prospects, could be considered human capital investment. While 'human capital' is a more abstract concept, skill refers to the ability to perform job-related tasks.

Skills can be of various kinds – physical, cognitive, and non-cognitive – each of which contribute towards performing certain aspects of job tasks (World Bank, 2018). Changing technology alters the value of different types of skills. To maintain competitiveness and increase productivity, small and medium-sized enterprises need workers who can help them access modern technology. This requires an educated workforce that can easily learn about modern methods of production and implement them in business, e.g. workers with digital marketing abilities so that small firms can use digital tools to expand their business. Larger and globally oriented firms need workers with the ability to innovate and expand internationally. In addition to technical knowledge, this also requires the ability to work with foreign firms, process information, utilise big data, etc.

Various strands of economic literature can contribute to a better understanding of the process of human capital development. A multidimensional conceptualisation of human capital, involving cognitive and non-cognitive characteristics as well as health, is widely accepted. Thus, the education system, as well as the health system, will need to be upgraded to foster skills development. Each of the components of human capital has its own formative processes. Furthermore, various components interact with each other during the formative years.

It is also well established that household (parental) resources play a significant role in human capital formation, especially during early childhood (Currie and Almond, 2011). Amongst poor households, budget and credit constraints can preclude adequate investment in human capital. For women, non-economic factors such as cultural norms can hinder investment. Recent research has also pointed to the role of factors outside the household's control. These include environmental factors such as exposure to air pollution. The incentives provided by the local labour market to invest in certain types of skills are also important, which partly depend on the returns to such investment in the form of greater employment opportunities and income.

The joint determination of occupational and human capital choice is also important to consider. Individuals make choices about occupations and careers by weighing the rewards and costs of gaining occupation-specific skills. Such investment must compete with other beneficial uses of an individual's time and financial resources. Therefore, the level of human capital investment in a country is determined not only by the supply of training institutions, but also by other economic factors. For example, a high cost of skills acquisition may dissuade individuals from training for and entering an occupation even when monetary rewards are high. To develop a country's human capital organically, we need to pay attention to the incentives faced by individuals who make an economic decision about investing in skills and training.

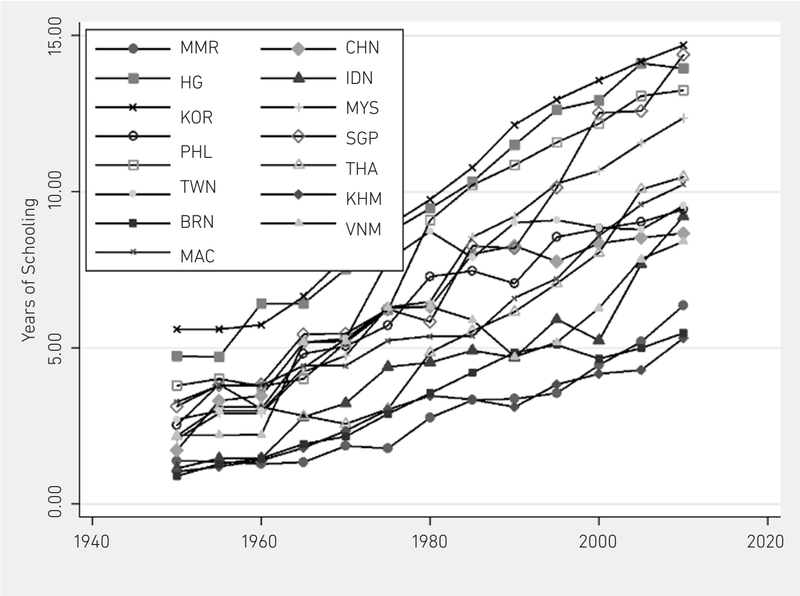
Skills Gap in ASEAN

Years of Schooling

The transition from growth driven by low-skilled jobs to growth driven by high-skilled jobs has been successfully completed by many developed Asian countries, including Hong Kong, Japan, the Republic of Korea (henceforth, Korea), Singapore, and Taiwan, (the Asian Tigers). The Asian Tigers' growth performance coincided with the rapid expansion in the quantity of education (Tilak, 2001). China is currently embarking on this transition. Looking to the future, middle-income AMS also need to make that transition over the next few decades if they are to continue their competitiveness.

In this regard, it is instructive to see how ASEAN economies stand vis-à-vis their East Asian counterparts in terms of human capital. Figure 9.2 shows the trends in years of completed schooling amongst 25- to 29-year-olds in selected East Asian countries. Although all countries have expanded the quantity of education, the gap between countries has widened over time, indicating a need for greater investment.

Figure 9.2 Trends in Years of Schooling for Individuals Aged 25–29



BRN = Brunei, CHN = China, HKG = Hong Kong, IDN = Indonesia, KHM = Cambodia, KOR = Republic of Korea, LAO = Lao PDR, MAC = Macao, MMR = Myanmar, MYS = Malaysia, PHL = Philippines, SGP = Singapore, THA = Thailand, TWN = Taiwan, VNM = Viet Nam.

Source: Barro and Lee (2013).

Human Capital Index

The current level of human capital in ASEAN varies across countries, as shown in Table 9.1 which is based on the Human Capital Index developed by the World Bank (World Bank, 2020). The Human Capital Index assesses the level of human capital based on the quantity and quality of education and health, showing a mixed picture. While the expected years of schooling are high (at least 9 years across all countries), the quality of education is low, resulting in lower learning-adjusted years of schooling. Similarly, scores on standardised tests also vary considerably across countries, with Singapore and Viet Nam leading the way and the Lao People's Democratic Republic (Lao PDR) and Indonesia lagging. On the health side, early life mortality has been considerably reduced, but there is wider variation in stunting rates, which indicates long-term nutritional availability and is a strong predictor of adult labour market outcomes.

Table 9.1 World Bank Human Capital Index, 2020

Country name	Probability of survival to age 5	Expected years of school	Harmonised test scores	Learning-adjusted years of school	Fraction of children under 5 not stunted	Adult survival rate	Human Capital Index 2020
Brunei Darussalam	0.99	13.2	438	9.2	0.80	0.88	**0.63**
Cambodia	0.97	9.5	452	6.8	0.68	0.84	**0.49**
Indonesia	0.98	12.4	395	7.8	0.72	0.85	**0.54**
Lao PDR	0.95	10.6	368	6.3	0.67	0.82	**0.46**
Malaysia	0.99	12.5	446	8.9	0.79	0.88	**0.61**
Myanmar	0.95	10.0	425	6.8	0.71	0.80	**0.48**
Philippines	0.97	12.9	362	7.5	0.70	0.82	**0.52**
Singapore	1.00	13.9	575	12.8	N/A	0.95	**0.88**
Thailand	0.99	12.7	427	8.7	0.89	0.87	**0.61**
Viet Nam	0.98	12.9	519	10.7	0.76	0.87	**0.69**
Japan	0.1	0.0	-0.1	-0.1	0.1	0.1	**0.2**

N/A = not available.

Source: World Bank (2020).

Quality of Education and Human Resources

The low quality of schooling in some AMS bodes ill for skills development. Development organisations have expressed concern about the 'learning crisis', as schooling has not translated into knowledge gains in many developing countries (World Bank, 2017). Table 9.2 tabulates measures of education quality in ASEAN based on standardised test assessments. One comparative measure is the Programme for International Student Assessment (PISA), which tests 15-year-old students' literacy and numeracy proficiency. The AMS participating in the 2018 PISA (reported in Table 9.2) generally scored below the Organisation for Economic Co-operation and Development (OECD) average, except Singapore (one of the top performers worldwide). While knowledge and learning are important indicators of the quality of an education system, they do not directly correspond to the ability of the education system to produce productive workers.

To assess the labour market returns of different levels of education, we can compare the wage differential between workers with various education levels. In the latest available estimates, returns to education vary from 5.1 in the Lao PDR to 12.5 in Singapore (Montenegro and Patrinos, 2014). This means that an additional year of schooling increases wages by 5.1% in the Lao PDR, compared with 12.5% in Singapore. This variation could partly, but not completely, be explained by quality differences. For example, differences across countries in specialisation in skill-intensive sectors might lead to differences in observed wages across education levels.

Table 9.2 Measures of Educational Quality and Skills in ASEAN

Country	PISA 2018	Returns to education
Brunei	423	N/A
Cambodia	N/A	5.6 (2007)
Indonesia	382	10.4 (2010)
Lao PDR	N/A	5.1 (2008)
Malaysia	431	12.0 (2010)
Myanmar	N/A	N/A
Philippines	350	8.6 (2011)
Singapore	556	12.5 (1998)
Thailand	412	9.4 (2011)
Viet Nam	N/A	N/A
OECD average	488	–

– = not relevant, N/A = not available, OECD = Organisation for Economic Co-operation and Development, PISA = Programme for International Student Assessment.

Notes: The second column shows the average math, science, and literacy scores in the 2018 PISA. The third column shows the available estimate of returns to an additional year of schooling during the year in parentheses based on Montenegro and Patrinos (2014).

Source: Authors' compilation from various sources.

These statistics reveal that many workers in AMS are trapped in mid-level skill jobs even with high-level schooling, which is unlikely to be sufficient to succeed in the era of the third unbundling. In developed countries, which were the first to adopt technology in the workplace, job polarisation is observed (Autor, Dorn, and Hanson, 2016). Recent technological changes – computerisation in particular – have caused a decrease in the demand for labour in routine task-intensive jobs. Other explanations include offshoring. Similar issues may arise in AMS as technology plays an increasing role in the economy, so developing a strong skills development system to mitigate the ill effects of technology is necessary.

Lack of skills has led to unequal distribution of the benefits of economic growth within AMS. Integration into the global value chain (GVC) has played an important role in expanding trade in developing countries, with Southeast Asian countries benefitting particularly from the fragmentation of the production process (Rodrik, 2018). During this period, we have seen large reductions in poverty and improvement in living standards, some of which can be attributed to trade-induced economic growth. At the same time, however, policymakers have been forced to deal with the issue of rising inequality. Recent research has found that while GVC integration tends to increase formality and average wages, benefits largely accrue to skilled workers, as evidenced by a faster rise in the skills premium in GVC integrated sectors (Paweenawat, 2019).

GVCs, which ease developing countries' integration into the world markets, seem to have underdelivered with respect to employment growth (Rodrik, 2018). This is likely because high quality requirements mean that GVC activities are not complementary to the existing labour resources of the economy. The technological needs are greater than what is widely available in developing countries. Therefore, GVC integration tends to benefit a select few who have the necessary skills, rather than a wide group of individuals. This is reminiscent of earlier literature on the impact of globalisation on labour market outcomes in developing countries, which also found mixed results (Pavcnik, 2017).

The role of GVCs in exacerbating inequality means that government policies are necessary to spread the benefits. However, not all policies are created equal. Many developing country governments aim to rise up the value chain, which may not necessarily be pro-poor. This leads to some counterproductive policies such as restricting exports of raw materials in order to add more value (Athukorala and Patnuru, 2019). However, focusing on domestic value added to guide policy is counterproductive. Rather, broad-based growth can be generated by focusing more heavily on increasing the country's human capital.

Strategies to Develop a Skills Development System

Reform Formal Education

The formal education system is the most important aspect of the skills development system, where reforms need to be targeted. It is where most individuals spend their formative years, and thus can help lay a solid foundation for skills throughout life. The link from education to skills is obvious. Educated workers can easily adopt the latest technology. They can adapt to changing circumstances, process information better, and learn new techniques. Additional schooling may also provide workers with 'soft' skills that enable them to work together with others to improve collective productivity.

But the existing education system, which was developed during the era of the first and second unbundlings, needs to be updated to meet the challenges of the third unbundling. Almost all children in the region attend primary schooling, but this is no longer sufficient. Much work remains to be done on raising enrolment at the secondary and tertiary level and improving the overall quality of education. The changing nature of the skills required to accomplish tasks that are – so far – beyond the capability of computers has put greater pressure on improving education quality in ASEAN.

Governments can pursue many actions to improve their education systems:

- Develop a national strategy for human resources development: A national strategy built around fulfilling the need for highly skilled workers for the modern economy can provide the necessary political push for reform. Such a strategy guides policymaking across the government, and thus is crucial for coordinated reforms that are more likely to succeed.
- Legislative action: In many countries, education laws were developed decades ago, so updating them is necessary to align them with the new economic environment. Education laws should set standards, allocate spending, and maintain accountability consistent with the needs of the modern economy. Some ideas include identifying and empowering high-performing educational institutions that consistently perform well, and providing space for partnerships between educational institutions that produce a skilled workforce and the businesses that employ them.
- Quality improvement: It is crucial to ensure that the education provided is of a high standard, as it is shown to have consequences for not only short-term outcomes like exam scores but also lifetime earnings. The quality of an education system is determined by its physical infrastructure, curriculum, and teachers. This requires investing in the professional development of teachers, upgrading the infrastructure of schools, and developing a curriculum that fosters the development of both cognitive and non-cognitive skills that will be high demand in the modern labour market.
- Mainstreaming vocational education: Vocational education can significantly contribute to meeting the need for semi-skilled workers. It can also be nimbler in meeting the changing requirements of the labour market. However, in many cases, countries have separate laws governing general and vocational education – essentially creating two, often incompatible, tracks from which students must choose at a young age. It is possible to create a comprehensive education policy that coherently combines both general and vocational tracks into a policy package and that improves the perception of vocational education. This is important because the needs of the modern labour market include both general skills that can adapt to different situations, and specific skills that help students transition into the labour force.
- Role of the non-government sector: The role of the private sector should not only be in the provision of education service but also in partnering with the government to improve the education system. The private sector can achieve cost efficiencies, but the government still needs to have equity goals in mind. Another aspect of the involvement of the non-government sector is to improve linkages between industry and educational institutions, particularly in the vocational and higher education sector. Employers should be encouraged to participate in curriculum and course design or engage in teaching. For instance, technology companies such as Google, IBM, and SAP offer many training programmes in digital skills. However, one key question relates to more widespread recognition of these fragmented training programmes.

Reskilling and Upskilling the Existing Workforce

Reskilling and upskilling are necessary to upgrade the skill levels of those already in the workforce in order to address the concern of the replacement of humans by machines and other technology in performing certain types of jobs, as well as to take advantage of new opportunities offered by technology. For developing East Asia, where labour-intensive sectors have driven economic growth for the last 15 years, concerns about the impact of technology on future job creation are understandable. Workers in the textile, clothing, and footwear industry, which employs a large share of workers in Southeast Asia, are vulnerable due to the labour-intensive nature of their tasks. According to the International Labour Organisation (ILO, 2018, more than half of the workers in Southeast Asian countries face the risk of job loss due to automation in the next two decades. In services, industries such as hotels and restaurants, and wholesale and retail trade will be most affected.

Reskilling and upskilling strategies need to focus on sectors that have a greater risk of job displacement due to changing technology. According to the framework used by the Asian Development Bank (ADB, 2018), industries with a high concentration of jobs that are intensive in routine and manual tasks have the highest likelihood of automation. Jobs on the production line are usually routine and manual, and we already see them being automated. For example, car assembly lines mainly use robots. A sector's share of routine manual jobs determines the degree to which that sector may be affected by new technology.

Reskilling entails providing workers with an adjacent set of skills that is closely related to the existing skillset, enabling them to perform tasks that cannot be done by technology. For example, assembly line workers could be trained to conduct quality control while some of their assembly tasks are conducted by machines. Most of the reskilling would require inculcating comfort in interaction with technology, including business use of smartphones and computers. Upskilling requires a more dramatic change in the workers' skillset and may require a more intensive retraining programme. This will be important in industries that face wholesale replacement by machines in job tasks. Depending upon the innate ability of the workers, existing skills, and realities of the economic conditions, either reskilling or upskilling could be pursued.

Reskilling and upskilling can foster job mobility, which is quite important. Workers who cannot repurpose their skills and utilise them in new sectors bear the brunt of the negative effects of structural change induced by technology. The main driver of unemployment is not increased job separation, but a lower job-finding rate. Autor, Dorn, and Hanson (2013) found that workers in the lowest tercile face a larger effect from exposure to a negative shock than workers at the top end. Furthermore, this effect is driven by the lower ability of low-wage workers to adjust at the extensive margin, i.e. to exit from sectors with greater exposure and find jobs in less exposed sectors. If labour markets are not well regulated, the impact of job displacement will relegate workers to the informal sector, where earnings and job benefits are lower.

Much of the reskilling could take place at the workplace itself, but it is not costless. The employer usually faces a choice between reskilling current workers or sacking them and hiring new ones. The decision is usually based on the relative costs of the two approaches. Analysis by the World Economic Forum (2018) estimated that, in the United States, the private sector could reskill 25%–30% of at-risk workers at a positive benefit–cost ratio. Some displacement in inevitable, so the government needs to step in to provide reskilling and upskilling services to support displaced workers so that they can be gainfully employed in emerging sectors. Such services could focus on providing short-term training to workers on specific skills. There are many examples of interventions, with mixed results. Training has to cater to local economic conditions and partnerships with the business sector are also crucial.

Reskilling and upskilling are related to a broader concept of 'lifelong learning', where skills acquisition takes place throughout our lifetimes. Lifelong learning is an 'organizing principle of education covering all phases of life and all forms of learning' (Yorozu, 2017: 11). Fostering lifelong learning is needed to ensure that individuals can adapt to future disruptions in the economic landscape, which is inevitable but also unpredictable. The ability to adapt to changing circumstances essentially requires a certain kind of ability to process new information and make decisions based on available data.

Developing a robust skills development system with elements of lifelong learning requires rethinking some elements of the existing system. Lifelong learning could be pursued by anyone and in various forms – including formal (in a training institution), informal (on-the-job), and non-formal arrangements. This could happen in community learning centres, online learning platforms, and professional development seminars. As it is such a decentralised process, it requires wide-ranging policy actions that complement each other (ILO, 2019). These could include employment placement services, training programmes, skilling incentives, and labour market legislations.

The crux of lifelong learning is the recognition of non-formal and informal schooling, including self-learning. The key question is how to recognise skills gained outside the formal system. Formally, this could take place through testing, which requires the development of a qualification framework. Informally, assessment could be done through peer recognition and endorsement via a professional network. Ultimately, employers are the best adjudicators of a candidate's skills, which means that policy could focus on improvement of the recruitment process.

Conclusion

Technology is having a profound impact on the economies of Southeast Asia, creating new opportunities for growth by ushering in the era of the third unbundling but also causing fears of job displacement and rising inequality. The loss of advantage conferred by cheap labour could result in a concentration of production tasks in developed countries. Therefore, industries that specialise in the labour-intensive part of the supply chain may see jobs evaporate. To maximise the benefits of technology for all workers, countries need to focus on an effective skills development system that increases the capabilities of the workforce.

Human capital plays a distinguished role in the era of the third unbundling. It will enable ASEAN economies to pursue 'leapfrogging' and 'feedback' while reviewing the existing 'step-by-step' development strategy, as discussed in Chapter 2. The type of skills needed will be varied. It includes technical and cognitive skills, problem-solving skills, and soft and social skills. The mode of providing these skills will also vary – including a formal general education system, industry-specific vocational education, reskilling and upskilling opportunities for existing workers, and fostering the notion of lifelong learning.

Given the status of skills in the region, policymakers in each AMS need to prioritise reforms that improve the quality of their human resources. They need to develop a national strategy for skills development to coordinate the actions of disparate government agencies, adopt regulations suitable for the technological era, ensure access to skills development for all citizens, improve the quality of schools, and work together with the private sector. The education system must be upgraded to deliver skills that will be prized in the future labour market. This means reassessing what and how students are taught, focusing not just on academic knowledge but also on social and emotional intelligence. This also means forging better partnerships between educational institutions and industry to mitigate the gap between the skills that workers learn and what businesses need. The reforms are needed to ensure that the gains from modern technology are spread to every worker.

References

ADB (2018), *Asian Development Outlook 2018: How Technology Affects Jobs*. Manila: Asian Development Bank. https://www.adb.org/publications/asian-development-outlook-2018-how-technology-affects-jobs (accessed 26 May 2020).

Athukorala, P. and A. Patunru (2019), 'Domestic Value Added, Exports, and Employment: An Input–Output Analysis of Indonesian Manufacturing', *ERIA Discussion Paper Series,* No. 2019–16. https://www.eria.org/publications/domestic-value-added-exports-and-employment-an-input-output-analysis-of-indonesian-manufacturing/ (accessed 13 August 2021).

Autor, D.H., D. Dorn, and G.H. Hanson (2013), 'The China Syndrome: Local Labor Market Effects of Import Competition in the United States', *American Economic Review*, 103(6), pp.2121–68.

Autor, D.H., D. Dorn, and G.H. Hanson (2016), 'The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade', *Annual Review of Economics*, 8, pp.205–40.

Autor, D.H., L.F. Katz, and M.S. Kearney (2006), 'The Polarization of the US Labor Market', *American Economic Review*, 96(2), pp.189–94.

Barro, R.J. and J.W. Lee (2013), 'A New Data Set of Educational Attainment in the World, 1950–2010', *Journal of Development Economics*, 104, pp.184–98.

Becker, G.S. (1962), 'Investment in Human Capital: A Theoretical Analysis', *Journal of Political Economy*, 70(5, Part 2), pp.9–49.

Chang, J.-H. and P. Huynh (2016), *ASEAN in Transformation: The Future of Jobs at Risk of Automation*. Geneva: International Labour Organization. https://www.ilo.org/actemp/publications/WCMS_579554/lang--en/index.htm (accessed 26 May 2020).

Currie, J. and D. Almond (2011), 'Human Capital Development Before Age Five', in O. Ashenfelte and D. Card (eds.) *Handbook of Labor Economics,* Volume 4, Part B. Amsterdam: Elsevier, pp.1315–1486.

Findlay, C. and M. Pangestu (2016), 'The Services Sector as a Driver of Change: Indonesia's Experience in the ASEAN Context', *Bulletin of Indonesian Economic Studies,* 52(1), pp.27–53.

Grady, D. (2020), 'A.I. Comes to the Operating Room', T*he New York Times*, 6 January. https://nyti.ms/2FpuhU7 (accessed 13 August 2021).

ILO (2017), *Conclusions on Skills for Improved Productivity, Employment Growth and Development.* Geneva: International Labour Organization.

ILO (2018), 'The Impact of Technology on the Quality and Quantity of Jobs', *Issue Brief*, No. 6. Geneva: International Labour Organization. https://www.ilo.org/global/topics/future-of-work/publications/issue-briefs/WCMS_618168/lang--en/index.htm (accessed 26 May 2020).

ILO (2019), 'Lifelong Learning: Concepts, Issues and Actions', Concept Paper. Geneva: International Labour Organization. https://www.ilo.org/skills/pubs/WCMS_711842/lang--en/index.htm (accessed 26 May 2020).

Kimura, F. (2017), '"Unbundlings" and Development Strategies in ASEAN: Old Issues and New Challenges', *ERIA Discussion Paper Series*, No. 2017–14. Jakarta: Economic Research Institute for ASEAN and East Asia.

Montenegro, C.E. and H.A. Patrinos (2014), 'Comparable Estimates of Returns to Schooling Around the World', *Policy Research Working Paper*, No. 7020. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/830831468147839247/pdf/WPS7020.pdf (accessed 26 May 2020).

Pavcnik, N. (2017), 'The Impact of Trade on Inequality in Developing Countries', *NBER Working Paper Series*, No. 23878. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/papers/w23878 (accessed 26 May 2020).

Paweenawat, S.W. (2019), 'The Impact of Global Value Chain Integration on Wages: Evidence from Matched Worker–Industry Data in Thailand', *ERIA Discussion Paper Series*, No. 2019–05. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/publications/the-impact-of-global-value-chain-integration-on-wages-evidence-from-matched-worker-industry-data-in-thailand/ (accessed 13 August 2021).

Rodrik, D. (2016), 'Premature Deindustrialization', *Journal of Economic Growth*, 21(1), pp.1–33.

Rodrik, D. (2018), 'New Technologies, Global Value Chains, and Developing Economies', *NBER Working Paper Series,* No. 25164. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/papers/w25164 (accessed 26 May 2020).

The Economist (2015), 'The Future of Factory Asia: A Tightening Grip', 14 March. https://www.economist.com/briefing/2015/03/12/a-tightening-grip (accessed 20 October 2019).

Tilak, J.B. (2001), 'Building Human Capital in East Asia: What Others Can Learn', WBI Working Papers, No. 22717. Washington DC: World Bank Institute. http://documents.worldbank.org/curated/en/412751468770664542/pdf/multi0page.pdf (accessed 20 Oct 2019).

UNESCO (2018), 'Domestic Financing in Education: A Smart Investment', Report of the SDG4 Steering Committee. Paris: United Nations Educational, Scientific and Cultural Organization.

World Bank (2017), 'World Bank Warns of "Learning Crisis" in Global Education', Press release, 26 September. https://www.worldbank.org/en/news/press-release/2017/09/26/world-bank-warns-of-learning-crisis-in-global-education (accessed 26 May 2020).

World Bank (2018), *World Development Report 2018: Learning to Realize Education's Promise*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/28340 (accessed 26 May 2020).

World Bank (2020), *The Human Capital Index 2020 Update: Human Capital in the Time of COVID-19.* Washington, DC: World Bank. http://hdl.handle.net/10986/34432 (accessed 13 August 2021).

World Economic Forum (2018), *Towards a Reskilling Revolution: Industry-Led Action for the Future of Work*. Geneva: World Economic Forum. https://www.weforum.org/whitepapers/towards-a-reskilling-revolution-industry-led-action-for-the-future-of-work (accessed 20 October 2019).

Yorozu, R., ed. (2017), 'Lifelong Learning in Transformation: Promising Practices in Southeast Asia', *UIL Publications Series on Lifelong Learning Policies and Strategies*, No. 4. Hamburg: UNESCO Institute for Lifelong Learning. https://unesdoc.unesco.org/ark:/48223/pf0000253603 (accessed 26 May 2020).

Chapter 10

Global Value Chains, Cities, and Urban Amenities: Case Study of ASEAN and East Asia

Shandre Mugan Thangavelu
Jeffrey Cheah Institute for Southeast Asia, Sunway University
Institute for International Trade, University of Adelaide

Fukunari Kimura
Chief Economist, ERIA
Professor, Faculty of Economics, Keio University

Dionisius A. Narjoko
Senior Economist, ERIA

Introduction

Regional and global production value chains and networks are important features, as well as the key driver of, economic growth and integration in East Asia and the Association of Southeast Asian Nations (ASEAN). The impact of global value chains (GVCs) on East Asian manufacturing and services activities, and hence on its economic development, is quite significant (Kimura, 2018; Baldwin, 2011; ASEAN, 2019). Recent evidence shows that domestic value added in the exports of ASEAN Member States (AMS) has been relatively high and stable since 2010 (ASEAN, 2019). The domestic value added in exports ranges from around 47.0% for Singapore to 90.3% for Brunei Darussalam. The foreign value added in exports is 39.0% for Singapore and 6.7% for Brunei.

East Asia and ASEAN are undergoing significant structural transformation due to the dynamism of regional and global value chains. This is driving deeper economic and regional integration. In fact, the global value chain (GVC) network is driving the economic transformation of East Asia from both the demand side in terms of forward-looking and dynamic consumerism, and supply-side effects of fragmentation and agglomeration – integrating deeper regional and global production networks in both manufacturing and services. The transformation of GVCs through digital and telecommunication technologies is creating new economic opportunities and inducing greater creative destruction in the respective East Asian and ASEAN economies.

The effects of GVCs are not a new phenomenon in Asia. In the 1970s, United States (US) retailers and big brand-name companies started offshoring their labour-intensive activities (Gereffi, 2014) in search of cheap labour advantages. However, in recent GVC transformation, the pace of GVCs has accelerated in terms of the speed, scale, depth, and breadth of global interaction (Elms and Low, 2013). The fragmentation process has intensified since the 2000s beyond the manufacturing sector to services such as accounting, medical procedures, and call centres (Gereffi and Sturgeon, 2013). GVCs have also proliferated geographically, involving more countries in various regions, and have become organisationally manifest in more complex and multilayer inter-firm networks across the globe. This production configuration –the most important feature of the global economy today (De Backer, De Lombaerde, and Iapadre, 2018; OECD, 2013) – is driven by technological progress; advances in the transport and logistics sector that lead to a significant decline in trade costs; more liberal regional and national policies supporting freer trade and investment flows; and the opening up of emerging economies, especially China and India (Kimura, 2018; Baldwin, 2013; De Backer, De Lombaerde, and Lapadre, 2018).

The key transformation of the GVCs is the depth and degree of integration and interdependence of economies in the region on global activities. There is a significant shift in trade patterns in the regional and global economy from the exchange of final goods to trade in parts and components. The geographic dispersion of production has substantially increased economic interdependence amongst economies around the world, especially in terms of investment flows and the intensification of flows in intermediate goods. WTO and IDE-JETRO (2011) estimated that trade in intermediate goods in 2009 represented more than 50% of non-fuel merchandise trade. The share of intermediate input trade was even higher (more than 50% of goods trade and almost 70% of services trade) in Gurría (2015) and roughly two-thirds in Johnson and Noguera (2012). In his latest book on the new globalisation, Baldwin (2016) described 21st century trade as a growing exchange of parts and components along with the international movement of production facilities, personnel, and know-how.

The other aspect of the GVC transformation is the level of growth of service activities and linkages in the production process. The fragmentation of production processes within and across countries due to technological advancements from telecommunication and information technologies has intensified the growth and interdependence of production processes between manufacturing and service activities. Services serve as inputs and linkages across value chain processes, making them the 'glue of supply chains' (Low, 2013) – sometimes referred to as the 'servicification' of production (Hoekman and Shepherd, 2017; Thangavelu, Wenxiao, and Oum, 2018). In the seminar work on the role of services in production and international trade, Jones and Kierzkowski (1990) firmly argued that the speed and efficiency with which service links operate clearly has a bearing on the optimal degree of fragmentation, and that gains from service liberalisation may exist in the form of greater participation in production processes. Baldwin (2016) considered services such as telecommunications, transport and logistics, trade-related finances, and customs clearance as necessary to coordinate fragmented production. The importance of services in GVCs is manifest in the large and increasing share of services in value-added trade, rising from 30% in 1985 to more than 40% in 2009 (Heuser and Mattoo, 2017). The impact of servicification in Asia is also reflected in Thangavelu, Wenxiao, and Oum (2018), which showed that the degree of servicification of manufacturing activities in ASEAN has increased over the years.

The recent transformation of the GVCs also highlights the importance of unbalanced growth within and between countries due to the unbalanced industrial and competitive responses. The key dimension of regional economic disparity is the level of responsiveness of key cities in domestic economies to absorb, diffuse, and disseminate key technologies and specific tasks to firms and workers to respond to dynamic shifts in the GVCs. The key competitive responses are driven by the flexibility of skilled workers to 'unbundle' the technologies and activities; technology-intensive infrastructure such as science parks, universities, and research centres; and social infrastructure such as urban amenities (hotels, restaurants, libraries, internet cafés), and soft and hard connectivity.

Glaeser, Ponzetto, and Zou (2015) highlighted the importance of cities creating urban networks that generate innovation and entrepreneurship to spur the economic growth of the domestic economy and region. Urban networks, through urban amenities, increase global economies of scale via innovation in services and global linkages, although the return on local domestic activities could decline due to the trade-off between urban congestion and living. In turn, the returns of urban networks to attract skilled workers to move to and live in large cities and megacities due to the higher returns from global urban networks (see Table 10.1).

Urban networks and agglomeration not only impact service innovation but also manufacturing activities, as urban amenities create economies of scale and knowledge spillovers for firms to innovate and increase their entrepreneurial activities (Chen, Hasan, and Jiang, 2020). The study also highlighted the agglomeration effects through the presence of top-tier universities in Asian cities creating linkages and raising the effectiveness of firm-level R&D activities.

In this chapter, we explore the development and transformation of GVCs in ASEAN and East Asia in terms of skills development, 'unbundling'[1] of manufacturing and services activities due to telecommunication and information technologies, and the importance of urban amenities to retain and maintain skilled labour in the key cities to drive economic growth. We used city-level data for East Asia and ASEAN from the United Nations (UN), Department of Economic and Social Affairs, Population Division, to understand the relationship between cities, GVCs, and urban amenities. The results of our study indicate the importance of cities and urban amenities as leverage both during the pandemic and in the post-pandemic recovery. Cities and urban centres will be key to develop, attract, and sustain digital technologies and maintain the degree of openness necessary for the pandemic recovery.

The next section discusses GVC transformation in East Asia and ASEAN. Section 3 explores the population agglomerations and trends of cities in East Asia. In section 4, we consider the topology of GVC transformation and unbundling effects of GVCs. We examine skills and their unbundling into tasks in section 4. Section 5 provides a policy discussion in terms of the pandemic recovery.

1 The 'unbundling' effects are discussed in Section 4.

GVC Transformation in East Asia and ASEAN

The East Asia region is transforming into one of the most dynamic regions in terms of production networks, and has seen an unprecedented expansion of trade in intermediate goods. Studies by Athukorala (2011); Kimura, Takahashi, and Hayakawa (2007); and Obashi and Kimura (2016) provided insights into and evidence on the determinants of GVC integration in East Asia. The region is expanding rapidly in terms of international production networks, characterised by a complex governance structure and interconnectedness due to production fragmentation in parts and components (Kimura, Takahashi, and Hayakawa, 2007). Kimura, Takahashi, and Hayakawa (2007) used the parts and components statistics to proxy trade in value added and regression with income gaps (to capture the location advantage) and distance (to capture the service link cost). The findings confirm the theoretical explanation that a difference in location advantage, measured by income gaps, is important in production networks.

Taguchi, Matsushima, and Hayakawa (2014) estimated the effect of location advantage and service link cost on production fragmentation, measured by bilateral trade in parts and components between Thailand and other countries in the Mekong subregion. The findings support the framework for fragmentation, whereby significant differences in location advantage and low service costs encourage firms to fragment production processes. In addition, using trade in parts and components to measure participation in GVCs, Athukorala (2011) adopted the gravity model to estimate the impacts of pair countries' characteristics and policies on trade in parts and components, and found that the stage of development and wage gaps significantly affect a country's attractiveness as the location of a production network.

The key trends of complex GVC participation are presented in Figure 1. The complex GVC participation rate is where the share of gross output involves production in two or more countries in the global production network. The average complex GVC participation in Asia is around 40%, indicating that the region participates in export activities in at least two countries. The key Asian countries participating in complex GVC activities are the Republic of Korea (henceforth, Korea), Malaysia, Singapore, Taiwan, Thailand, and Viet Nam. The GVC activities of these countries indicate more than a 50% average share of gross exports in complex GVC activities, highlighting their reliance on GVC activities to drive their export growth. The high share of complex GVC activities reflects the level of diversification of export activities in these countries, particularly in electronics and electrical, machine parts and components, and transport equipment.

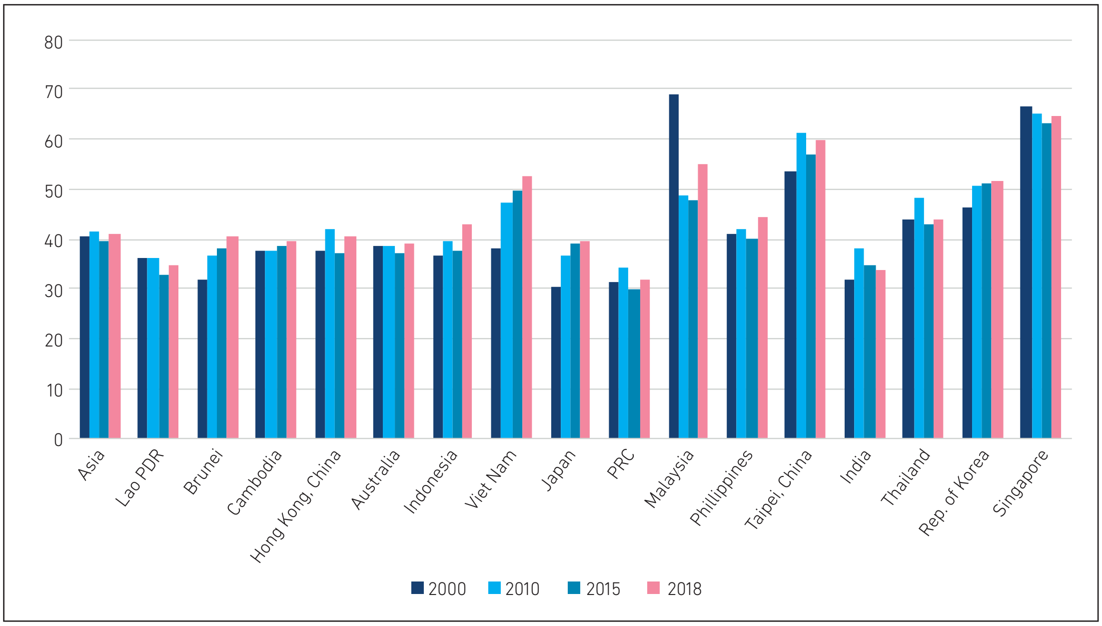
It is interesting to note that the complex GVC network is also driven by the sophistication and diversification of the service sector through service linkages and services GVCs. The key economies that rely on services trade are Singapore and Hong Kong. We observe that

Singapore is more involved in complex GVC activities than Hong Kong, perhaps because the larger Chinese hinterland affects Hong Kong's economy.

Malaysia and Viet Nam provide interesting comparisons in ASEAN. The complex GVC participation rate of Viet Nam has increased significantly since 2000, as more than 50% of its gross exports were involved in complex GVC activities in 2018. In contrast, we observe a significant decline in complex GVC activities for Malaysia since 2000, as the share of gross exports in complex GVC activities declined from nearly 70% in 2000 to around 50% in 2018. The declining share of complex GVC activities for Malaysia is of key concern, as it reflects the structural issues and lack of key economic fundamentals in the domestic economy to move up the value chain and participate in more complex GVC activities.

Two of ASEAN's least developed countries (LDCs) – Cambodia and the Lao People's Democratic Republic (Lao PDR) – tend to have a lower share of gross exports in complex GVC activities, especially the Lao PDR, which is below the average share of 40% for Asia. We note that complex GVC activities for Cambodia have increased over time from 38% in 2000 to 40% in 2018, showing signs of diversification in exports. However, Cambodia's main exports are still in textiles and wearing apparel, heavily driven by investment from China.

Figure 10.1 Complex GVC Participation in Asia: 2000–2018



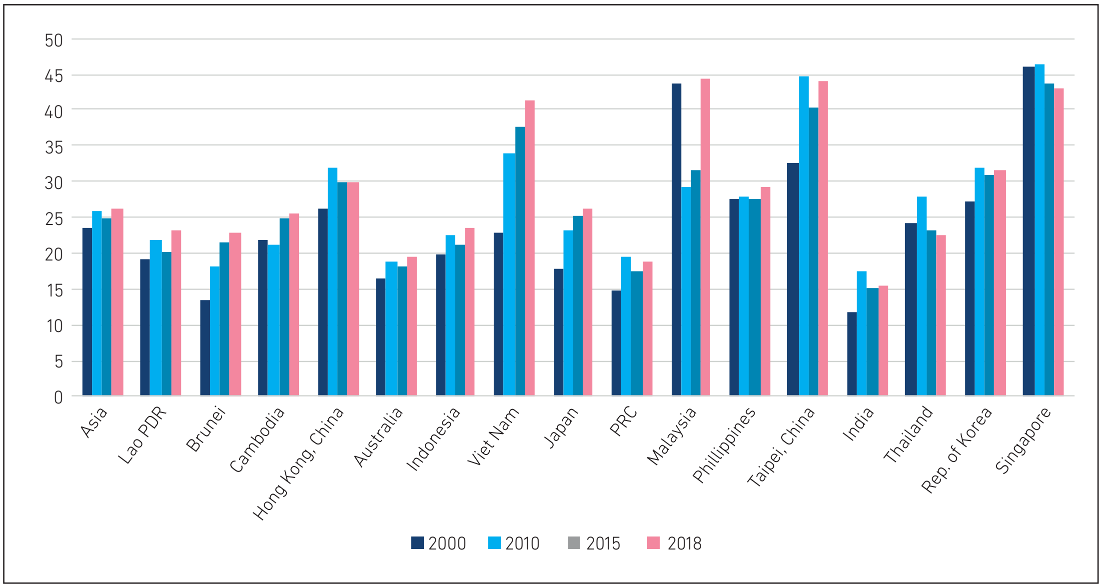
GVC = global value chain.

Note: The Figure follows ADB style for country names.

Source: ADB (2019).

The complex regional value chain (RVC) activities from 2000 to 2018 are shown in Figure 10.2, reflecting the share of gross exports in production across two countries in the same region. Overall, Asia has less complex RVC activities than complex GVC activities. The share of complex RVC activities is only around 25% of the share of gross exports. The key Asian countries with higher complex RVC activities are Korea, Malaysia, Singapore, Taiwan, and Viet Nam. Thailand has a lower share of complex RVC, declining from 28% in 2010 to nearly 22% in 2018. In contrast, the complex RVC activities of Viet Nam rose from 23% in 2000 to more than 41% in 2018. We also observe a higher rate of complex RVC activities for the Philippines, at 29% in 2018, slightly above the Asian average of 25% of gross exports. The other AMS – Brunei, Cambodia, the Lao PDR, and Indonesia – tend to experience lower complex RVC activities, reflecting a less sophisticated production structure and weaker linkages to participate fully in complex value chain production.

Figure 10.2 Complex Regional Value Chain Participation in Asia, 2000–2018



GVC = global value chain, RVC = regional value chain.

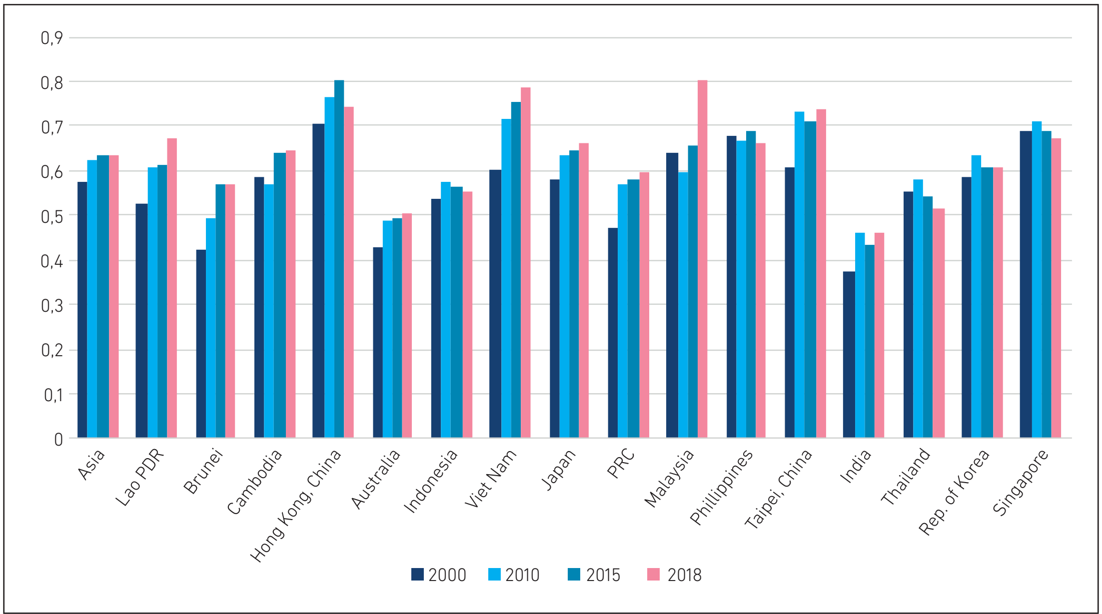
Note: The Figure follows ADB style for country names.

Source: ADB (2019).

The complex RVC to GVC ratio is presented in Figure 10.3. The ratio shows that AMS still rely on complex RVCs to drive their export activities. The key Asian countries – Malaysia, the Philippines, Hong Kong, Singapore, and Viet Nam – rely on the regional production structure to drive their export growth. Indonesia tends to experience lower RVC–GVC intensity across the AMS, reflecting the weakness of its value chain activities and the diversification of its value chain exports to participate in the complex GVC activities in

RVC and GVC. The ASEAN less developed countries (LDCs) of Cambodia and the Lao PDR are weaker in terms of complex GVC activities, as their export activities are not sufficiently sophisticated to cross several production networks in the regional and global value chains.

Figure 10.3 Complex RVC to GVC Ratio in Asia, 2000–2018



GVC = global value chain, RVC = regional value chain.

Note: The Figure follows ADB style for country names.

Source: ADB (2019).

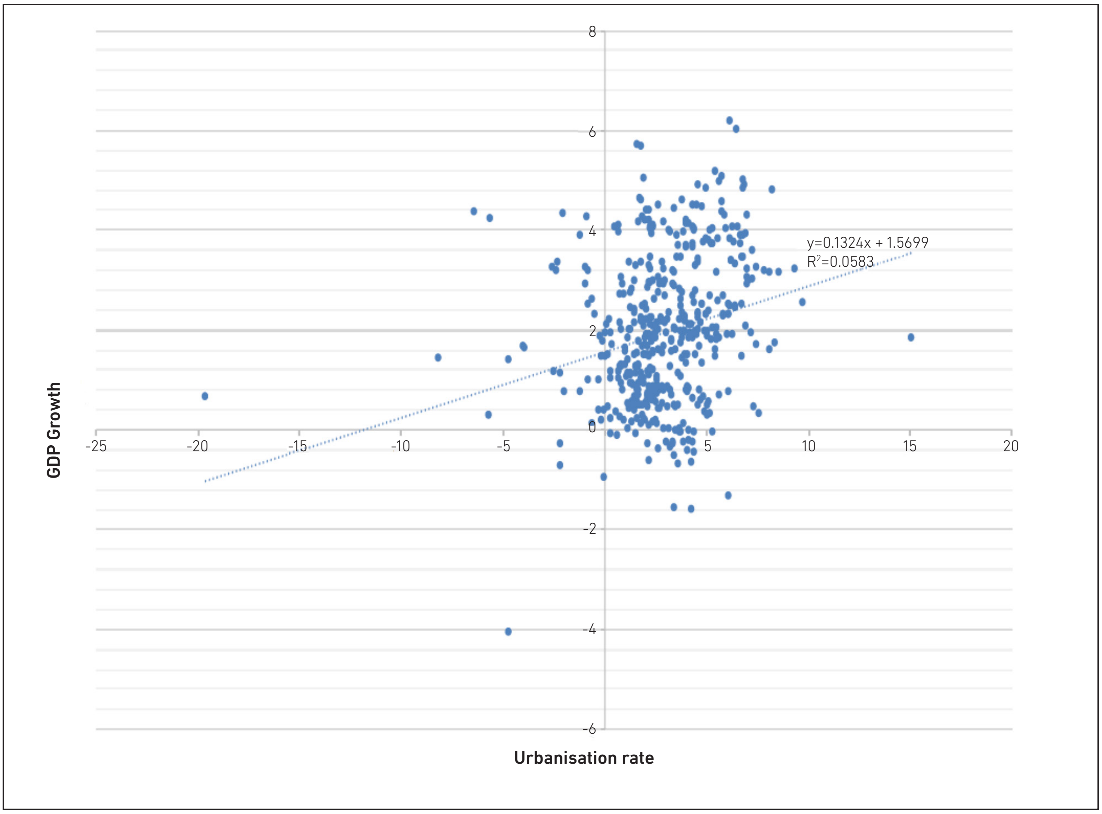
The weaker linkages of key AMS, which prevent participation in complex GVC and RVC activities, are mirrored at the regional level and hinder it from moving up the value chain. The key fundamentals to harness the GVC network – technology, human capital, strong forward-looking institutions, and connectivity in soft and hard infrastructure – are still lacking in the ASEAN region. This provides ample opportunity to undertake more active economic liberalisation and key reforms to improve the GVC and RVC network in the region.

The development of the regional and global value chain network is critically dependent on key domestic fundamentals such as human capital development in skills, technological development and harnessing digital technologies in information and communication technologies (ICTs), and the development of urban centres to create agglomerative activities in both economic and social dimensions.

Urbanisation and Trends of Cities in ASEAN and East Asia

Urbanisation has positive impacts on the economic growth of domestic and regional economies (UN, 2019). The positive relationships between economic growth and the urbanisation rate are presented in Figure 10.4. Urbanisation is primarily driven by population densities and non-agricultural economic activities in terms of manufacturing and services. It is based on the agglomeration of activities in cities, comprising townships, municipalities, and metropolitan areas. It is clear from Figure 10.4 that the growth of cities drives urbanisation and in turn drives economic activities and growth in the economy.

Figure 10.4 Real GDP Growth and Urbanisation Rate, 2018–2019



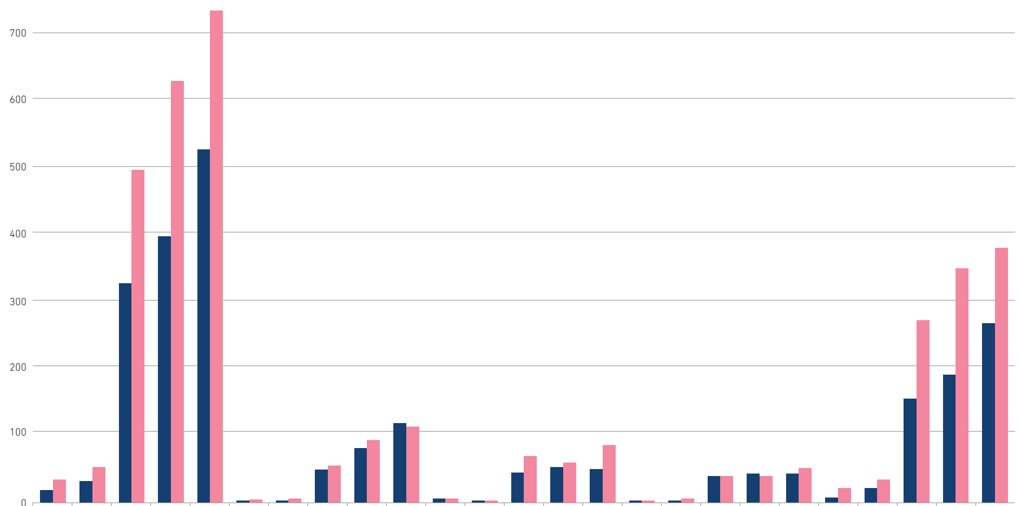
GDP = gross domestic product.

Source: World Bank (2003), World Development Indicators, 2003. Washington, DC: World Bank. http://www.worldbank.org/data/wdi2003/index.htm (accessed 27 December 2020).

The competitiveness of cities is multidimensional, as indicated by Glaeser, Ponzetto, and Zou (2015), in terms of the local returns to scale in innovation, supply of skilled labour elasticity, and supply of housing and urban amenities. The urban strategy of megacities (with populations of 10 million and above as defined by UN (2019)) that attract skilled workers and drive innovation, or networks of large cities creating urban agglomerations, is contingent on institutional reforms, urban networks, urban amenities, global and regional linkages, and the degree of innovation driven by entrepreneurship and small and medium-sized enterprises (SMEs) in the respective regions.

The key trends of different size classes of cities, in terms of population, are presented in Figures 10.5-10.7. Figure 10.5 gives the number of cities by size classes in terms of population for the respective regions. There has been strong growth in medium-sized cities (populations of 1 million–5 million) and small cities (less than 1 million), as these cities experienced significant growth from 2000 to 2020. The number of small-sized cities with a population of 500,000–1 million in the world increased from 396 to 626, and the cities with a population of 300,000–500,000 increased from 524 to 729 from 2000 to 2020, respectively. It is clear from Figure 10.5 that the large increase in medium-sized and small cities is driven primarily by the growth of cities in Asia, particularly economic growth and development in Southeast and East Asia, during the past 2 decades.

Figure 10.5 Number of Cities by Size Classes (Population Size) and Region, 2000-2020



	World - 10m to more	World - 5m to 10m	World - 1m to 5m	World - 500k to 1m	World - 300k to 500k	Eur - 10m to more	Eur - 5m to 10m	Eur - 1m to 5m	Eur - 500k to 1m	Eur - 300k to 500k	Latin Amer - 10m to more	Latin Amer - 5m to 10m	Latin Amer - 1m to 5m
2000	16	30	325	396	524	1	3	49	78	115	4	3	44
2020	34	52	494	626	729	2	4	89	89	114	6	3	65

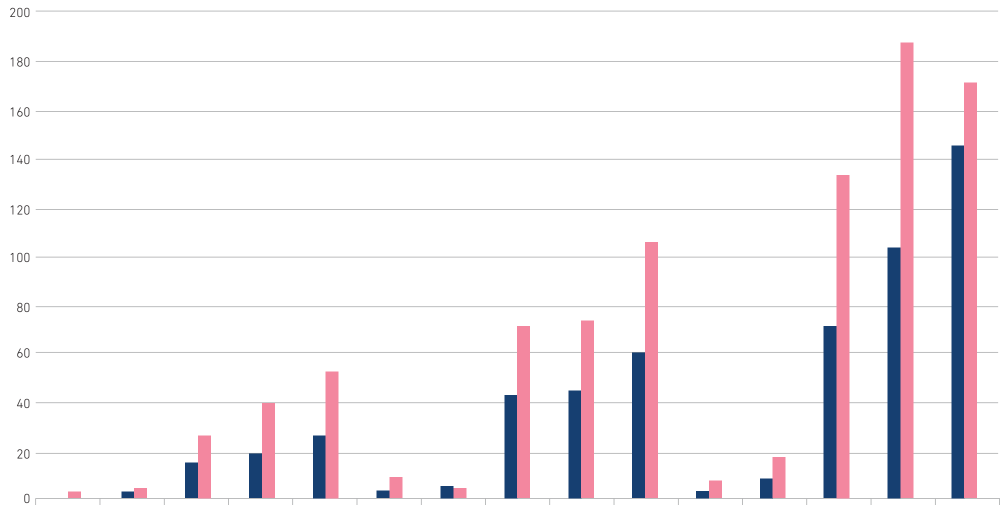
	Latin Amer - 500k to 1m	Latin Amer - 300k to 500k	North Amer - 10m to more	North Amer - 5m to 10m	North Amer - 1m to 5m	North Amer - 500k to 1m	North Amer - 300k to 500k	Asia - 10m to more	Asia - 5m to 10m	Asia - 1m to 5m	Asia - 500k to 1m	Asia - 300k to 500k
2000	53	48	2	2	37	39	41	8	20	152	191	267
2020	58	83	2	4	38	38	48	21	30	269	348	378

Amer = America, Eur = Europe, k = thousand, m = million.

Source: UN, 2019.

We also provide a breakdown of cities by size classes (population size) and region in Asia in Figure 10.6. A detailed breakdown of 794 cities in East Asia, South Asia (India), and Southeast Asia by city size classes (population size) – small (less than 500,000), small to medium-sized (500,000–1 million), medium-sized (1 million–5 million), and large cities and megacities (5 million and above) – is in Annex A (Figures A1 to A4). First, we observe significant growth in East Asian cities, mainly driven by the economic development of China, Korea, Japan, and Taiwan. Medium-sized and small cities in China grew significantly from 2000 to 2020, driven by economic liberalisation and development. The number of large cities and megacities doubled in China from nine to 18 large cities (5 million–10 million) and four to eight megacities from 2000 to 2020. South Asia also experienced growth in medium-sized and small cities, driven by the economic liberalisation and development of the Indian economy. In Southeast Asia, the number of small and medium-sized cities doubled from 2000 to 2020, and three megacities emerged during the same period.

Figure 10.6 Number of Cities by Class Type (Population Size) in Asia, 2000–2020



	SEA - 10m to more	SEA - 5m to 10m	SEA - 1m to 5m	SEA - 500k to 1m	SEA - 300k to 500k	SA - 10m to more	SA - 5m to 10m	SA - 1m to 5m	SA - 500k to 1m	SA - 300k to 500k	EA - 10m to more	EA - 5m to 10m	EA - 1m to 5m	EA - 500k to 1m	EA - 300k to 500k
2000	0	3	16	19	27	4	6	44	45	61	4	9	72	104	146
2020	3	4	27	40	53	9	5	72	74	106	8	18	134	188	171

EA = East Asia, K = thousand, m = million, SA = South Asia, SEA = Southeast Asia.

Source: UN, 2019.

The critical issue for small and medium-sized cities is whether these cities are efficient in terms of creating urban agglomeration and an urban network to drive sustainable economic growth of the domestic economy and the region. The key factors that increase the competitiveness of cities are urban linkages from soft and hard infrastructure, digital connectivity, skilled labour, urban amenities, urban policies to facilitate innovation and entrepreneurship, and the capacity of cities to participate in global and regional trade and investment activities. Table 10.1 presents the types of cities in terms of population size for the top 120 cities in Asia, based on the definition of cities by UN Urbanization Prospect 2018 (UN, 2019).

Most of the cities in Asia covered in Table 10.1 are medium-sized, with populations of 2 million–5 million. However, we observe significant differences across and within the size classes (population size) of cities. First, the megacities and large cities have a higher degree of openness in terms of connectedness to global and regional networks than medium-sized cities. The megacities and large cities are exposed to regional and global networks through service and trade linkages in goods and services activities. Second, the degree of participation in GVC activities varies between cities based on the key domestic fundamentals of technologies; connectivity in soft and hard infrastructure such as telecommunication technologies, and infrastructure; institutional reforms and structure; level of human capital; quality of urban amenities; and degree of connectedness across regional and global cities. For example, Singapore is a medium-sized city, but it is more connected to regional and global activities than Delhi or Dhaka, which are considered megacities by UN (2019). Urban amenities also play an important role in improving the competitiveness of cities, since urban amenities are generally better in more skilled and forward-looking cities as more educated and skilled workers tend to gravitate to cities with better amenities (Glaeser, Ponzetto, and Zou, 2015). In addition, efficient cities tend to invest more in quality amenities – driven by the preferences of the skilled and educated city populations. Population density is critical for cities and domestic economies to grow, but it is not a sufficient condition for efficient and sustainable development in the next stage of growth in Asia. The next stage of growth in East Asia and ASEAN will be critically dependent on the efficiency of cities in connecting to regional and global value chain activities.

Table 10.1 Size Classes of Cities (Population Size) – Top 120 Cities in Asia, 2020

Megacities (10 million and above)	Large cities (5 million–10 million)	Medium-sized cities (3 million–5 million)	Medium-sized to small cities (2 million–3 million)
Tokyo (37,393)	Nagoya (9,552)	Melbourne (4,968)	Surabaya (2,944)
Dhaka (31,234)	Chengdu (9,136)	Sydney (4,926)	Shizuoka-Hamamatsu (2,922)
Delhi (30,291)	Nanjing (8,847)	Xinbei (4,759)	Zhongshan (2,914)
Shanghai (27,058)	Ho Chi Minh City (8,602)	Hà Noi (4,678)	Nagpur (2,893)
Karachi (23,128)	Wuhan (8,365)	Changsha (4,578)	Incheon (2,801)
Beijing (20,463)	Ahmadabad (8,059)	Kunming (4,443)	Coimbatore (2,787)
Mumbai (20,411)	Xi'an (8,001)	Changchun (4,426)	Depok (2,727)
Osaka (19,165)	Kuala Lumpur (7,997)	Wulumqi (4,369)	Handan (2,727)
Lahore (19,117)	Hangzhou (7,642)	Shantou (4,327)	Taibei (2,721)
Chongqing (15,872)	Hong Kong (7,548)	Hefei (4,242)	Sapporo (2,670)
Kolkata (14,850)	Dongguan (7,408)	Ningbo (4,116)	Huai'an (2,655)
Manila (13,923)	Foshan (7,327)	Shijiazhuang (4,114)	Weifang (2,654)
Tianjin (13,589)	Shenyang (7,220)	Jaipur (3,909)	Zibo (2,640)
Guangzhou (13,302)	Surat (7,185)	Taiyuan (3,891)	Thiruvananthapuram (2,585)
Shenzhen (12,357)	Chittagong (7,110)	Nanning (3,860)	Bandung (2,580)
Bangaluru (12,327)	Suzhou, Jiangsu (7,070)	Xiamen (3,720)	Shaoxing (2,540)
Chennai (10,971)	Pune (6,629)	Fujian (3,686)	Yantai (2,527)
Jakarta (10,770)	Haerbin (6,387)	Lucknow (3,677)	Huizhou (2,525)
Bangkok (10,539)	Singapore (5,935)	Jiangsu (3,625)	Tao Yeun (2,462)
Hyderabad (10,004)	Qingdao (5,620)	Wenzhou (3,624)	Patna (2,436)
Seoul (9,963)	Dalian (5,618)	Nanchang (3,598)	Brisbane (2,406)
	Kitakyushu-Fukuoka (5,529)	Kozhikode (3,555)	Bhopal (2,390)
	Shandong (5,360)	Busan (3,465)	Luoyang (2,387)
	Yangon (5,332)	Tangshan, Hebei (3,426)	Tangerang (2,339)
	Zhengzhou (5,323)	Bekasi (3,394)	Medan (2,338)
		Malappuram (3,391)	Sendai (2,327)
		Guiyang (3,317)	Nantong (2,276)
		Preshawa (3,279)	Agra (2,210)
		Wuxi, Jiangsu (3,256)	Daegu (2,199)
		Rawalpindi (3,175)	Baotou (2190)
		Kanpur (3,124)	Vadodara (2,190)
		Kochi (3,082)	Visakhapatnam (2,175)
		Lanzhou (3,081)	Kannur (2,167)
		Thrissur (3,068)	Liuzhou (2,165)
		Indore (3,017)	Hohhot (2,163)
			Xuzhou (2,146)
			Hiroshima (2,083)
			Phnom Penh (2,078)
			Nashik (2,066)
			Perth (2,042)
			Vijayawada (2,040)

Note: Population (million) in parentheses.

Source: (UN, 2019).

Topology of GVC Transformation and Unbundling Effects in ASEAN and East Asia: GVCs, Cities, and Regional Development

GVC activities in East Asia and ASEAN are both inducing fragmentation and creating agglomeration activities in manufacturing and service activities in the region. In the initial stages of development, recent studies have identified two important stages of fragmentation or unbundling of industrial activities in terms of the first and second stages (Kimura, 2018; Baldwin, 2011; Kimura and Obashi, 2015). In this section, we integrate the GVC activities, structural transformation of the economy, and urban amenities in an integrated framework of open economic strategies and development. The topology of the GVC activities, structural transformation, and urban amenities is shown in Table 10.2.

Table 10.2 Topology of GVCs, Structural Transformation, and Urban Amenities

Tier 3: Underdeveloped economy: low level of industrial activity	Tier 2a: Hook up with GVCs (1st unbundling): resource-based/ labour-intensive industries	Tier 2b: Participate in production networks (2nd unbundling, stage 1) – jump-start industrialisation with machinery industries	Tier 2c: Form industrial agglomeration (2nd unbundling, stage 2) – accelerate technology transfer/spillover	Tier 1: Create innovation hub – urban amenities (3rd unbundling): high innovation and digital transformation
Trade cost				
High	Low	Low	Low	Low
Communication cost				
High	High	Low	Low	Low
Face-to-face cost				
High	High	High	Medium	Low
Trade				
Movement of goods: low	Movement of goods: high	Movement of ideas (plus goods): medium Service trade increase: tourism, finance	Movement of ideas (plus goods): high Service linkages and service GVCs Service trade increases: tourism, finance, aviation, logistics, business services	Movement of people (plus ideas and goods) Trade in high value-added goods Service GVCs and high value-added services Services trade and investment are critical

Tier 3: Underdeveloped economy: low level of industrial activity	Tier 2a: Hook up with GVCs (1st unbundling): resource-based/ labour-intensive industries	Tier 2b: Participate in production networks (2nd unbundling, stage 1) – jump-start industrialisation with machinery industries	Tier 2c: Form industrial agglomeration (2nd unbundling, stage 2) – accelerate technology transfer/spillover	Tier 1: Create innovation hub – urban amenities (3rd unbundling): high innovation and digital transformation
International division of labour				
Low	Industry-wise: fragmentation in production and consumption	Task-wise: industry-level fragmentation (medium)	Task-wise: industry-level fragmentation (high)	People-wise: individual skills and task fragmentation
Skills and human capital				
Unskilled Primary and lower education	Unskilled and semi-skilled Primary and upper primary education	Semi-skilled and skilled (low) Upper primary, secondary, and upper secondary; technical education; vocational training	Semi-skilled (high) and skilled (low); secondary, upper secondary, and tertiary education (low); technical education, vocational training Technical and vocational education is critical	Skilled and semi-skilled (high) Upper secondary and tertiary education Technical and science education Vocational training Technical and vocational education is critical Emphasis on lifelong learning platform
Movement of labour				
Rural–urban migration: low	Rural–urban migration: high unskilled labour from rural sector to urban sector	Rural–urban migration: high for semi-skilled and skilled labour from rural sector to urban sector Linkages between urban centres: low Migration between urban centres: low	Rural–urban migration: high Between urban centres: moderate Movement of skilled foreign labour (moderate)	Movement of labour (domestic and foreign) between urban centres: high (daily movement) Rural–urban migration: high; movement of skilled foreign labour (high); virtual movement of skilled labour

Tier 3: Underdeveloped economy: low level of industrial activity	Tier 2a: Hook up with GVCs (1st unbundling): resource-based/ labour-intensive industries	Tier 2b: Participate in production networks (2nd unbundling, stage 1) – jump-start industrialisation with machinery industries	Tier 2c: Form industrial agglomeration (2nd unbundling, stage 2) – accelerate technology transfer/spillover	Tier 1: Create innovation hub – urban amenities (3rd unbundling): high innovation and digital transformation
Regional and global value chains				
Low RVC and GVC	GVC participation with labour-intensive activities Service trade increase in tourism and finance (low)	GVC participation and low level of GVC positioning Service linkages Service GVC (low) in tourism, logistics, aviation Openness leads to disruptions in GVC (low) in trade	GVC participation and high positioning Service GVC (high) Servicification of manufacturing (low) Greater GVC disruptions in trade (high) and technology (low)	GVC positioning (high) in high value-added activities; innovative services and GVC Servicification of manufacturing (high) High GVC disruptions from trade and technology
City development and urban amenities				
Basic amenities; lack of infrastructure such as roads, highways, ports, airports; weak rural–urban linkages Low-tier cities Low telecom infrastructure	Develop key infrastructure such as roads, highways, ports, airports; develop rural–urban linkages Develop medium-tier cities (low) Weak urban amenities and linkages such as hotels, restaurants, hospitals, parks, schools, universities, public housing Develop telecom linkages and infrastructure (domestic)	Develop strong linkages in infrastructure in more ports, airports, highways Strengthen rural–urban linkages Develop strong urban amenities such as higher tier hotels, restaurants, shopping centres, universities, public and private hospitals, public and private schools Develop medium-tier cities (high) Increase in linkages between urban centres and cities Stronger telecom linkages and infrastructure in domestic economy; there is a need to develop regional linkages in telecommunication (soft and hard infrastructure)	Develop regional linkages in infrastructure in terms of ports, airports, highways Develop strong tier 2 and tier 1 cities Increase linkages in urban centres Develop strong urban amenities such as quality schools, universities, private and public housing, private and public schools, private and public hospitals, libraries, parks Transport infrastructure: mass rapid transport, fast trains, telecom connectivity Develop strong rural–urban linkages Strong telecom linkages and infrastructure to regional trade and investment activities	Develop high technology-intensive infrastructure such as digital infrastructure Strong linkages between cities in the region Strong rural–urban city linkages Strong urban amenities and linkages Highly innovative urban centre Innovation and growth driven by urban centres Telecom infrastructure is in high digital technology Level of Innovation in cities: Innovation and Knowledge driven cities

GVC = global value chain, RVC = regional value chain.

Sources: Kimura (2018); Thangavelu and Wenxiao (2021); ERIA (2010).

First Unbundling

In the first unbundling, the role of government is important to drive rapid industrialisation and to overcome coordination failures due to the lumpiness and complexity of industries (Baldwin, 2011; Kimura, 2018). The economy will experience high communication and face-to-face costs because of lack of digital technologies. It will also experience industry-wise fragmentation in production and consumption. There is a common objective across the public and private sectors in terms of driving openness and seeking new global markets. At this stage, trade is necessary for importing key inputs to goods that are then exported. Industrial policy to coordinate and reduce the cost of entry to manufacturing activities will be critical to create industry-level agglomerate activities, since a larger set of activities helps to develop value chain operations. These developments are not straightforward, and it is important to note that it took several decades to build up the supply chain in East Asia.

At this stage, the economy could adopt an economic liberalisation and openness strategy to increase trade and investment due to declining trade costs. We should expect countries to participate in GVC activities through low-tier factor intensity activities (e.g. raw material exports) and labour-intensive activities (e.g. garment and textile exports). The labour force only has unskilled workers with primary or lower education. We expect greater movement of unskilled labour from rural to urban areas to support the development of labour-intensive activities. The rural–urban linkages are much weaker at this stage, with weak infrastructure in roads, highways, ports, and airports. The economy will start developing basic infrastructure such as roads, highways, ports, and airports. It will also experience very weak urban amenities, and we observe the development of small-tier cities due to rural–urban migration. At this stage, we will observe the development of traditional services trade (e.g. tourism and logistics) and some level of development in the financial sector.

Second Stage Unbundling

In the second stage unbundling, there is a less need to build up large supply chains and there are lower transaction costs to participate in the supply chains due to the strong connectivity already in place thanks to ICTs. At this stage, we will experience lower trade and communication costs. However, we will still experience high face-to-face costs due to lack of digital infrastructure and technologies. The economy will experience task-wise fragmentation in terms of resource-intensive, labour-intensive, skill-intensive, skilled and knowledge-intensive, and knowledge-intensive production in the GVCs. Due to the low trade and communication costs, economies can join the chain more easily and quickly. However, the participating firm and therefore the chain itself become more 'footloose'. There is more rapid technological change and competition, as more cost-competitive economies enter the chain. At this stage, with respect to governments and institutions, we will observe greater 'learning by governing' and institutional convergence as governments learn how to manage institutional development from other successful economies, thereby increasing the convergence of institutions in the region.

The role and the challenges facing the government, multinationals, and domestic firms are quite different in the second unbundling. Export success may have been achieved in the first unbundling, but policymakers face many new questions in the second unbundling: Which supply chains should be joined? Should nations strive to set up their own GVCs? What is the optimal technology policy (intellectual property rights, etc.)? Different nations will adopt different industrial strategies without their efforts being guided by formal models that explicitly incorporate supply chains (Baldwin, 2011).

To understand the second stage unbundling, we can summarise it into two stages. In the first stage, the economy will experience low trade and communication costs, but high face-to-face costs. At this stage, the economy will be able to move up the value chain and participate in labour-intensive and semi-skilled-intensive industrial activities in the GVC. In the second stage, the economy will experience a moderate decline in face-to-face costs due to investment in telecommunication infrastructure and technologies that allow the economy to position itself and move up to more skill-intensive and skilled and knowledge-intensive activities in the GVC.

One of the key challenges of the second stage unbundling is the development of skills and human capital, as the transition to a skilled labour force will take time to develop. In the first stage of the second unbundling, the labour force will have mostly semi-skilled labour in terms of upper primary, secondary, and upper secondary education. At this stage, technical education and vocational training will be critical as the skills required for the technical aspects of manufacturing and services activities will intensify. In the second stage of the second unbundling, the skill requirements will be higher as the labour force requires upper secondary and tertiary education. The labour force also requires training in technical and vocational skills, and the importance of a lifelong learning framework will be emphasised.

In the second unbundling, the economy requires the twin engine of manufacturing and services to drive economic growth. The importance and efficiency of service activities in trade and investment will be critical to maintain and sustain economic growth and development in the economy and region.

It is interesting to observe that services sector growth becomes more important in the second stage of production unbundling in terms of creating services linkages. Several factors lead to the importance of services linkages in the second stage. First, skills and human capital tend to drive the key services linkages in the global production value chain. Second, key services sectors tend to become important components of trade – such as distributional services, financial services, transport and aviation services, telecommunication services, and logistic services. This is again driven by human capital development and urban and suburban amenities in the form of soft and hard infrastructure development as the region opens up for trade and investment. The soft and hard infrastructure tends to reduce the cost of services linkages, thereby increasing the intensity for further developments and linkages to global production value chain activities. Third, the development of infrastructure, such as ports, airports, and roads, creates linkages and increases the agglomerative effects for arm's-length industrial activities. This increases the participation of SMEs, creating linkages with multinational firms for product and process innovation in the region.

At this second stage, we will observe the development of medium-sized cities, and urban linkages will be critical to create agglomeration across the cities. The development of medium-sized and large cities will be driven by greater rural–urban migration and greater movement of foreign skilled workers to cities. We will also observe the importance of cities in driving the performance of value chains. There are various mechanisms. One is the capability of attracting and retaining skilled workers (Glaeser, Ponzetto, and Zou, 2015). Cities with strong urban and suburban amenities tend to be more competitive in attracting skilled workers to live and work, adding to the competitiveness of the services sector. More developed countries and cities need urban amenities – such as good schools, universities, research centres, shopping centres, hotels and restaurants, and entertainment amenities – to attract skilled workers in terms of (i) greater varieties of services and consumer goods; (ii) aesthetics and physical settings of infrastructure, (iii) good public goods, and (iv) convenience and speed of delivery of services (Kimura and Obashi, 2015). Another role for cities is to shape the way that businesses and people interact with each other to produce ideas about doing things differently, i.e. the way cities can drive creativity. This will create more innovative activities in services unbundling and new ways of doing business, as well as new types of goods and new production technologies.

In the second stage of the second unbundling, the ICT revolution and technological improvements will lower communication costs – leading to more production unbundling. We will also observe a moderate decline in face-to-face costs, which will increase the service linkages in the GVCs. We will observe greater movement of ideas and more industry-wise division of labour. In the second stage, there is less need to build up large supply chains and there are lower transaction costs to participate in the supply chain. As a result, economies can join and participate in the GVC more easily and quickly. However, the participating corporations and therefore the chain itself becomes more 'footloose'. There is more rapid technological change and competition, as more cost-competitive economies enter the chain. The services sector will be crucial in creating service linkages in the global production value chain. At this stage, we will observe greater growth in the services sector of the domestic economy as well as in trade. As service linkages and servicification increase in the economy, we will also experience greater GVC disruptions from technological and economic shocks, which will have a direct impact on both the manufacturing and service activities in the GVC.

Third Stage Unbundling

In the third unbundling, we will observe further ICT revolution and technological improvements – leading to lowering face-to-face transaction costs – and more people-to-people transactions. At this stage, economies will experience more task-based activities and more fragmentation of individual skills, and an increase in service sector trade and activities. We expect more business-to-consumer and consumer-to-consumer activities. At this stage, there will be significant technology and labour market implications from the third unbundling. The economy requires a high level of skills and human capital to drive the innovation and entrepreneurial activities in the economy. The labour force requires upper secondary and tertiary education, particularly in science and technical education at both the secondary and tertiary. There is also a need to develop lifelong learning activities in science and technical based education and skills development through the life cycle of workers in the labour market. This is critical to retain workers in the labour market as the economy will be subjected to a high level of disruptions from technology and economic shocks.

The impact of ICT in the third unbundling will have important implications for economic and industrial policy. Information technology such as artificial intelligence and the digital economy (Industry 4.0) will have a direct impact on breaking down individual skills and will reduce the task-based activities. These technologies will create concentration and agglomeration activities in services and manufacturing. In contrast, communication technologies such as smartphones will likely overcome distances and generate dispersion or fragmentation of activities. Both innovations have different but significant impacts on the domestic economy and the labour market. Industry policy needs to manage both the agglomeration effects and dispersion effects.

In the third unbundling, we will observe the importance of cities in driving the performance of value chains in terms of human capital and technologies. The efficiency and intensity of cities will be important in attracting and retaining skilled labour and in increasing innovation activities to be positioned at higher value-added activities of the regional and global value chains (Glaeser, Ponzetto, and Zou, 2015). Cities with strong urban and suburban amenities tend to be more competitive to attract skilled workers to live and work, adding to the competitiveness of the services sector. The urban agglomeration driven by urban amenities and communication and telecommunication technologies is necessary to create economies of scale and a scope of activities for cities at this stage of unbundling – in terms of the unbundling of technologies and skills to drive economic growth. This requires large cities and megacities. It might also be possible to have several large cities creating urban linkages between cities, and urban agglomeration with suburban segments of their administrative boundaries. At this stage, urban amenities – together with technology intensities and densities through communication and telecommunication technologies – will be important in increasing the efficiency of large cities and megacities to attract domestic and foreign skilled labour. We will observe both physical as well as virtual movement of labour between cities across regional and global boundaries, thereby increasing the skilled and task-wise fragmentation of individual workers, and greater unbundling of the skills to tasks. We will observe greater acceleration of value-added services and services linkages to support more complex GVC activities in the economy.

The regional and global supply chain activities in East Asia and ASEAN are growing and deepening as more mature economies move to the second stage of production fragmentation and emerging AMS build up an industrial base for the first stage of production fragmentation. However, we also observe certain challenges in Asia. The level of liberalisation – in particular, services and investment liberalisation – is losing its momentum and slowing down. Asian cities are plagued with high population densities, decreasing the returns to urbanisation (through pollution and congestion) and limiting their contribution to regional growth. The level of trade and investment liberalisation in multilateral agreements such as the Regional Comprehensive Economic Partnership is becoming weaker and tends to be of a very low denomination for further regional integration.

Policy Discussion

Several policy issues must be addressed, as East Asian and ASEAN economies are at different stages of growth in the global production value chain. The more developed AMS – Indonesia, the Philippines, Thailand, and Viet Nam – are at the middle stage of the second unbundling; Malaysia is at a higher stage of the second unbundling; and two of the ASEAN LDCs (Cambodia and the Lao PDR) are at the beginning of the second unbundling. Singapore, the city state, is already at the beginning of the third unbundling. The important of urban amenities and growth of cities will be critical at the next stage of growth in ASEAN and the region.

We observe that both the first and second unbundlings are occurring concurrently in the development of Asia as the global supply chain activities in East Asia and ASEAN are growing and deepening. However, we also see challenges emerging in the region. The level of liberalisation in services and investment is losing its momentum and slowing down across AMS due to the pandemic shock. Asian cities are plagued with high population densities, decreasing the returns to urbanisation (through pollution and congestion) and limiting their productive contribution to the regional growth. The level of trade and investment liberalisation in multilateral agreements such as the Regional Comprehensive Economic Partnership will be important to maintain and align domestic economies to sustain the economic competitiveness of domestic economies in the region.

The questions of how to manage and create agglomeration and dispersion effects in the services sector will be important policy discussions for the next stage of growth in East Asia. Governments might have to adopt a balanced approach to manage both the agglomeration and dispersion effects in the economy. Such an approach will be critically dependent on the development of urban amenities, urban linkages, and labour force skills to manage the technological disruptions as well as the movement of people within and between cities. This will be critical for AMS in the pandemic recovery and in setting the stage for the next stage of growth.

The nexus of GVCs, structural transformation, and urban amenities has several policy implications:

a. Skills and human capital are key factors linking production, competitiveness, innovation, and economic growth in the development of GVCs (Thangavelu and Narjoko, 2014; Thangavelu and Wenxiao, 2021). The development of GVCs also imposes new challenges to the high-skilled human capital in these countries, which are tailored to compete with skills from developed countries and to meet the international standards of GVCs. It is very clear that human capital is one of the key fundamentals to improve the firms' participation in GVCs as well as to position to higher-value activities at higher tiers of the GVC. The level of human capital in the ASEAN region is still too low to fully participate in GVCs and to shift to higher stages of GVC activities, especially in the second stage of the second unbundling. The labour force in ASEAN less developed countries (LDCs) have only primary or lower primary education, and there is a need to shift the educational level to upper primary and secondary level education. We also observe that the more developed AMS – Indonesia, Malaysia, Thailand, and Viet Nam – need a more holistic framework of human capital development that emphasises quality education and increases educational attainment to upper secondary and tertiary education, particularly in science and technical education. There is also a need to create an integrated framework for training and retraining of workers in relevant skills to retain workers in the labour market, as these countries experience more GVC disruptions.
b. The weaker services linkages of key AMS, preventing them from participating in complex GVC and RVC activities, reflect the weakness of the region to move up the value chain activities. The key fundamentals to harness the GVC network – technology, human capital, strong forward-looking institutions, and connectivity in soft and hard infrastructure – are still lacking in the ASEAN region. This provides ample opportunity to undertake more active economic liberalisation and key reforms to improve the GVC and RVC network in the region.
c. We also noticed that AMS are weaker in complex RVC and GVC activities, which indicates the weakness of key fundamentals in the domestic economy. The development of the regional and global value network is critically dependent on key domestic fundamentals such as human capital development in skills, technological development and harnessing digital technologies in ICTs, and the development of urban centres to create agglomerative activities in both the economic and social dimensions.

d. To balance the agglomerative and dispersion effects in the domestic economy, there is a need to develop a coordinated industry strategy that aligns forward-looking policies in industrial and human capital development policies in education and training. The alignment of industrial and educational policies in the overall development strategy will provide a domestic policy reform to coordinate the structural transformation of the domestic economy to the changes in the regional and global value chains.
e. There is a need for further liberalisation of services and investment in the ASEAN region. The services sector is still hampered by behind-the-border issues and higher regulatory burdens imposed by domestic institutions. The next stage of liberalisation could focus on key services sectors (e.g. aviation, logistics, finance, e-commerce, educational services, and business services) in creating stronger GVC linkages in the region. Traditional services trade sectors in ASEAN LDCs, such as tourism, could be improved and elevated to more service GVC activities such as green or cultural tourism.
f. The liberalisation of services in investment is critical to push innovation and entrepreneurship in developing new services GVCs and services linkages in the domestic economy and the region. The reforms to national information management systems in the domestic economy and coordination at the regional level will provide a platform to develop a region-wide digital framework to support and develop a more resilience GVC network to support innovative activities in the region.
g. The liberalisation of services should also be aligned with the movement of people, particularly the movement of semi-skilled and skilled workers, in the region. The movement of people will be critical to develop and create city and urban linkages within the domestic economy and between cities in the region. This will have important implications for the third unbundling in the ASEAN region.
h. Since East and Southeast Asia experienced a significant increase in medium-sized and small cities from 2000 to 2020, there is a need to create linkages between cities to increase the movement of people and ideas across cities to support and expand more innovative and entrepreneurial activities in the domestic economy. It is also important to create urban agglomeration in cities by developing competitive suburban and metropolitan areas closer to the cities. The competitiveness of these cities will be critical to drive the next stage of growth in the region. The competitiveness of ASEAN cities will be critically dependent on the quality of urban amenities, which increase the liveability of cities and attract skilled labour to live in and contribute to cities' innovation activities. Urban amenities will also be important in managing the negative impacts of medium-sized and large cities in terms of congestion and the higher cost of living. The competitiveness of the cities in Asia and ASEAN through the quality of urban amenities, service linkages, and skilled labour will be critical for recovery during and after the pandemic and for the structural transformation of ASEAN and East Asia for the next stage of sustainable and inclusive growth.

References

ADB (2019), *Asian Economic Integration Report 2019: Demographic Change, Productivity, and the Role of Technology*. Manila: Asian Development Bank.

ASEAN (2019), *ASEAN Integration Report 2019*. Jakarta: ASEAN Secretariat.

Athukorala, P. (2011), 'Production Networks and Trade Patterns in East Asia: Regionalization or Globalization?', *Asian Economic Papers*, 10(1), pp.65–95.

Baldwin, R. (2011), '21st Century Regionalism: Filling the Gap between 21st Century Trade and 20th Century Trade Rules', *Centre for Economic Policy Research Policy Insight*, No. 56. London: CEPR.

Baldwin, R. (2016), *The Great Convergence: Information Technology and the New Globalization*. Cambridge, MA: The Belknap Press of Harvard University Press.

Chen, L., R. Hasan, Y. Jiang (2020), 'Urban Agglomeration and Firm Innovation: Evidence from Asia', *ADB Economics Working Paper Series*, No. 616. Manila: Asian Development Bank.

Elms, D.K. and P. Low, eds. (2013), *Global Value Chains in a Changing World.* Geneva: Fung Global Institute (FGI), Nanyang Technological University (NTU), and World Trade Organization (WTO).

ERIA (2010), *Comprehensive Asia Development Plan*. Jakarta: Economic Research Institute for ASEAN and East Asia.

De Backer, K., P. De Lombaerde, and L. Iapadre (2018), 'Analyzing Global and Regional Value Chains', *International Economics,* 153, pp.3–10.

Gereffi, G. (2014), 'A Global Value Chain Perspective on Industrial Policy and Development in Emerging Markets', *Duke Journal of Comparative and International Law*, 24(3), p.433–58.

Gereffi, G. and T. Sturgeon (2013), 'Global Value Chains and Industrial Policy: The Role of Emerging Economies', in D.K. Elms and P. Low (eds.) *Global Value Chains in a Changing World.* Geneva: Fung Global Institute (FGI), Nanyang Technological University (NTU), and World Trade Organization (WTO), pp.329–60.

Glaeser, E.L., G.A.M. Ponzetto, and Y. Zou (2015), 'Urban Networks: Connecting Markets, People, and Ideas', *NBER Working Paper Series*, No. 21794. Cambridge, MA: National Bureau of Economic Research.

Gurría, A. (2015), Remarks at Session on the Slowdown in Global Trade, Istanbul G20 Trade Ministers Meeting, 6 October. http://www.oecd.org/about/secretary-general/istanbul-g20-trade-ministers-meeting-remarks-at-session-on-the-slowdown-in-global-trade.htm.

Heuser, C. and A. Mattoo (2017), 'Services Trade and Global Value Chains', in World Bank, IDE-JETRO, OECD, UIBE, and WTO, *Measuring and Analyzing the Impact of GVCs on Economic Development*, Global Value Chain Development Report 2017. Washington DC: World Bank, pp.141–59.

Hoekman, B. and B. Shepherd (2017), 'Services Productivity, Trade Policy and Manufacturing Exports', *The World Economy*, 40(3), pp.499–516.

Johnson , Robert and G. Noguera, 2012. 'Accounting for Intermediates: Production sharing and trade in value-added', Journal of International Economics, vol. 86, (2), pp.224–36.

Jones, R.W. and H. Kierzkowski (1990), 'The Role of Services in Production and International Trade: A Theoretical Framework', in R.W. Jones and A.O. Krueger (eds.) *The Political Economy of International Trade*. Oxford: Basil Blackwell, pp.31–48.

Kimura, F. (2018), '"Unbundlings" and Development Strategies in ASEAN: Old Issues and New Challenges', *ERIA Discussion Paper Series,* ERIA-DP-2017-14. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Kimura, F., Y. Takahashi, and K. Hayakawa (2007), 'Fragmentation and Parts and Components Trade: Comparison Between East Asia and Europe', *The North American Journal of Economics and Finance*, 18(1), pp.23–40.

Noguera, G. (2012), 'Trade Costs and Gravity for Gross and Value Added Trade', *Job Market Paper*, Columbia University.
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.645.3562&rep=rep1&type=pdf.

Obashi, A. and F. Kimura (2016), 'Deepening and Widening of Production Networks in ASEAN', *ERIA Discussion Paper Series*, ERIA-DP-2016-09. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

OECD (2013), *Interconnected Economies: Benefiting from Global Value Chains*. Paris: Organisation for Economic Co-operation.

Taguchi, H., D. Matsushima, and K. Hayakawa (2014), 'The Emerging Production Networks in Mekong Region', *International Journal of Trade and Global Markets,* 7(1), pp.18–35.

Thangavelu, S.M. and D. Narjoko (2014), 'Human Capital, FTAs and Foreign Direct Investment Flows into ASEAN', *Journal of Asian Economics*, 35, pp.65–76.

Thangavelu, S.M. and W. Wenxiao (2021), 'Skills and Human Capital Development Policies of ASEAN', in F. Kimura, M. Pangestu, S.M. Thangavelu, and C. Findlay (eds), *Handbook on East Asian Integration*, Cheltenham: Edward Elgar, pp.390–412.

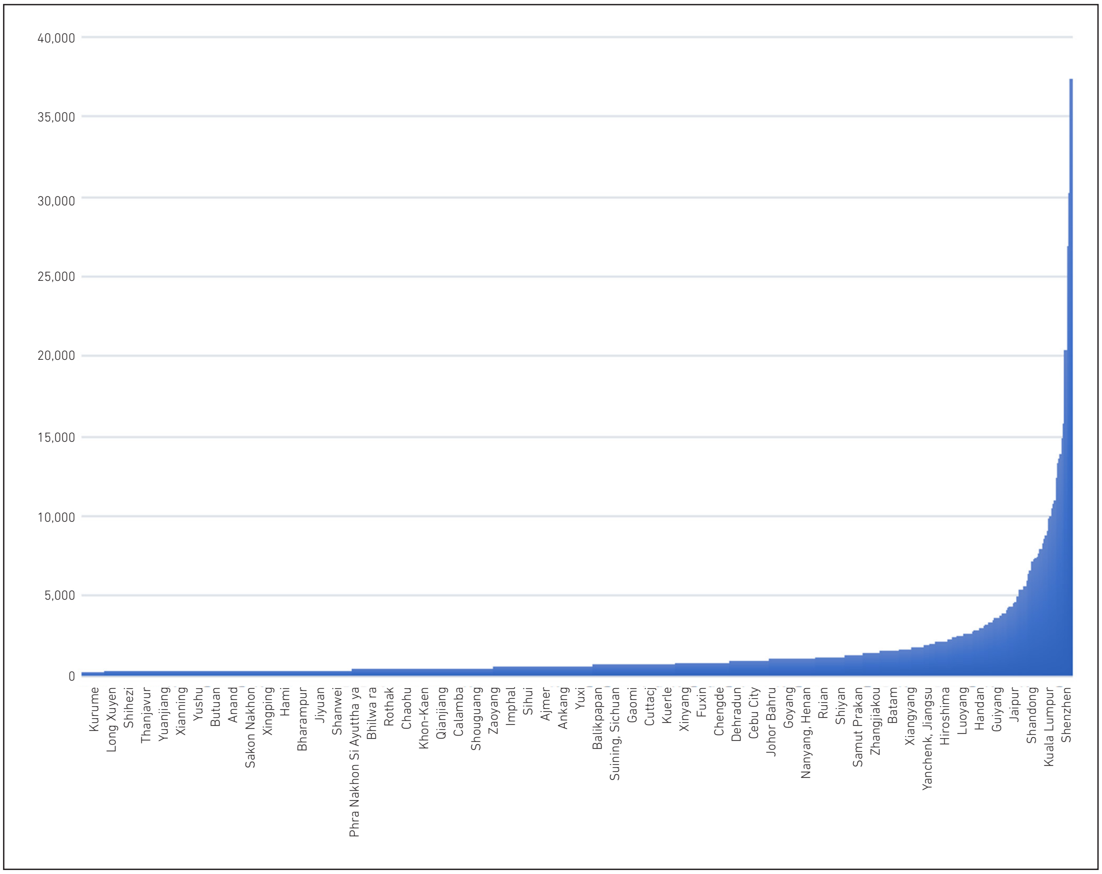
Thangavelu, S.M., W. Wenxiao, and S. Oum (2018), 'Servicification in Global Value Chains: Comparative analysis of selected Asian countries with OECD', *The World Economy*, 41(11), pp.3045–70.

UN (2019), *World Urbanization Prospects: The 2018 Revision*. New York: United Nations Department of Economic and Social Affairs, Population Division.

WTO and IDE-JETRO, 2011. Trade Patterns and Global Value Chains in East Asia: From Trade in Goods to Trade in Tasks, World Trade Organization, 2011 (https://www.wto.org/english/res_e/booksp_e/stat_tradepat_globvalchains_e.pdf)

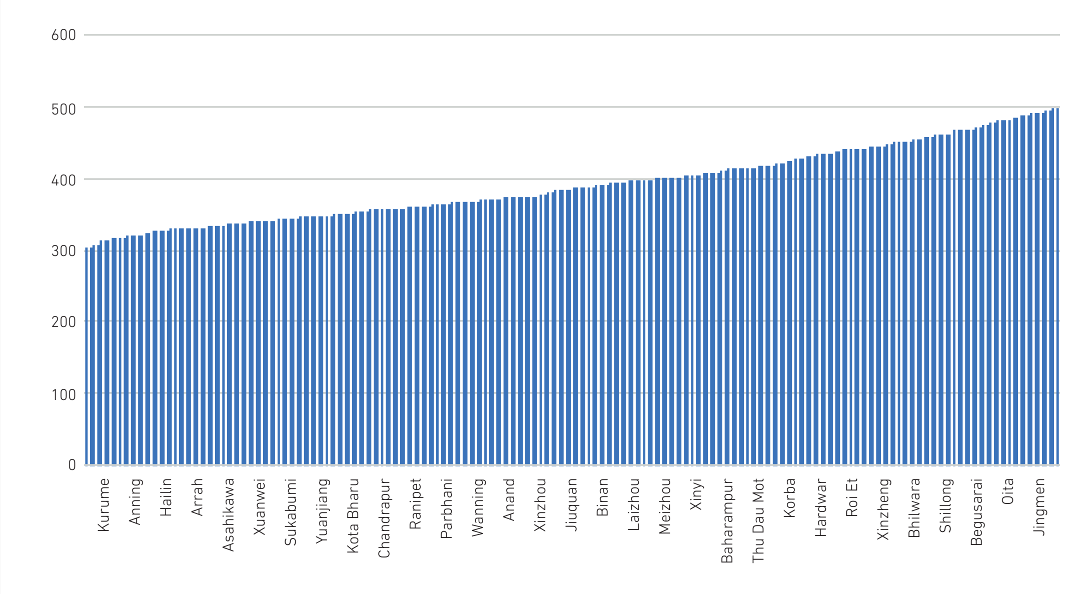
Annex

Figure A1 Asian Cities by Class Size (population), 2020



Source: UN World Urbanization Prospect 2018 (UN, 2019).

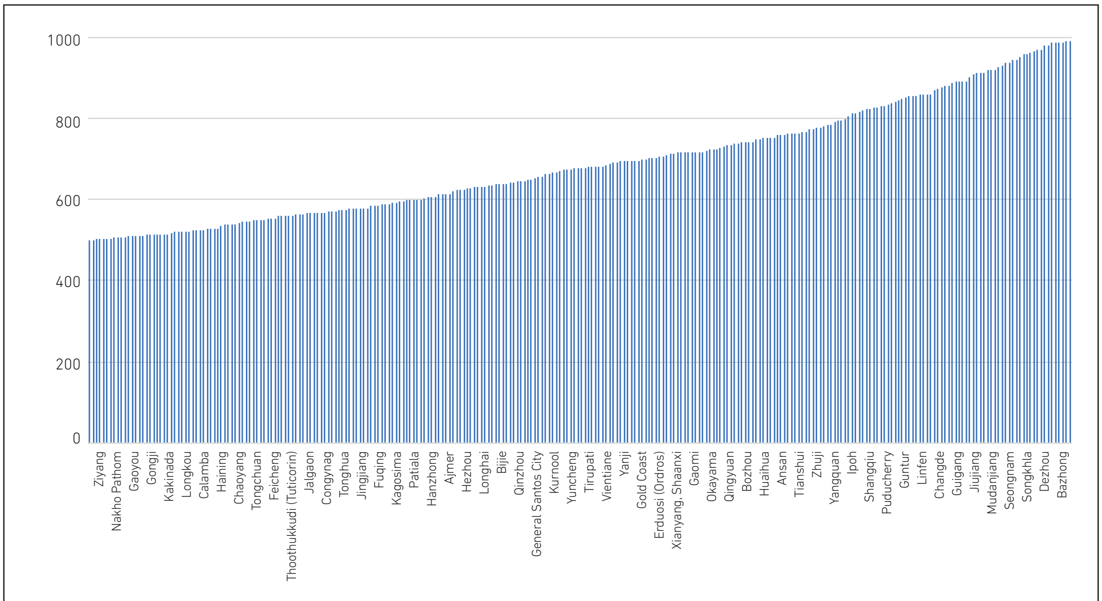
Figure A2 Small Cities in Asia, 2020 (population less than 500,000)



Note: 794 Asian cities.

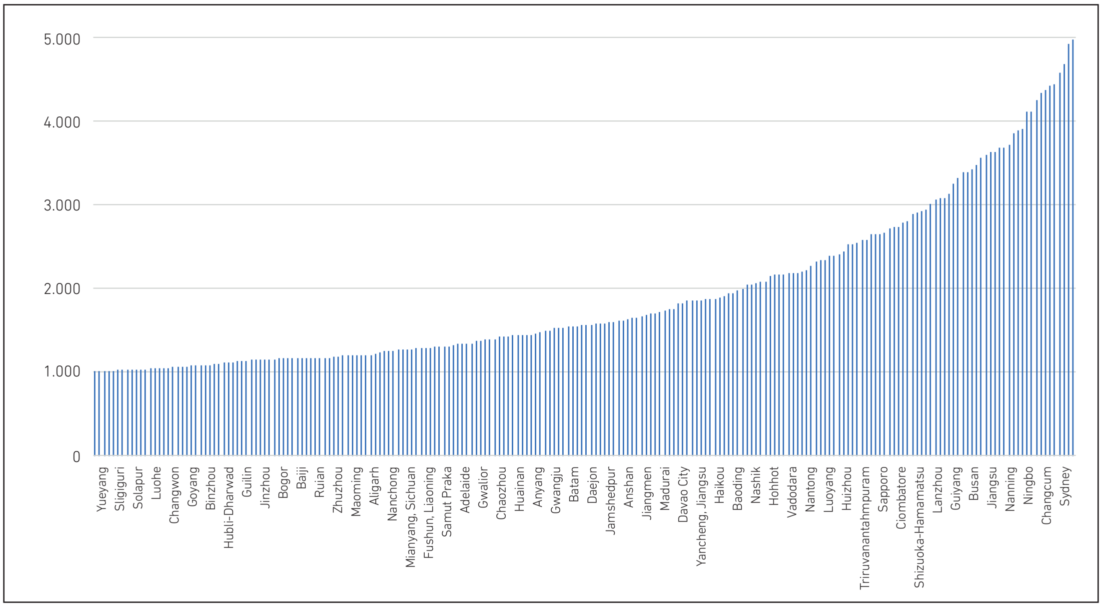
Source: UN World Urbanization Prospect 2018, UN (2019).

Figure A3 Class Size of Cities in Asia (Population 500k to 1m) - Small-Medium Sized Cities, 2020



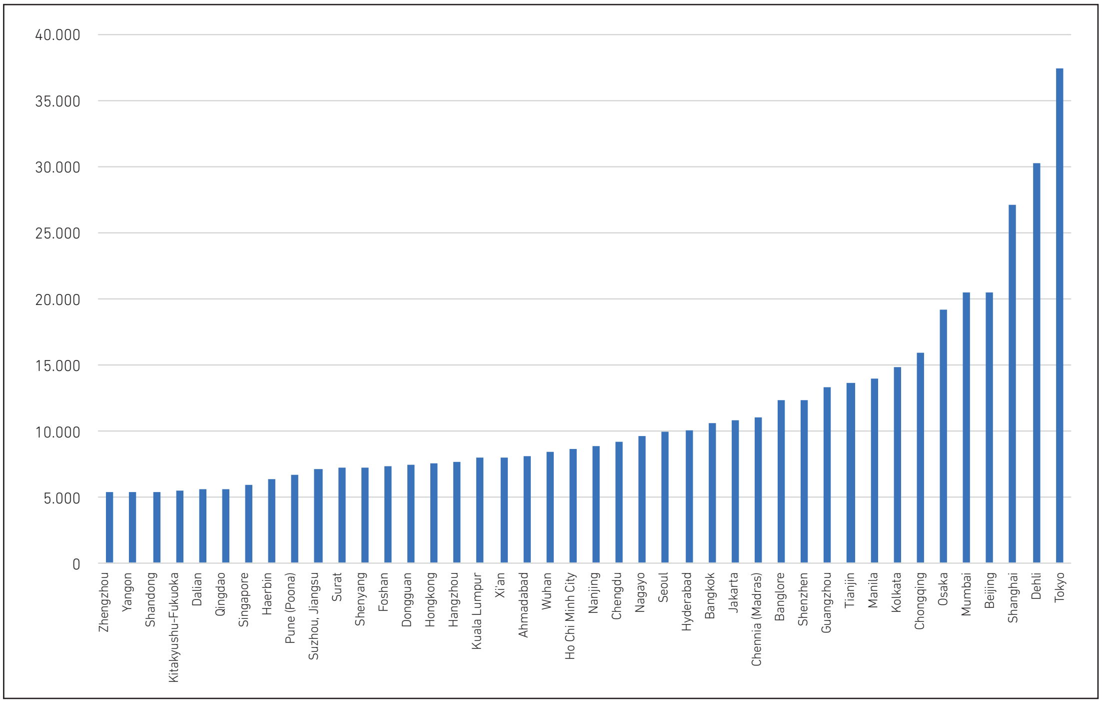
Source: UN World Urbanization Prospect 2018, UN (2019).

Figure A4 Class Size of Cities in Asia (Population 1m to 5m) -Medium Sized Cities, 2020



Source: UN World Urbanization Prospect 2018, UN (2019).

Figure A5 Class Size of Cities in Asia (Population 5m and above) -Large and Mega-Sized Sized Cities, 2020



Source: UN World Urbanization Prospects, 2018, UN (2019).

Chapter 11

Realising Smart Cities

Venkatachalam Anbumozhi
Director of Research Strategy and Innovation, ERIA

Cities' Role in Improving Quality of Life

Cities are spaces of great opportunity and challenge. About half of the population of the Association of Southeast Asian Nations (ASEAN) and East Asia lives in urban areas, and cities will drive most of the region's future growth. Economic activities and social interactions are centred around cities, where innovations not only thrive, but also where environmental pressures such as emissions and pollution are prevalent. New technological and digital solutions could relieve these pressures, deliver integrated services efficiently, and maximise social inclusion.

Smart cities are where challenges with the second and third unbundling and solutions meet. They are a nation's centre of trade, innovation, and skills education; and the gateway to globalisation. With Southeast Asia and East Asia rapidly urbanising, cities will grow in importance. In 2017, the ASEAN Smart Cities Network (ASCN) [1] was opportunely established, as more and more cities are exploring smart solutions to address economic, environmental, and social challenges. There are many challenges on this smart city journey, while experimenting with new technological solutions, developing performance indicators, and devising viable financial mechanisms. The urban population is expected to double between 2020 and 2050. This creates urgency to solve our most pressing challenges and create opportunities for reducing communication, trade, travel and meeting costs – enhancing human power by capitalising on migration and accommodating fragmented production costs to enhance the quality of city dwellers' lives. In this critical reflection looking at the ASCN and other similar movements in China, India, and Japan, this chapter tries to understand whether information and communication technology (ICT) infrastructure development at the city level brings smart service delivery or smart cities are part of holistic urban planning solutions that would lead to improve the quality of life.

Economic and Social Dividends of Cities

Cities are complex, organic, self-organising, and non-linear systems, so they evolve and change constantly. Contemporary cities can be considered as a large number of interconnected citizens, businesses, transport and communication networks, services, and utilities. Between now and 2030, the number of city dwellers in ASEAN and East Asian countries is projected to rise from about 500 million to 900 million. Urbanisation

[1] The 26 pilot cities of that network have developed their vision in the process of crafting city-specific action plans.

at this rate will significantly increase energy demand, as more energy will be required to support greater economic activity, expanded urban infrastructure, and the rising need for municipal services. Barles (2010) explained the metabolism of cities – generally consisting of the input of goods and the output of waste – with consistent negative externalities, which amplifies people's well-being.

Urban challenges – such as planning, economic development, resilient water supply, integrated data and security systems, responsive transport networks, environmental protection, sustainable resources management, risk management, sustainable waste management, energy management, emission control, education, social care and support, and the provision of local services – are putting immense pressure on cities, their infrastructure, and governance. Over the past five decades, the complexities and the speed of change, together with the need for integrated solutions, have been major challenges for local authorities, which have traditionally tackled such issues in silos. To ensure that such growth is sustainable, the ASEAN Socio-Cultural Community Blueprint 2025 (ASEAN, 2016) recommended enhanced coordination with relevant sectors to create environmentally sustainable cities and strengthen the capacity of local governments in conducting the greenhouse gas inventory. The blueprint also recommended strengthening the efforts of governments, the private sector, and communities to reduce emissions and pollution for an improved standard of living. Like many of the previous urban infrastructure visions – liveable cities, environment-friendly cities, and low-carbon cities – the concept of smart cities calls for tackling the challenging question of how alternative digital infrastructure choices can help in better managing their resources (Centre for Liveable Cities, 2018).

Smart Cities, Urban Amenities, and Digital Solutions for Well-Being

The conceptualisation of smart cities varies from city to city and from country to country. So far, leading the smart city pack in ASEAN and East Asia are Singapore, the Republic of Korea (henceforth, Korea), Malaysia, India, and China:

(i) Under the Smart Nation initiative, Singapore aims to harness the use of digital and smart technologies to become a more economically competitive and liveable global city. The Smart Nation plan outlines several key enablers such as an e-payment gateway, smart urban mobility, and a national digital identification system which would help to fulfil its low-carbon ambitions.

(ii) The Korean cities of Seoul and Busan have been placing emphasis on incorporating the internet of things (IoT) into the daily lives of their residents. They have also bundled government utility services for delivery via an e-platform as part of their digitalisation. To bolster such programmes, the government relies heavily on big data analytics to understand its citizens better and to fine-tune its initiatives so that they better serve city populations in an environmentally sustainable way.

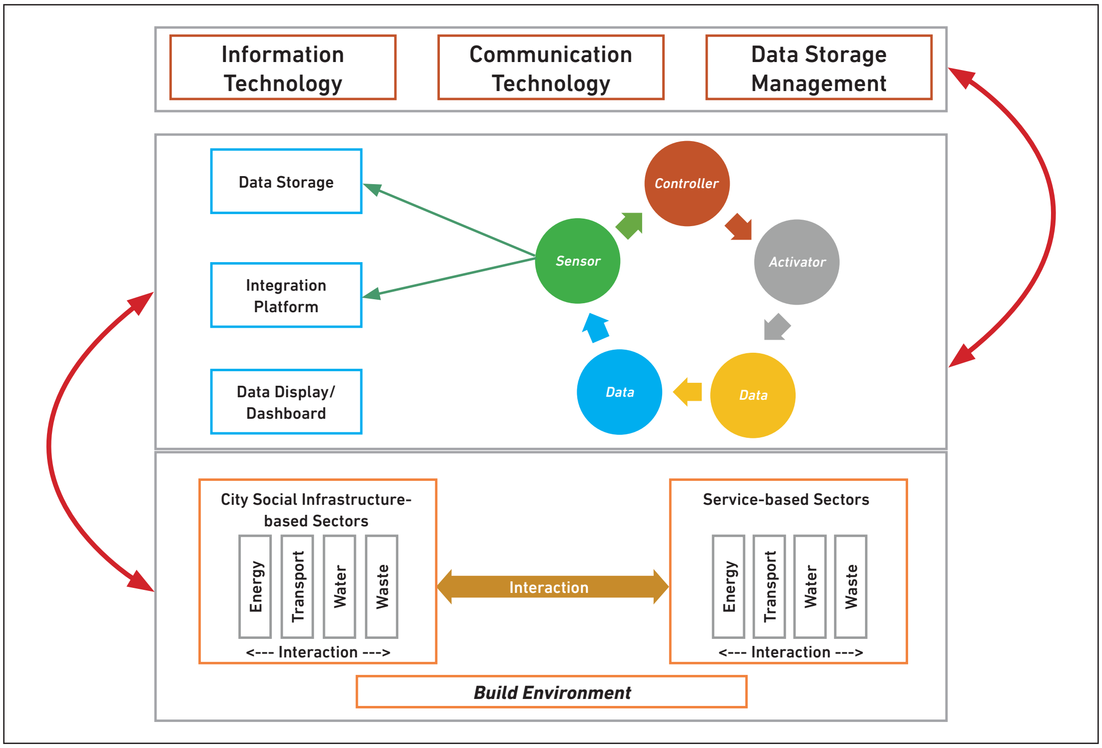
(iii) Malaysia, on the other hand, has turned to artificial intelligence (AI) to solve its urban congestion woes and to herald a new era of smart city development in the country. The project will essentially give authorities eyes in the sky as they leverage data mining and video and image recognition capabilities to track and optimise traffic flows. It is scheduled to be first launched in the country's capital, Kuala Lumpur.

(iv) India's smart cities programmes focus more on electronic service delivery, waste-to-energy conversion, and the introduction of smart metres for energy efficiency improvement.

(v) China's smart cities programme is designed to accomplish the goals of renewable energy generation, sludge solidification, and the recovery of resource use through energy recapturing.

Thus, the emerging concept of smart cities embeds an element of urban design that uses highly advanced technologies, wherein energy service is becoming one big and highly complex cyber-physical system, in which computer-based algorithms improve the quality of life of the city residents and build a sustainable and clean environment for them. The smart city architecture represents ICT-enabled service delivery, as illustrated in Figure 11.1.

Figure 11.1 **Smart City Architecture for Improving Service Delivery**



Source: Authors.

The basic framework conditions are that city services such as energy, transport, water, and waste management are changing with digital technology driven concepts and tools, such as sensors, instrumentation, mobile phones, geospatial information, open data, big data, IoT, and geographic information, which define the governance structure of the administration.

ASEAN Member States are in this smart city race. Indonesia, which is the largest economy in the region, is working to develop Jakarta into a smart city. Amongst the initiatives launched are the Jakarta One Card, a rubbish truck tracker, and a smart street lighting system. Thailand, in collaboration with tech giants Dell and Intel, is combatting the problem of an ageing population via the Saensuk Smart City project. Davao City in the Philippines, alongside prominent tech player IBM, has implemented IBM's Intelligent Operations Centre to support public safety and security. The centre allows real-time monitoring of city operations, which improves energy use efficiency and provides timely responses during emergencies. The coastal town of Danang in Viet Nam aspires to be the country's inaugural smart city by 2025. It is currently in talks with IBM to leverage the IBM Smarter Cities initiative. Areas of cooperation include the development of smart city infrastructure, efficient waste management, and air quality control.

This enthusiasm for smart cities is based on the belief that the application of digital technologies has the potential to become a panacea for urban problems and provide more efficient services. Such careful considerations require a common framework of reference, as shown in Figure 11.2, to enable the stakeholders in a smart city to discuss, decide, and then plan to become smart. From Figure 11.2, it is clear that data and ICT will play a large part in smart future urbanism. If that happens, smart cities will be an effective integration of physical infrastructure, digital technology, and human systems to deliver a sustainable, prosperous, and inclusive future for their citizens. In that sense, being smart or deploying ICT is not an end in itself, but rather can be an enabling condition that may lead to other desirable, social, economic, and environmental outcomes. City officials need to have a better understanding about both the benefits and costs involved.

Smart City Domain and Architecture

Smart cities were conceptualised during the past two decades in various parts of Europe and Asia, but they have different visions, as observed in the 26 ASCN cities (see Appendix). Nonetheless, smart cities continue to be an essential part of urban infrastructure planning. This is changing with technology-driven concepts and tools such as open data, big data, IoT, urban sensors, volunteered geographic information, and electronic democracy. These concepts and tools are redefining the city and how to manage and govern it. While ICT is only one option for addressing urbanisation and environmental concerns, it can be a powerful one. For example, the recent application of mobile-based applications for organising city events and controlling road traffic shows the potential for altering urban infrastructure planning, where smart urbanism is designed with more availability of user-generated data for better city governance. There is no doubt that ICT will play an important role in making cities smarter in delivering essential services. However, how cities are utilising ICT and aggregated data for the specific needs and requirements of the improved well-being of city residents is as important as the technology implementation in smart city progress.

To reveal the typology of smart cities, six application areas defined by the vision documents of the ASCN are explored, where smart cities are based on domains and subdomains (Table 11.1).

Table 11.1 Six Application Areas of Smart Cities

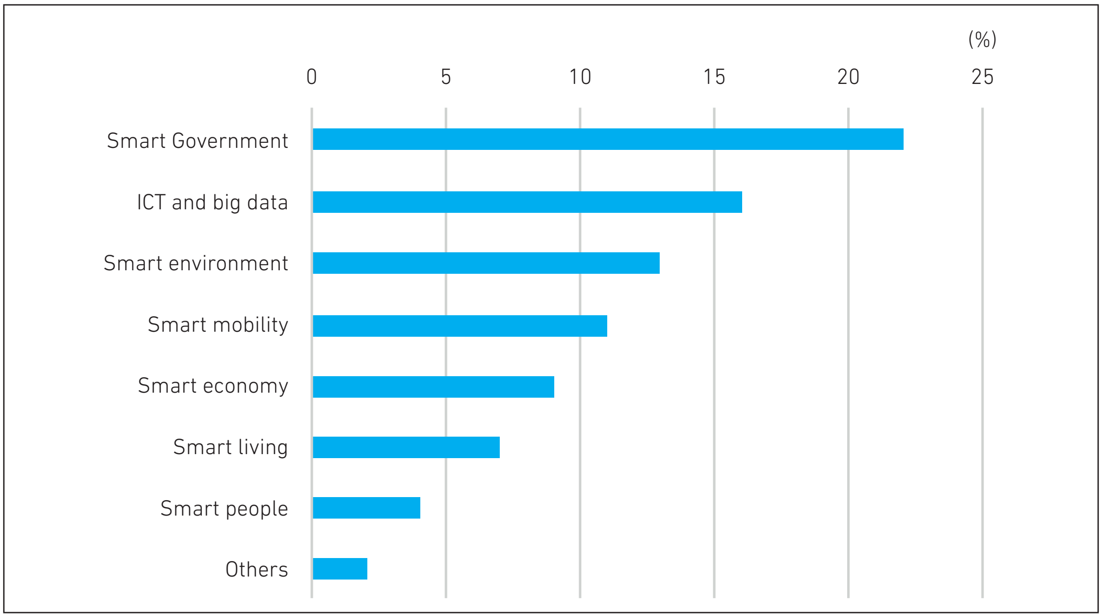
Smart Economy Competitiveness	**Smart Environment** Natural resources	**Smart Mobility** Transport and ICT
Smart Government **Participation**	**Smart People** Social and human capital	**Smart Living** Quality of life

ICT = information and communication technology.

Source: Authors.

A detailed review of smart city initiatives (ERIA, 2020) indicated that there are two different approaches to developing smart cities – top down and bottom up. A typical top–down approach can be observed in India's Smart Cities Mission prepared by the Ministry of Housing and Urban Affairs. China's 14th five-year plan encompasses a new type of urbanisation plan for 2021 – 2025. The previous five-year plan, 2016–2020 also planned investment in Chinese smart city projects and programmes, with more focus on technological issues compared with the Indian smart city programme. An ERIA survey on the ASCN found that apart from the six application areas mentioned in Table 11.1, different smart city application types are also in operation (Figure 11.2). It should be pointed out here that many of the ASEAN smart cities analysed have more than one smart city application.

Figure 11.2 Smart City Application Types in ASEAN



ASEAN = Association of Southeast Asian Nations, ICT = information and communication technology.

Source: Anbumozhi and Kumar (2019).

Based on the definition and operational application types, it is possible to create a taxonomy with four large branches: (i) business-related categories, (ii) citizen-related categories, (iii) environment-related categories, and (iv) government-related categories. Table 11.2 presents a domain taxonomy that can be used to categorise different smart city approaches.

Table 11.2 Domain Taxonomy of Different Smart Cities

Domains	Subdomains
Business-related smart city domains	Entrepreneurship Enterprise management Logistics Transactions
Citizen-related smart city domains	Education Healthcare Public transport Smart traffic Tourism
Environment-related smart city domains	Renewable energy Smart grid Building and housing Waste management Water management Pollution control Public space
Government-related smart city domains	Emergency response E-government Public safety Public service Transparency

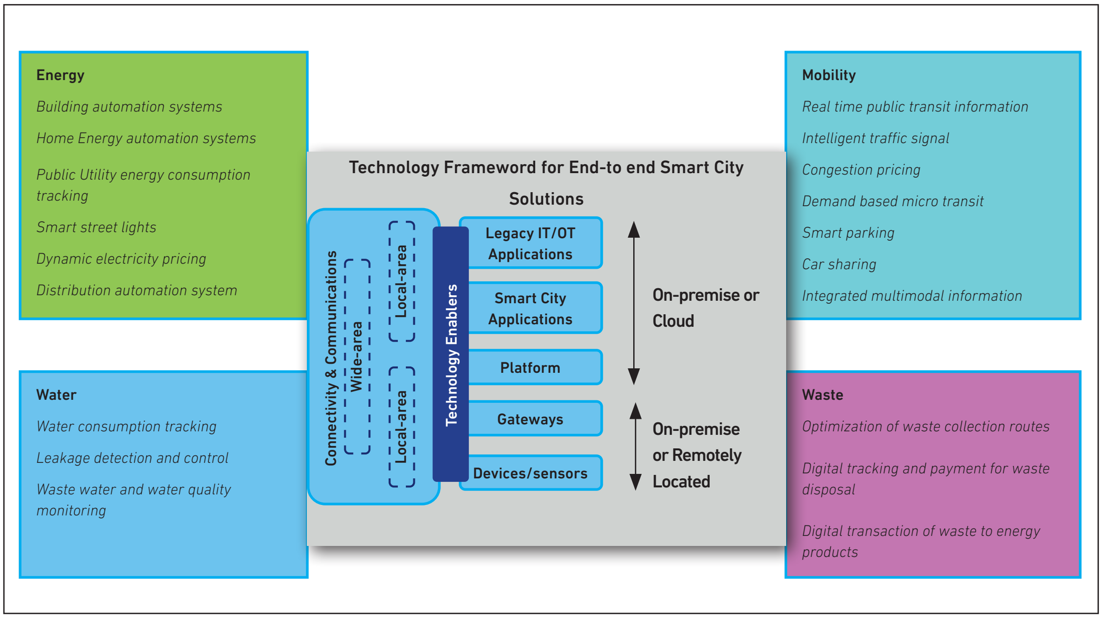
Source: Thompson (2017).

Tackling the dual challenges of governing urbanisation and increasing resource consumption remains the priority of smart city development, and these challenges need to have a direct relationship with the demands from citizens.

Innovative urban leaders such as Singapore have begun to tap into a new stream of data on the state and performance of their cities, often in real time, to realise a forward-looking vision of a smart city – a city that leverages information technology (IT) and communication technology and connectivity to make better decisions on reducing the trade costs and achieving better delivery of services and to improve the quality of life, which are aspirations of urban citizens. Smart city programmes are complex and diverse endeavours that encompass various existing and emerging technologies, environmental designs, and humanistic innovations. Their common outlook on technologies is illustrated in Figure 11.3. They include the domains of energy, mobility, water, and waste, which are fully integrated with or by IoT. Specifically, smart cities collect a lot of data through instrumentation, bring these data together through integration, and then analyse the integrated data for intelligence on how to improve a city's services for the third unbundling.

In an IoT-enabled smart city ecosystem, devices can be aggregated according to their geographical position and assessed by an integrated system. Sensor services and instrumentation devices for gathering specific data for service domains such as energy, transport, waste, and water can be used to monitor their resource consumption or the movement of people. The interlinking of enabling technologies through a platform provides a substructure that facilitates enhanced service provision to the consumers/users connected to each other. In Figure 11.3, the interconnection amongst the four service domains through IoT consequently integrates the different aspects of citizens' lives by creating cost-effective city services, enhancing public transformation, and reducing traffic congestion. At the national level, it could play a vital role in environmental and energy policymaking, e.g. pollution reduction, energy conservation, monitoring systems, and needed urban infrastructure. Thus, it would help to supply systems with more efficiency, lower costs, and more secure operations through energy conservation rules, economic competitiveness, and reliability levels (Gubbi et al., 2013).

Figure 11.3 Technology Applications and Enablers of Smart Cities



IT = information technology, OT = operations technology.

Source: Anbumozhi and Kumar (2019).

Quality of life has many dimensions, from the clean air residents breathe to the quality water they drink. Several IoT applications address these kinds of practical and very human concerns. Woetzel et al. (2018) and Anbumozhi (2020a) found that cities could improve some key quality of life indicators by 10%–30%, which translates into lives saved, reduced crime, shorter commutes, a lower health burden, and carbon emissions averted.

Despite widespread enthusiasm and appreciation of the benefits, however, most cities in ASEAN struggle to understand how best to invest in smart city infrastructure and connectivity to deliver long-term value (Hilton and Marsh, 2017). While evidence of a sustained impact remains elusive, governments allocate significant budget to smart city projects. China has launched a reported $70 billion smart city credit line and an $8 billion investment fund. India is aiming for the home-grown IT industry to construct 100 smart cities, with a yearly budget of $1.2 billion (Federation of American Scientists, 2011).

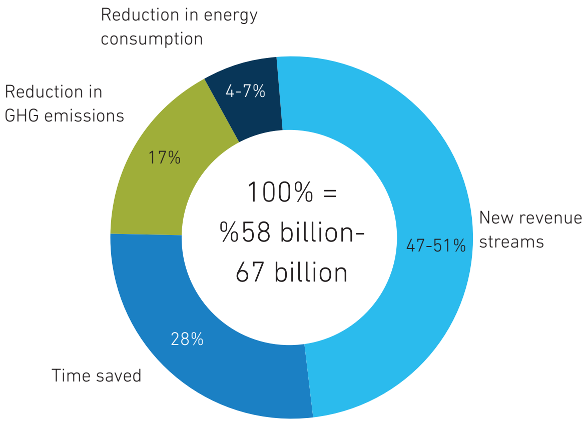
Pragmatically, in ASEAN – through a network – old and new cites alike have begun to incorporate smart technologies into the everyday fabric and complexity of their existing urban centres to drive greater economic efficiencies in city operations; provide a platform for innovations on a citywide scale; and promote social inclusion through heightened accountability, citizen empowerment, and smarter governance.

Achieving Efficiency and Improving Quality of Life Through Smart Cities Based on Technology and Data

By collecting large amounts of data and translating these data into insights, cities could boost the efficiency and responsiveness of their operations. The integration of smart technologies – ICT, AI, automation, sensors, etc. – can help cities to match the supply of public services with real-time needs and to uncover emerging problems such as energy blackouts, clogged water supply, and congested traffic before crises emerge. Smart technologies make this possible in several ways, with many quantitative benefits (Figure 11.4).

Figure 11.4 Well-Being Benefits of Smart City Technological Applications

Mobility applications cn create almost $70 billion in value across Southeast Asia.



Examples

Singapore
- Implemented dynamic congestion pricing
- Traffic congestion is down by 15% since its introduction in 1990
- Public transit has gone from 45% to 65% of the city/s commutes

Malaysia
- Grab acquired Uber's Southeast Asia business in 2018. It provides yup to 2.5 million rides daily

Indonesia
- Ride-hailing company Go-Jek currently has a fleet of more than a million car and motorcycles

GHG = greenhouse gas.

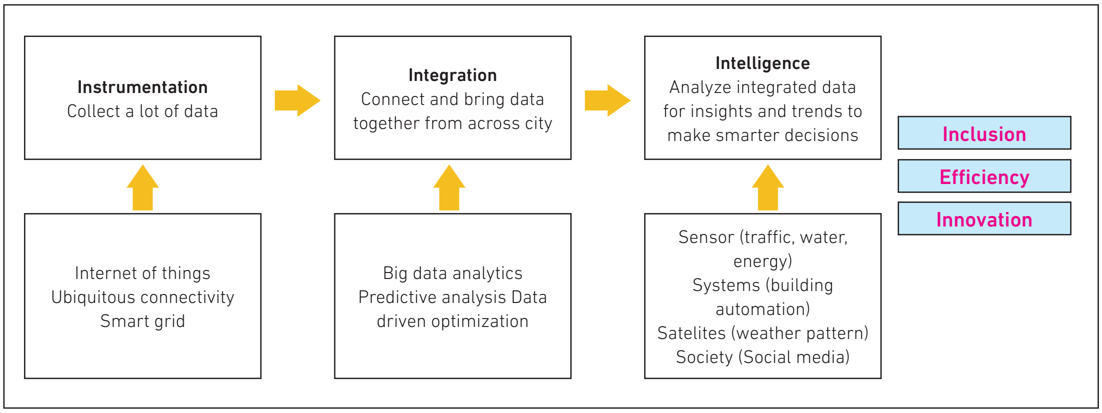
Source: Woetzel et al. (2018).

Automated optimisation translates data from cameras, sensors, and anonymised cell phone records into intelligence, e.g. to help optimise traffic flows in real time. Predictive analysis uses such data to track and predict everything from rainfall to landslides during typhoons, thus contributing to strengthening business continuity plans. Evidence-based decision-making and planning can continuously monitor milestones and targets to ensure that cities can quickly take corrective action as needed to achieve productivity goals in a cost-effective way.

Innovation and Inclusion Through Smart Collaboration

Most smart innovations have their origins in the private sector (Yarime, 2018). Indeed, a city is essentially a complex economic system of production systems, and each of the systems generates data that can be analysed to make the third unbundling feasible. But for individual smart systems to add up to a smart city, innovations must be on a citywide scale. That requires contributions and ideas not just from commercial firms but also from governments and citizens through 'public–private–people partnership' in three stages, as illustrated in Figure 11.5.

Figure 11.5 Smart Cities – From Data to Intelligence for Well-Being



Source: Author.

Open data, social media, and cell phones enable governments, firms, and citizens to exchange vast amounts of information at virtually no cost – making it easy to share knowledge and ideas throughout society. These tools also enable real-time collaboration, allowing governments to view their citizens and firms not just as passive customers of public services, but as key partners in innovative problems (Anbumozhi, 2020b). Singapore, Seoul, Takamatsu, Jakarta, and Mandalay have begun to use this collaborative approach to bring together city residents, businesses, and city governments to experiment with innovations to reduce their city's environmental footprint, increase economic efficiency, and enhance social inclusion.

Governments can benefit by facilitating innovations through three platforms (Talari et al., 2017; Hilton and Marsh, 2017). Through local open data, cities share local data with the public, promoting transparency, accountability, and collaborative problem-solving. Through living labs, governments designate parts of the city as test beds to pilot-test new ideas collectively. Through incubation centres, cities partner with local universities and industries to seed transdisciplinary research centres with systematic access to local city data.

City leaders should focus smart city efforts on the needs of all residents (Hilton and Marsh, 2017). Three valuable emerging experiences in the region are worth noting. First, using data to target the most vulnerable, as Singapore is doing by developing a comprehensive geographic database of socio-economic and physical indicators to prioritise housing investments. Second, opening up data to promote accountability, including grassroots initiatives such as the mapping of facilities, pollution, and community needs as in Salem. Third, tapping mobile connectivity and civic participation, as Jakarta is doing for participatory governance and for crowdsourcing the identification of polluting vehicles.

Conclusion

The diffusion of smart technologies and explosion of data will give rise to the third unbundling. Cities could stimulate this process by becoming living laboratories for smart innovations that translate local experiments into global knowledge and global knowledge into local solutions. Accelerating this progress will require actions at all levels. Cities in ASEAN and East Asia could work together to establish open standards for IoT devices and data collection protocols. This would avoid becoming locked in to a few big technology companies. It would also make it easier to share solutions such as a community-developed application programming interface in, say, Jakarta, which can be rapidly deployed in Kuala Lumpur through mutual recognition agreements. Local governments could address the often-fragmented structure of their bureaucracy and outdated rules that are incompatible with the design and implementation of an integrated ICT system that facilitates the movement of people, knowledge, and ideas across city/national boundaries.

References

Anbumozhi, V. (2020a), 'Low-Carbon Energy Performance Evaluation of ICT Enabled Smart City Models in ASEAN', Proceedings of the IAEE 2020 Conference Program, Auckland, 12–15 February.

Anbumozhi, V. (2020b), 'Driving Sustainability Innovations through Smart Cities', Proceedings of the International Symposium on Realizing Smart cities, Salem, 27–29 February.

Anbumozhi, V. and S. Kumar (2019), 'Realizing Smart Cities – Issue in Focus', Proceedings of the Working Group Meeting on Realizing Smart Cities, Chiang Mai, 23–24 July.

ASEAN (2015), *ASEAN Economic Community Blueprint 2025.* Jakarta: ASEAN Secretariat. https://asean.org/book/asean-economic-community-blueprint-2025/ (accessed 10 March 2022).

Barles, S. (2010), 'Society, Energy and Materials: The Contribution of Urban Metabolism Studies to Sustainable Urban Development Issues', *Journal of Environmental Planning and Management*, 53(4), pp.439–55.

Centre for Liveable Cities (2018), *ASEAN Smart Cities Network.* Singapore: Centre for Liveable Cities. https://www.clc.gov.sg/research-publications/publications/books/view/asean-smart-cities-network (accessed 25 January 2022).

ERIA (2020), 'Proceedings of the International Conference on Driving Sustainability Innovations Through Smart Cities', Salem, 28–29 February.

Federation of American Scientists (2011), 'Six Technologies with Potential Impacts on US Interests out to 2025'. Washington, DC.

Gubbi, J., R. Buyya, S. Marusic, and M. Palaniswami (2013), 'Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions', *Future Generation Computer Systems*, 29(7), pp.1645–60.

Hilton, S. and A. Marsh (2017), 'Shaping Successful Smart Cities: Reflections on the APPG Smart Cities' Top Tips for City Mayors'. Bristol: University of Bristol.

Sta. Maria, R., S. Urata, and P.S. Intal, Jr., eds. (2017), *The ASEAN Economic Community into 2025 and Beyond*, ASEAN@50, Volume 5. Jakarta: Economic Research Institute for ASEAN and East Asia.

Talari, S., M. Shafie-khah, P. Siano, V. Loia, A. Tomasetti, J.P.S. Catalão (2017), 'A Review of Smart Cities Based on the Internet of Things Concept', *Energies*, 10(4), pp.1–23.

Thompson, E.M. (2017), 'Smart City: Adding to the Complexity of Cities', Proceedings of the 33rd CAADE Conference, Volume 1. Vienna: Vienna University of Technology. https://core.ac.uk/download/pdf/46520503.pdf (accessed 25 January 2022).

Woetzel, J., D.-Y. Lin, M. Sridhar, and S.-E. Yap (2018), 'Smart Cities in Southeast Asia', *Discussion Paper*, July. Singapore: McKinsey Global Institute. https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-in-southeast-asia (25 January 2022).

Yarime, M. (2018), 'Japan's Experience of Creating Innovation from Smart Cities: Implications for Public Policy for Urban Sustainability', *JICA-RI Working Paper*, No. 170. Tokyo: Japan International Cooperation Agency Research Institute. https://www.jica.go.jp/jica-ri/publication/workingpaper/wp_170.html (accessed 25 January 2022).

Appendix. ASEAN Smart Cities Network (ASCN)

Brunei

1. Bandar Seri Begawan

Objectives of smart city action plan	Not applicable
Priority project 1	**Revitalisation of Kampong Ayer (water village)** National Development Plan for housing in the water village
Priority project 2	**Clean River Management Projects** Cleaning of the Brunei River around Bandar Seri Begawan
Other projects in the pipeline	Not applicable
Support needed	• Learning good practices from other successful smart cities • Overseas consultants for planning and strategy formulation of smart cities • Sharing of capacity building on technological and digital expertise/learning

Cambodia

2. Battambang

Objectives of smart city action plan	In 2015, the Land Use Master Plan of Battambang Municipality, which is aimed at sustainable development, focused on six main pillars: (i) city of good governance and administrative management; (ii) green and healthy city; (iii) heritage, culture, and tourism city; (iv) regional centre of commerce and services; (v) regional centre of agricultural product processing and trade; and (vi) regional centre of education and knowledge.
Priority project 1	**Capacity Development in Marketing to Investors** • To improve marketing capacity to investors interested in projects to enhance Battambang's local economy and environment • Investors play an important role where the local government has limited budget to provide public services and to build infrastructure such as transport networks
Priority project 2	**High-Level Expertise Building** To build up capacity and skills for the implementation of future smart city plans
Other projects in the pipeline	Night Market (improvement of sanitation and support to vendors); Wastewater Treatment; River Embankment
Support needed	• Funding • Advisory support • Technical expertise in the smart and sustainable urbanisation domain • Strategic spatial planning

3. Phnom Penh

Objectives of smart city action plan	• To have sustainable development • To promote the city's potential for investment • To create a liveable city for future generations • To have an open and connected city • To have a peaceful and secured city
Priority project 1	**Smart Public Spaces** 11 important boulevards in Phnom Penh city taken as pilot projects for development into smart public spaces
Priority project 2	**Public Transit Development** Implementation of bus, tramway, skytrain, and waterbus
Other projects in the pipeline	Affordable Housing Programmes; Waste Management System; Poverty Reduction; Clean Urban Environment
Support needed	• Capacity building • Action plan for efficient master plan implementation • District plan for local development • Creating urban regulation in detail

4. Siem Reap

Objectives of smart city action plan	• Urbanisation of City Development Plan • Smart Street Light and Control System
Priority project 1	**Security and Public Order**
Priority project 2	**Waste Management**
Other projects in the pipeline	Smart and Secure System for Tourist Sites; Infrastructure Quality
Support needed	• Technical support • Financial support • Regional framework and supported system

Indonesia

5. Makassar

Objectives of smart city action plan	Strengthening coordination and integration of data and information services, faster emergency services, and responsive collaboration for an inclusive government in expressing the smart city vision of Makassar City to create a liveable world-class city for all.
Priority project 1	**Technopark Development** • A tool for the city government to educate society through technology development • To facilitate the need for the growth and development of industries, especially innovative small- and medium-scale industries, the provision of services to industries within a specially prepared area, and increased productivity and competitiveness
Priority project 2	**Online Integrated Tax System** Assist the implementation of an integrated online tax system and improve the convenience for taxpayers in fulfilling their tax obligations
Other projects in the pipeline	Big Data Analytics; Integrated Public Service Access; Management Information System Asset City of Makassar (SAMATA); PTSP 5 Star; SMART RTH; Data Center Health; Disaster Response Alert in Hallway
Support needed	• To overcome implementation barriers: o Building a high literacy community ecosystem (education) o Realising the environmental community security system (resilient city) o Sensing, coordinating, and networking for improved quality and the impacts of new social media o Developing partnerships with the tech sector o Engaging citizens through open-source apps

6. Banyuwangi

Objectives of smart city action plan	• Providing a digital platform and practical implementation of regional development plans based on the smart city concept • Providing guidance on development planning of Banyuwangi based on six dimensions of smart cities (smart governance, smart economy, smart society, smart branding, smart living, and smart environment) • Preparing smart city development priorities in the short term (1 year: 2017–2018), medium term (5 years: 2018–2023), and long term (10 years: 2018–2028)
Priority project 1	**Improvements to Public Service Access to Remote Areas**
Priority project 2	**Improvements to the Education System** • Improve access to education for all communities • Reduce dropout rates • Equip students with skills and knowledge on digital media

Other projects in the pipeline	Not applicable
Support needed	• Funding for the implementation of technology in education, health, and environment • Technical expertise in waste processing

7. Jakarta

Objectives of smart city action plan	To achieve the desired standard of living for the citizens of Jakarta while ensuring responsible natural resources management by utilising integrated information and communication technology in all public sectors
Priority project 1	**Oke Otrip** One-for-all payment card for integrated public transportation in Jakarta
Priority project 2	**Jaki** Mobile phone applications and website for information related to Jakarta, where people can also submit a report about problems they face
Other projects in the pipeline	Okemart; Developing Affordable Housing Programmes
Support needed	• Additional technical expertise • Cooperation with each ministry and related agencies in implementing smart city programmes • Funding from the regional budget

Lao PDR

8. Luang Prabang

Objectives of smart city action plan	Not applicable
Priority project 1	**Wetland Environmental Improvement Project** • Preservation of natural ponds and wetlands to protect green spaces • Construction of urban drainage network/storm drainages to protect the city centre from flooding
Priority project 2	**Construction of Concrete Alleyways and Footpaths** • To improve and upgrade the existing dirt paths in the city centre to concrete • To lay bricks for sidewalks in the city centre to improve accessibility
Other projects in the pipeline	Improvement of Waste Landfill Site, Improvement of Riverbanks, Construction of Public Toilets and Wastewater Treatment Units, and Construction of Sludge Treatment Site
Support needed	• Financial support • Capacity building

9. Vientiane

Objectives of smart city action plan	To develop a smart and sustainable city
Priority project 1	**Faecal Sludge Management Project**
Priority project 2	**Major Development Sites along 450th Anniversary Road**
Other projects in the pipeline	Nongping Project; Vientiane Expressway Project; Latsavong Project
Support needed	Funding support

Malaysia

10. Johor Bahru

Objectives of smart city action plan	Smart City Iskandar Malaysia is a tool to accelerate Iskandar Malaysia vision to become a strong and sustainable metropolis of international standing.
Priority project 1	**Iskandar Malaysia Urban Observatory** • A central data centre to collate, update, analyse, manage, and disseminate data and information in Iskandar Malaysia • A knowledge hub to improve the region-wide base of urban knowledge on Iskandar Malaysia • A monitoring and assessment centre to monitor the progress of Iskandar Malaysia in implementing the Comprehensive Development Plan (CDP), its urban condition, and trends • Technical services that help to monitor programmes and provide capacity building in implementing policies at the local level
Priority project 2	**Management of Water Resources & Distribution** • Rollout of Integrated Urban Water Management Blueprint • Includes sourcing of new water solutions, enhancement of service delivery and distribution, and optimisation of water resources through technology to cater for future population and business needs
Other projects in the pipeline	Global District Energy in Cities; Building Efficiency Accelerator; Low-Carbon Society; Smart City Action Plan for Local Authorities in Iskandar Malaysia; Integrated Transport System
Support needed	• Strong government support on implementation and monitoring • Integration and coordination amongst stakeholders • Enhanced public–private partnerships • Continuous research and development (R&D), innovation, and creativity

11. Kuala Lumpur

Objectives of smart city action plan	• Development plans (Kuala Lumpur Structure Plan 2020 and Draft Kuala Lumpur City Plan 2020): Vision to be a World Class City by 2020 – to be achieved through four principles: world-class working, living, and business environment, and city governance • Kuala Lumpur Low Carbon Society Blueprint 2030: Vision to be a World Class Sustainable City 2030: 70 by 30 A Greener Better Kuala Lumpur – through 10 actions: green growth, energy-efficient spatial structure, green mobility, sustainable energy system, community engagement and green lifestyle, low-carbon green building, green and blue network, sustainable waste management, sustainable water management, and green urban governance • Draft Kuala Lumpur Competitive City Master Plan: Vision to be a World Class Competitive City by 2030
Priority project 1	**Low-Carbon Society Blueprint** This blueprint will provide Kuala Lumpur City Hall with a strategic direction and clear framework for coordinating related policies and programmes towards the reduction of greenhouse gas emissions for Kuala Lumpur
Priority project 2	**City Competitiveness Master Plan** • This master plan takes into account the competitive advantage of the city in consultation with the private sector, civil society, and other relevant stakeholders • The development of a city competitiveness master plan will ensure that the city remains economically advanced and is a great place to live for urban residents of all socio-economic levels
Other projects in the pipeline	Heritage Trails in City Centre; Green Enterprise Zone in City; Green and Blue Network Study
Support needed	• Funding • Advisory support • Technical expertise, especially in information and communication technology (ICT) areas, to achieve a smart and sustainable city vision and objectives

12. Kota Kinabalu

Objectives of smart city action plan	**Goal**: To transform Kota Kinabalu into a clean, green, and liveable city **Vision**: To administer Kota Kinabalu City through efficient and effective services with sustainable development.
Priority project 1	**Tanjung Aru to Universiti Malaysia Sabah -Pedestrian Walkway and Cycleway** A world-class pedestrian walkway and cycleway that is safe, interesting, and provides a variety of experiences for recreational cyclists and commuters
Priority project 2	**Sembulan River Beautification** To restore a vital city resource by restoring and regenerating the Sembulan River corridor so that it becomes an essential 'greenway' for recreation and leisure, and a focal point for wildlife and special recreation; provides excellent opportunities for multiuse waterfront development; improves social interaction; and creates a sense of community
Other projects in the pipeline	Safe City Programme, Anti-Litter Bug Campaign, Reduction of Plastic Bag Usage Campaign, Mottainai KK, Program Kasih Sayang Pulau Gaya, KK Green City Action Plan, Smart Cities Action Plan
Support needed	• Technical expertise to advise on various sectors of smart/sustainable development initiatives, including the preparation of the action plan and the involvement of local or international investors to implement the programmes set in the action plan • A regulatory framework to allow the collaboration of the city and investors implementing the smart/sustainable development programmes

13. Kuching, Sarawak

Objectives of smart city action plan	Improving the quality of life and achieving the status of smart state through digital transformation
Priority project 1	**Transport & Smart Mobility** Establish comfortable and safe mobility for commuters using smart technologies
Priority project 2	**Flood Management and Response System** Undertake: • integrated smart development planning • stormwater management programme • flood information management system
Other projects in the pipeline	Smart Water Supply Services, Smart Solid Waste Management System
Support needed	Not applicable

Myanmar

14. Nay Pyi Taw

Objectives of smart city action plan	The city's five visions are: • to be environmentally sustainable • to be green and liveable • to be a knowledge hub • to be an international aviation transit, cargo, and logistics hub • to be climate change resilient
Priority project 1	**Improvement of Nay Pyi Taw City Master Plan** • Nay Pyi Taw city was established by combining three old townships (Pyinmana, Lewe, and Tatkone) and surrounding villages and farmlands. The whole territory will be developed by urbanising the villages and farmlands and through resettlement. • The Smart City Initiative Project will be implemented partially at the Diplomatic Zone, Hotel Zone, and proposed International University zone (the first in Myanmar to be constructed in cooperation with the Republic of Korea). • The Hotel Zone has completed infrastructure while the other two zones have established basic infrastructure (e.g. roads, electricity and water supply, and communication networks), but improvements are needed.
Priority project 2	**Affordable Housing Development** • Construction of medium-rise low-cost affordable housing for government employees • Pilot project construction was completed in 2017 through government construction and investment from public–private partnerships.
Other projects in the pipeline	Logistics Hub, Innovative Improvement of Nay Pyi Taw Infrastructure Project
Support needed	Not applicable

15. Mandalay

Objectives of smart city action plan	Not applicable
Priority project 1	**Waste Management Systems** • Goal A: Maximise municipal solid waste collection and recycling in the city • Goal B: Improve final treatment and disposal system in the city • Goal C: Maximise proper collection and disposal of industrial and hazardous waste • Goal D: Maximise proper disposal and treatment of wastewater • Goal E: Capacity development, awareness raising, and advocacy • Goal F: Ensure services remain sustainable through review, monitoring, innovation, and improvement
Priority project 2	**Affordable Housing Programme**
Other projects in the pipeline	Traffic decongestion
Support needed	Not applicable

16. Yangon

Objectives of smart city action plan	Not applicable
Priority project 1	**Low-Cost Rental Housing and Transport-Oriented Development** • Low-cost rental houses for targeted groups • To develop growth characteristics, highway bus terminal for smooth transportation between Yangon and Ayeyarwady division, and to link it strongly with Yangon Public Transportation (Yangon Bus Service) • To establish dry port zone for easy flow of goods • To develop public rental housing system to upgrade the socio-economic state of the homeless and workers who are in need of housing
Priority project 2	**Conservation of Yangon City Downtown Area** • Preserve Yangon's unique heritage and image • Become an economic hub through well-balanced development in city functions • Become a sustainable city where citizens can live and work peacefully • Create a systematic and sustainable developing city style and good social environment in Yangon • Define construction design and land use according to zoning for a reduction of damage caused by natural disasters
Other projects in the pipeline	Bo Ba Htoo Affordable Housing Project, Industrial Zone
Support needed	Not applicable

Philippines

17. Cebu

Objectives of smart city action plan	Not applicable
Priority project 1	**Automated Citywide Traffic Control Systems**
Priority project 2	**Transport Expansion Plan**
Other projects in the pipeline	Cebu Bus Rapid Transit; Call Centre City; Long Life Programme; Extension/ Expansion of the Cebu Bus Rapid Transit System
Support needed	• Access to capital funds and technical assistance • Advisory support • High level of technology transfer to allow initiative and creativity at the local level to continue and sustain all programmes and projects

18. Davao City

Objectives of smart city action plan	1. To improve the quality of life of citizens, especially those who are underprivileged 2. Improve public service delivery, bureaucracy, and governance through the use of the latest management information systems 3. To ensure the public's safety and security, and efficiently address the current traffic conditions in the city, with the aid of modern information technology 4. To have a healthy, safe, and secured environment 5. Provide linkages and collaboration with local, national, and international agencies to achieve sustainable development Action Plan: 1. Creation of Davao City General Development Direction by identifying key priority areas of concern 2. Creation of Davao City Government ICT Policy and Enterprise Architecture Plan (EO 20 series of 2016)

Priority project 1	**<u>Intelligent Transport and Traffic System and Security</u>** • The smart traffic system, along with traffic surveillance monitoring, has been fully operational since 2010. 'No contact apprehension' has been implemented to sanction traffic violators. • However, due to the ever-growing challenges of traffic management, the City Government of Davao is looking to enhance traffic management capabilities by leveraging the latest technological innovations available. • The city government would also like to give equal weight to safety and security, ensuring that the traffic and transportation solution to be adopted is inclusive, with security mechanisms. • The city government will implement the following traffic and transport projects: (i) High Priority Bus System (funded by the Asian Development Bank), (ii) Railway System (funded by the Japan International Cooperation Agency), and (iii) Traffic Signalization System Upgrade (funded by the Department of Transportation). • Technology needed: smart traffic signalisation upgrade, smart high-priority bus system, and smart railway system • Considerations: cost of investment, cost of maintenance, scalability, integration amongst the different systems to be implemented, compatibility with the existing traffic signalisation system
Priority project 2	**<u>Converged Command and Control Center</u>** • In the Philippines, Davao City is the only civil government to have a Public Safety and Security Command Center (PSSCC) specifically tasked to orchestrate all undertakings relative to safety and security. • The PSSCC is a centre for all coordination efforts to ensure maximum efficiency of all resources involved in safety and security operations within the city, and leads multi-agency mechanisms whenever there are incidents beyond the capacity of a single agency. • A converged command and control solution will enable the PSSCC to easily link to other agencies and acquire near-, if not real-time, information that is critical in the planning and implementation of particular safety and security standards. • Technology needed: video and data analytics, video management systems, unified communication systems, unified open platform • Considerations: cost of investment, cost of maintenance, scalability, interoperability

19. Manila

Objectives of smart city action plan	To achieve the desired standard of living for the citizens of Manila while ensuring responsible natural resources management by utilising integrated information and communication technology in all public sectors
Priority project 1	Creating a smart city with a smart grid that allows artificial intelligence to monitor the consumption, production, and transportation of energy efficiently. The SMART Grid is a revolutionary infrastructural and utility gird that enables artificial intelligence to effectively monitor the consumption, production, storage, and transportation of energy. At the same time, it will provide flexibility for localised consumption.
Priority project 2	Provide a green and sustainable building environment and enhance the quality of life for residents; design a city with residential, commercial, healthcare, educational, recreational, retail, and all other types of facilities and services that are all efficiently connected.
Other projects in the pipeline	• Enhanced Flood Monitoring and Prevention • Traffic Management • Manila Resident ID Issuance
Support needed	• Additional technical expertise • Cooperation with each ministry and related agencies in implementing smart city programmes • Funding from the national budget

Singapore

20. Singapore

Objectives of smart city action plan	Singapore's Smart Nation is not intended to be just a technology project, but a whole-of-nation journey to fundamentally remake the nation through technology, with strong collaboration between the public, private, and people sectors. The goals include (i) building a leaner and stronger public sector, where agencies are at the global leading edge of service delivery, transformation, and innovation; (ii) building a vibrant economy that remains attractive to foreign investment and talent, with competitive local enterprises and opportunities for Singaporeans, and with companies leveraging digital technologies to reinvent their processes and production; and (iii) making services more accessible to all, and connecting people and communities better, to encourage a sense of optimism and confidence in the opportunities that the future Singapore brings.
Priority project 1	**E-Payments** Providing seamless and integrated e-payment platforms and options
Priority project 2	**National Digital Identity** Digital identity and authentication for all citizens

Other projects in the pipeline	Smart Nation Sensor Platform; Moments of Life (one-stop platform for citizens to interact with multiple government agencies); Smart Urban Mobility; Smarter Estate Planning & Management; Digital Health
Support needed	• Industry support to find and develop the best use cases for the Smart Nation initiatives • Development of business models for various initiatives to be successfully implemented and adopted

Thailand

21. Bangkok

Objectives of smart city action plan	To drive the projects/programmes in the action plan in a suitable timeframe
Priority project 1	**Development in Bang Sue Area** • Bang Sue will be the next transportation hub of Thailand. • This project will be overseen by the State Railway of Thailand.
Priority project 2	**Smart City Plan and Investment Plan**
Other projects in the pipeline	Not applicable
Support needed	• Advisory support from other countries on smart cities • Interest in private enterprises to invest in areas which house pilot smart city projects

22. Chonburi

Objectives of smart city action plan	Key performance indicators by 2040: • 30% renewable energy + energy storage • Reduce energy consumption by 20% • Reduce carbon dioxide emissions by 30% • Energy self-reliance • Smart grid system
Priority project 1	**Smart Grid Project** Partnership with AMATA Corporation PCL to manage electrical network, generation systems, transmission systems, and power distribution system, with energy management and storage system
Priority project 2	**Waste to Energy** Partnership with AMATA Corporation PCL to convert waste in Amata Nakorn industrial estate to energy (electricity)
Other projects in the pipeline	Not applicable
Support needed	Technological support in waste management

23. Phuket

Objectives of smart city action plan	Building sustainable tourism in Phuket that will consist of seven smart areas: 1. Smart Tourism: Income distribution 2. Smart Safety: Phuket safe city 3. Smart Environment: Sustainable environment for tourism growth 4. Smart Economy: Hub of creative economy 5. Smart Governance: Sustainable city 6. Smart Education: Smart learning community 7. Smart Healthcare: Digital healthcare
Priority project 1	**City Data Platform** • The City Data Platform builds big data for city management and makes the data available for local governments and start-ups • Data include local data from both private and public sources (e.g. CCTV, internet of things (IoT) sensors, log files of free Wi-Fi/wristbands/bike sharing, VISA spending). Data from the central government are also available (e.g. weather radar and GPS from public transport). • The data will be cleaned, anonymised, quality assured, and categorised before being opened via an application programming interface (API), with defined security and access levels. • The platform will work like a marketplace of city data and anyone can retrieve the data for their business analyses and planning.
Priority project 2	**CCTV Safe City** • To invest in 3,500 cameras for full area coverage in Phuket • Since 2017, video analytics have been implemented and CCTVs have been integrated (from various Visitor Management Systems), with the control centre at city hall. • The analytics include law enforcement, licence plate recognition (LPR), and face recognition. • These are customised to fit the requirements of the traffic police to enforce red-light violation, speeding, vehicle counting, and classification and illegal parking. • The project aims to extend the CCTV coverage to the whole Phuket area.
Other projects in the pipeline	Phuket Intelligent Operation Centre; Proof of Concept (POC) Safe Beach; Environment IoT Sensors; Maritime Safety; Airport Light Rail
Support needed	• Master plan study for public–private partnership investment and business model for smart cities • Funding for proof-of-concept projects and investment master plan development

Viet Nam

24. Da Nang

Objectives of smart city action plan	To improve the quality of life and efficiency of urban services and activities; to improve competitiveness while ensuring the needs of the present and future generations in economic, social, environmental, and cultural terms
Priority project 1	**Bus Rapid Transit (BRT)** • Smart bus station • Real-time traffic information system • Bus management system • Customer information system • Signal priority traffic system
Priority project 2	**Intelligent Traffic Control System** • Upgrade Transport Control Center • Completion of network and camera installation • Software to detect traffic flow and violations
Other projects in the pipeline	Intelligent Operation Control Center; Smart Citizens
Support needed	• Funding • Technical support

25. Hanoi

Objectives of smart city action plan	• Developing e-government closely associated with administrative reform, raising the quality and efficiency of state agencies, contributing to raising the city's competitiveness, developing the knowledge economy, and providing the best public services for people and businesses • Developing basic components of the smart city to raise the efficiency and effectiveness of the social administration work of state management agencies; step-by-step improvements to the quality of life of people and competitiveness of the city
Priority project 1	**Intelligent Operations Center** • Building of component centres: o Supervision, traffic control, and crime prevention in public o Centre for reception and processing of emergency information, fire prevention, and search and rescue o Data Analysis Center o Security Monitoring Center o Center for Monitoring of Administrative Services

Priority project 2	**<u>Development of Intelligent Transportation</u>** • Traffic control and supervision • Management of public transport • Traffic instructions • iParking card management • Electronic tickets
Other projects in the pipeline	Building E-government; Smart Tourism
Support needed	• Capital and budget support • Access to knowledge, information, and experience on creating an intelligent city • Enablers to make intelligent city development decisions in accordance with Hanoi's conditions (through workshops, trainings, and experiential learning) • Support for human resources training (management and implementation) • Introduction to qualified partners in intelligent city building

26. Ho Chi Minh City

Objectives of smart city action plan	Vision under Ho Chi Minh City's Smart City Master Plan Towards 2025: Ho Chi Minh City will attain rapid and sustainable economic development through optimal resource utilisation and citizen-centric governance General objectives of Ho Chi Minh City's Smart City Master Plan for 2017–2025: • Maintaining economic growth towards a knowledge economy and a digital economy • Enhancing urban management efficiency through forecasting • Improving liveability and workability • Increasing citizen participation
Priority project	**<u>Integrated Operations Center (IOC)</u>** Development of a technology framework and model
Other projects in the pipeline	Shared Data Warehouse and Corresponding Integration of Data and Technical Guidelines; Topography and Cadastral Maps; Citizen Database; Enterprise Database; One-Stop Service E-Portal for the Public; Security Operations Center
Support needed	• Financial support • Sharing of best practices, policies, and solution technologies in the field of smart cities through site visits • Technical and consulting assistance for developing and implementing important projects such as a Forecasting Center, economic policies and development strategies, and Intelligent Operations Center

Chapter 12

The Role of the Automotive Sector in Regional Economic Development

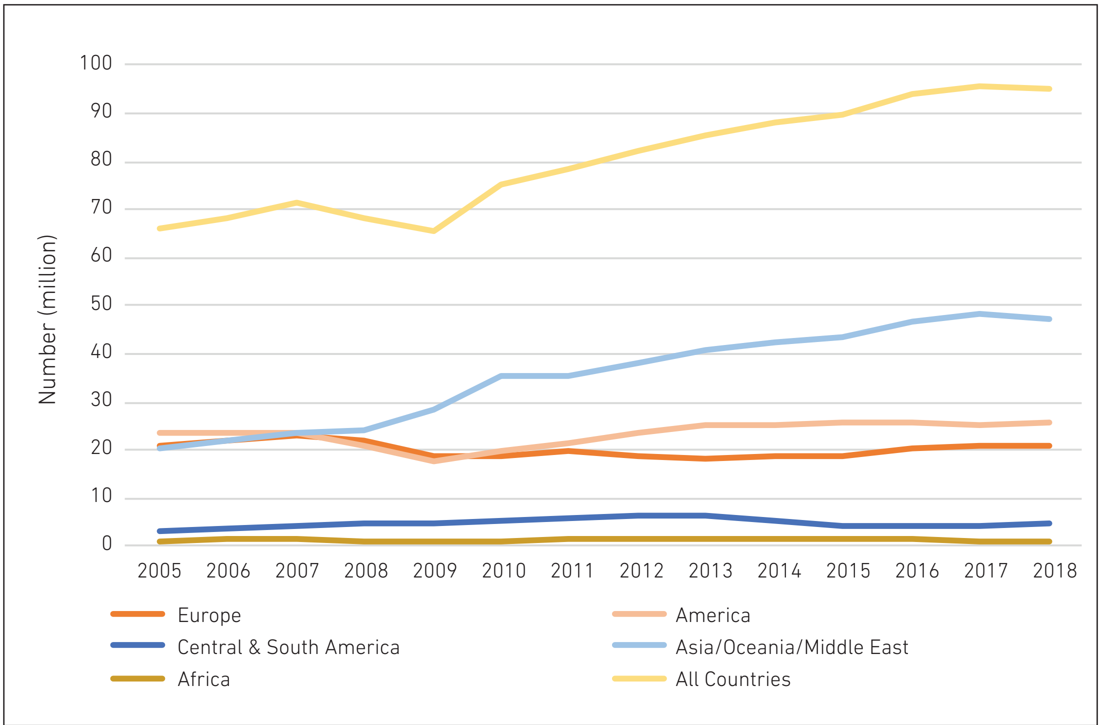
Fusanori Iwasaki
Executive Assistant to the President/Senior Research Associate, ERIA

Yasushi Ueki
Senior Research Fellow, IDE-JETRO; Research Fellow, ERIA

Introduction

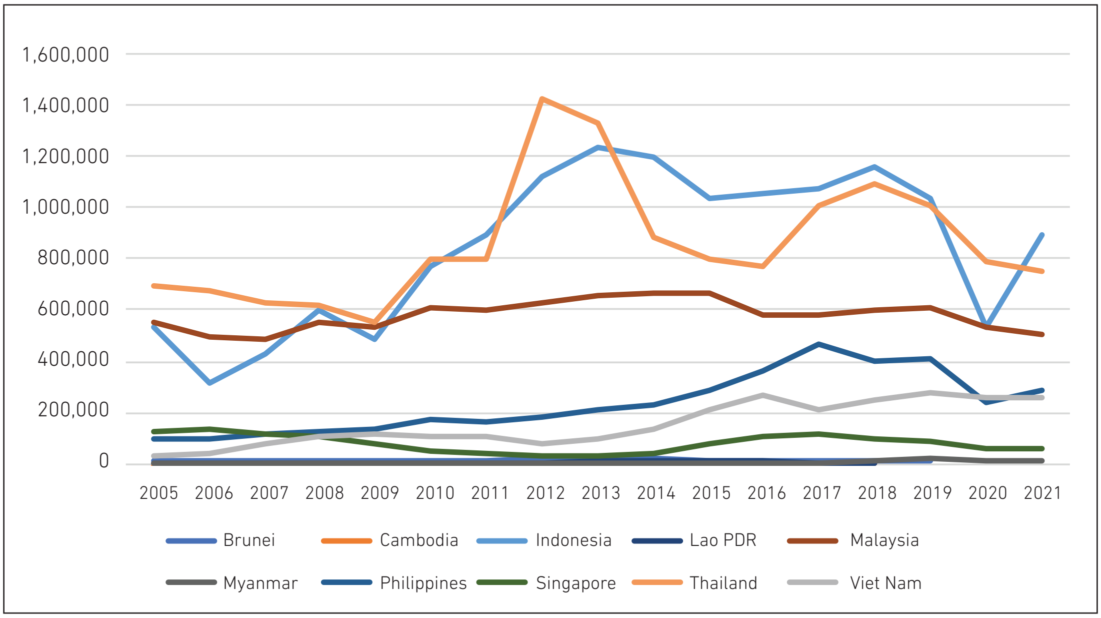
By 2040, almost all Association of Southeast Asian Nations (ASEAN) Member States (AMS) will be high-income countries, constituting a growth centre in the world economy (ERIA, 2019). Due to increasing incomes, the transportation sector will grow dramatically until 2040. According to the International Organization of Motor Vehicle Manufacturers (OICA), automotive sales and production have increased dramatically in the last decade (Figure 12.1). Figure 12.1 shows that global vehicle sales (including commercial and passenger cars) reached 95 million units in 2018, driven by the considerable growth rate of Asia, Oceania, and the Middle East. However, Figure 12.2 shows that some AMS (e.g. Thailand and Indonesia) slowed the increase in sales from 2014 to 2018, while the Philippines and Viet Nam maintained robust high growth rates. In terms of AMS production, only five countries – Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam – produce a significant number of vehicles and maintain a stable growth rate, with some fluctuations (except in Malaysia). Thailand produces about twice the average number of sales, while others produce less than the domestic market demand.

Figure 12.1 Total Global Vehicle Sales in All Countries



Source: OICA (n.d.), Global Sales Statistics. https://www.oica.net/category/sales-statistics/ (accessed 26 November 2021).

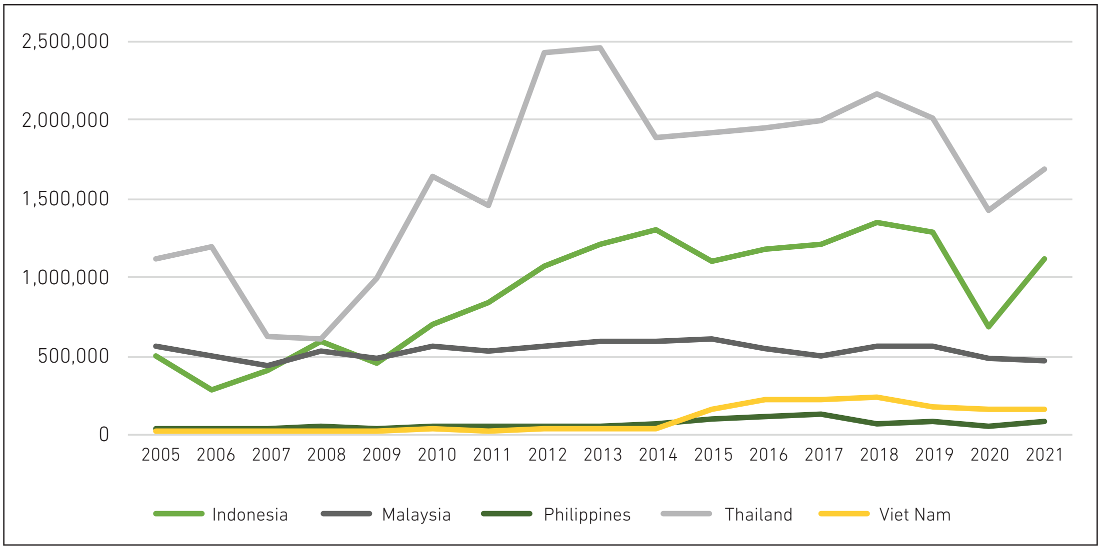
Figure 12.2 Total Number of Vehicle Sales in ASEAN



ASEAN = Association of Southeast Asian Nations.

Source: OICA (n.d.), Global Sales Statistics. https://www.oica.net/category/sales-statistics/ (accessed 26 November 2021). ASEAN Automotive Federations (AAF), https://www.asean-autofed.com/index.html (accessed 17 July 2022). (The data on Brunei (2020-2021), Cambodia (2019-2021), and Lao PDR (2019-2021) are no data.)

Figure 12.3 Total Number of Vehicles Produced in ASEAN



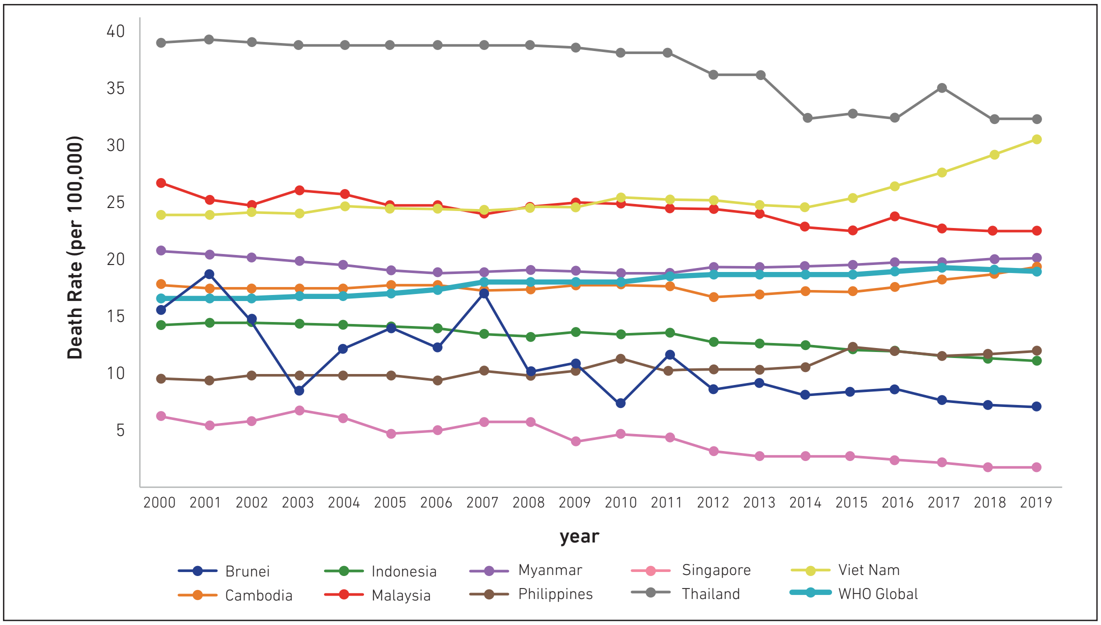
ASEAN = Association of Southeast Asian Nations.

Source: OICA (n.d.), data base. AAF statistics (n. d.). (Accessed 20 July 2022).

To achieve a prosperous and healthy society by utilising the potential of automobiles, AMS should upgrade manufacturing and pursue sustainable industrial development through innovation. The automotive sector, which is one of the largest manufacturing segments, faces a massive transformation due to digitalisation such as the internet of things (IoT), artificial intelligence (AI), autonomous driving, and electrification, by using big data. This is not only a challenge for automotive companies but also a great opportunity for the development of the manufacturing sector as well as the software industry.

The other challenge for AMS is to realise sustainable mobility. Automotives and the 'motorisation society'[1] also have massive negative impacts on society (Uzawa, 1974). The digitalisation of the automotive industry has the potential to mitigate such social costs. Figure 12.4 and 12.5 illustrate the ratio of traffic deaths in ASEAN and the East Asia Summit (EAS) 6 countries.[2] While deaths in the EAS 6 countries are below the World Health Organization (WHO) global level, deaths in some AMS are quite high. Vehicle sales in AMS are still increasing, so transportation infrastructure, laws, and traffic regulations need to be developed and implemented as designed in the motorisation society.

Figure 12.4 Death Rate of Automotive Traffic Accidents in ASEAN



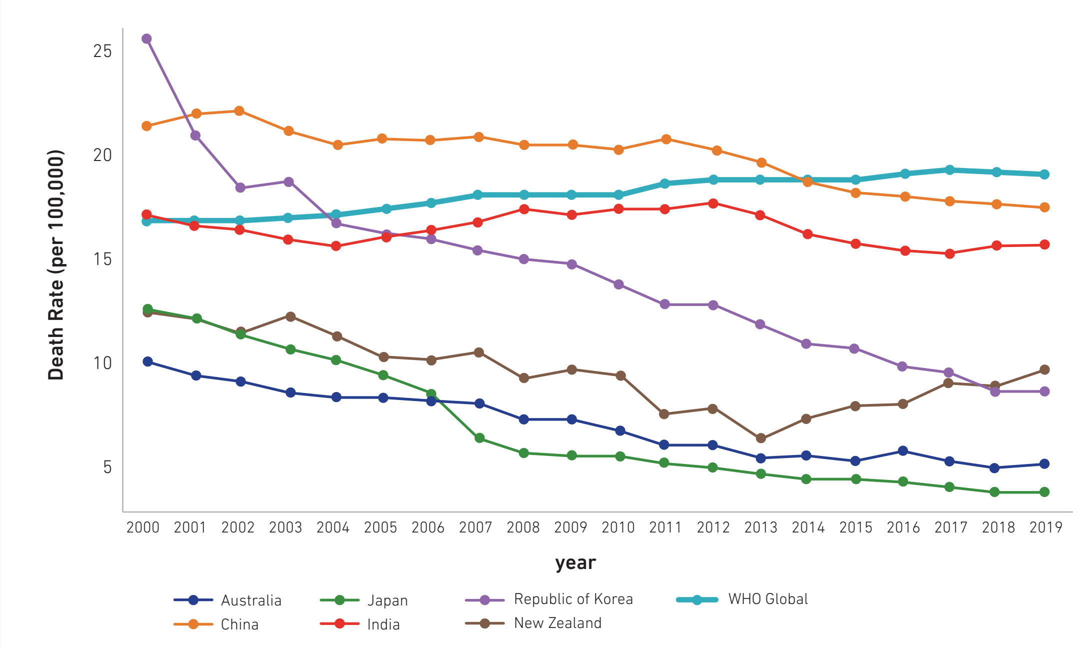
ASEAN = Association of Southeast Asian Nations, WHO = World Health Organization.

Source: WHO (n.d.), The Global Health Observatory: Estimated Road Traffic Death Rate (per 100,000 population). https://www.who.int/data/gho/data/themes/topics/sdg-target-3_6-road-traffic-injuries (accessed 26 November 2021).

[1] 'Motorisation' here refers to the social change that occurs when many people can purchase their own cars due to the rapid increase in income level.

[2] EAS 6 countries in this paper refer to Australia, China, India, Japan, New Zealand, the Republic of Korea – the original members of the EAS except the 10 AMS.

Figure 12.5 Death Rate from Automotive Traffic Accidents in the EAS 6 Countries*



ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit, WHO = World Health Organization.

* Australia, China, India, Japan, New Zealand, and the Republic of Korea.

Source: WHO (n.d.), The Global Health Observatory: Estimated Road Traffic Death Rate (per 100,000 population). https://www.who.int/data/gho/data/themes/topics/sdg-target-3_6-road-traffic-injuries (accessed 26 November 2021).

Digital technologies enable many companies to strengthen their own automotive and auto-parts businesses and to create value chains for these industries to achieve innovation, establish new initiatives, and create a sustainable, efficient, and environmentally friendly automotive society in the region. Global trends in the automotive industry – connected, autonomous, shared/service, and electrified (CASE) and Mobility as a Service (MaaS) – will realise the potential of digital technologies. These new waves will also change the landscape of three dimensions of connectivity: physical, institutional, and people to people. Based on the digital transformation in the automotive sector, the ASEAN and East Asia regions need to develop complex infrastructure for electrification and autonomous driving, but also various laws and regulations, as well as human resources initiatives, for the new technologies.

This chapter investigates the development of the automotive industry in the ASEAN region in conjunction with digitalisation. First, it describes the automotive industry's social cost and how digitalisation such as the CASE could mitigate the risk. Second, it focuses on using digital technologies in the automotive industry for further development in the region. Third, it presents challenges for the ASEAN region to address common issues for the three aspects of connectivity in terms of automotive policies.

Social Costs of Motorisation

The rapid progress of the automotive and motorisation society has massive negative impacts on our communities. Uzawa (1974) pointed out the importance of internalising the social costs of motorisation and automotive industry development. Internalisation of the social costs means that car users cover installing and maintaining the infrastructure required to protect fundamental human rights in society (Uzawa, 1974; Nishitateno, 2014).

Several AMS are still emerging economies on the way to realising the motorisation society. Motorisation also entails several social costs, such as increasing traffic accidents, noise, air pollution, and climate change risks due to greenhouse gas emissions (Uzawa, 1974). Some big cities, including the capitals of AMS, suffer from significant traffic congestion and air pollution.[3] Traffic congestion also causes losses in terms of time, business costs, productivity, and output levels (Weisbrod, Vary, and Treyz, 2003). It is necessary to consider these external negative costs to mitigate or internalise the motorisation society.

While the automotive sector creates some negative impacts for society, the technologies of CASE and MaaS have great potential to mitigate these risks. Table 12.1 lists the high external costs of the automotive society and the technologies that have the potential to diminish these costs.

[3] For example, Jakarta was the third most affected city in the world by traffic congestion, after Mexico City and Bangkok, in 2018. People in Jakarta spend 22 days a year stuck in traffic compared with citizens of other major Asian cities (19 days on average), according to a study by Uber and Boston Consulting Group (ASEAN Post, 2019).

Table 12.1 **External Costs of Motorisation and Mitigation Technologies**

External costs	Technologies
Accidents	Advanced driver-assistance system (ADAS) Connected and autonomous vehicles
Air pollution	Electrification
Climate change	Well-to-wheel zero-emission vehicles (ZEVs)
Noise	Electrification
Congestion	Connected, sharing, and a large share of electric autonomous vehicles
Well-to-tank emissions	Renewable energy, energy efficiency

Source: Authors, based on Uzawa (1974).

To solve the issues in Table 12.1, we can consider using CASE technologies. For example, the increase in connected vehicles promotes the advanced driver-assistance system (ADAS).[4] Using a variety of devices that support communication amongst vehicles on the road, vehicle-to-vehicle (V2V) communication will dramatically reduce the number of road accidents in both private and public transportation.[5] Through IoT technologies and connected vehicles, V2V technologies will prevent collisions of vehicles and pedestrians and improve energy efficiency.

Electric vehicles (EVs) are regarded as an alternative towards a cleaner transportation sector. Due to the absence of exhaust gas emissions, the electrification of vehicles helps to mitigate localised pollution such as nitrogen oxides (NOx) and sulphur oxides (SOx), which is particularly important in overpopulated urban areas (Cassals et al., 2016). In addition, electrification reduces noise. However, greenhouse gas (GHG) emissions need to be carefully considered because they are directly related to a country's primary energy mix for electricity generation. Woo, Choi, and Ahn (2017) calculated the GHG emissions of battery electric vehicles (BEVs) in 70 countries, including the Asia and the Pacific region, which are highly reliant on fossil fuels in their mix and produce strong GHG emissions. Electrification does not cut all carbon dioxide (CO_2) emissions, as it depends on how the electricity is created.[6] Therefore, the use of renewable energy such as solar photovoltaic (PV) or wind power generation promotes zero-emission vehicles (ZEVs).

[4] ADAS refers to technologies that help reduce human error and prevent car accidents. By using sensors, ADAS provides information on the surrounding environment of a car and supports drivers to take adequate action to avoid accidents. Although ADAS is part of autonomous driving technologies, the level of autonomous driving is not high (level two).

[5] See RGBSI (n.d.). Devices supporting V2V technologies include radio-frequency identification (RFID) readers, signage, cameras, lane makers, streetlights, and parking meters.

[6] ERIA (2019) illustrated how the vehicle type depends on CO_2 emissions by well-to-tank and tank-to-wheel.

Connected and fully autonomous vehicles can reduce traffic congestion. Especially in the major urban areas of ASEAN, traffic congestion provides negative opportunity costs such as time loss and logistics deficiencies and causes air and noise pollution due to the rapid increase in vehicle accumulation.[7]

To sum up, the new waves in the automotive industry provide a pathway to solve the social problems derived from a more motorised society. Rapidly emerging countries in the ASEAN and East Asia region have a great opportunity to use the new technologies of digitalisation. The CASE and MaaS trend, described in the next section, is a clear example of automotive digitalisation.

Development of the CASE and MaaS Concepts

Concepts of CASE and MaaS have become popular worldwide and are the near-future direction of the motorisation society in developed countries. Some developed countries will use new types of vehicles – including EVs, autonomous driving systems, and connected cars – as well as sharing services in the 2020s. Hopefully, in the 2030s, emerging countries, particularly AMS, will also start to install such new technology in the automotive sector (Nakanishi, forthcoming). The trend of CASE and MaaS is one of the significant achievements of the digital transformation of the automotive parts sector and makes this sector more competitive due to the entry of different industries such as electronics and software development firms.

CASE is a concept of a digital revolution in the industry from the standpoint of the automotive sector. The term is an acronym for four crucial trends in the automotive industry – 'C' for connected (a vehicle that is constantly connected to the network), 'A' for autonomous (autonomous driving), 'S' for shared and service, and 'E' for electric. German-based Daimler coined CASE in 2008, and it has been widely used since the mid-2010s (Nakanishi, forthcoming). The critical point is that each element of CASE is not independent, but strongly linked to enhancing the effectiveness of driving.

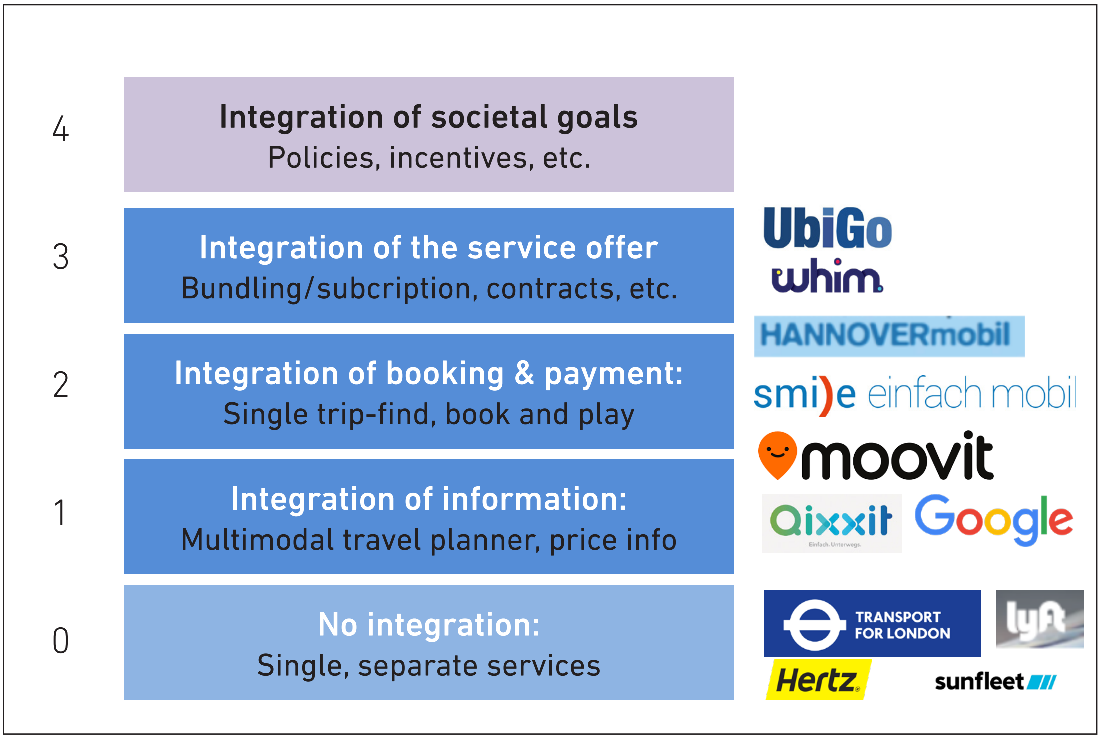
[7] For the example of Jakarta, see ASEAN Post (2019).

Connected cars refer to vehicles that are linked to the network and communicate with road infrastructure as well as other vehicles on the road through the network. Although the connectedness is an essential element of the autonomous driving system, connected cars also provide passengers with some services through online bases. The autonomous attribute enables passengers to drive vehicles without human intervention. Although full automation driving (level 5) has still not been achieved, a lower level of automation (e.g. ADAS) can reduce the risk of traffic accidents and enables people with disabilities to drive vehicles by themselves.[8] Sharing and service have great potential to disrupt the use of a vehicle from ownership to sharing. Car sharing encourages passengers to view vehicles as a transportation service tool. Therefore, like MaaS, transportation systems are linked through online applications and passengers can choose their optimal transportation mode. Finally, the electrified feature means that the vehicle consists of an electric battery for energy storage, an electric motor, and a controller (Larminie and Lowry, 2012). EVs are not limited to BEVs, as they also include hybrid EVs, plug-in hybrid EVs, and fuel cell vehicles (Schröder and Iwasaki, 2021).

MaaS is a broader concept that incorporates CASE. However, we define MaaS as part of the concept of CASE ('S' for service). MaaS is an integrative concept that bundles different transport modalities into a single, seamless service to provide tailored mobility solutions that cater to users' travel needs (Mukhtar-Landgren et al., 2016; Karlsson et al., 2017; and Smith, Sochor, and Sarasini, 2018). For example, MaaS Global, established in 2015, started the first subscription style transportation in Finland. Through the mobile application, users combine their optimal transportation choices, including buses, taxis, trains, and car sharing. MaaS provides solutions for the so-called 'last mile' problem by providing optimal connections from public transportation to taxis or car sharing to the destination (Figure 12.6).

[8] Level 0: no automation, level 1: driver assistance, level 2: partial automation, level 3: conditional automation, level 4: high automation, and level 5: full automation (Rivard, 2018).

Figure 12.6 **Proposed Topology of MaaS**



MaaS = Mobility as a Service.

Note: Includes levels 0–4 (left) and examples (right).

Source: Smith, Sochor, and Sarasini (2018).

MaaS encompasses everything from social transportation to urban planning and helps solve social issues. It improves our quality of life and the quality of the towns and cities we live in by enabling people to travel efficiently, redistributing road space more efficiently (Nakanishi, forthcoming).

Therefore, the new trends of CASE and MaaS have great potential to mitigate the social costs of the motorisation society. Rapidly developing AMS need to integrate these waves into their automotive industry policies. However, several negative impacts of CASE need to be considered (Table 12.2).

Table 12.2 Costs and Benefits of CASE

Negative impacts of CASE	
• **Connected**	Security and privacy issues
• **Autonomous**	Lack of reliable technologies and necessary institutions
• **Service/Shared**	Inconsistency with the current institutions
• **Electrified**	Lack of a profitable business model
Benefits of CASE	
• **Connected**	Infrastructure for autonomous driving and sharing
• **Autonomous**	Enhanced safety
• **Service/Shared**	Users do not need to own cars, connecting to another services New business opportunities
• **Electrified**	Reduction in carbon and greenhouse gas emissions

CASE = connected, autonomous, shared/service, and electrified.

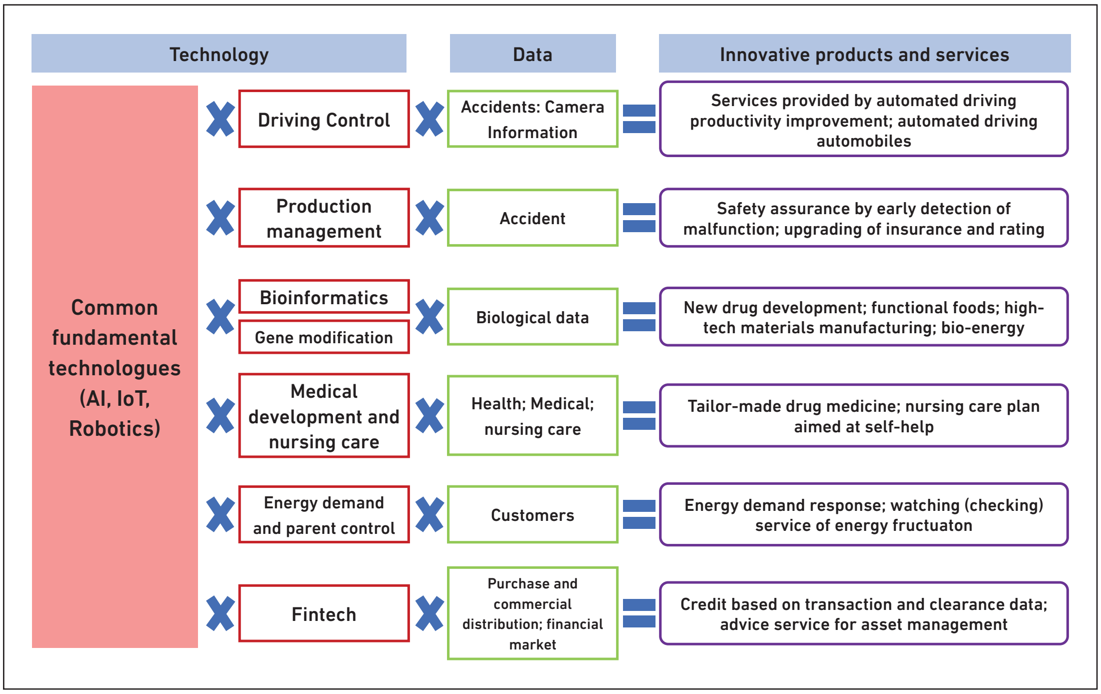
Source: Authors.

Connected cars will provide the basis of autonomous driving, but robust security and privacy protection are also necessary. For example, in line with the European Union's General Data Protection Regulation (2016), the European Data Protection Supervisor released a report on connected cars and data protection.[9] Connected cars are linked with diverse direct and indirect individual data, and the amount of data is much larger than before. Regarding autonomous driving systems, it is still quite a hurdle to achieve total autonomous driving due to lack of reliable technologies and necessary institutions. Large-capacity data communication facilities are still nascent, particularly in emerging countries. The service and shared aspect of CASE also poses significant challenges as an economically viable or profitable business model. Although some ride-share companies provide other services (e.g. delivery of goods and services and financial services) through their application platforms, it is challenging for conventional automotive and parts companies to maintain their existing profitable business models. Finally, electrification requires further development of battery technologies to achieve massive cost reductions. Battery charging stations or other charging technologies and infrastructure must be installed for further EV penetration.

[9] BearingPoint Institute (n.d.); and European Data Protection Supervisor (2019).

Nishimura et al. (2019) showed that new technologies, which constitute the core of the Fourth Industrial Revolution, are the common technological foundation for next-generation industries to emerge and prosper (Figure 12.7). To fill the gap between using new technologies and producing innovative products and services, a tight association is indispensable amongst various existing technologies (IoT, big data, AI, and robotics) and relevant and abundant data.

Figure 12.7 Examples of the Combinations of Technologies and Data



Source: Nishimura et al. (2019)

Nakanishi (forthcoming) states that:

> the foundation for CASE is 'Connected' (as in connected cars). Data accumulated from connected vehicles become big data, which will be analysed using AI. The analysed data (and analysis results) will be fed back into the real world as automated driving and mobility services. This continuous cycle allows for seamless connections that form CASE innovations.

Nakanishi (forthcoming) projects that almost all new vehicle sales in advanced countries will be 'connected cars' and about 1 billion vehicles will be connected with the network by 2030.

Digitalisation has great potential not only to facilitate the economic transformation of ASEAN based on new technologies but also to markedly increase society's ability to address social problems and promote social progress in a more efficient and effective manner. Digitalisation and CASE provide great opportunities to achieve sustainable motorisation and further economic growth simultaneously. Enhancing connectivity, including the digital aspects, is an effective way to improve social welfare in each country and in the region as a whole. The next section touches upon each aspect of connectivity – physical, institutional, and people to people – in terms of the development of the automotive sector.

The next section classifies the transformation of ASEAN's automotive industry in line with the concept of connectivity.

Development of Physical Connectivity in the Automotive and Parts Sectors

The last Comprehensive Asia Development Plan (CADP) 2.0 (ERIA, 2015) listed 176 automotive-related infrastructure projects (e.g. roads and bridges) out of a total of 779 projects (see Chapter 11 of this report).

The data for physical connectivity show that some AMS still have a low level of complex infrastructure to cope with motorisation. To facilitate motorisation, it is essential to install sufficient complex infrastructure such as roads, parking spaces, traffic light systems, and institutional infrastructure (e.g. laws and regulations of traffic rules, and car insurance); and to enhance drivers' awareness of and compliance with traffic rules. Some AMS could immediately deploy such infrastructure.

Some developed countries will use new types of vehicles – including EVs, autonomous driving systems, connected cars, and sharing services – in the 2020s. Currently, these movements are classified under technologies such as CASE and MaaS. Some AMS are promoting the penetration of new types of vehicles, in particular EVs. The governments of Indonesia, Malaysia, and the Thailand have released their targets for EVs in the 2030s–2040s (Schröder, Iwasaki, and Kobayashi, 2021).

New energy vehicles (NEVs) also require hard and soft (institutional) infrastructure. Although institutional aspects (e.g. laws and regulations) need to be harmonised in the region,[10] complex infrastructure is needed but still limited. The complex infrastructure required includes bright road marking systems, wireless networking, electric suppliers (V2V and vehicle-to-grid), digital maps for autonomous driving, and sufficient charging stations (grid-to-vehicle and vehicle-to-grid).

Some AMS lag significantly in infrastructure development, but the absence of existing infrastructure would allow them to build new infrastructure (e.g. charging stations) from scratch for NEVs. For example, it is necessary to install many charging stations for EVs. Although we consider charging stations a type of petrol station, future technologies will try to design wireless (non-contact) charging on the road, mainly through highways (Autoevolution, 2021). Problems related to fixed charging stations (similar to petrol stations) include the need to (i) increase the battery capacity; (ii) set up charging stations at regular intervals; and (iii) supply a large amount of power at high speed, making it unsuitable for EVs with a short cruising range. In developed and emerging cities where petrol stations are already widespread, this can be dealt with by refurbishing gas stations as charging stations.[11] However, in developing countries, new technologies such as non-contact charging could be installed on the street. Since the spread of power supply helps to minimise the number of batteries, a dramatic increase in EVs would be possible if it spreads in line with new urban development.

Another essential issue is autonomous driving and connected vehicles. Although it is hard to rapidly accomplish level 4 or 5 of the autonomous driving system, AMS could introduce assistance for minimising traffic accidents. Vehicle-to-Infrastructure (V2I) technologies are desirable in ASEAN to harmonise autonomous vehicles and infrastructure.[12] Urban areas need to be designed for autonomous driving. New urbanisation – smart city projects – should include V2I technologies and infrastructure. New and existing drivers also need to be trained in the new technology and driving systems.

Some Asian countries have proposed a target for EV penetration. For example, the Government of China targeted reaching a certain number of EVs by 2020 and created a development strategy for EV charging infrastructure (Blatt, 2018). Half are expected to be NEVs – electric, plug-in hybrid, or fuel cell-powered; and the other half will be hybrids (Tabeta, 2020).

[10] Institutional connectivity will be discussed in section

[11] For example, Shell has expanded its EV charging networks by acquiring the largest EV charging network in the United Kingdom: ubitricity (Reuters, 2021).

[12] V2I roadside units are one of the technologies for autonomous driving systems that help transmit traffic light information to vehicle locations and these locations to walking people's smartphones. (Kyocera, n.d.).

Regarding the penetration of EVs in ASEAN, Schröder, Iwasaki, and Kobayashi (2021) described the current EV situation in the region. According to the review, charging stations are crucial infrastructure for EV penetration. The Government of Malaysia has proposed increasing the number of charging stations to 125,000 by 2030. The Government of Indonesia targets 1,000 charging stations by 2025 and 10,000 by 2050 (Tempo, 2017). In 2021, the Government of Indonesia set ambitious targets for EV production: 600,000 units of production per year by 2030 (Kompas, 2021).

In terms of charging infrastructure, Pertamina and Shell have established EV charging station services in Jakarta (Tempo, 2020; Harsono, 2021). Indonesia will require more than 31,000 charging stations, according to the road map of the State Electricity Company (PLN) (Harsono, 2020).

Infrastructure development for the automotive industry is still nascent in Asian developing countries, but many infrastructure construction projects are being developed. Both physical and institutional connectivity need to be developed to implement CASE and MaaS in ASEAN. The next section discusses institutional connectivity.

Developing and Strengthening Institutional Connectivity

Institutional connectivity covers laws and regulations, international agreements, procedures, and capacity building programmes (ASEAN, 2010). In terms of the development of the automotive industry, many regulations cover the safety of automotive transportation as well as environmental issues (exhaust gas emissions). Some AMS have adopted the international standard on exhaust gas emissions, e.g. Thailand adopted the Euro 4 standard on light-duty vehicles in 2012 and Indonesia adopted Euro 4 for gasoline vehicles in 2018. Many AMS plan to implement more stringent regulations in the coming years.[13]

Although the new waves of CASE and MaaS provide opportunities to meet environmental regulations and international standards, regulatory harmonisation and management should be considered to promote the introduction of new technologies in the automotive industry. The major institutional challenges for development of the automotive industry are listed below:

[13] The European Commission introduced emissions regulations in 1992 (Euro 1) to protect air quality and reduce greenhouse gases (European Commission, n.d.). The regulations were tightened to Euro 6 in September 2015. AMS use these standards for national emissions regulations. For example, Viet Nam and Malaysia have installed the Euro 5 standards and Thailand is installing the Euro 6 standard in 2022 (EU–ASEAN Business Council, 2021).

- *Environmental standards*: AMS need to take advantage of innovation and lead the global automotive industry by promoting the circular economy in the automotive sector. AMS should introduce adequate environmental standards (e.g. exhaust gas emissions and noise) to realise a sustainable mobility society in each country.
- *EVs*: Due to the transition to ZEVs, EVs are increasingly attractive in both developed and developing countries. EVs promote the development of renewable energy technologies. Regulating the reuse and recycling of used batteries is another crucial issue.[14]
- *CASE and MaaS*: Various kinds of hard and soft infrastructure need to be introduced, such as sustainable and stable telecommunication lines, intelligent transportation systems, and high-speed charging stations and related technology. Ride-share systems, for example, use web applications (e.g. Grab and Gojek) as well as regulation for safety management and deregulation for the existing transportation system.

Vehicle Type Harmonisation

Regarding the harmonisation of automotive production, a recent achievement in institutional harmonisation is the adoption of the ASEAN Mutual Recognition Arrangement on Type Approval for Automotive Products in 2019 (ASEAN, 2019). The ASEAN Automotive Council, which will comprise one representative from each AMS, will be established to monitor the effective functioning of this arrangement. The arrangement will facilitate mutual recognition of conformity assessments for new automotive products (Table 12.3) (ASEAN 2019: Article 4: Scope and Coverage, 1).

Table 12.3 List of Automotive Products Within the Scope of the Arrangement

No.	Automotive products	United Nations regulations
1	Braking system	R13
2	Braking system	R13H
3	Safety-belt anchorage	R14
4	Safety-belt and restraint system	R16
5	Seats	R17
6	Head restraints	R25
7	Audible warning device	R28
8	Pneumatic tyre	R30
9	Speedometer	R39

[14] See Nakanishi (forthcoming).

No.	Automotive products	United Nations regulations
10	Exhaust emission	R40
11	Noise	R41
12	Safety glazing materials and their installation	R43
13	Devices for indirect vision	R46
14	Exhaust emission	R49
15	Sound emission	R51
16	Pneumatic tyre	R54
17	Pneumatic tyre	R75
18	Steering equipment	R79
19	Exhaust emission	R83

Note: United Nations regulations refer to the automotive type regulation based on United Nations Economic Commission for Europe (n.d.)
Source: ASEAN (2019: Annex 1).

Although only Malaysia and Thailand have adopted the United Nations regulation, the ASEAN arrangement will help to reduce the number of tests and procedures for parts certification in other countries, leading to a decrease in time and costs, advancing vehicle technologies and regulations, and facilitating the export of certificated automotive parts and products both regionally and globally (MLIT and JASIC, 2021).[15]

Smart City Development

The development of smart cities, through city planning, is key to the promotion of an environmentally friendly transportation system. ASEAN adopted the ASEAN Smart Cities Network in 2018 to discuss and encourage the development of smart cities in the region (ASEAN, 2018). Various definitions of smart cities have been proposed, but the consensus is that adopting information and communication technology and an integrated infrastructure system enhances urban transport operations and services and improves quality of life (Anbumozhi, 2020). The ASEAN Smart Cities Network has six components: (i) smart governance, (ii) smart living, (iii) smart economy, (iv) smart people, (v) smart environment, and (vi) smart mobility.

[15] United Nations (2017).

Box 12.1 Smart City and Energy Efficiency Project in the Philippines*

SoftBank Corporation, with financial support from the New Energy and Industrial Technology Development Organization (NEDO), implemented a demonstration project on a new mobility system in Manila from 2016 to 2018. The objective of the project was to attain efficient public transportation and energy conservation effects by introducing an EV mobility system. The information technology system provides the operation management, asset management, charging management and service platform system. Each EV had communication devices to send real-time data on the location, driving, battery, and passenger boarding record to central management.

Source: NEDO (2018), 'Completion of Demonstration Project in the Philippines on Next-Generation Public Transportation System Using Electric Tricycles', News article, 30 October. https://www.nedo.go.jp/english/news/AA5en_100398.html.

Box 12.2 Urban Transit System with Electric Buses in Malaysia*

The New Energy and Industrial Technology Development Organization (NEDO) and Putrajaya implemented a demonstration project on urban transit systems by introducing large electric buses in 2015. The objective of the project was to demonstrate an electric bus with a super-fast charging system and a large-capacity battery. The project was expected to be replicated in Kuala Lumpur to realise the vision of a low-carbon, green capital city in Malaysia, with potential for replication throughout the ASEAN region.

A full charge requires 10 minutes and allows a bus to operate for 6–8 hours. Lithium titanate oxide (LTO) batteries enable safe operations, a long lifespan, low-temperature performance, rapid charging, high input/output power, and large effective capacity.

Source: NEDO (2017), 'Demonstration Project for Large EV Bus System Launches in Malaysia', News article, 28 August. https://www.nedo.go.jp/english/news/AA5en_100258.html.

People-to-People Connectivity: Human Resources Development

The third aspect of connectivity is people to people, which includes education and tourism (ASEAN, 2016). Regarding the development of the automotive industry, education and human resources development will be crucial.

Through international industry–academia–government collaboration and self-help, each AMS needs to upgrade its technology educational system at each level (e.g. polytechnics, universities, technical and vocational education and training, and graduate schools) to train engineers for mass production with high-quality standards. In the future, graduates of such programmes will be good candidates for dealing with new manufacturing technologies, such as automation, IoT, and AI. Some AMS should install essential technologies from foreign companies to increase their international competitiveness. Training of automotive service technicians and infrastructure engineers is also a future challenge for new market development.

Increasing technology transfer from multinational corporations is another issue that AMS need to address. To upgrade the productivity of local firms, especially small and medium-sized enterprises, these firms should strengthen their linkages with multinational corporations and increase their participation in global value chains. Connections amongst engineers are also inevitable to achieve such a development model.

Conclusion

This chapter analysed infrastructure development, with a focus on the automotive transportation sector. It discussed four essential elements:

(i) The development of a motorisation society in ASEAN through rapid economic growth.

(ii) Utilisation of digital technologies to mitigate the negative impacts of motorisation (CASE and MaaS).

(iii) Sustainable automotive industry development to improve social and environmental welfare (the Fourth Industrial Revolution (4IR) and Society 5.0).[16]

(iv) Development of a standard platform for the automotive industry (policy) (physical, institutional, and people-to-people connectivity)

The aim of this paper is to raise awareness of the rapid changes in the automotive sector in the 21st century and the necessity of infrastructure development for achieving it.

The transportation sector needs to mitigate greenhouse gas emissions to achieve carbon-neutral status and meet the United Nations Sustainable Development Goals. CASE and MaaS, driven by the advancement of digital technologies, will play a vital role as the automotive infrastructure of the 21st century for reducing social costs. AMS should consider the deployment of necessary infrastructure for EVs and autonomous vehicles in particular in the 2030s.

16 Society 5.0 is a concept proposed by the Government of Japan, meaning 'a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space' (Government of Japan Cabinet Office, n.d.).

References

Anbumozhi, V. (2020), 'A Dialogue on Realizing Smart Cities', Virtual Public Dialogue, 14 May. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/media/0.-Realizing-Smart-Cities---Anbu-PPT.pdf. (Access 20 July 2022)

ASEAN (2010), *Master Plan on ASEAN Connectivity*. Jakarta: ASEAN Secretariat.

ASEAN (2016), *Master Plan on ASEAN Connectivity 2025*. Jakarta: ASEAN Secretariat.

ASEAN (2018), ASEAN Smart Cities Network Smart City Action Plans, as of 18 July 2018, https://asean.org/storage/2019/02/ASCN-Consolidated-SCAPs.pdf. (Access 20 July 2022).

ASEAN (2019), 'ASEAN Mutual Recognition Agreement on Type Approval for Automotive Products'. Jakarta: ASEAN Secretariat. http://agreement.asean.org/media/download/20210205131820.pdf. (Access 20 July 2022).

ASEAN Post (2019), 'Jokowi Wants Jakartans to Use Public Transport', 10 February. https://theaseanpost.com/article/jokowi-wants-jakartans-use-public-transport.

Autoevolution (2021), 'Sweden Successfully Tests Wireless Charging Road Set to Revolutionise Mobility', 27 January. https://www.autoevolution.com/news/sweden-successfully-tests-wireless-charging-road-set-to-revolutionize-mobility-155137.html.

Bakker, S. et al. (2017), 'Low-Carbon Transport Policy in Four ASEAN Countries: Developments in Indonesia, the Philippines, Thailand and Vietnam', *Sustainability*, 9(7), 1217.

BearingPoint Institute (n.d.), 'Connected Cars and Privacy: Shifting Gear from GDPR?'. https://www.bearingpoint.com/files/BEI008_06_GDPR_Connected-cars-and-privacy-shifting-gear-for-GDPR_final.pdf?download=0&itemId=434626.

Blatt, D.N. (2018), 'Law and Policy on the Development and Promotion of the New Energy Vehicle (NEV) Market in China', *Journal of Asian Electric Vehicles*, 16(1), pp.1781–88.

Cassals, L.C., E. Martinez-Laserna, B.A. García, and N. Nieto (2016), 'Sustainability Analysis of the Electric Vehicle Use in Europe for CO_2 Emissions Reduction', *Journal of Cleaner Production*, 127, pp.425–37.

ERIA (2015), *The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/ERIA-RPR-FY2014-04.pdf (Access 20 July 2022).

ERIA (2019), *ASEAN Vision 2040: Towards a Bolder and Stronger ASEAN Community.* Jakarta: Economic Research Institute for ASEAN and East Asia, https://www.eria.org/uploads/media/0.AV2040_VOL1.pdf (Access 20 July 2022).

EU–ASEAN Business Council (2021), *Advancing ASEAN's Fuel Economy & Emissions Standards, Post Pandemic, June 2021*. https://www.eu-asean.eu/wp-content/uploads/2022/02/Advancing-ASEANs-Fuel-Economy-Emissions-Standards-Post-Pandemic-2021.pdf. (Access 20 July 2022)

European Commission (n.d.), Emissions in the Automotive Sector. https://ec.europa.eu/growth/sectors/automotive-industry/environmental-protection/emissions-automotive-sector_en. (Access 20 July 2022)

European Data Protection Supervisor (2019), 'TechDispatch #3: Connected Cars', 20 December. https://edps.europa.eu/data-protection/our-work/publications/techdispatch/techdispatch-3-connected-cars_en. (Access 20 July 2022)

Government of Japan, Cabinet Office (n.d.), Society 5.0. https://www8.cao.go.jp/cstp/english/society5_0/index.html. (Access 20 July 2022)

Harsono, N. (2020), 'Indonesia Needs 31,000 Charging Stations to Reach Electric Vehicle Goals', *The Jakarta Post*, 4 September. https://www.thejakartapost.com/news/2020/09/04/indonesia-needs-31000-charging-stations-to-reach-electric-vehicle-goals.html. (Access 20 July 2022)

Harsono, N. (2021), 'Shell Opens Its First EV Charging Station in Indonesia', The Jakarta Post, 5 April. https://www.thejakartapost.com/news/2021/04/05/shell-opens-its-first-ev-charging-station-in-indonesia.html. (Access 20 July 2022)

Karlsson, M. et al. (2017), 'Mobility-as-a-Service: A Tentative Framework for Analysing Institutional Conditions', Presented at the 45th European Transport Conference, Barcelona, 4–6 October.

Kompas (2021), Bahas Rencana Menjadikan Indonesia Pemain Utama Mobil Listrik, 16 July 2021, https://otomotif.kompas.com/read/2021/07/16/094200315/bahas-rencana-menjadikan-indonesia-pemain-utama-mobil-listrik?page=all (Access 17 May 2022).

Kyocera (n.d.), 'Rosokuki no Kaihatsu de Mezasu "Jiko nonai Koutsu Shakai"' (Aiming for an "Accident-Free Traffic Society" through the Development of Roadside Devices). https://www.kyocera.co.jp/be_innovation/mobility/interview2/ (accessed 10 April 2021).

Larminie J. and J. Lowry (2012), *Electric Vehicle Technology Explained*, Second Edition. Chichester, UK: John Wiley & Sons.

MLIT and JASIC (2021), 'Toward Expanding International Harmonization of Vehicle Regulations and Reciprocal Recognition of Approvals'. Tokyo: Ministry of Land, Infrastructure, Transport and Tourism and Japan Automobile Standards International Center. https://www.jasic.org/j/08_publication/pamphlets/pdf/harm.pdf. (Access 20 July 2022).

Mukthar-Landgren, D. et al. (2016), 'Institutional Conditions for Integrated Mobility Services (IMS): Towards a Framework for Analysis', *K2 Working Papers*, No. 2016:16. Lund, Sweden: K2 (National Centre for Research and Education on Public Transport).

Nakanishi, T. (forthcoming), CASE: New Waves in the Automotive Industry in Viet Nam, by ERIA Vietnamese Automotive Industry Policy Studies.

Nishimura, H., M. Ambashi, F. Iwasaki, and M. Maeda (2019), 'Harnessing New Technologies for Social and Economic Progress Toward ASEAN 2040', in F. Kimura, V. Anbumozhi, H. Nishimura (eds.) *Transforming and Deepening the ASEAN Community*. Jakarta: Economic Research Institute for ASEAN and East Asia, pp.50–71.

Nishitateno, S. (2014), 'Internalization of the Social Costs of Automobiles as Seen from International Perspectives', *RIETI Policy Update,* No. 058 Tokyo: Research Institute of Economy, Trade and Industry. https://www.rieti.go.jp/en/special/policy-update/058.html. (Access 20 July 2022)

Orlovska, J., F. Novakazi, C. Wickman, and R. Soderberg (2019), 'Mixed-Method Design for User Behavior Evaluation of Automated Driver Assistance Systems: An Automotive Industry Case', in *Proceedings of the 22nd International Conference on Engineering Design (ICED19)*, Delft, the Netherlands, 5–8 August.

Poullikkas, A. (2015), 'Sustainable Options for Electric Vehicle Technologies', *Renewable and Sustainable Energy Reviews,* 41, pp.1277–87.

Reuters (2021), 'Shell to Acquire UK's Largest Electric Vehicle Charging Network', 25 January. https://www.reuters.com/article/us-ubitricity-m-a-shell-idUSKBN29U0TC. (Access 20 July 2022)

RGBSI (n.d.), 'What Is Vehicle to Infrastructure V2I Technology?', Blog. https://blog.rgbsi.com/what-is-v2i-technology#:~:text=Vehicle%2Dto%2Dinfrastructure%20(V2I,and%20parking%20meters%20among%20others (accessed 6 October 2020).

Rivard, G. (2018), 'Understanding the Various Levels of Autonomy in Vehicles: From 0 to 5, Where Are We At?', Auto123.com, 2 June. https://www.auto123.com/en/news/vehicle-autonomy-levels-explained/64372/. (Access 20 July 2022)

Schröder, M. and F. Iwasaki (2021), 'Current Situation of Electric Vehicles in ASEAN', in M. Schröder, F. Iwasaki, and H. Kobayashi (eds.) Promotion of Electromobility in ASEAN: States, Carmakers, and International Production Networks. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.1–32.

Schröder, M., F. Iwasaki, and H. Kobayashi, eds. (2021), *Promotion of Electromobility in ASEAN: States, Carmakers, and International Production Networks.* Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Smith, G., J. Sochor, S. Sarasini (2018), 'Mobility as a Service: Comparing Developments in Sweden and Finland', *Research in Transportation Business & Management,* 27, pp.36–45.

Sochor, J., H. Arby, M. Karlsson, and S. Sarasini (2017), 'A Topological Approach to Mobility as a Service: A Proposed Tool for Understanding Requirements and Effects, and for Aiding the Integration of Societal Goals', Conference Proceedings of 1st International Conference on Mobility as a Service (ICOMaaS), Tampere, Finland, 28–29 November.

Tabeta, S. (2020), 'China Plans to Phase Out Conventional Gas-Burning Cars by 2035', *Nikkei Asia*, 27 October. https://asia.nikkei.com/Business/Automobiles/China-plans-to-phase-out-conventional-gas-burning-cars-by-2035. (Access 20 July 2022)

Tempo (2017), 'Pemerintah Tetapkan Empat Target Percepatan Kendaraan Listrik' (The Government Sets Four Targets for the Acceleration of Electric Vehicles), Gooto.com, 25 August. https://www.gooto.com/read/903001/pemerintah-tetapkan-empat-target-percepatan-kendaraan-listrik. (Access 20 July 2022)

Tempo (2020), 'Pertamina's First Electric Vehicle Charging Station Starts Operating Today', 10 December. https://en.tempo.co/read/1413431/pertaminas-first-electric-vehicle-charging-station-starts-operating-today. (Access 20 July 2022)

United Nations (2017), 'Agreement Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations'. https://unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2017/E-ECE-TRANS-505-Rev.3e.pdf. (Access 20 July 2022)

United Nations Economic Commission for Europe (n.d.), Status of the 1958 Agreement (and of the annexed regulations). https://unece.org/status-1958-agreement-and-annexed-regulations (accessed 24 July 2021).

Uzawa, H. (1974), *The Social Costs of Automotives* (in Japanese). Tokyo: Iwanami Shoten.

Weisbrod, G., D. Vary, and G. Treyz (2003), 'Measuring Economic Costs of Urban Traffic Congestion to Business', *Transportation Research Record*, 1839(1), pp.98–106.

Woo J., H. Choi, and J. Ahn (2017), 'Well-to-Wheel Analysis of Greenhouse Gas Emissions for Electric Vehicles Based on Electricity Generation Mix: A Global Perspective', *Transportation Research Part D: Transport and Environment*, 51, pp.340–50.

Ziebinski, A., R. Cupek, D. Grzechca, and L. Chruszczyk (2017), 'Review of Advanced Driver Assistance Systems (ADAS)', AIP Conference Proceedings, 1906:120002, https://doi.org/10.1063/1.5012394.

PART 3
Inclusiveness

Chapter 13

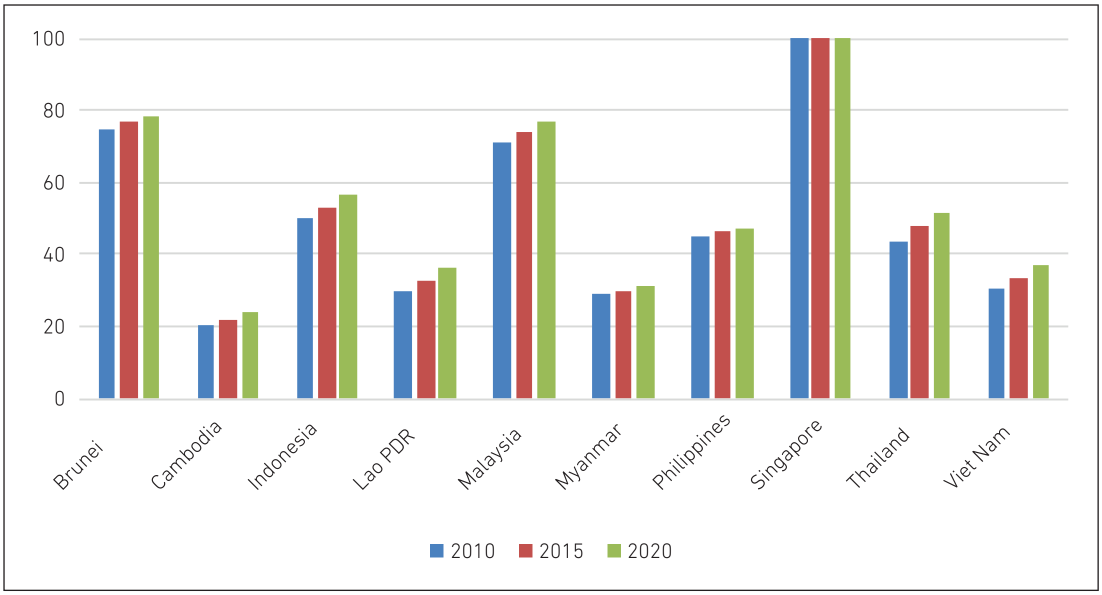
Inclusive Growth

Fauziah Zen
Senior Economist, ERIA

Urban and Rural Development

The rapid urbanisation rate in East Asia has transformed villages into cities, enlarged cities, and formed several megacities. The United Nations projects that there will be 1.2 billion new urban residents in the region by 2050 (United Nations, 2019). Figure 13.1 shows the increasing population living in cities in the Association of Southeast Asian Nations (ASEAN) Member States (AMS) during the last decade. Bangkok, Jakarta, and Manila have populations of more than 10 million, known as megacities. The cheap cost of construction in major East Asian cities such as Bangkok, Jakarta, and Kuala Lumpur has contributed to a rapid expansion of cities' development. In parallel with urbanisation and population growth, the megacities of ASEAN have created concentrated economic poles and connectivity. This, in turn, attracts a higher rate of urbanisation and development, leaving other regions – especially rural areas – behind.

Figure 13.1 Population Living in Urban Areas in Southeast Asia Countries (%)



Source: SDG Gateway Data Explorer. https://dataexplorer.unescap.org/ (accessed 1 August 2021).

Rapid urbanisation can have twofold consequences. It nurtures cities to flourish faster and produce high outputs because of the concentration of talent. But at the same time, because not everyone moving to cities will succeed, the gaps between income and social classes become wider. Urban poverty has long been a major issue in development studies. It is not only related to the inequality index, but more importantly, it is about the lack of a safe living environment and lack of access to clean water, primary education, healthcare services, and basic infrastructure.

In parallel, rapid urban development widens the gaps between urban and rural areas. It can attract more villagers to move to cities, often without proper preparation, and lead to additional urban problems, including unemployment and poverty. From a regional development perspective, urban and rural areas are interdependent and support each other. A large portion of the demand for food produced in rural areas comes from cities, which generate cash flows and other spillovers to rural areas. The mutually beneficial rural–urban relationship implies that both areas should be developed along harmonious paths. This means that determinants of development, including infrastructure and sectoral development, should move in the same direction and be compatible.

Since East Asia shows no signs of slowing urban population growth, this issue is crucial. The Asia-Pacific region became a majority urban population in 2019 and will have 1.2 billion new urban residents by 2050 (United Nations, 2019). This could push higher rural–urban inequality, which would harm inclusive growth.

Significant gaps between urban and rural status that can cause wider inequality are typically related to access, education, and options in the labour market. Many rural areas are disadvantaged because of their remoteness from the market, educational and healthcare facilities, and other public and private services. Some facilities are only provided in the nearest city, making connectivity more critical. Additionally, the reduction in services provided to rural areas is often the result of the low population penalty. In fiscal policy, the common transfer system from national to decentralised regions is usually based on the number of people serviced. Hence, better public services generally have a positive correlation with the density and the number of populations. People living in low-density rural areas have low incentives to stay because of the quality-of-service provision, but when more people leave, the density becomes lower. The lower density causes lower transfers from the national government, making public services less financed, and a vicious circle ensues.

Educational services are typically better in urban areas, driven by higher per capita public financing, efficiency, competition from private providers, better monitoring, and sufficient demand. This is a typical problem faced by both developed and developing countries. The analysis of the Programme for International Student Assessment (PISA) results from the participating students of the Organisation for Economic Co-operation and Development (OECD) countries shows that students from bigger cities (more than 100,000 people) perform better than students from villages, rural areas, or towns with up to 100,000 inhabitants. Socio-economic status explains part of the performance differences. Schools in urban settings are larger, tend to benefit from better educational resources, and often enjoy greater autonomy in allocating those resources (OECD, 2013).

The labour market in rural areas provides fewer options than that of urban areas due to lower demand; the seasonality of sectors such as agriculture and tourism; low-paid or non-remunerative jobs; and the availability of employment in limited sectors such as agriculture, fisheries, local public services, and small trading. Lower educational attainment and limited skills of rural workers make them less competitive than their counterparts in urban areas. Low demand for skilled labour pushes people with above-average skills to move to cities to obtain suitable jobs and better income.

Urban versus rural poverty issues are complex because of the limited data available to understand the whole picture and the divergence of both endogenous and exogenous determinants. The two most populous countries, China and India, show different dynamics in poverty data. In 2012, the headcount ratios in urban areas of China and India were higher than in rural areas. China has successfully eliminated rural poverty from about 10% in 2012 to 1.7% in 2018, while the total extreme poverty rate was zero in 2020, according to official national data.[1] India has no official data on rural poverty, but the headcount ratio at the national poverty line was 21.9% in 2011.[2] By 2020, the headcount ratios in India were 49.5% in urban areas and 37.0% in rural areas (Consumer Pyramids Household Survey from Dhingra and Ghatak, 2021). The coronavirus disease (COVID-19) pandemic has contributed to increasing urban poverty in India, indicated by the urban unemployment rate jumping from 8.8% in April–June 2019 to 20.8% in April–June 2020 (Dhingra and Ghatak, 2021).

[1] World Bank (n.d.), Poverty Headcount Ratio at National Poverty Lines (% of population) – China. https://data.worldbank.org/indicator/SI.POV.NAHC?locations=CN (accessed 14 June 2022).

[2] World Bank (n.d.), Poverty Headcount Ratio at National Poverty Lines (% of population) – India. https://data.worldbank.org/indicator/SI.POV.NAHC?locations=IN (accessed 15 June 2022).

With the world's concerted efforts to eliminate extreme poverty, the fundamental problems with poverty in rural areas no longer relate to starvation but rather lack of quality education, facilities to support economic activities, and sources of non-agricultural income. If governments provide social security, including healthcare and education, they will provide the rural poor with basic human necessities. Yu and Li (2021) found that the elasticity of rural poverty incidence to social security expenditure is –0.2255, which indicates that social security expenditure helps reduce rural absolute poverty. During hardship, such as an economic crisis or pandemic, poor urban migrants may return to villages which provide a better informal support system.

Characteristics of Rural–Urban Development

Urban and rural development have followed different patterns. Urban development is determined by the economic activities of residents, and migration contributes significantly to urban population growth. Top educational institutions, well-paid jobs, and modern facilities attract young talent from all over, making cities grow faster than rural areas. Urban areas have been expanding to accommodate the increasing urban population and activities. Urban growth varies across regions and typically forms zones based on the residents' main activities. Depending on the country, urban expansion can be planned in advance or grow under non-restricted spatial planning. Both the public and private sectors participate in establishing facilities for urban residents and commuters.

On the other hand, rural development is less autonomous, given the significant role of national governments in providing public facilities such as roads, terminals, traditional markets, electricity, water, and telecommunications. With a shallow market, private participation in developing rural facilities is very low. Governments only shifted their approach from providing subsidies to promoting investment when they saw increasing economic activities and potential for capitalisation. This shift occurred in developed countries during the 1990s, as observed by Shucksmith (2013). However, in many emerging economies, the approach to rural development is still top–down. Governments allocate public funds to villages, and villages have little authority to decide their own paths.

Synergising Rural–Urban Development

Urban activities are supported by massive infrastructure development, allowing residents to improve their productivity and quality of life. Since infrastructure and sectoral development generally depend on demand, they are spatially unique. Typical transportation facilities in urban areas, for instance, are built to accommodate speedy and mass mobility. At the same time, information and communication technology (ICT) infrastructure may use fibre optics as a standard backbone to allow fast and big data communications. In rural areas, transportation supports simple connectivity inside the region and access to markets and essential facilities such as health facilities, schools, and local government offices.

Cities are supported by their outskirts and rural areas, particularly for food provision. Rural producers efficiently supply many products based on agriculture, home industry, or small-scale production, as well as agricultural products. Such products are sent to cities via simple transportation methods because of the proximity and their small scale.

Logistics systems play a significant role in efficient post-harvest delivery, especially in tropical countries where harvests and livestock are under firm climate control during transportation from producers in rural areas to distributors in cities. Inappropriate vehicles, poor roads, and inefficient logistical management hinder the preservation of perishable commodities during transport (Rolle, 2006). In India, less than 4% of fresh products are transported using the cold chain (Joardder and Hasan Masud, 2019). About one-third of fresh fruit and vegetables are thrown away globally because their quality drops below acceptance limits (Gustavsson et al., 2011). This is a huge unacceptable loss that is preventable. Improving efficiency in supply chains benefits both producers and consumers; thus, it should be prioritised. Apart from infrastructure such as roads or railways and temperature-controlled vehicles, logistics management is crucial. The Food and Agriculture Organization of the United Nations (FAO, 2001) has provided livestock handling guidelines that include suitable transportation modalities.

The principle of integrated rural–urban development is to facilitate the growth potential of rural and urban areas while strengthening their linkages to produce synergised outputs. Cities need to have adequate infrastructure – allowing efficient mobility; fast data transfer; and sufficient, up-to-date, and innovative economic and education centres. Zoning is a crucial part of city planning to facilitate smooth mobility and sustainability. Meanwhile, villages and peripheral areas should be provided with adequate infrastructure to support agriculture and its related sectors (including home industry and ecotourism), smooth connectivity to city hubs, accessibility to markets (including cross-border markets), education with appropriate levels and skills, healthcare centres, and better ICT connectivity.

Typical problems arising from local development issues are imbalanced priorities and paths between urban and rural development strategies. Urban planners may ignore the needs and effects of urban development on its periphery, while rural development is expected to respond to changing demands from cities. A synchronised and synergised urban–periphery linkage requires mutual interest to incorporate rural planning into urban planning.

Digital Divide

Since ICT is becoming an essential aspect of development, this section discusses the major challenges and consequences – the digital divide and infrastructure gaps between rural and urban areas – which are fundamental in the policy discussion to promote inclusive growth.

The power of cities is, unsurprisingly, very big. McKinsey Global Institute identified the 3,000 largest cities globally and found that they represent 67% of the world's gross domestic product (GDP) and 40% of the population. Further, the top 50 cities in this group are home to 8% of the world's population but contribute 21% of global GDP (Manyika et al., 2018). Those cities include 10 cities in China; three in Japan; two in India; one each in the Republic of Korea and Australia; and the capitals of the ASEAN5: Bangkok, Jakarta, Kuala Lumpur, Manila, and Singapore. Economies of scale and agglomeration allow them to outperform other non-metropolitan cities.

Given the limited public resources, development programmes typically prioritise urban areas before rural areas. This results in wide gaps between urban and rural areas in terms of the quality of infrastructure, efficiency, level of data connectivity, and transport mobility. The gap is especially wide in information technology (IT) systems due to the economies of scale and focus. IT infrastructure projects require significant demand to become financially viable; otherwise, they cannot attract private investment for the projects, and they become a public sector responsibility. With limited resources and fierce competition between programmes, governments face a shortage of public funding.

The situation is usually addressed by allocating the funds to the most prioritised project, typically determined by the outputs it generates. ICT becomes more productive in urban activities when it is measured by monetised outputs. In ICT utilisation, wage differences between urban and rural workers and monetary outputs from financial services versus the agricultural sector are huge, making ICT a high priority in the urban economy but less important in the rural economy. Policymakers consider it more appropriate to spend public funds on traditional agriculture and basic infrastructure rather than build an internet backbone, following the principles of public investment valuation. Hence, gaps exist and even widen in many emerging countries. At the national level, gaps amongst emerging economies are also present in infrastructure status, institutional aspects (policy and regulations), and skills (Table 14.1).

Table 13.1 Key Digital Economic Indicators in Selected AMS

Country	Connectivity			Payments			Logistics		Skills	Policy and regulations			
	Mobile broadband subscribers (% of population)	Mobile broadband prices (500 MB/month) as a % of GNI per capita	Fixed broadband subscribers (% of population)	% of digital payments in the past year	% of online payment for internet purchases	% of online firms using digital payments	Logistics Performance Index score (max. 5)	Integrated index for postal development	Human Capital Development Index global rank (out of 120)	Cross-border data flow restrictions	Data privacy regulations	Consumer protection regulations	Cybersecurity expenditure as % of GDP
Cambodia	67%	1.10%	2%	16%	—	—	2.8	19.7	97	No	No	Yes	—
Lao PDR	51%	—	1%	12%	—	—	2.07	41.4	105	No	No	Draft	—
Malaysia	116%	0.90%	8%	76%	52%	57%	3.43	66.0	52	Yes	Yes	Yes	0.08%
Indonesia	100%	1.40%	3%	34%	49%	51%	2.98	49.4	69	Yes	Yes	Yes	0.02%
Philippines	40%	1.50%	3%	23%	—	52%	2.86	33.9	46	No	Yes	Yes	0.04%
Thailand	170%	1.20%	11%	62%	—	—	3.26	66.1	57	No	Yes	Yes	0.05%
Viet Nam	82%	1.40%	12%	22%	10%	51%	2.98	47.8	68	Yes	Draft	Yes	0.04%

— = not available, AMS = ASEAN Member State, ASEAN = Association of Southeast Asian Nations, GDP = gross domestic product, GNI = gross national income, MB = megabyte.

Sources: World Bank (2016) from ITU (2017), Measuring the Information Society Report 2017. Geneva: International Telecommunication Union;

In the Networked Readiness Index business usage pillar, Singapore ranked 14th globally, while Malaysia was 26th, Indonesia 34th, Thailand 51st, Viet Nam 81st, the Lao People's Democratic Republic (Lao PDR) 89th, Cambodia 104th, and Myanmar 138th (Baller, Dutta, and Lanvin, 2016). This index includes the measures of firms' technology absorption capacity and overall capacity to innovate. Hence, East Asia faces a diverse ICT status across the states, with Singapore in an advanced position and other countries in between Singapore and the CLM countries (Cambodia, the Lao PDR, and Myanmar). Differences amongst AMS are a window of opportunity for further cooperation, not only for governments but also for firms. Improving the least developed economies is important to enlarge the size of the ASEAN market – which will benefit all AMS and prevent widening of gaps between clusters.

The CLM countries have the lowest ICT adaptation rankings amongst AMS and share some common characteristics:

- More people live in rural areas than in urban areas – Cambodia: 77%, the Lao PDR: 66%, Myanmar: 70%, and Viet Nam: 65% (ASEAN, 2018).
- The share of the population using the internet is 34% in the Lao PDR and 35% in Myanmar, while Cambodia has the highest share at 79% (2020 estimates by ITU, 2021).
- Internet usage for business-to-consumer transactions was about 4% in Cambodia and the Lao PDR, and 3.3% in Myanmar (Baller, Dutta, and Lanvin, 2016).
- Less than 1% of the population has a fixed broadband subscription (ITU, 2019).
- The 4G (LTE) network is in the early stage of implementation.

A study by the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS, 2018) found that Cambodia has both the cheapest mobile internet prices and the third-highest mobile data usage in the world. Internet usage in the country is the second highest amongst the least developed countries. The less regulated internet market in Cambodia drives market competitiveness; this is an important lesson for other emerging markets, as confirmed by the World Bank (2016). However, Cambodia's ICT progress has not created economic outputs beyond social networking and entertainment purposes. The top website is the video-sharing YouTube portal.

Further, the country has a significant trade deficit in ICT-related activities, as overseas ICT companies gain revenue from advertisements targeted at Cambodians paid by Cambodian companies. Cambodia also imports far more than it exports in computer and information services. Therefore, opening the economy requires a holistic approach to allow people to reap the economic benefits of ICT development. Unfortunately, data on the rural digital sector are insufficient and out of date, especially in the Lao PDR and Myanmar. Since the coverage and quality of ICT services in urban areas in these countries are the lowest in Southeast Asia, one can surmise that the condition in rural areas is no better.

However, if rural areas have insufficient ICT infrastructure, they cannot maximise their potential and the urban–rural ICT gaps widen – creating obstacles to synergised urban–rural linkages. This is not a win–win situation for both rural and urban development. Additionally, China's experience shows that investing in rural connectivity benefits not only small enterprises but also vulnerable groups such as women and persons with disabilities.[3]

Options to fix the problem are limited, given the countries' size and economic capacity, but some efforts are worth considering:

(i) Governments may impose national minimum access standards for ICT to guarantee countrywide access. Satellite-based technology is very useful in a large country (e.g. the Indonesian archipelago) or in subregions such as the Mekong Subregion.

(ii) Governments may raise the standard once the minimum standard is met. This could create a positive externality where ICT utilisation boosts productivity and generates additional income for users, making it affordable to pay for upgraded ICT services. Private investment can play an important role in this stage.

(iii) Spatial and sector needs must be mapped to unlock the potential of rural areas. Universities and other research institutions can contribute to accelerating and supporting rural development by analysing the local potential and developing a strategy to nurture it. Some regions may need faster data connectivity, while others focus on establishing data centres or developing specific applications.

(iv) Rural communities require capacity building to reap the economic benefits of ICT. Digitalisation of government services can be used to familiarise people with digital applications in daily life. Governments need to have a comprehensive medium- to long-term digital government agenda and utilise it to accelerate rural digital development.

(v) Governments should provide a legal framework to guarantee business and user rights, facilitate market mechanisms, and support innovation, while maintaining market competitiveness. Regulations on cybersecurity, data privacy and protection, and e-commerce should be prioritised.

(vi) Another feasible approach is mandating infrastructure sharing amongst ICT operators to improve efficiency and create a level playing field. This is not an easy task. It has been adopted in Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam, but not yet in CLM countries (World Bank, 2016).

[3] At the end of 2014, there were more than 70,000 merchants in 200 Taobao villages and many more in other rural areas. Most of the stores were small, with an average of 2.5 employees. About one-third of the owners were female, one-fifth were previously unemployed, and 1% were persons with disabilities. One of Alibaba's top 'netpreneurs', confined to a wheelchair after an accident, built a thriving online livestock business (Alizila, 2014).

Rural Inclusiveness

Apart from gaps in digital infrastructure, other gaps are also critical: (i) the transportation system; (ii) electricity; and (iii) the quality of water, sanitation, and hygiene (WASH).

Transportation

Transportation in rural areas typically uses simple vehicles, but is not necessarily efficient because of economies of scale. Other characteristics are the spatial scarcity of public facilities, low population density, and underdeveloped public transport networks. Passenger cars are the main modality, and rural people rely on privately owned modified passenger cars (e.g. long jeeps converted to 'minibuses') for public transport because many people cannot afford to buy vehicles. If the market or nearest city centre is far, villagers must pay expensive transport costs and change vehicles several times. High logistics costs can hurt the welfare of farmers or fisherfolk and damage their products during transportation. Improving transportation networks and management in rural–urban connectivity also prevents product loss from inefficient supply chain management.

Electricity

Electricity provision can be challenging if villages are very small and far from the national grid system. Significant investment is required to establish a grid system from power plants to transmission centres and to wire the electricity to houses via distribution lines. If the number of households and the demand for electricity consumption is low, the investment will be non-viable. National grid systems are not efficient in large and sparsely populated countries. Large archipelagic countries with many inhabited small islands face the same challenges. To overcome such challenges, countries need to consider suitable renewable and micro-level energy sources, such as mini-grid systems, solar panels, and mini-hydropower.

Table 13.2 shows the percentages of electricity access in rural and urban areas in AMS. Note that the numbers in Table 13.2 do not show the quality of electricity access.[4]

[4] See, for example, Sulaiman (2019).

Table 13.2 Access to Electricity in AMS

Country	Rural (% of population)		Urban (% of population)	
	2000	2017	2000	2017
Brunei Darussalam	100	100	100	100
Cambodia	7	86	61	99
Indonesia	79	96	95	100
Lao PDR	28	91	96	100
Malaysia	–	100	–	100
Myanmar	–	60	–	93
Philippines	62	90	90	96
Thailand	74	100	100	100
Viet Nam	82	100	99	100

– = no data, AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations.

Source: World Bank (2019).

Countries may have different definitions of 'access to electrification', and the quality of electricity access could vary widely. The World Bank's quality level framework is grouped into five tiers (Table 13.3), characterised by the following attributes: peak available capacity, duration of service per day, duration of evening service, affordability, legality, and quality (voltage).

Table 13.3 Framework of the Quality of Electricity Access

ACCESS TO ELECTRICITY SUPPLY

ATTRIBUTES	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Peak available capacity (W)	-	>1	>500	>200	>2,000	>2,000
Duration (hours)	-	≥4	≥4	≥4	≥4	≥4
Evening supply (hrs)	-	≥2	≥2	≥2	≥4	≥4
Affordability	-	-	√	√	√	√
Legality	-	-	-	√	√	√
Quality (Volatge	-	-	-	√	√	√

- Five-tier framework
- Based on six attributes of electricity supply
- As electricity supply improves, an increasing number of electricity services become possible

Index of access to electricity supply = $\sum(P_T \times T)$

with P_T = Proportion of households at tier T

T = tier number {0, 1,2, 3, 4, 5}

Source: Portale et al. (2013).

Water, Sanitation, and Hygiene

Lack of basic WASH facilities hamper efforts to reduce child and maternal mortality, illness, and stunting. The relationship between adequate WASH and the poor status of maternal and child health and mortality shows the importance of upgrading both the coverage and the quality of water and sanitation. In AMS, WASH problems occur in both rural and urban areas (Table 13.4-13.6). Coverage has improved in recent years, but the quality of water and sanitation needs to be improved.

Table 13.4 Access to National Drinking Water (estimates, at least basic)

Country	Urban (% of population)		Rural (% of population)	
	2000	2017	2000	2017
Cambodia	76	90	47	65
Indonesia	90	98	66	86
Lao PDR	77	97	38	78
Malaysia	>99	>99	94	90
Myanmar	68	95	38	78
Philippines	93	97	79	91
Thailand	98	>99	92	>99
Viet Nam	94	>99	76	96

Note: Highlighted = under 80%.

Source: WHO–UNICEF Joint Monitoring Programme (n.d.), JMP Global Database. https://washdata.org/ (accessed 5 August 2021).

Table 13.5 Access to National Sanitation (estimates, at least basic)

Country	Urban (% of population)		Rural (% of population)	
	2000	2017	2000	2017
Cambodia	46	93	2	61
Indonesia	63	92	25	80
Lao PDR	67	98	17	69
Malaysia	98	>99	94	99

Country	Urban (% of population)		Rural (% of population)	
	2000	2017	2000	2017
Myanmar	82	79	67	71
Philippines	72	82	53	82
Thailand	89	>99	93	98
Viet Nam	81	96	43	85

Note: Highlighted = under 80%.

Source: WHO–UNICEF Joint Monitoring Programme (n.d.), JMP Global Database. https://washdata.org/ (accessed 5 August 2021).

Table 13.6 Access to National Hygiene (Estimates, at least basic, 2020)

Item	National (% of population)	Urban (% of population)	Rural (% of population)
Cambodia	74	83	71
Indonesia	94	96	91
Lao PDR	56	73	46
Myanmar	75	83	71
Philippines	82	85	79
Thailand	85	87	83
Viet Nam	86	93	82

Note: Highlighted = under 80%.

Source: WHO–UNICEF Joint Monitoring Programme (n.d.), JMP Global Database. https://washdata.org/ (accessed 5 August 2021).

The Lao Social Indicator Survey II revealed that 81% (urban) and 89% (rural) of water samples tested at households and sources were contaminated with E-coli (United Nations in Lao PDR, 2019). Some 69% of rural Laotians do not have basic handwashing facilities with soap and water, compared with 27% of urban Laotians. In Cambodia, 40% of people in rural areas and 12% of people in urban areas do not have basic handwashing facilities. Despite improvements in WASH coverage, 81% of the poorest rural Cambodians practise open defecation, compared with 11% of the wealthiest rural Cambodians. Many people still do not know about safe WASH risk prevention practices, especially in rural areas (UNICEF Cambodia, 2019).

The CLM countries have scores under 80 for rural sanitation (Table 14.5). Indonesia and the Philippines are large archipelagic countries with decentralised governments in which local governments are responsible for WASH provision. Hence, WASH provision varies widely across local jurisdictions, depending on the capacity of local administrations, geographical challenges (e.g. some islands in Indonesia experience long droughts that last several years), and local fiscal capacity.

Governments achieve significant improvements when they make a serious effort. In smaller economies such as Cambodia and the Lao PDR, partnerships with the international community and support from local non-governmental organisations contribute considerably to the outputs. This model should be continuously utilised, especially to improve the situation in rural areas. People with low purchasing power need some subsidies, and services can be provided through programmes designed to leverage people's capacity. For example, receiving subsidised electricity can be bundled with participating in WASH programmes or education for children. Another possible bundling programme is subsidising farmers who join cooperatives to facilitate better access to capacity building programmes and financial credits.

Conclusion

AMS have made significant improvements in their development status, especially Cambodia, the Lao PDR, Myanmar, and Viet Nam, during the last two decades. Viet Nam is monumental in this regard. However, as occurs in many places around the world, the development paths tend to favour urban rather than rural areas – resulting in wide gaps between them. Rural development faces specific challenges such as economies of scale and low capacity, scattered populations, and lack of connectivity with the larger economy. By recognising the special characteristics of the rural economy, authorities can create appropriate policies to address the challenges. AMS can promote rural inclusiveness by applying comprehensive policies on social, spatial, and sectoral development.

National policy concerns the whole social development agenda, including poverty eradication and narrowing the inequality gaps – giving a helicopter view of policymakers towards achieving the national vision. Regional and local policies are derived from national policies by considering spatial and sector issues. Spatial linkages and rural–urban interdependency bond the whole policy.

Despite its small scale and non-viable investment features, investing in rural development is important for several reasons: (i) people in rural areas have the same rights as people in urban areas to fulfil their basic needs; (ii) the potential of rural areas is significant and influential at a macro level; (iii) the linkages between rural and urban areas show their interdependence; and (iv) successful urbanisation depends on the quality of the migrants, who mainly come from rural areas.

There are also success stories of investing in rural infrastructure and development, such as previously mentioned in China and other places worldwide. Viet Nam's remarkable economic development and productivity cannot be detached from its massive nationwide investment in infrastructure, education, and healthcare. Bose, Uddin, and Mondal (2013) found that the villages in Bangladesh supplied with electricity demonstrated positive effects on production, profit margins, development and business modernisation, women's empowerment, quality of life, and human capital development. The European Union created the common agricultural policy (CAP) with dedicated funding from the European Agricultural Fund for Rural Development to contribute to the cross-cutting objectives of innovation, environment, and climate change mitigation and adaptation.[5]

Efforts by AMS to improve the quality life of the rural population, especially countries in the Mekong Subregion, should be praised and continued. Partnerships with the international community – both as lender and as technical support – and with local communities have demonstrated positive outputs. Other options include attracting private sector participation by offering mutually beneficial schemes; linking rural areas to larger economic region, especially areas near cities and neighbouring countries; integrating rural–urban development planning; and exploring a market-based approach.

To develop a market-based approach to finance social infrastructure, green bonds and development bonds merit consideration. The Cambodia Rural Sanitation Development Impact Bond (DIB) – an initiative of the United States Agency for International Development, the Stone Family Foundation, and the International Development Enterprise – is the world's first DIB for sanitation. It aims to eradicate the high rates of open defecation in the country and accelerate the Government of Cambodia's efforts to reach universal sanitation. The DIB covers six provinces and aims to reduce stunting and prevent the spread of disease and contamination of drinking water. The fund supports the government's aim of eliminating open defecation by 2025 (iDE, 2019). Additionally, green bonds under the climate change adaptation scheme can be issued, especially for energy sector development in rural areas.

5 For more details see European Union (n.d.).

References

Alizila (2014), 'Report: "Taobao Villages" in Rural China Grow Tenfold in 2014', 22 December. https://www.alizila.com/report-taobao-villages-in-rural-china-grow-tenfold-in-2014/.

Almeida, R., J. Behrman, and D. Robalino (2012), *The Right Skills for the Job? Rethinking Training Policies for Workers*, Human Development Perspectives. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/535251468156871924/The-right-skills-for-the-job-Rethinking-training-policies-for-workers.

ASEAN (2018), 'ASEAN Statistical Leaflet 2018: Key Socio-Economic Indicators'. Jakarta: ASEAN Secretariat. https://www.aseanstats.org/wp-content/uploads/2018/10/ASEAN_Statistical_Leaflet_2018.pdf.

Baller, S., S. Dutta, and B. Lanvin (eds.) (2016), 'Global Information Technology Report 2016: Networked Readiness Index', World Economic Forum and INSEAD. https://reports.weforum.org/global-information-technology-report-2016/networked-readiness-index/.

Bose, T.K., M.R. Uddin, and A. Mondal (2013), 'Impact of Electricity Access to Rural SMEs', *International Journal of Managing Value and Supply Chains*, 4(4), pp.17–28.

Dhingra, S. and M. Ghatak (2021), 'The Pandemic in Data: How Covid-19 Has Devastated India's Economy', Scroll.in, 9 July. https://scroll.in/article/999275/the-pandemic-in-data-how-covid-19-has-devasted-indias-economy.

European Union (n.d.), Rural Development. https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development_en.

FAO (2001), *Guidelines for Humane Handling, Transport and Slaughter of Livestock*. Bangkok: Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific. http://www.fao.org/3/x6909e/x6909e00.htm#Contents.

Gustavsson J., C. Cederberg, U. Sonesson, R. van Otterdijk, and A. Meybeck (2011), *Global Food Losses and Food Waste: Extent, Causes and Prevention*. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/3/a-i2697e.pdf.

iDE (2019), 'World's First $10 Million Sanitation Development Impact Bond Launches', International Development Enterprises, Press release, 18 November. https://www.ideglobal.org/press/cambodia-rural-sanitation-dib.

ITU (2019), 'ITU-D ICT Statistics. https://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx (accessed 20 April 2020).

ITU (2021), *Connectivity in the Least Developed Countries: Status Report 2021*. Geneva: International Telecommunication Union. https://www.itu.int/itu-d/reports/statistics/connectivity-in-the-least-developed-countries-status-report-2021/.

Joardder, M.U.H and M. Hasan Masud (2019), *Food Preservation in Developing Countries: Challenges and Solutions*. Berlin: Springer International Publishing.

Manyika, J., S. Ramaswamy, J. Bughin, J. Woetzel, M. Birshan, and Z. Nagpalet (2018), '"Superstars": The Dynamics of Firms, Sectors, and Cities Leading the Global Economy', Discussion Paper, McKinsey Global Institute, October. https://www.mckinsey.com/featured-insights/innovation-and-growth/superstars-the-dynamics-of-firms-sectors-and-cities-leading-the-global-economy.

OECD (2013), 'PISA in Focus'. Paris: Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/education/pisa-in-focus_22260919.

Phong, K. and J. Solá (2015), 'Mobile Phone and Internet in Cambodia 2015'. USAID, Open Institute, Development Innovations, and The Asia Foundation. https://asiafoundation.org/publication/mobile-phones-and-internet-in-cambodia-2015/.

Portale, E. et al. (2013), *Global Tracking Framework,* Washington, DC: World Bank. http://documents.worldbank.org/curated/en/603241469672143906/Global-tracking-framework.

Rolle, R.S. (2006), 'Improving Postharvest Management and Marketing in the Asia-Pacific Region: Issues and Challenges Trends', in R.S. Rolle (ed.) *Postharvest Management of Fruit and Vegetables in the Asia-Pacific Region*. Tokyo: Asian Productivity Organization, pp.23–31.

Shucksmith, M. (2013), 'Environment, Food and Rural Affairs Committee', Written evidence from Professor Mark Shucksmith OBE.
https://publications.parliament.uk/pa/cm201314/cmselect/cmenvfru/602/602we16.htm.

Sulaiman, S.R. (2019), 'Govt Says 98.05 Percent of Households Have Electricity. What Does it Mean?', *The Jakarta Post* 23 January. https://www.thejakartapost.com/news/2019/01/23/govt-says-98-05-percent-of-households-have-electricity-what-does-it-mean.html.

UN-OHRLLS (2018), 'Leveraging Investments in Broadband for National Development: The Case of Cambodia'. New York: United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States. http://unohrlls.org/custom-content/uploads/2019/02/Cambodia-Broadband-Case-Study-UNOHRLLS-2018.pdf.

UNICEF Cambodia (2019), 'Water, Sanitation and Hygiene'. https://www.unicef.org/cambodia/water-sanitation-and-hygiene.

UNICEF and World Health Organization (2019), *Progress on Household Drinking Water, Sanitation and Hygiene 2000–2017: Special Focus on Inequalities*. New York: United Nations Children's Fund. https://www.who.int/water_sanitation_health/publications/jmp-report-2019/en/.

United Nations (2019), *The Future of Asian and Pacific Cities: Transformative Pathways Towards Sustainable Urban Development*. Bangkok: United Nations. https://www.unescap.org/sites/default/d8files/knowledge-products/Future%20of%20AP%20Cities%20Report%202019.pdf.

United Nations in Lao PDR (2019), '2018 Progress Report: Lao PDR–United Nations Partnership Framework 2017–2021: A Partnership for Sustainable Development', https://reliefweb.int/sites/reliefweb.int/files/resources/2018%20UNPF_Progress%20Report_English.pdf.

World Bank (2016), *World Development Report* 2016: Digital Dividends. Washington, DC: World Bank. https://www.worldbank.org/en/publication/wdr2016.

World Bank (2019), 'World Development Indicators–Environment'. http://datatopics.worldbank.org/world-development-indicators/themes/environment.html (accessed 30 March 2020).

Yu, L. and X. Li (2021), *The Effects of Social Security Expenditure on Reducing Income Inequality and Rural Poverty in China, Journal of Integrative Agriculture*, 20(4), pp. 1060–67.

Chapter 14

MSME Responses to the COVID-19 Pandemic and Their Way Forward

Dionisius A. Narjoko
Senior Economist, ERIA

Background

Micro, small, and medium-sized enterprises (MSMEs) play an important role in an economy and for the development of a country. They dominate the number of enterprises and provide jobs for a large portion of the labour force, although they are not the biggest contributor to output creation in aggregate. MSMEs are spread across all sectors of the economy, with a large number in manufacturing and services. In many developing countries, micro and small enterprises can absorb workers in the informal sector, making them agents for alleviating poverty through economic activities.

MSMEs are solid building blocks for industrial development, especially in the formation of industrial agglomerations and international production networks (IPNs). The enterprises, especially medium-sized ones and to some extent small ones, are critical for IPNs as they present themselves to multinational enterprises (MNEs) as arm's-length suppliers that maximise the combination of business transactions between the local economy and across country borders.[1] They are agents of industrial development, as the backward linkages established through their association with MNEs accelerate technology transfer amongst small and medium-sized enterprises (SMEs), especially those participating in IPNs. Deeper and more extensive participation of SMEs in IPNs over time improves competitiveness, which leads to higher participation of SMEs in the international market – expanding the contribution of SMEs in improving a country's trade balance.

The rapid spread of the coronavirus disease (COVID-19) from March 2020 plunged the world into the biggest global crisis since the early 1900s. The pandemic triggered border closings both between and within countries that, while necessary to manage the spread of the virus, halted the world economy. The lockdowns disturbed not only the supply side, through disruptions to production caused by the closing down of factories, but also the demand side. Strict limitations on the movement of people cut demand for various products and services, fuelling the contraction on the production side. As a result of these factors, the world economy saw a deep contraction in the second quarter of 2020 and had not yet fully recovered by the end of that year.

[1] As in the two-dimensional fragmentation and industrial agglomeration model of Kimura and Ando (2005).

The pandemic has put pressure on how business is done and is likely to induce changes in the way of conducting business, including for MSMEs. However, it is not clear what exactly these changes will be, whether they are temporary or could translate to permanent changes in MSME models, and in which direction they will converge (or whether they will converge). This chapter attempts to provide answers to these questions, based on what we know so far and some evidence on the responses of MSMEs to the pandemic. The objective is for the Comprehensive Asia Development Plan 3.0 (CADP 3.0) to devise ideas on how policy could be geared towards assisting MSMEs more effectively in the future. Given the theme of CADP 3.0, special attention is given to elucidate the role of digitalisation in MSME development in the future.

The rest of this chapter is organised as follows. Section 2 outlines a general framework for a model of MSME responses to the pandemic crisis. It is important to contemplate potential responses of MSMEs during the crisis because of the pandemic.

Section 3 presents key messages from the Association of Southeast Asian Nations (ASEAN) SME Policy Index (ASPI) 2018, which should provide an indication of whether the pre-pandemic policy framework can support possible changes that will take place in the post-pandemic era. This section is limited to the ASEAN Member States (AMS). While this is not ideal – as it does not cover the ASEAN Plus Six countries[2] – it is acceptable as the AMS are the centre of gravity in East Asia economic integration and are the recipient countries of foreign direct investment (FDI) from the Plus Six countries. Section 4 presents policy responses introduced and implemented in selected countries during the pandemic. Section 5 concludes by presenting the lessons learned from the pandemic crisis for policy recommendations.

[2] The ASEAN Plus Six countries are Japan, China, the Republic of Korea, Australia, New Zealand, and India.

Analytical Framework: MSME Responses to the COVID-19 Pandemic

Factors affecting the performance of MSMEs come from two directions: the supply and demand sides. Supply-side factors are those that affect the productivity level or growth of the enterprises. Unlike large enterprises or MNEs, MSMEs are inherently less competitive than their larger counterparts, theoretically rooted in their inability to operate at a minimum efficient scale in a given industry. As typically argued in the literature (e.g. Tybout, 2000), however, the flexibility and nimbleness of MSMEs can compensate for the weakness coming from the scale effect, allowing MSMEs and large corporations to coexist.

The situation during the pandemic has been very different. The pandemic shock has affected both the supply and demand sides, as a result of large-scale social restriction policies since the beginning of the pandemic, including the closing of country borders. The lockdowns have limited both business operations and people's mobility, affecting the performance of all types of companies – especially MSMEs. Nevertheless, some have argued that the impact is far greater on the demand side (e.g. World Bank, 2021).

The supply side of MSMEs is adversely affected through two channels:

(i) The reduction in the number of workers, as people were kept at home or workers have been unwell (OECD, 2020): The prolonged lockdown, including long quarantine measures for people travelling between countries, leads to further and more severe drops in capacity utilisation, reducing output even further.

(ii) The unavailability of inputs produced overseas: As the production structure of modern companies tends to be globally connected along production value chains, an outbreak in one country will stop the supply of products/inputs from that country. For example, a drop in the production of manufacturing products in AMS very early in the pandemic was caused by a shortfall in the supply of inputs from China (ERIA et al., 2021).

In terms of the demand side, the drop in demand created a domino effect on MSME sales and other performance measures – eventually significantly increasing risks to their survival. Based on its survey during the peak of the crisis, ADB (2020) reported that most MSMEs in some AMS (i.e. Indonesia, the Lao People's Democratic Republic (Lao PDR), the Philippines, and Thailand) suspended operations within 1 month of the beginning of the pandemic. Domestic demand was reported to have fallen by 30%–40% across these countries. The enterprises that remained in operation thus faced a very low demand situation, which imposed a high risk to their survival. A similar picture may be drawn from a survey of companies in 132 countries conducted by the International Trade Centre in 2020, in which nearly two-thirds of micro and small firms reported that the crisis strongly affected their business operations, compared with about 40% of large companies. One-fifth of SMEs said they risked shutting down permanently within 3 months (ITC, 2020).

The pandemic has adversely affected employment. In 2020, two out of three MSMEs in some AMS reduced their workforce in March and April (ADB, 2020), and the same pattern persisted until the end of April (ILO, 2020). Job losses in MSMEs were apparent during the 2 months following the pandemic outbreak. Wage levels were also negatively impacted, as more than half of the MSMEs revealed that they deferred their workers' wages (ADB, 2020).

Regardless of the channels and the depth of the adverse impacts of the pandemic on MSMEs, some enterprises have been able to weather the crisis – surviving and even growing. It is important to understand why this was the case, or what led to this outcome. The following subsection attempts to set a framework for MSME responses to the pandemic crisis.

Business model pivoting

MSMEs will not be able to survive in the longer term after the pandemic if they do not adjust to changes in the demand and supply situation. A recent World Bank survey of enterprises in Indonesia during the pandemic revealed that enterprises reach out to consumers by changing, diversifying, and switching product categories (World Bank, 2021) of final consumer products.

Since the onset of the pandemic, MSMEs have engaged in sectors whose products or services remained relevant despite physical distancing measures and operational restrictions, such as necessities. Indeed, they would need to have adapted their business model in reaching out to customers. Implementing digital sales and distribution channels, using electronic payment technology, and adjusting the product/service format may become business strategies to fulfil customer demands.

Some other non-essential sectors that require face-to-face interactions with customers to operate (e.g. non-essential retail, accommodation, and entertainment services) may experience a total loss of demand because of changing customer behaviour and business dynamics during the pandemic. For these sectors, a strategy to generate revenue could involve pivoting to new business models or even extending the business to new ventures.

Market access

Reaching out to new customers is another survival strategy. This is a step further than business pivoting and leveraging the 'nimbleness' of a typical MSME. To do this, MSMEs can obtain wider access to market their products along the supply chain of a product or service instead of depending heavily on the retail market. For enterprises in Indonesia, a survey showed that 23% of medium-sized businesses received orders from other companies (subcontractors) as their marketing strategy during the pandemic (Bappenas, 2020). In exchange, governments can provide incentives or recognition for the successful implementation of such collaboration.

Another method for SMEs to reach new customers is through exports. SMEs are usually confined to domestic markets, but opportunities exist in export markets. However, some would argue that such opportunities are limited as many countries around the world, if not all, have experienced a pandemic-induced economic shock.

Financial relief

Despite the economic stimuli introduced to facilitate credit to businesses, many MSMEs remain under-supported because of their inability to fulfil the conditions for access to credit from financial institutions, e.g. the lack of secured assets for collateral, informal business entities, or irregular cash flows. Therefore, a new type of credit line or short-term financing should be introduced to support MSMEs in surviving the crisis. Examples of this include loans to cover working capital, upgrading of business facilities, enabling the digitalisation of business models, and other efforts to improve MSME capability in meeting customer demands in the new normal.

Different programmes can be introduced to assist MSMEs in accessing cash and short-term financing, e.g. channelling liquidity to financial institutions so they can provide MSMEs with no or low-interest loans, offering partial credit guarantees on MSME loans, and subsidising interest payments on loans taken by MSMEs. Assisting MSMEs to cover their fixed costs is another important line of support. Providing subsidies on rent and utilities, as well as rebates on or deferrals of tax payments would also help ensure the survival of businesses. Various surveys have confirmed that the top financial support priorities of MSMEs during the pandemic were access to finance and deferral of bill payments (e.g. utility bills, social security premiums, and taxes) (ILO, 2020).

In implementing such programmes, policymakers should collaborate with financial institutions that have proven capability working with MSMEs to ensure robust risk management measures. During the current excess liquidity and low interest rate environment, it is also a good opportunity for established financial institutions to introduce corporate social responsibility programmes that focus on lending to the MSME segment.

In addition to the factors suggested by the analytical framework outlined above, it is important to recognise that the impact of the pandemic likely varies by sector. This has been observed in many countries, as documented in various publications. For example, a study by McKinsey & Company underlined the varying impact across sectors (Dua et al., 2020). Examining the impact of the COVID-19 pandemic on SMEs in the United States, McKinsey reported high risks of business closures amongst SMEs in services sectors such as accommodation, food, and education, due to changes in customer behaviour – especially the physical distancing and operational restrictions that began during the pandemic. Other small businesses may close because they were already at risk financially before the crisis. The most vulnerable small businesses face both financial and COVID-19 related challenges.

ASEAN SME Policy Index 2018

To map the likely changes in MSME behaviour or performance in the post-pandemic period, it is useful to get some idea of the typical policy approach to MSMEs before the pandemic. One strategy is by looking at the policy situation in the literature, and a convenient source for this is the ASPI. This section draws on key facts and messages from the ASPI 2018 for this purpose (OECD/ERIA, 2018).

The ASPI 2018 surveyed and evaluated policy for MSME development in the 10 AMS up to 2016–2017. It adopted a methodology devised by the Organisation for Economic Co-operation and Development (OECD) that was refined by the Economic Research Institute for ASEAN and East Asia (ERIA) and OECD for the ASPI 2018. The methodology covers eight policy dimensions in the AMS, each of which is assessed by three components representing different stages of the policy cycle: (i) planning and design, (ii) implementation, and (iii) monitoring and evaluation.[3] OECD/ERIA (2018) discusses the policy assessment and draws key messages regarding policy and the way forward.

[3] The policy dimensions and sub-policy dimensions, along with their concordance with the goals and desired outcomes of the ASEAN Strategic Action Plan for SME Development, 2016–2025, are presented in Appendix 1.

The following subsections summarise the key findings and messages of the ASPI 2018, organised by policy dimensions that are pertinent to regional economic integration. Given space limitations, this study only highlights a few policy dimensions – productivity, market access and internationalisation, and access to finance. The complete findings are in OECD/ERIA (2018).

Productivity

The ability of firms to make capital investments, including upgrading technology, allows them to increase their productivity – thereby improving their competitiveness. The policy dimension in the ASPI addresses this subject by measuring the degree of government policy intervention to increase productivity and to improve the factors affecting the productivity of SMEs in AMS.

AMS have generally progressed considerably in this policy dimension, despite remaining challenges. The survey carried out for the ASPI 2018 found that SMEs across the ASEAN region have not contributed significantly to overall productivity gains in the region (OECD and ERIA, 2018).

The Strategic Action Plan for SME Development, 2016–2025 (ASEAN Secretariat, 2015) underlined the importance of capital investment as the objective of policy to improve the productivity growth of SMEs in the region. Capital investment programmes for SMEs exist in five AMS, but the implementation is generally small in scale in most cases and, except in Singapore and the Philippines, many of these programmes are not aligned with best practices – potentially leading to mismatched investments.

Further, although AMS scored quite high in the ASPI for productivity enhancement, they scored low for policy implementation. This is due to the limited number of capital investment programmes in half of the AMS.

There is a growing tendency to involve the private sector in providing capacity building. This is reflected in the role of business development services (BDS), which are important for SMEs as they provide information and advice to support enterprises in becoming more productive. AMS have made progress in the provision of information on and implementation of BDS since the publication of the previous ASPI (2014). Private BDS providers are increasingly available in ASEAN, and the region has a large number of BDS enablers (e.g. incubators, accelerators, and co-working spaces) often run by private sector providers.

The policy index also measures policy to encourage clustering of SMEs. In general, clusters create an environment conducive to productivity gains, which are a factor of growth, and so form a structure that helps enterprises meet the challenges of international competition (OECD, 2009). Here, SMEs play an important role by providing linkages to set off a chain reaction of broad-based industrial development in industrial clusters.

The ASPI 2018 found that SME participation in clusters was rather limited, despite well-established incentive policies for companies to cluster their operations – mostly fiscal incentives such as tax holidays for corporate income tax, value-added tax, withholding tax, etc. As part of the policies on clustering, the policy index also measures policy to provide facilities that encourage networking amongst innovative companies, such as science/industrial parks, competitive clusters, or technology centres. Here, there are disparities in terms of the level of development and sufficiency of facilities relative to the needs of a given country. Singapore and Malaysia have the most advanced facilities, especially in the digital economy (e.g. digital hubs and cyber centres), while the other AMS do not.

Despite improvements in the region, the policy index found that linkages in the cluster zones amongst SMEs and between SMEs and large enterprises are still not well established. The participation of SMEs in the clusters is still relatively small.

Market access and internationalisation

With respect to access to international markets, there are wide differences in terms of policy implementation across AMS. Policy to promote exports in general is quite advanced in the ASEAN-5 or the older members of ASEAN (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) relative to the younger members of the association (Cambodia, the Lao PDR, Myanmar, and Viet Nam). The ASEAN-5 typically have many types of programmes in place, which are fully operational and funded. The programmes tend to offer SMEs support across a wide range of areas, from trade policy information and market intelligence to complying with FTA rulings; moreover, they not only facilitate SME participation at major trade fairs but also support them with marketing, product development, and navigating export markets (OECD and ERIA, 2018).

In terms of SME participation in global value chains (GVCs), the policy index measures the sophistication and intensity of government programmes to promote linkages between SMEs and other firms, especially multinationals, exporters, or input suppliers in general. This includes the policy that promotes technology transfer from MNEs multinational to SMEs. Most of the ASEAN-5 and Viet Nam have programmes in place that promote the participation of SMEs in GVCs. These include business-matching programmes carried out through specialised industrial parks and FDI incentives. Cambodia and the Lao PDR are in the early stage of development in this policy area.

There is a wide range of policy approaches across the AMS – from the sophisticated market-driven model of collaboration between the government and MNEs (e.g. as in Singapore) to the middle ground of a standard partnership–facilitation between local SMEs and MNEs (e.g. as in Indonesia and the Philippines) or mandatory SME–MNE partnerships (e.g. as in Viet Nam).

It is important to highlight the policy towards e-commerce promotion for MSMEs in accessing markets in other countries (exports).[4] E-commerce has been growing, and continues to grow rapidly, in Southeast Asia. In Indonesia, for example, starting from a contribution of only 2% to total retail trade in 2016, e-commerce grew massively to a 20% contribution in 2020 (World Bank, 2021). Further growth is expected in the next decade or so, with some forecasting it to amount to a growth rate of around 32% per annum (World Bank, 2021). All this opens opportunities for MSMEs to use e-commerce to access non-traditional markets, including those in foreign countries, without overcoming their scale disadvantage.

Policy on e-commerce amongst AMS, and as in many countries in the world, is still in its infancy, although the ASEAN-5 seem to be the most advanced in the policy environment in increasing the use of e-commerce by MSMEs. They have clear legal instruments in place to govern e-commerce, e-payments, and consumer protection. These countries have also implemented nationwide e-commerce programmes that that have included MSMEs as targets. The other AMS (i.e. Cambodia, Lao PDR, Myanmar, and Viet Nam) have not yet adopted a policy framework for MSMEs and e-commerce, and therefore are still very limited in their programmes to support MSME participation in e-commerce.

Access to finance

Previous studies have established the idea that financing obstacles impede growth in smaller firms (e.g. Beck, Klapper, and Mendoza, 2010). SMEs often find it harder to access external financing because financial institutions are often reluctant to lend to this segment, given the higher risk profile associated with SMEs. Moreover, the extent of financial constraints for SMEs tends to be pronounced in developing countries, where SMEs may lack professional management and financial literacy skills, and where gaps may exist in the legal framework to protect creditor rights.

The ASPI, including its 2018 edition, has a policy dimension that attempts to measure the degree of sophistication and scope of government policies that can improve the access to, or availability of, financing for SMEs. This dimension has two parts: (i) to measure the regulatory system and framework, and (ii) to look at policy instruments to ensure the availability of diversified sources of financing for SMEs.

[4] E-commerce is covered under the internationalisation aspect of SMEs in the ASPI 2018. It is not covered in the context of domestic markets, which seems to be equally important as the world is learning from survival efforts during the COVID-19 pandemic.

One of the most important elements in the first part is regulatory readiness to ensure the existence of institutions to mitigate credit risk, such as credit information facilities and collateral registries, and adopting rules and regulations to protect creditor rights. This is particularly important because the Strategic Action Plan for SME Development 2016–2025 lists the harmonisation of credit reporting, and potentially the creation of an ASEAN-level credit information system, as a strategic long-term goal. The findings of the ASPI 2018 suggest that important progress has taken place over the last 10 years in building up credit information systems across ASEAN. However, significant disparities remain in the breadth and depth of coverage across AMS that must be addressed as a first step (OECD and ERIA, 2018: 90).

As for credit guarantee schemes, as a major policy to reduce credit risk, the policy in ASEAN is still skewed towards the more developed AMS – five AMS (Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam) have a public or public/private credit guarantee scheme in place, while six AMS have government-sponsored export financing schemes. Brunei Darussalam, Cambodia, the Lao PDR, and Myanmar have neither facility, though the necessity of a public guarantee scheme is limited in Brunei Darussalam given its small size and well-capitalised banking sector.

In terms of policy to ensure the availability of a diverse source of financing for SMEs, the impression is that many of the policies for bank loans for SMEs are channelled through state-owned entities. For instance, of the six AMS that have government-funded export financing schemes in place, five are run through export-import banks (in Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam). This is a popular model in emerging and developing markets, where operational risks are generally higher, and thus the backing of a sovereign entity can facilitate financiers to take on a higher level of credit risk (OECD and ERIA, 2018: 96).

Another important policy instrument that is introduced to increase bank loans for SMEs is the provision of a credit line to banks for SME lending, which is currently provided in eight countries (all except Brunei Darussalam and Myanmar). In Cambodia, Indonesia, the Philippines, and Malaysia, interest rate subsidies are provided. In two AMS (Indonesia and the Philippines), mandatory lending programmes have been implemented (OECD and ERIA, 2018: 99).

Access to stock market funding has started to become popular amongst SMEs in AMS. As reported in the ASPI 2018 (OECD/ERIA, 2018: 93), six AMS (Cambodia, Indonesia, Malaysia, the Philippines, Thailand, and Singapore) have also established junior board markets on which SMEs can list. Malaysia, Singapore, and Thailand have had such facilities in place for 10 years or more and have more than 100 listed firms. Indonesia launched its junior board, the IDX Incubator, in 2018, with the goal of listing 1,000 unicorn start-ups with a total market capitalisation of $1 billion by 2020. In 2015, Cambodia launched its junior board, called the Growth Board, for the Cambodia Securities Exchange (CSX), and an Excellence Programme for building SME capacity to meet listing requirements, although the board remains relatively shallow and illiquid.

Funding from equity instruments is still at an early stage for the region, despite the high level of regulatory development in Singapore and Malaysia. The other countries are in line in terms of policy to raise capital from equity, namely Thailand, Indonesia, and Viet Nam, driven mainly by the very high demand for private equity/venture capital to these countries. Most of these deals are in the technology, media, and telecommunications sector (Preqin, 2017; Bhalla et al., 2012). This alternative source of funding for SMEs is not yet a common option offered in Brunei Darussalam, Cambodia, the Lao PDR, or Myanmar, given the lack or limited depth of stock exchanges in these countries.

Programmes to Support MSMEs During the Pandemic

This section reviews the literature for successful programmes being implemented in several countries to support and sustain the survival of MSMEs during the pandemic. The review aims at drawing relevant and important information as reference, or as input, for designing support for the survival of MSMEs in the future should another crisis occur. It intends to learn from successful programmes in several countries, such as Australia, the Republic of Korea (henceforth, Korea), Malaysia, and Thailand.

The programmes outlined by these countries suggest that business pivoting has a higher chance of occurring because of the comprehensive capacity building programmes to support onboarding to e-commerce, digitalisation, and human capital development. This is obvious in the programmes implemented by Korea and Australia, for example, whereby capital accumulation in the digital sector, or digital infrastructure, typically is already at an advanced level. These types of programmes also exist in various formats in Malaysia.

Programmes to strengthen the capacity of MSMEs in these countries focus more on sophisticated wireless technology that relies on high-speed internet, such as cloud computing and virtual reality. This type of capacity building increases innovation capability, which will eventually allow the enterprises to create new products or services, permitting business pivoting to occur more swiftly.

Obtaining greater market access through government procurement seems to be a widely acceptable programme. It appears in at least three countries under the review (Australia, Korea, and China). Government procurement programmes for MSMEs even exist in Germany and the European Union. These programmes typically set the official quota for MSME participation, introduce procedure simplification, and provide assistance for MSMEs to capture the captive market from the procurement. Government support is sometimes even stronger if the special allocation for MSMEs comes with a special/cheaper loan facility, as in Korea's procurement programme.

Resources allotted for MSMEs through procurement programmes always have a downside risk of being misused to gain political popularity for the regime in power. It is therefore important for the programme to be well connected to a robust monitoring and evaluation mechanism.

The high degree of variation in the quota set for MSMEs, or limitation of project size for MSMEs, highlight one of the challenges in the implementation of allocated procurement program for MSMEs, that is, the lack of clear guidance on the optimal level of MSME participation in procurement. In addition, there is a looming issue on the horizon for this type of programme as it is against the principle of equal treatment commonly adopted by free trade agreements (FTAs), especially the modern model of FTAs such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

Programmes to provide financial relief for MSMEs seem to be the most widely implemented programmes globally. These programmes are found in all countries covered by this literature review, and include a range of relief schemes covering workers' expenses, operating costs, tax obligations, and the cost of raising capital.

Wage subsidies are a common programme to reduce workers' expenses and to help MSMEs retain workers during low demand situations such as the current pandemic. At least three types of wage subsidies have been implemented in many countries – employee relief funds, employee leave subsidies, and strategic incentives. The most adopted type is employee relief funds, which are essentially a direct cash transfer from the government to enterprises in distress. As highlighted by many of the countries covered by the review, the typical challenge in the implementation of this programme is related to the eligibility of the recipient – i.e. a subset of workers is not eligible to receive the subsidy, and poor programme design may lead to mis-targeting of the recipients.

Financial relief to reduce operating costs usually takes the form of discounted prices for rent or utilities (e.g. electricity and water), while relief for the cost of raising capital takes the form of discounted interest rates for loans granted to MSMEs. In some cases, the facility for cheaper capital comes with other supporting features such as fast loan processing or very relaxed terms for loan repayments.

Another type of financial assistance that it is not directly targeted at MSMEs is voucher programmes. Voucher programmes are essentially a consumer subsidy and provide a discount on the price of a product. However, unlike conventional consumer cash subsidy programmes, the discount here is linked to several products or services sold exclusively by MSMEs. The expected impact is clear, that is, the lower prices for customers are expected to trigger or increase demand for certain goods or services from MSMEs.

The literature has indicated that cash vouchers have been the most popular type of voucher during the pandemic. Cash vouchers were found to have been implemented in China, Korea, Thailand, and Malaysia. More importantly, the size of resources allocated by the governments of these countries for cash vouchers is significant, suggesting a belief by these governments that such programmes have a strong impact on MSMEs. The statistics from Korea and China, for example, show that cash vouchers are a powerful programme to raise demand for MSMEs.

It is important to note that cash vouchers can be even more effective and powerful in the digital era than, for example, a decade ago. This is because they can be distributed easily via e-commerce platforms, which significantly increases the programmes' coverage – not only because these platforms open up access to larger market coverage but also because several e-commerce platforms operate in each country. This is another reason for the popularity of this type of programme.

For the purpose of policy implementation, it is important to try to understand the necessary conditions, or basic requirements, that warrant successful implementation of a programme to boost demand for MSMEs. While it is not easy to determine these from a literature review, some of them are indicated and are worth mentioning.

Perhaps the most important requirement is for the country to have a solid database on MSMEs. This should be at the enterprise level and consistently maintained over time – preferably in longitudinal format, which requires a census for every sensible period (e.g. once every 5 years or so). A robust database is critical for various reasons, including defining the optimal size of the resources allocated to MSMEs, targeting the enterprises, and determining the types of programme to match the enterprises' characteristics.

The second requirement is a well-established e-commerce industry and robust digital infrastructure. This is important considering the effectiveness of onboarding MSMEs to e-commerce platforms.

The next important condition is a solid regulatory framework, especially for programmes related to affirmative action, as in the resources allocated for MSMEs in government procurement and financial assistance programmes. Here, regulations need to cater to the interests of all parties involved in the programme to ensure transparency and good governance and to maintain contestability in the market granted by the state to MSMEs. All of these factors are important, but the latter is the most important for government procurement programmes because a guaranteed market share always invites vested interests to dominate the market.

Rounding Up: MSMEs in the Post-Pandemic Era

The analysis in the previous sections describes lessons learned from the pandemic crisis for policy recommendations.

The first is to intensify and expand MSMEs' onboarding to e-commerce platforms. Onboarding e-commerce platforms is a popular strategic action promoted by governments and participated in by MSMEs in many countries during the pandemic crisis. This is because e-commerce can reach much wider markets that are not revealed because of social distancing during the pandemic. The intensive margin can take various forms, such as improving the quality of the product sold by enterprises or the quality of serving customers. As for the extensive margin, the recommendation is to expand programmes to as many e-commerce platforms as available in a country.

Onboarding MSMEs to e-commerce platforms is also important for other reasons. First, it provides a training ground for local enterprises to compete with others in digital markets. Second, onboarding provides a chance (buying time) for enterprises to improve the quality of the products or services they sell. Competing nationwide on large platforms is typically more demanding in many aspects, including product quality.

Onboarding MSMEs is not a straightforward action, however. There is a lot to do, especially since most of them (the micro and small ones) lack the necessary knowledge and capability to onboard the platforms for the first time. This is related to digital literacy issues for micro and small enterprises, which governments can help address. Another typical barrier is lack of digital infrastructure, especially in remote areas. It is clearly the responsibility of governments to address the issue through investment.

Finally, the use of discount vouchers, especially those disbursed digitally through the business process of e-commerce platforms, has had a positive impact on the survival of MSMEs. This is consistent with findings in many countries and the theory on the impact of discount vouchers. Therefore, it is justified if government plans to re-implement such a programme in the future especially in the event of an economic crisis. The challenge is how to design the mechanics of disbursing the funding for such vouchers. It is important to promote efforts to invent innovative ways to disburse the funding effectively and efficiently with minimised institutional barriers.

The second is to build the capacity of MSMEs. A smooth transition to a new business format requires capacity building support for MSMEs. Such capacity building programmes should involve partnership with multiple stakeholders, such as digital business players (e-commerce, marketplaces, digital payments, logistics, etc.), business associations, and corporations, to provide practical know-how and promote end-to-end impacts to the local economy.

The recommendation to improve capacity is consistent with the finding of the ASPI 2018, which indicates the weak implementation of many programmes to increase productivity in many AMS.

In the context of the pandemic crisis, capacity building could be more focused on trying to access the potential demand that exists but is not clearly revealed because of lockdowns or social distancing measures. The following are the key features of successful capacity building programmes: (i) coaching and mentoring with close interaction between trainers and entrepreneurs, (ii) the scope of the training covers end-to-end entrepreneurial/business acumen, and (iii) flexibility for different needs across enterprises.

Another important theme of capacity building is innovation. The strategic option to pivot to another business or quickly change the business model is a more general form of process or product innovation. The only difference between this strategy and the more general theoretical definition is that the strategy needs to be carried out quickly as the time dimension is critical during a crisis. As a lesson learned, it is worth mainstreaming innovation amongst MSMEs in a bid to hedge against another crisis in the future, and one way governments can do so is by providing capacity building programmes focusing on building the innovation capability of enterprises.

This can be done by applying the strategy at the cluster level, to achieve maximum impact as it is narrowly targeted to a specific group of MSMEs. The strategy then is to capitalise on established products and ecosystems. Specialisation in the production of one or a few products in a cluster should make it easier for the programme to upgrade the innovation capability of enterprises. The same logic applies for upgrading the capability for process innovation because there is typically an established business ecosystem in a cluster. Overall, targeting the programmes at clusters would be the most efficient approach if the intention is to increase innovation capability.

The third is to simplify the mechanism to provide financing for MSMEs. Financial assistance is very important for the survival of companies during an economic crisis, including the one created by the pandemic. The extent of the importance is even higher for MSMEs, as in general they are much less connected to the formal financial or banking system. Further, as reflected in the findings of the ASPI 2018, very few alternative financing (i.e. non-banking loans) policies or instruments are designed and created for MSMEs as the target consumers.

In the era of the accelerated digital economy during the pandemic, it is important to further develop fintech as an alternative source of financing for MSMEs. Fintech can provide other viable options of financing for MSMEs through its simpler mechanisms and quick processing times, enabled by the digitisation of back-end credit review processes. Provided that the cost of financing that fintech offers can be covered by the margin from operating revenues, fintech services can assist MSMEs in financing their working capital requirements.

References

ADB (2020), *Asia Small and Medium-Sized Enterprise Monitor 2020: Volume II – COVID-19 Impact on Micro, Small, and Medium-Sized Enterprises in Developing Asia*. Manila: Asian Development Bank.

ASEAN Secretariat (2015), *ASEAN Strategic Action Plan for SME Development*: 2016–2025. Jakarta: ASEAN Secretariat.

Bappenas (2020), 'Kajian Kebijakan Penanggulangan Dampak COVID-19 Terhadap UMKM: Survei Kebutuhan Pemulihan Usaha Bagi UMKM Indonesia (Study on the Policy on the Countermeasures to the Impact of COVID-19 on MSMEs: Survey of the Need for Recovery of MSMEs in Indonesia)'. Jakarta: Bappenas (National Development Planning Agency).

Beck, T., L.F. Klapper, and J.C. Mendoza (2010), 'The Typology of Partial Credit Guarantee Funds around the World', *Journal of Financial Stability*, 6(1), pp.10–25.

Bhalla, V., C. Harris, D. Khanna, X. Wu, and A. Dolya (2012), *Private Equity in Southeast Asia: Increasing Success, Rising Competition*. Boston: Boston Consulting Group.

Dua, A., K. Ellingrud, D. Mahajan, and J. Silberg (2020), 'Which Small Businesses Are Most Vulnerable to COVID-19 – and When', McKinsey & Company, 18 June. https://www.mckinsey.com/featured-insights/americas/which-small-businesses-are-most-vulnerable-to-covid-19-and-when

ERIA, CAITEC, JETRO, and KIEP (2021), *Joint Study on 10+3 Cooperation for Improvement of Supply Chain Connectivity (SCC)*. Jakarta: Economic Research Institute for ASEAN and East Asia.

ILO (2020), 'The Clock Is Ticking for Survival of Indonesian Enterprises, Jobs at Risk', *ILO Brief*, May 2020. Jakarta: International Labour Organization.

ITC (2020), *SME Competitiveness Outlook 2020: COVID-19: The Great Lockdown and its Impact on Small Business.* Geneva: International Trade Centre.

Kimura, F. and M. Ando (2005), 'Two-Dimensional Fragmentation in East Asia: Conceptual Framework and Empirics', *International Review of Economics and Finance,* 14(3), pp.317–48.

OECD (2009), *Clusters, Innovation and Entrepreneurship*, Local Economic and Employment Development (LEED). Paris: Organisation for Economic Co-operation and Development.

OECD (2020), *Enterprise Policy Responses to COVID-19 in ASEAN: Measures to Boost MSME Resilience*. Paris: Organisation for Economic Co-operation and Development.

OECD/ERIA (2018), *SME Policy Index: ASEAN 2018: Boosting Competitiveness and Inclusive Growth*. Paris: Organisation for Economic Co-operation and Development/Jakarta: Economic Research Institute for ASEAN and East Asia.

Preqin (2017), 'Preqin Special Report: Asian Private Equity and Venture Capital', https://www.preqin.com/insights/research/reports/preqin-special-report-asian-private-equity-venture-capital

Tybout, J.R (2000), 'Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?', *Journal of Economic Literature*, 38(1), pp.11–44.

World Bank (2021), 'Gender Insights from the COVID-19 Digital Merchant Survey'. Washington, DC: World Bank.

Appendix. ASPI 2018 Assessment Framework

2018 ASPI dimensions and sub-dimensions	ASEAN SAP SMED strategic goals and desired outcomes
1. *Productivity, technology, and innovation*	**A. *Productivity, technology, and innovation***
1.1 Productivity measures	A.1 Productivity will be enhanced
1.2 Business development services	A.2 Industry clusters will be enhanced
1.3 Productive agglomerations and clusters enhancement 1.4 Technology and innovation promotion	A.3 Innovation will be promoted as a key competitive advantage
2. *Environmental policies and SMEs*	**A. *Productivity, technology, and innovation***
2.1 Environmental policies targeting SMEs 2.2 Incentives and instruments for greening SME operations	A.3 Innovation will be promoted as a key competitive advantage
3. *Access to finance*	**B. *Increase access to finance***
3.1 Legal, regulatory, and institutional framework on access to finance	B.1 Institutional framework for access to finance will be developed and enhanced
3.2 Diversified sources of enterprise finance 3.3. Diversified sources of enterprise finance (microfinance component)	B.2 Financial inclusion (and literacy) will be promoted, and the ability of MSMEs to engage in the financial system will be enhanced
4. *Access to market and internationalisation*	**C. Enhance market access and internationalisation**
4.1 Export promotion	C.1 Support schemes for market access and integration into the global supply chain will be further developed
4.2 Integration to global value chains	C.2 Export capacity will be promoted
4.3 Use of e-commerce	
4.4 Quality standards	
4.5 Trade facilitation	
5. *Institutional framework*	**D. Enhance policy framework and regulatory environment**
5.1 SME definition 5.2 Strategic planning, policy design, and coordination	D.1 Inter- and intra-governmental cooperation in terms of policy and regulation will be enhanced
5.3 Measures to tackle the informal economy	D.3 Obtaining of permits and business registration will be streamlined

2018 ASPI dimensions and sub-dimensions	ASEAN SAP SMED strategic goals and desired outcomes
6. *Legislation, regulation, and tax*	**D. *Enhance policy framework and regulatory environment***
6.1 Public–private consultations	D.2 MSMEs' interests will be promoted, and involvement in the decision-making processes will be enhanced
6.2 Legislative simplification and regulatory impact analysis 6.3 Company registration	D.3 Obtaining of permits and business registration will be streamlined
6.4 Ease of filing taxes	
6.5 E-government	
7. *Entrepreneurial education and skills*	**E. *Promote entrepreneurship and human capital development***
7.1 Promotion of entrepreneurial education 7.2 Entrepreneurial skills	E.1 Entrepreneurial education and learning programmes will be instituted
8. *Social enterprises and inclusive SMEs*	**E. *Promote entrepreneurship and human capital development***
8.1 Social enterprises 8.2 Inclusive SMEs	E.2 Human capital development for MSMEs will be enhanced, especially for women and youth

ASEAN = Association of Southeast Asian Nations; ASPI = ASEAN SME Policy Index; ERIA = Economic Research Institute for ASEAN and East Asia; MSMEs = micro, small, and medium-sized enterprises; OECD = Organisation for Economic Co-operation and Development; SAP = Strategic Action Plan; SMED = SME Development; SMEs = small and medium-sized enterprises.

Source: OECD/ERIA (2018).

Chapter 15

Healthcare

Vanessa Yong
Deputy Director, Ministry of Health, Singapore

Introduction

This chapter focuses on healthcare in the context of development strategy. In particular, we discuss the roles of information and communication technologies (ICTs) in healthcare – their uses, benefits, and challenges, which are critical in the 'third unbundling' as discussed in chapter 1, and provide key areas for consideration in developing a digital healthcare strategy towards improvements in productivity and the next stage in socio-economic growth.

The Association of Southeast Asian Nations (ASEAN) and East Asia countries are currently, at different rates, undergoing a remarkable demographic transition which will result in an unprecedented increase in the numbers and proportion of older people. As a region, the United Nations projected that Asia would be home to more than 937 million people who are 65 years or older by 2050 (UN, 2017). The ageing of our population raises important sustainability issues for societies, notably the pressure placed on health systems and more generally, on social care. Inevitably, the demand for long-term care will increase. Along with this, there will be a need to build capacity in the long-term care workforce and facilities. To this end, the Economic Research Institute for ASEAN and East Asia (ERIA) prepared a report to address these issues and made recommendations for greater bilateral and regional cooperation and support to meet the challenges (Hayashi, 2019).

Under the current demographic situation, it is perhaps more important than ever now to develop new models of care in the health field, such as an integrative approach to healthcare services and delivery, which can more efficiently and effectively accommodate the healthcare needs of a growing ageing population. To achieve this purpose, many countries have increasingly turned to ICTs, which provide opportunities and serve as enabling tools to solve their healthcare problems. Indeed, ICTs have become a critical catalyst for improving healthcare efficiencies and productivity. The successful transition towards healthcare digitalisation is, however, a challenging process that requires good vision, strategic planning, policies, and governance, which we discuss in the last section.

Healthcare Digitalisation as an Enabler

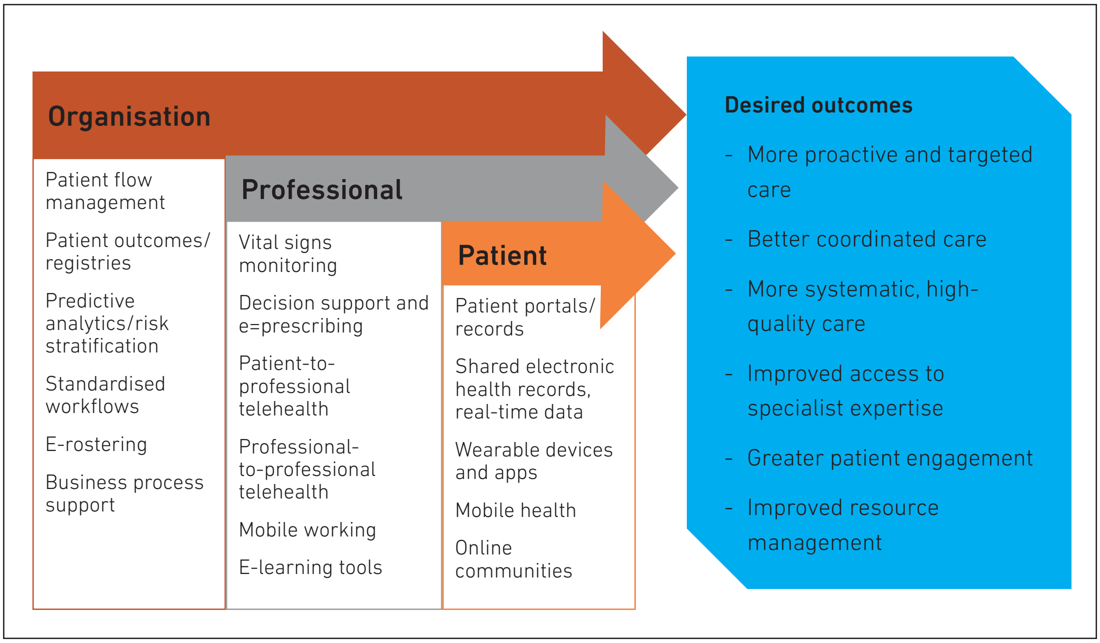
ICT for health, also referred to as 'eHealth', represents one of the key instruments for healthcare delivery and public health today. Healthcare digitalisation plays an important role towards achieving universal health coverage for sustainable development. As defined by the World Health Organization (WHO, 2016), universal health coverage means all people and communities can use the promotive, preventive, curative, rehabilitative and palliative health services they need, of sufficient quality to be effective, while also ensuring that the use of these services does not expose the user to financial hardship. In a nutshell, it is the triple concurrent objectives of (i) accessibility, (ii) affordability, and (iii) quality of care in healthcare delivery. Digital healthcare enables these three aspects and supports achieving universal health coverage, which is a target in meeting the goal to 'ensure healthy lives and promote well-being for all at all ages' (Goal 3, Target 8) in the Sustainable Development Goals adopted by the United Nations (UN) General Assembly in September 2015. The appropriate utilisation of digital tools in healthcare could thus provide opportunities for improving the accessibility, affordability, and quality of care, thereby contributing to sustainable development.

ICT comprises two interrelated aspects: (i) the information component, where new and innovative methods of data use (e.g. in gathering, processing, analysing, and integrating), enabled by technology, produce greater efficiencies in power and speed; and (ii) the communication component, where the growing widespread access to and use of low-cost internet and smartphone devices mitigate challenges in the delivery of healthcare services across distances and rising healthcare costs.

It has generally been acknowledged in the health community that we are at least a decade behind other industries in the use of ICT for healthcare, and are further behind in realising the productivity and value improvements that have been seen elsewhere as a result of ICT use. Nevertheless, the situation is changing. Since the 1990s, the initial approach in extracting productivity improvements followed that of other industries – one that is focused on improving transactions, removing duplication, increasing back-office efficiency, and streamlining certain processes. These are still important today and there is still more to do, particularly in newly developed and developing countries. From the 2000s onwards, some countries have progressively developed and trialled information technology (IT) systems for specific applications which, while useful and serve their function, are typically 'silos' and require better integration. More recent developments involve efforts in the integration of IT systems and using data-driven predictive analytics (e.g. artificial intelligence (AI)) to enable medical advancements in areas such as diagnostics, robotics, and genomics.

Over the span of a few short decades, a wide range of digital technologies has been developed to support health and medicine. A non-exhaustive list of ICT uses in healthcare includes electronic health records; telehealth; mobile health; decision support systems; chronic diseases management services; practice, patient, and clinical management systems; electronic medical services; health knowledge resources; distance learning for health professionals; and health information systems. Figure 15.1 shows some of their applications at the patient, healthcare professional, and organisation levels; and the desired outcomes.

Figure 15.1 Information and Communication Technology Uses in Healthcare and the Desired Outcomes



Source: Author's compilation

We briefly describe below a few salient examples that have potential for widespread adoption in today's context, particularly for newly developed and developing countries.

Telehealth

Telehealth, encompassing telemedicine and telecare, supports the provision of healthcare services at a distance, i.e. the individual and healthcare providers need not be in the same location. Telehealth enables the delivery of safe and quality care to individuals living in areas with limited access to services. Some countries have already adopted electronic store-and-forward services such as those that involve acquiring medical data (e.g. images) and transmission to a healthcare provider (e.g. doctor or medical specialist) for offline assessment and treatment recommendation (e.g. teleradiology and telepathology). The use of remote monitoring services also enables healthcare providers to monitor an individual's condition remotely, using technologies such as implanted devices and sensors with wireless or wired connections. In addition, digital interactive services enable real-time interaction between individuals and their healthcare providers through means such as mobile phones, video conferences, and other forms of online and remote communication. Classic examples are psychiatry and mental health services.

With the growth of smartphones use, a subcategory of telehealth has also emerged. Mobile health, commonly known as 'mHealth', refers to services and information provided through mobile technology such as smartphones and handheld computers. mHealth has emerged rapidly in developing countries as a result of the large penetration of mobile phones and the lack of other modern health infrastructure. The mobile devices can be used for real-time monitoring of an individual's health; diagnostic and treatment support, health advice, and medication compliance; health information for practitioners, researchers, and patients; and health education and awareness programmes. For older persons and those with special needs, telehealth services such as remote alerts (e.g. in domestic accidents such as falls) and remote monitoring (e.g. vital signs, blood glucose, and weight) may enable them to remain independent in their homes as well as increase their sense of connectivity with the broader community.

Decision Support Systems

Decision support systems (DSSs) assist healthcare providers in making diagnosis and treatment decisions. These systems combine an individual's current and historical health information with the healthcare provider's knowledge, to provide advice intended to result in better quality care and outcomes for the individual. For example, in the area of medication management, decision support tools draw on electronic knowledge sources such as clinical practice guidelines and knowledge bases, and apply this knowledge to local patient and clinical data through expert rules to guide medications decision-making. DSSs, when coupled with a comprehensive and accurate base of patient information, are able to identify potential drug interactions, dosing inaccuracies, and prescribing errors that could lead to serious adverse events. These technologies, which aid clinical decision-making and help clinicians to manage the exponential growth in medical knowledge and evidence, offer substantial opportunities to reduce variation and improve the quality of care. There is strong evidence that they can improve the quality of clinical decision-making (Jaspers et al., 2011) and some evidence that they can lower costs (Fillmore, Bray, and Kawamoto, 2013).

Practice, Patient, and Clinical Management Systems

Practice, patient, and clinical management systems refer to the computer systems that healthcare organisations use to manage the delivery of care to individuals. These systems provide the ability to capture, store, access, and share health information for patients during their care episode. They can also provide a broad range of healthcare management and delivery functions for a healthcare entity, such as diagnostics management, scheduling and resourcing management, clinical care management, and reporting. Practice, patient, and clinical management systems form one of the foundations required for collecting, recording, and sharing electronic information across a country's health sector.

The use of a range of digital technologies provides opportunities to improve healthcare services and delivery. Imison et al. (2016) discussed some of the benefits in detail, which are summarised as follows:

(a) **More proactive and targeted care.** Use of real-time patient monitoring and powerful analytics to deliver more proactive and targeted care.

(b) **Better coordinated care.** Reduce the costs and harms that come from poor communication and fragmented care by developing IT systems to integrate and coordinate care and support providers in collaborating more effectively.

(c) **More systematic,** high-quality care. Use of clinical information decision support and knowledge management tools, integrated into standardised workflows, to deliver more systematic, high-quality care.

(d) **Improved access to specialist expertise.** Use of telehealth to reduce costly referrals, avoid admissions and unnecessary appointments, and improve the ability of professionals to get things right the first time by providing access to specialist expertise and advice easily and in real time.

(e) **Greater patient engagement.** Reduce the transaction costs and rewrite the relationship with patients and carers by providing tools for patient engagement and self-management that allow more meaningful participation in care and more opportunities for self-service.

(f) **Improved resource management.** Adapt the tools used in other sectors for improved resource management to plan staff rosters and patient flow, match capacity to demand, and improve scheduling.

Notwithstanding the tremendous benefits that healthcare digitalisation offers, there are often large, though not insurmountable, challenges present. The obstacles in the successful development and application of ICT are usually multifaceted in nature and would likely require concerted efforts by multiple stakeholders who have the appropriate resources to overcome them. With opportunities for technology transfers, the challenges are not limited to the unavailability of technology (Ariani, Koesoema, and Soegijoko, 2017), but include a wide range of factors such as financial feasibility and funding; infrastructure, access, equity, and quality; knowledge, expertise, and research evidence; leadership and governance; interoperability and security issues; and sociocultural and technological environments.

Notably, we highlight the challenge of accessibility for some subgroups of the population, such as older persons. Digitalisation and the rapid use of ICT could marginalise some older persons who may be less savvy about technology or have less access to digital resources. For instance, recent national surveys conducted by ERIA in the Philippines (Ogena, 2019) and Viet Nam (Tran, Dang, and Vu, 2020) found that internet access and mobile phone ownership amongst older persons remained relatively low. Measures may need to be taken to provide better accessibility and learning support to older persons to narrow the digital divide.

Existing and potential challenges should be thoroughly considered at the onset of the conceptualisation and design stage and adequately addressed, for higher chances of successful implementation and adoption, and to minimise the risks of costly mistakes.

Development Strategy in Healthcare Digitalisation

At the core of developing a digitalised healthcare strategy, or any development strategy, is building strong capacities and capabilities in both hard and soft infrastructure. We offer some pertinent considerations towards achieving the positive outcomes of healthcare digitalisation. These considerations are drawn from our knowledge of and experience in the health sector, particularly and importantly, from insights gleaned in discussions with a range of stakeholders at multiple levels who are currently operating in an evolving digital healthcare ecosystem. We single out five key areas to take note of when developing a digital healthcare strategy.

1. The first and most fundamental aspect for successful healthcare digitalisation lies less in the technologies themselves but in people and new ways of thinking and doing. Technology is, after all, a means to an end, and not the end in itself, to augment productivity and achieve development and growth. Moreover, failures in technology

projects are more often than not a result of weak conceptualisation and poorly executed implementation plans rather than the technology itself. Therefore, in the first instance, it is critical that leaders and decision-makers, who are knowledgeable in both the clinical and technology thought-spheres, are able to envision and embrace new ways of working and reimagine current work processes. Alongside the digital transformation, leaders need to build a culture that is receptive to change and put in place a change management process. The success rate of technology adoption increases significantly when organisations and individuals are receptive to change and are adequately equipped with the necessary mindset, tools, skills, and expertise to use new technologies. To this end, many countries have developed comprehensive 'Smart Nation' plans to serve as a road map for broad-level digital transformation and change, not only for the health sector but also across all sectors.

2. Second, the technologies that have provided the greatest immediate benefits have been carefully designed to make people's jobs or patient interactions easier, with considerable investment in the design process. Where technological interventions have failed miserably, insufficient attention has been given to the design of the system or the technological interventions were simply layered on without careful consideration, on top of existing structures and work patterns, resulting in additional workload and frustrations for users. For example, poorly designed systems have led to significant increases in the time spent on data entry and multiple unhelpful alerts. This can be mitigated by system designs that automate data entry, such as direct feeds from equipment that monitors vital signs.

   For technology systems to meet the needs and solve the problems of the people who are going to use them, be they patients or professionals, a deep understanding of the work as well as the needs of the worker is required. Despite this, the worker is often simply a recipient of the end product and is not involved in the development of the systems' architecture or user interfaces. It would be much more fruitful to involve the end-user in the development process and collect feedback in the process for a product that is meant for their use. When systems meet clinical needs, they are much more likely to succeed.

   Increasingly, organisations also need to consider a balance between implementing an off-the-shelf package solution (which could be customised) and 'knitting together' existing clinical systems in their organisation. The combination of a core package solution with a small number of specialist clinical systems is emerging as the norm in top-performing digital hospitals.

3. Third, while healthcare digitalisation offers opportunities to generate and store massive data with relative ease in comparison to analogue medical and health records, the optimal usage of these data will be vastly limited without the capacity and capability for sophisticated data management and data analytics. Improving productivity requires extensive redesign of work processes; the use of predictive models to reduce variation, allocate resources, anticipate demand, and intervene early; and the ability to learn and adapt. None of these is achievable without data analytical tools and expertise available in real time for advanced support in planning, management, and improvement.

   Successful healthcare digitalisations have made significant investments in developing data analytics capacities to enable generating insights from the data collected within both clinical and non-clinical systems. Appropriate data mining, supported by sophisticated search tools and hyper-indexing, is used across all data systems simultaneously. Investing in and developing strong data analytics capacities and capabilities in a trained and skilled workforce can drive improvement in many areas, including operational and clinical processes as well as population health management and the optimisation of medical treatment.

4. Fourth, issues of interoperability and the safeguarding of shared data need to be taken into account from the start. Data sharing across multiple settings is essential to supporting coordinated care and realising the full benefits of digital technology in healthcare. However, up until more recently, there has generally been an inability to share and combine data between different IT systems. Whole health economy benefits can be realised if healthcare providers are able to share the same instance of clinical information systems that comply with national data and interoperability standards.

   The sharing of data would necessarily require robust security protection tools and data governance in the form of privacy legislation and enforcement policies, particularly in the face of growing threats from cyberattacks and data leaks. Data governance mechanisms must be put in place to give patients the confidence to share their data across care settings, and to assure healthcare professionals as they move away from paper-based systems. Actions are required at the national and local levels to help organisations hold and share data safely and to protect sensitive medical and health records.

5. Finally, it is a truism that technology does not stand still and will almost certainly become obsolete with the passage of time. Therefore, continuous iterations and 'upgrading' are needed alongside developing new innovations in both processes and products. Conceptualising and implementing digital technologies are an ongoing transformational change. Even with careful designs, a number of iterations may be needed in the design of systems before a tipping point is reached where all the investments pay off. The fact that digital technologies are in a constant state of evolution and adaptation is a double-edged sword, as it also allows for their full potential to be realised.

   Some important developments for applications in healthcare include natural language processing to allow free text to be structured and analysed; the growth of AI, decision support, and cognitive computing, which offer opportunities for more automation and improved decision-making; the increasing intelligence and reach of devices supported by the internet of things (IoT) and sensor technology, which will open up new possibilities for better resource management, patient self-care, improved prevention, and remote monitoring; and distributed ledger technology (DLT), which may revolutionise the way in which we manage and share data. DLT uses blockchain technology, which provides a means of creating a secure digital identity and allowing multiple users to work from a shared central database, potentially alleviating problems with interoperability.

Conclusion

Countries at varying stages of socio-economic development will, undoubtedly, have different rates of progression towards healthcare digitalisation. Extending the discussion in chapter 1, the digital progressions will have to adopt a step-by-step tiered approach. For instance, at the most basic first tier, developing countries could simply convert analogue medical and health records to digital data, i.e. the digitisation of data. The middle tiers of progression offer possibilities of improved healthcare vis-à-vis better health monitoring, healthcare services delivery, and holistic integrated healthcare, supported by the interoperability of digital systems. At higher tiers, developed countries could harness sophisticated data-driven predictive analytics for the advancement of breakthroughs in medicine, such as genomics medicine.

In the healthcare industry, it would be rather challenging to skip tiers. There is also a common misconception that countries can leapfrog to more advanced digital technologies. However, without a parallel focus on creating an enabling environment, innovations in ICT will remain isolated and have only a limited impact on health. A national digital healthcare plan in this context should focus on making the case for digitalisation, creating awareness and establishing a strong foundation for investment, providing workforce education and skills training, and adopting digitalisation in priority systems and services.

Clearly, the successful digitalisation of a country's healthcare is a mammoth task – one that cannot be achieved alone – and active collaboration is crucial. In this regard, public–private partnerships, coupled with academic research and development, are often one of the cornerstones of many digital solutions, with digital technology providers spearheading technological innovation within a national enabling policy and technological infrastructure. Such public–private sector collaborations extend to sustainable funding for ICT investments both within and beyond national borders. ASEAN and East Asian policymakers and ICT solution stakeholders can leverage each other's expertise, and bilateral and regional cooperation remain critical for the building of consensus on policies, sharing of knowledge, and facilitating better use of resources.

To conclude, the road to healthcare digitalisation is a long, arduous, and relatively expensive endeavour at all development stages, one that is not without pitfalls and challenges along the journey. Nonetheless, through active collaboration with partners, careful design, and systematic implementation, there is high potential to reap efficiencies and to achieve the triple aim of universal healthcare services delivery – accessible, affordable, and high-quality care.

References

Ariani, A., A.P. Koesoema, and S. Soegijoko (2017), 'Innovative Healthcare Applications of ICT for Developing Countries', in H. Qudrat-Ullah and P. Tsasis (eds.) *Innovative Healthcare Systems for the 21st Century*. Cham: Springer, pp.15–70.

ERIA (2015), *The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*. Jakarta: Economic Research Institute for ASEAN and East Asia.

Fillmore, C.L., B.E. Bray, and K. Kawamoto (2013), 'Systematic Review of Clinical Decision Support Interventions with Potential for Inpatient Cost Reduction', *BMC Medical Informatics Decision Making*, 13(135).

Hayashi, R., ed. (2019), 'Demand and Supply of Long-Term Care for Older Persons in Asia'. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/media/RPR_FY2018_08.pdf (accessed 6 June 2020).

Imison C., S. Castle-Clarke, R. Watson, and N. Edwards (2016), *Delivering the Benefits of Digital Health Care.* London: Nuffield Trust. https://www.nuffieldtrust.org.uk/files/2017-01/delivering-the-benefits-of-digital-technology-web-final.pdf (accessed 6 June 2020).

Jaspers, M.W.M., M. Smeulers, H. Vermeulen, and L.W. Peute (2011), 'Effects of Clinical Decision-Support Systems on Practitioner Performance and Patient Outcomes: A Synthesis of High-Quality Systematic Review Findings', *Journal of the American Medical Informatics Association*, 18(3), pp.327–34.

Ogena, M.B. (2019), 'Activities, Social Isolation, and Information Technology', in G.T. Cruz, C.J.P. Cruz, and Y. Saito (eds.) *Ageing and Health in the Philippines.* Jakarta: Economic Research Institute for ASEAN and East Asia, pp.129–148. https://www.eria.org/uploads/media/Books/2019-Dec-ERIA-Ageing-And-Health-In-The-Philippines.pdf (accessed 6 June 2020).

Qudrat-Ullah, H. and P. Tsasis (2017), *Innovative Healthcare Systems for the 21st Century*. Cham: Springer Press.

Tran, M.T., L.T. Dang and N.C. Vu (2020), 'Activities, Social Isolation, and Information Technology', in N.C. Vu , M.T. Tran, L.T. Dang, C.-L. Chei, and Y. Saito (eds.) *Ageing and Health in Viet Nam*. Jakarta: Economic Research Institute for ASEAN and East Asia, pp.106–124. https://www.eria.org/uploads/media/Books/2020-Ageing-and-Health-VietNam/Ageing-and-Health-in-Viet-Nam-new.pdf (assessed 28 December 2020)

UN (2015), *Transforming Our World: The 2030 Agenda for Sustainable Development*, the 17th Session of the General Assembly, 25 September 2015. New York: United Nations.

UN (2017), *World Population Prospects: The 2017 Revision*, DVD edition. New York: United Nations Department of Economic and Social Affairs, Population Division.

Wachter, R. (2015), *The Digital Doctor: Hope, Hype, and Harm at the Dawn of Medicine's Computer Age*. New York: McGraw-Hill Education.

WHO (2010), *The World Health Report: Health Systems Financing: The Path to Universal Coverage*. Geneva: World Health Organization.

WHO (2016), *Global Diffusion of eHealth: Making Universal Health Coverage Achievable*, Report of the Third Global Survey on eHealth. Geneva: World Health Organization.

Chapter 16

Food and Agriculture

Masanori Kozono
Policy Fellow, ERIA

Introduction

This chapter focuses on the food and agriculture sector in the context of value-adding strategy through innovative technologies. It discusses the strategy of enhancing the resilience of the food value chain and agricultural productivity with digital and other advanced technologies. It also addresses the global focus on a sustainable food system.

The contribution of the agriculture sector to the national economies of Southeast and East Asian countries has gradually declined with economic growth. The contribution of agriculture, forestry, and fisheries to gross domestic product (GDP) is not large – even in the least developed countries (LDCs) of the region (Table 16.1; Figure 16.1). However, in terms of jobs, the ratio of agricultural employment to total employment cannot be ignored (Table 16.2; Figure 16.2). This is particularly evident in Cambodia, the Lao People's Democratic Republic (Lao PDR), Myanmar, and Viet Nam (the CLMV countries). Furthermore, the rural population in the Association of Southeast Asian Nations (ASEAN) Member States is still higher than the urban population. Therefore, for ASEAN Member States (AMS), especially CLMV countries, improving the productivity of the agriculture sector has large potential to increase income levels and decrease the disparity between urban and rural areas.

Table 16.1 Agriculture, Forestry, and Fishing Value Added
(% of GDP, 2020)

Brunei Darus-salam	Cam-bodia	Indo-nesia	Lao PDR	Malay-sia	Myan-mar	Philip-pines	Singa-pore	Thai-land	Viet Nam	China	Japan (2019)	Repub-lic of Korea
1.2	22.4	13.7	16.2	8.2	22.0	10.2	0.0	8.6	14.9	7.7	1.0	1.8

GDP = gross domestic product.

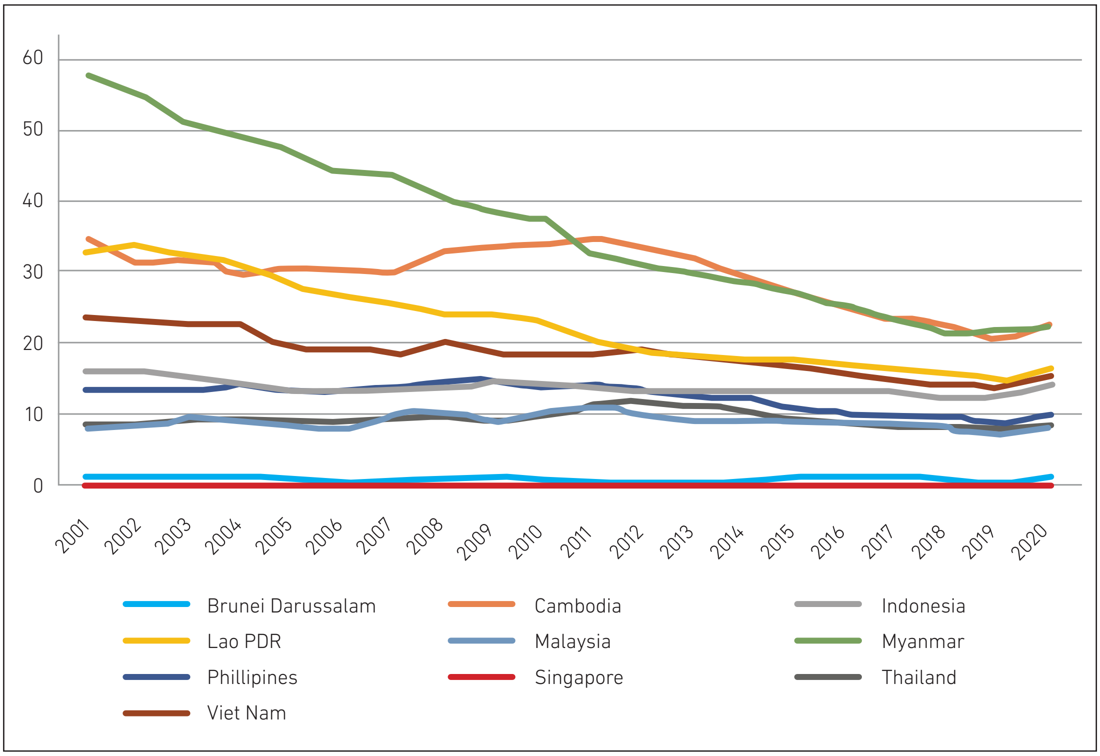
Source: World Bank (n.d.), Agriculture, Forestry, and Fishing, Value Added (% of GDP). https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?name_desc=false (accessed 14 January 2022).

Table 16.2 Employment in Agriculture
(% of total employment, 2019)

Brunei Darus-salam	Cam-bodia	Indo-nesia	Lao PDR	Malay-sia	Myan-mar	Philip-pines	Singa-pore	Thai-land	Viet Nam	China	Japan (2019)	Repub-lic of Korea
2.0	34.5	28.5	61.4	10.3	48.8	22.9	0.0	31.4	37.2	25.3	3.4	5.1

Source: World Bank (n.d.), Employment in Agriculture (% of total employment) (modelled ILO estimate). https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?name_desc=false (accessed 14 January 2022).

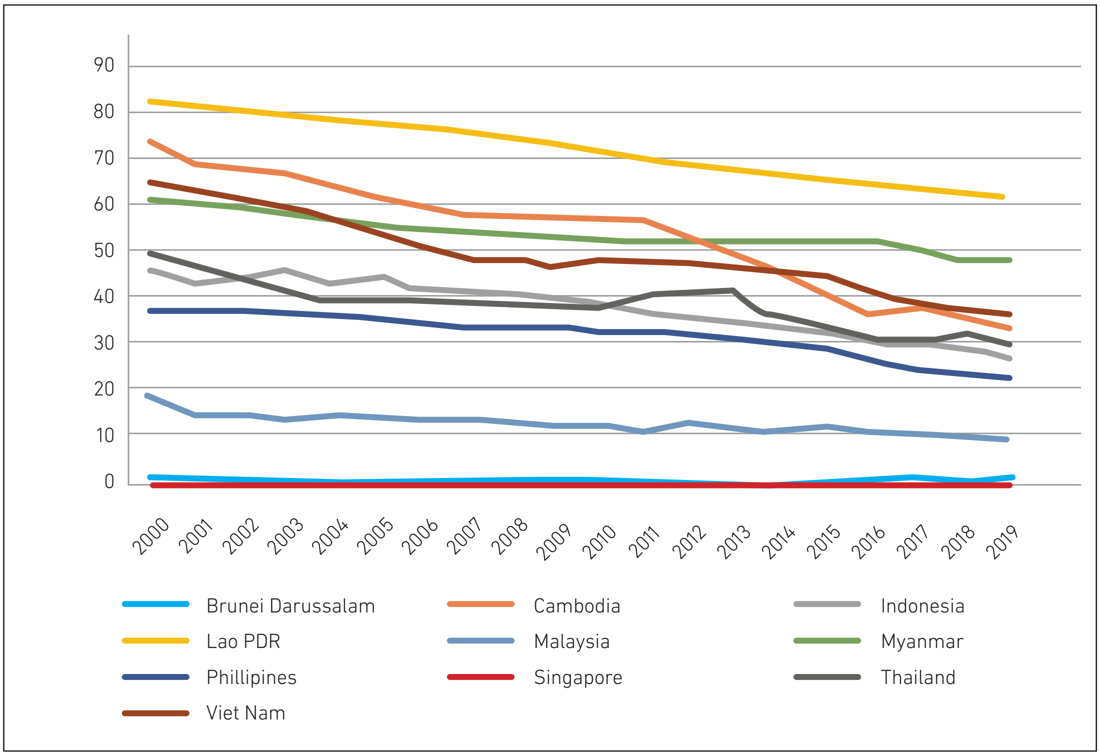
Figure 16.1 **Transition of Agriculture, Forestry, and Fishing, Value Added**
(% of GDP)



GDP = gross domestic product.

Source: World Bank (n.d.), Agriculture, Forestry, and Fishing, Value Added (% of GDP). https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?name_desc=false (accessed 14 January 2022).

Figure 16.2 Transition of Employment in Agriculture
(% of total employment)



Source: World Bank (n.d.), Employment in Agriculture (% of total employment) (modelled ILO estimate). https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?name_desc=false (accessed 14 January 2022).

The food and agriculture sector is facing various challenges. Steady population growth, which is projected to increase from 7.8 billion in 2020 to more than 9.8 billion in 2050 globally and from 4.6 billion to more than 5.3 billion in Asia during the same period (United Nations Department of Economic and Social Affairs, 2022) – indicates a continuous increase in food demand. To meet this growth, a rapid increase in food supply is a priority issue. However, it is difficult to increase productive agricultural land area rapidly, so acceleration of agricultural productivity with innovation is urgently needed (Table 16.3).

Table16.3 Agricultural Land Area
(1,000 ha)

Item		2010	2019	Average annual growth rate (%)
World	Agricultural land	4,795,848	4,752,111	–0.10
	Arable land	1,361,101	1,383,346	0.18
East Asia	Agricultural land	652,173	650,547	–0.03
	Arable land	130,795	128,571	–0.19
Southeast Asia	Agricultural land	127,497	138,961	0.96
	Arable land	68,117	72,886	0.75

ha = hectare.

Source: FAO (n.d.), FAOSTAT, Land Use. https://www.fao.org/faostat/en/#data/RL (accessed 21 September 2021).

Several emerging issues also have adverse impacts on food security. Natural disasters and damage – such as droughts, floods, and outbreaks of pest and plant disease caused by climate change – increase in frequency and scale every year globally. These disasters directly affect agricultural production. In addition, the coronavirus disease (COVID-19) pandemic has disrupted the food supply chain and affected agricultural production globally and regionally. Tackling these challenges requires enhancement of resilient food and agricultural supply chains with innovative technologies, ranging from production, processing, and distribution to consumption.

To enhance the resilience of food supply chains and ensure food security, various research studies and organisations recommend the application of digital technologies in the food and agriculture sector. Further, the development of a modern cold chain that can maintain food quality, secure food safety, and reduce post-harvest loss and food loss is an effective means to improve the food and agricultural supply chain – especially in Southeast Asia, which is mostly tropical.

Regional Food Security

Although the term 'food security' is used in various contexts, the most accepted definition is: 'Food security exists when all people, at all times, have physical, [social] and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life' (FAO, 2008: 1). This definition was agreed at the 1996 World Food Summit, and the term 'social' was added in 2002. The definition identifies the four main dimensions of food security: (i) the physical **availability** of food, (ii) economic and physical **access** to food, (iii) food **utilisation**, and (iv) the **stability** of the other three dimensions over time (FAO, 2008). When we assess the status of food security in any country and/or region, these dimensions need to be considered.

Status of Regional Food Security

According to two notable food security indicators – the prevalence of undernourishment[1] and the prevalence of moderate or severe food insecurity[2] in the total population – undernourishment has been improved steadily and continuously in these two decades. However, food security has deteriorated in many Southeast and East Asian countries in line with global trends, as a result of COVID-19 (Table 16.4; Figure 16.3).

Table 16.4 Indicators Related to Food Security

Countries/ Regions	Prevalence of undernourishment in the total population (%)			Prevalence of moderate or severe food insecurity in the total population (%)		
	2014–2016	2017–2019	2018–2020	2014–2016	2017–2019	2018–2020
Brunei Darussalam	<2.5	<2.5	<2.5	n.a	n.a	n.a
Cambodia	8.9	6.8	6.2	48.9	44.1	44.8
Indonesia	7.0	6.4	6.5	6.0	7.0	6.2
Lao PDR	6.7	5.4	5.3	n.a	n.a	29.4
Malaysia	3.8	3.2	3.2	17.4	15.1	18.7

[1] **Prevalence of undernourishment:** This indicator is an estimate of the proportion of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life. It is expressed as a percentage (Global SDG Indicator Platform, n.d.). This indicator will measure progress towards the Sustainable Development Goal (SDG) Target 2.1. (By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious, and sufficient food all year round.)

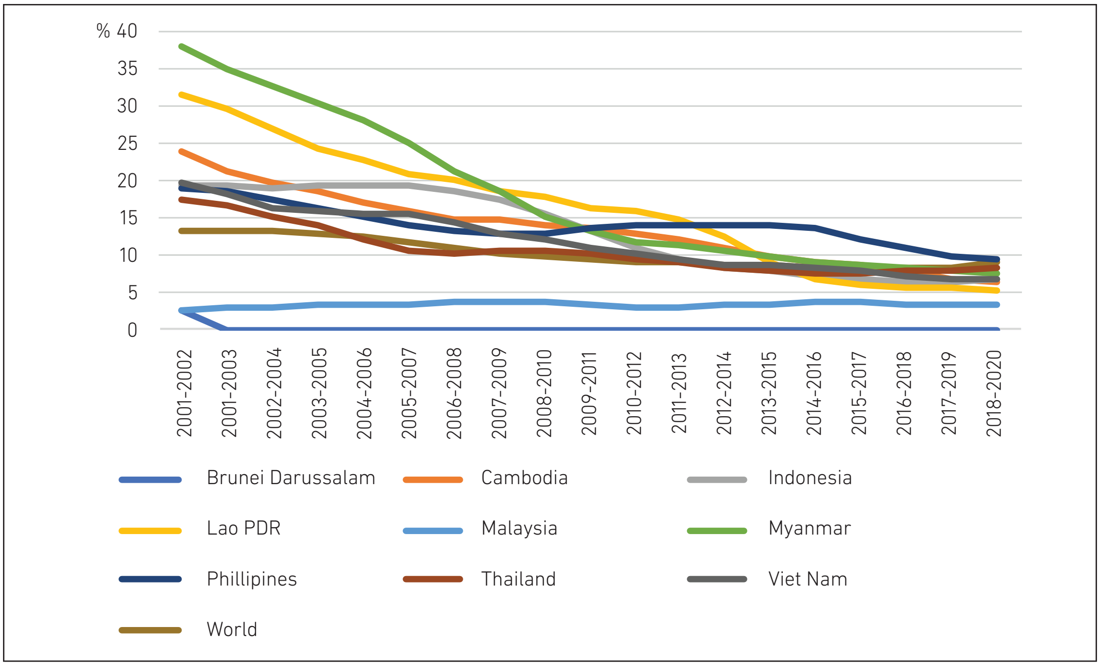
[2] **Prevalence of moderate or severe food insecurity in the total population:** This indicator provides internationally comparable estimates of the proportion of the population facing moderate or severe difficulties in accessing food. The Food Insecurity Experience Scale (FIES) produces a measure of the severity of food insecurity experienced by individuals or households, based on direct interviews. The indicator will measure progress towards SDG Target 2.1 (FAO, 2021a). Data are available from 2014.

Countries/ Regions	Prevalence of undernourishment in the total population (%)			Prevalence of moderate or severe food insecurity in the total population (%)		
	2014–2016	2017–2019	2018–2020	2014–2016	2017–2019	2018–2020
Myanmar	8.9	7.8	7.6	n.a	n.a	22.2
Philippines	13.3	9.7	9.4	41.2	41.2	42.7
Singapore	n.a	n.a	n.a	2.8	4.7	4.5
Thailand	7.3	7.9	8.2	15.1	26.4	29.8
Viet Nam	8.1	6.8	6.7	6.3	6.2	6.5
China	<2.5	<2.5	<2.5	n.a	n.a	n.a
Japan	<2.5	<2.5	<2.5	2.6	3.2	3.4
Republic of Korea	<2.5	<2.5	<2.5	4.8	5.2	5.1
World	8.3	8.3	8.9	23.0	25.8	27.6

n.a. = not applicable.

Source: FAO (n.d.), FAOSTAT, Suite of Food Security Indicators. https://www.fao.org/faostat/en/#data/FS (accessed 21 September 2021).

Figure 16.3 Prevalence of Undernourishment in the Total Population



Source: FAO (n.d.), FAOSTAT, Suite of Food Security Indicators. https://www.fao.org/faostat/en/#data/FS (accessed 21 September 2021).

Regional Initiative for Ensuring Food Security

To address the food security issues, the ASEAN Ministers of Agriculture and Forestry adopted the ASEAN Integrated Food Security (AIFS) Framework and Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) 2021–2025 in October 2020, as a successor to the 2015–2020 AIFS Framework and SPA-FS. The AIFS framework is a regional umbrella for initiatives related to food security, and the goal is to ensure long-term food security and improve the livelihoods of farmers in the ASEAN region (Islam and Kieu, 2020). In this framework, two key mechanisms are stressed: (i) the ASEAN Plus Three Emergency Rice Reserve (APTERR) and (ii) the ASEAN Food Security Information System (AFSIS).

The APTERR aims to strengthen food security, alleviate poverty, and eradicate malnourishment amongst its members – including the AMS plus China, Japan, and the Republic of Korea – without distorting normal trade. Under the APTERR, the rice reserve is available for consumption through a three-tier programme. During 2020–2021, the tier three programme, designed for acute emergencies and other humanitarian responses to food insecurity, distributed 5,029 metric tons of rice contributed by Japan and the Republic of Korea to address emergencies including natural calamities and the COVID-19 pandemic in Cambodia, Myanmar, and the Philippines (APTERR, n.d.). Since its establishment as a permanent mechanism in 2013, following its preparatory stage and the East Asia Emergency Rice Reserve pilot project, APTERR has been contributing to regional stability in terms of food security. In contrast, AFSIS started operations in 2003 and has been implementing projects to strengthen food security in the region through the systematic collection, analysis, and dissemination of data and information related to food security. AFSIS also publishes the ASEAN Agricultural Commodity Outlook and Early Warning Information reports.

APTERR and AFSIS have been contributing to ensuring regional food security since their establishment. To help boost the potential of these mechanisms, APTERR could consider expanding the coverage of the target commodity (rice) to other crop commodities that are important for regional food security – such as maize, soybean, sugar, and cassava. AFSIS could be transformed into a permanent mechanism like the APTERR, to provide more stable operations.

Support from Development Organisations

Apart from regional initiatives, support from development partners has played an important role in ensuring national food security in LDCs through various projects. For example, in Cambodia, which is in a relatively high food insecurity situation, different international development organisations – such as the World Bank, Asian Development Bank (ADB), International Fund for Agricultural Development, Agence Française de Développement, Japan International Cooperation Agency, and Korea International Cooperation Agency – are implementing projects in the fields of agriculture, natural resources, and rural development. These include interventions for the development/improvement of the agricultural value chain, inclusive marketing for smallholders, water resources management, and climate-resilient agriculture (ADB, 2021). These projects contribute significantly to enhancing national food security by reducing poverty, improving rural livelihoods, raising farm productivity, and increasing smallholders' income.

Utilisation of Digital Technologies in the Food and Agriculture Sector

Digital transformation has penetrated the food and agriculture sector in recent years. Digital innovations and technologies are expected to be part of the solution for the constraints and challenges facing the global agriculture sector. Digitalisation of the food and agriculture sector has the potential to deliver not only economic benefits through increased agricultural productivity, cost efficiency, and market opportunities, but also social and cultural benefits through increased communication in an inclusive manner as well as environmental benefits through optimised resource utilisation (Trendov, Varas, and Zeng, 2019). Although the potential benefits of digitalising the agriculture sector are convincing, we need to pay attention to challenges that often be observed in the agriculture sector and rural areas, such as the gap in basic conditions for digital transformation including infrastructure and connectivity (e.g. internet access, mobile network coverage, and electricity supply); digital literacy of rural workers; and the institutional support system. Along with issues regarding the digital divide, the gap in data collection ability is a challenge to be addressed.

Developed countries prepare and implement national or regional strategies and/or government initiatives for enhancing the utilisation of digital technology in the food and agriculture sector. For example, European Union (EU) member states signed a declaration on 'A smart and sustainable digital future for European agriculture and rural areas' in 2019, which stresses the potential of digital technologies to help tackle important and urgent economic, social, climate, and environmental challenges facing the EU's agri-food sector and rural areas. In Japan, the Ministry of Agriculture, Forestry and Fisheries is implementing a package of measures to promote digital agriculture or 'smart agriculture' that consists of (i) demonstration, analysis, and dissemination of smart agriculture (e.g. demonstration site of smart agriculture); (ii) creation and dissemination of new support services to farmers; (iii) creation of an enabling environment (e.g. agricultural data collaboration platform); (iv) provision of education on smart agriculture; and (v) overseas promotion (e.g. collaborative projects and technical assistance for developing countries).

Status of Digital Technology Use in ASEAN Agriculture

In AMS, the food and agriculture sector has been active in digital innovation for the past several years, but in a differentiated way. In the past two decades, global advances in precision agriculture, remote sensing, robots, farm management information systems, and computer-aided decision support systems have paved the way for a broad digital transformation in farming in selected countries and some parts of the food value chain. Recent developments – such as the internet of things, big data, blockchain, drones, and artificial intelligence – allow for the integration of isolated lines of development into smart, connected agricultural production systems and resilient food value chains.

The Organisation for Economic Co-operation and Development (OECD, 2019) divided the existing digital technologies in relation to data in food and agriculture into five purposes and 12 categories (Table 16.5).

Table 16.5 Uses of Digital Technologies in the Food and Agriculture Sector

Technology purpose	Category	Sub-category (example)
Data collection technologies	Remote sensing	Satellite-mounted data acquisition/monitoring systems, drone-mounted data acquisition/ monitoring system, etc.
	In situ sensing	Water quality sensors, air quality sensors, in situ meteorological sensors, crop monitors, livestock monitors, data from precision agricultural machinery, etc.
	Crowdsourcing data collection	'Serious games' for gathering agri-environmental data, etc.
	Online surveys/ censuses	Data collection portals (e.g. online census)
	Financial/market data collection	Retail scanner data, business software for recording financial or market information (e.g. database entry systems)
Data analysis technologies	GIS-based and sensor-based analytical tools	Land use–land cover mapping, soil mapping, software (e.g. programs, apps) for translating sensor and other farm data into actionable information, software for automating agricultural machinery which uses sensor or other farm data as input, software for measuring and grading agricultural outputs, etc.
	Crowdsourcing data analysis	Crowdsourcing applications for data sorting/ labelling
	Deep learning/AI	Data cleaning algorithms, big data analysis algorithms, machine learning, predictive analytics
Data storage technologies	Secure and accessible data storage	Cloud storage, confidential computing, virtual data centres
Data management technologies	Data management technologies	Distributed ledger technologies (e.g. blockchain), interoperability programs and apps
Data transfer and sharing; digital communications; trading, payment and service delivery platform	Digital communication technologies	Social media, web-based video conferencing, machine-assisted communication (e.g. chatbots), etc.
	Online platforms - property right, payment, services, and market	Online property rights and permits registries, online trading platforms, online payment platforms, service delivery platforms, etc.

AI = artificial intelligence, GIS = geographic information system.

Source: OECD (2019), modified by author.

These digital technologies have not yet been fully utilised in AMS, and are expected to help the food and agriculture sector in ASEAN to evolve in a data-driven, intelligent, agile, and interconnected system of systems. In the Fourth Industrial Revolution that is reaching ASEAN, the operations of each agricultural process will have the potential to be automatically integrated in the regional food chain.

According to a survey conducted in 2021 by the Economic Research Institute for ASEAN and East Asia (ERIA) through its research network, the baseline situation of digital technology utilisation in the food and agriculture sector in ASEAN is as follows.

Potential for digitalised food and agricultural production:

- Lack of knowledge and skills of users
- Limited internet access for some farmers in rural areas
- High start-up costs for the procurement of digital equipment
- High maintenance and data analysis costs
- Need for exploring the possibility of smart farming in various subsectors (the utilisation of digital technology currently concentrates mostly on crops and some aquaculture application)

Potential for digitalised food supply chain and finance:

- Mostly ad hoc approaches to digital marketing of products
- Limited resources to comply with traceability requirement
- Need for training on maintaining field records
- Need for harmonised standards for traceability
- Need to assure consumers of the origin and quality of the products
- Need to prevent commercial fraud in meeting the needs of domestic and international consumers

Thus, there are many challenges and opportunities in digital transformation in the ASEAN food and agriculture sector.

Until 2021, ASEAN did not have a consolidated regional strategy for the utilisation of digital technologies in the food and agriculture sector that could enhance farm productivity and improve supply chain resilience at the scale required. ASEAN's Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Forestry, 2016–2025 serves as the regional strategic plan for the food and agriculture sector. It clearly states the priority areas of cooperation, strategic thrusts, and action programmes. However, it only mentions information and communication technology (ICT) as a method of extension and dissemination of successful technologies, and does not describe the utilisation of digital technologies in the food and agriculture sector comprehensively. The ASEAN Comprehensive Recovery Framework (ACRF) – the consolidated exit strategy from

COVID-19 agreed in 2020 – prioritises accelerating inclusive digital transformation as one of the five main strategies, but does not focus on the utilisation of digital technologies in the food and agriculture sector. However, the implementation plan of the ACRF mentions the need to develop ASEAN guidelines on the utilisation of digital technologies for the ASEAN food and agriculture sector, to be adopted in 2021. Based on this situation, ASEAN started paying attention to the development of regional guidelines on promoting the utilisation of digital technologies in the food and agriculture sector.

ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Sector

In response to the need to formulate regional guidelines on the utilisation of digital technologies in the food and agriculture sector, based on evidence-based information and regional consultation, related ASEAN sectoral working groups (e.g. the ASEAN Technical Working Group on Agricultural Research and Development) discussed the actual and potential status of digital agriculture in ASEAN as well as the contents of the guidelines, with support from the ASEAN Secretariat and relevant institutions including ERIA. Several regional workshops were organised in 2021 for AMS to identify and consider good practices and potential technologies as well as government initiatives, with the participation of resource persons from academia, government, and the private sector in Asia and other regions. As the outcome of a series of discussions, the draft ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Sector were prepared, and later endorsed at the 43rd Meeting of the ASEAN Ministers of Agriculture and Forestry on 27 October 2021.

The guidelines aim to provide guidance not only for ASEAN governments but also for various stakeholders in the food and agricultural value chain – including producers and technology users (e.g. farmers, fishers, and other producers); agribusiness enterprises and key players in the agri-tech industry; financial and lending institutions; academic and research institutions; and civil society. An outline of the guidelines is in Figure 16.4.

The ASEAN guidelines are comprehensive and cover various aspects such as the use of technologies, the enabling environment, and capacity development.

Figure 16.4 Outline of the ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Sector

1	Background
2	Objective and orientation
3	Scope and definitions
4	Accelerating the transformation of the ASEAN food and agriculture sector through digital technologies and innovations and its challenges
5	ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Sector
	Guideline 1: Contribute to food security, food safety, and nutrition by improving the value chains (production, post-production, market access/linkages, and value addition)
	Guideline 2: Support equitable, sustainable, and inclusive economic development in the food and agriculture sector; and ensure much-needed investment in infrastructure and related support services (e.g. digital banking, accounting, and investment for access to loans, microfinance, and reporting)
	Guideline 3: Support the generation and diffusion of appropriate digital innovations for resource-efficient, sustainable, and safe food and agriculture sector
	Guideline 4: Foster capacity building, engagement, and empowerment – especially for the youth, women, and marginalised groups
	Guideline 5: Improve the resilience of the food and agriculture sector during disruptions caused by unprecedented events and shocks
	Guideline 6: Strengthen regional partnerships/approaches for digital innovations in the food and agriculture sector
6	Roles and responsibilities of stakeholders

ASEAN = Association of Southeast Asian Nations.

Source: Author's compilation.

As a next step, each AMS should prepare national strategies on the utilisation of digital technologies in the food and agriculture sector and/or a road map for digitalising agriculture, in line with the domestic agricultural situation and strategy of each country, referring to the agreed regional guidelines. There is no one-size-fits-all solution leading to the digital transformation of the food and agriculture sector, and each country has its own priorities.

Cold Chain Development

A cold chain is an indispensable element to consider in the development of a global as well as a domestic food supply chain, especially for perishable products such as higher value processed, livestock, dairy, and aquatic products. Although the cold chain is defined in various ways in the literature, it can be described as a type of supply chain that involves the storage and transportation of temperature-sensitive goods. Cold chains can be classified into three main fields: (i) food cold chains; (ii) pharmaceutical cold chains; and (iii) other cold chains (e.g. cold chains for semiconductors). This section focuses on the food cold chain, so references to 'cold chain' are to the food cold chain. The cold chain involves uninterrupted transportation and storage activities within a low and controlled temperature range to extend or maintain fresh food products (Ali, Nagalingam, and Gurd, 2018). In other words, a cold chain requires seamless connectivity with controlled temperature from production to consumption. To realise the connectivity, cold storage and refrigerated transport are indispensable infrastructure.

Cold Chain in ASEAN

A cold chain is a significant element in the improvement of food value chains and the realisation of higher value addition of agricultural products, especially in AMS as they mostly have tropical climates. In the ASEAN region, various factors – including increased income caused by economic growth, an increase in the number of middle-income households, lifestyle changes, and the rise of modern supermarkets – have contributed to the rapid expansion of demand for cold chains. Data from a recent study indicated that demand for cold chains has steadily increased in some AMS. For example, frozen food consumption in Indonesia rose from 5,082,000 tons in 2014 to 6,631,000 tons in 2018, an annual average increase of more than 6%. In the Lao PDR, the import of frozen, chilled, and fresh products that require temperature control increased from $3.14 billion in 2015 to $3.84 billion in 2017 (Kusano, 2019). In addition, the COVID-19 pandemic has accelerated the growth of online grocery and e-commerce, which contributed to the growth in demand for cold chains.

However, in most AMS, the cold chain system is underdeveloped or not functioning well due to various causes. A case study conducted in Viet Nam pointed out several obstacles to cold chain implementation, including deficient professional skills, lack of quality and safety control measures, poor infrastructure, high installation and operation costs, inadequate education and training for farmers, deficient standardisation, and lack of government support for local businesses (Gligor, Tan, and Nguyen, 2018). An ADB report on Cambodia's agriculture and rural development also pointed out that the country does not have a reliable cold chain system to ensure the proper handling and safe storage and distribution of perishable agricultural and food products (ADB, 2021). This status of cold chains is one of the bottlenecks for the development of a resilient food supply chain and the realisation of higher value addition of agricultural products.

Cold Chain Constraints, Challenges, and Solutions in ASEAN

A cold chain study conducted in 2020/2021 by ERIA identified several constraints and challenges for the development of a cold chain in ASEAN. Typical issues are as follows.

Cold chain infrastructure and tools related issues

(i) **High investment costs to enter cold chain business:** The initial investment cost for a cold chain business is relatively high because cold storage needs to be constructed as an essential facility and requires refrigerated trucks. Most farmers and agribusiness operators are categorised as micro, small, and medium-sized businesses. It is very difficult for such businesses to prepare essential facilities and equipment for cold chain businesses by themselves.

(ii) **Lack of appropriate equipment for temperature measurement and records in storage and transportation across the supply chain:** Consistent temperature control along the cold chain and traceability require the installation of equipment for continuous temperature measurement and recording. However, many cold chains do not have such equipment installed.

(iii) **Lack of stable and affordable power supply:** A modern cold chain needs stable electricity supply to keep products within the range of designated temperatures. Perishable food products lose their value if the temperature in the cold storage rises, even during a short power outage.

Institution, strategy, standards, and regulation

(i) **Lack of specialised government institution or organisation focusing on cold chain development:** A cold chain is a form of food value chain that involves a wide range of activities, including the production of raw materials, processing, distribution, and consumption. Thus, the development of cold chains is a kind of cross-cutting challenge, as it involves various stakeholders and activities. Typically, several ministries – such as the Ministry of Agriculture, the Ministry of Transportation, the Ministry of Trade, and other ministries and agencies – are engaged in cold chain development. Therefore, communication and coordination amongst ministries and agencies are very important for cold chain development. However, ministries and agencies often work individually, with poor coordination or lack thereof, creating institutional constraints.

(ii) **Lack of clear strategies for cold chain development across the chain:** Integrated national strategies for cold chain development are rarely in place, perhaps because of the diversity of ministries and agencies involved in this area. A cold chain development strategy should be formulated in line with higher-level policies such as national development plans and food security policies.

(iii) **Lack of standards and regulations by product:** As cold chain handling differs by product (e.g. fruit and vegetables, livestock products, and marine products), detailed product-specific handling standards are required. At present, few countries have such standards or guidance.

Human resources

(i) **Lack of skilled personnel in cold chain operations:** When temperature control in cold storage and refrigerated trucks is not managed properly, the quality of food products deteriorates and can affect consumers' health. Operators engaged in cold chain operations often have insufficient knowledge and skills in terms of cold chain handling.

(ii) **Lack of awareness and knowledge of cold chain impacts on product quality and value:** Operators who are directly involved in cold chain operations – such as farmers, cold storage managers, refrigerated truck drivers, and retailers – frequently do not have sufficient knowledge of cold chain impacts on food quality and safety. As a result, the continuity of the cold chain is often broken through inappropriate handling of cold chain products that require careful temperature control. In addition, not all cold chain stakeholders correctly understand the benefits of cold chains, such as reducing food loss, maintaining quality, and ensuring food safety. It is necessary to raise awareness amongst consumers about the value of cold chain products so that they may become more willing to pay a higher price for cold chain products.

To address these issues, the following measures are recommended to be considered by governments and related stakeholders:

(i) For infrastructure-related issues (e.g. the installation of essential facilities and stable power supply at affordable prices), government initiatives and supports (e.g. tax incentives) should be considered. The introduction of a public–private partnership scheme for the development of cold chain infrastructure is also a potential solution.

(ii) As the development of cold chains is a cross-cutting challenge, the establishment of a specialised institution or a consolidated team that focuses on the development of entire cold chains is desirable. Consolidated national strategies covering all cold chain stakeholders and activities are also needed.

(iii) Regarding human resources development, standardised training for cold chain operators and other stakeholders is essential to improve the quality of cold chains.

In addition,

(iv) To facilitate the engagement of smallholders (e.g. farmers and cooperatives) in cold chains – in other words, to facilitate the development of inclusive cold chains – the development and dissemination of model cases of successful cold chains is effective. At present, smallholders are generally not inclined to use the cold chain as they face many challenges and obstacles to joining the cold chain system. However, learning from successful model cases could help to change their mindset.

(v) Key players in the modern cold chain business in ASEAN tend to be joint ventures with foreign companies that have advanced technologies and skills in terms of cold chain operations. Therefore, the promotion of alliances with foreign companies or the facilitation of foreign investment by cold chain companies could be an effective strategy for developing or strengthening domestic cold chains.

Efforts to Develop a Global Cold Chain: Japan's Case

The cold chain has significantly expanded the range of trade in terms of geographical and temporal aspects for perishable and high-value food and produce. Cold chains are now an integral part of building a global food supply chain.

Japan's Ministry of Land, Infrastructure, Transport and Tourism developed the Vision and Strategy of the ASEAN Smart Cold Chain Plan in 2019, through a series of discussions by an expert working group composed of representatives from related ministries and government organisations, cold chain related enterprises, and academics. The purpose of the vision and strategy is to enable Japanese logistics companies and logistics equipment manufacturers to organically utilise Japan's logistics systems, standards, and technologies to realise high-quality and environmentally friendly cold chains or 'smart cold chains' through the collective efforts of the related Japanese stakeholders, including the public and private sectors, in response to the recent increase in demand for cold chain logistics in AMS. This is an example of a national effort to develop a global food value chain that enhances global trade in food and agricultural products.

Sustainable Food System

In 2021, the United Nations (UN) Food Systems Summit and its Pre-Summit were held in September in New York and in July in Rome, respectively. Head of state, ministers, governments, international organisations, the private sector, non-governmental organisations, and other diverse actors from around the world participated in the global events to leverage the power of food systems to deliver progress on all 17 Sustainable Development Goals (SDGs), by launching new actions, solutions, and strategies.

The summit took place in the context of increasing recognition of the importance of a stable food supply and sustainable agricultural development. The concept of enhancing the sustainability of the food system while reducing greenhouse gas (GHG) emissions has been positioned as a core concept in agricultural policy and government initiatives. Countries and regions, especially those that are developed, have set ambitious targets to reduce GHG emissions and have developed strategies to achieve such targets.

Strategies in Developed Countries

Recognising that climate change and environmental degradation are an existential threat to Europe and the world, the EU set out the European Green Deal in December 2019 to overcome these challenges. This initiative aims to achieve net zero GHG emissions by 2050. As the contribution of the food and agriculture sector to realise the goal, the Farm to Fork Strategy was formulated and published in May 2020 – aiming to make food systems fair, healthy, and environmentally friendly. This strategy comprehensively addresses the challenges of sustainable food systems and recognises the inextricable links between healthy people, healthy societies, and a healthy planet. Under the strategy, the EU set the following numerical goals, amongst others, with a target year of 2030:

- 50% reduction in the overall use and risk of chemical pesticides
- 50% reduction in food waste per capita
- At least a 20% reduction in the use of fertilisers
- 50% reduction in the sales of antimicrobials used in livestock and aquaculture
- At least 25% of agricultural land used for organic farming

In October 2020, the Prime Minister of Japan declared that Japan aims to reduce GHG emissions to zero as a whole by 2050, to realise a carbon-neutral, carbon-free society. To contribute to this effort in terms of the food and agriculture, forestry, and fisheries sectors, the Ministry of Agriculture, Forestry and Fisheries announced the Measures for achievement of Decarbonization and Resilience with Innovation (MeaDRI) in May 2021. MeaDRI, a medium- to long-term strategy, is expected to pave the way towards the development of a sustainable food system by enhancing stakeholder engagement at each stage of food supply chains and by promoting innovation to reduce the environmental load. This strategy aims to achieve the following goals, amongst others:

- Zero CO_2 emissions from the agriculture, forestry, and fisheries sectors by 2050
- 50% reduction in the risk-weighted use of chemical pesticides through the dissemination of integrated pest management and newly developed alternatives by 2050
- 30% reduction in chemical fertiliser use by 2050

- Increase in the organic farming area to 1 million hectares (equivalent to 25% of farmland) by 2050
- At least 30% enhancement in the productivity of food manufacturers by 2030
- Sustainable sourcing for import materials by 2030
- 90% and more superior varieties in forestry seedling
- 100% of artificial seedling rates in aquaculture of Japanese eel, Pacific bluefin

The ministry stressed that these targets will be enabled through the development and dissemination of innovative technologies.

The United States (US) Department of Agriculture published the Agriculture Innovation Agenda in February 2020, which aims to achieve the goal of increasing US agricultural production by 40% while halving the environmental footprint of US agriculture by 2050 through stimulating innovation. The following goals have been set, amongst others, with a focus on technological development:

- 50% reduction in food loss and food waste by 2030
- Strengthen soil health and carbon storage in agriculture by 2050, with a net reduction in the current carbon footprint of agriculture
- 30% reduction of nutrient outflow to water by 2050

Strategies in ASEAN

ASEAN has a comprehensive strategic plan for cooperation in the food, agriculture, and forestry sectors – the Vision and Strategic Plan for ASEAN Cooperation on Food, Agriculture and Forestry, 2016–2025. The plan, adopted by the ASEAN Ministers of Agriculture and Forestry in September 2015, describes strategies for enhancing sustainable agricultural production: (i) enhance the quantity and quality of production with sustainable, 'green' technologies and resource management systems, and minimise pre- and post-harvest losses and waste; and (ii) increase the resilience to climate change, natural disasters, and other shocks. It also covers environmentally friendly activities such as the Good Agricultural Practices; climate-smart and/or friendly agriculture; and collaboration with regional and international bodies to minimise GHG emissions from food, agriculture, and forestry. In addition, the AIFS Framework and SPA-FS, 2021–2025 emphasised enhancing resilience to climate change and increasing sustainable agricultural production and productivity as emerging challenges in food security. Furthermore, introducing climate-smart agriculture was one of the outputs. The ACRF, adopted by the ASEAN Summit in November 2020, stated the importance of investing in sustainable agriculture and food systems. The Implementation Plan of the ACRF cited the need to 'develop and implement ASEAN guidelines for sustainable agriculture' but did not specify a time frame (ASEAN, 2020c: 50).

These key documents show that AMS recognise the importance of sustainable agriculture – specifically, improving agricultural production and productivity while reducing the environmental load. These strategies are not legally binding instruments. It is desirable to set more concrete goals through numerical targets with time frames and to create regional guidance specifying prioritised activities along the food supply chain, to accelerate the realisation of a sustainable agriculture and food system in ASEAN.

Recent Regional Efforts

As a recent interregional effort in Southeast and East Asia to create a sustainable food system, Japan and seven AMS (Cambodia, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam) released the Joint Statement on Sustainable Agricultural Production and Food System in July 2021 at the Pre-Summit of the UN Food Systems Summit. This joint statement stressed the following points:

- These countries in Monsoon Asia share regional particularities regarding agricultural production, such as the high humidity and temperature climate conditions, an abundance of paddy fields, and a high percentage of small and medium-sized farmers.
- Innovation in agriculture and related industries is key to sustainable agricultural production and food systems, especially for small and medium-sized farmers, and private sector investments need to be encouraged to enhance such innovation.
- International collaboration is important to introduce innovative and sustainable agriculture practices and technologies such as digital tools.
- The statement concludes with a ministerial resolution to promote and deepen collaboration through joint research projects and existing frameworks to achieve a balance between productivity and environmental protection.

It is necessary to promote balanced efforts to improve agricultural productivity and consider the environmental load by utilising regional cooperation frameworks such as the ASEAN Plus Three[3] and the East Asia Summit. Such efforts will contribute to the realisation of a sustainable food system for the region.

[3] ASEAN Plus Three refers to the 10 AMS plus China, Japan, and the Republic of Korea.

Conclusion

As discussed, the food and agriculture sector faces multiple challenges. The acceleration of the increase in the productivity of agriculture and food production is needed to provide sufficient and nutritious food to the growing regional and global population, while the availability of natural resources such as productive agricultural land and fresh water for agriculture is becoming constrained. Recent external shocks – including the disruption of agricultural production and food supply chains due to the COVID-19 pandemic as well as adverse effects on agricultural production by frequent natural disasters such as droughts and floods – have reminded us of the need to enhance the resilience of agricultural production and food supply chains. At the same time, we need to consider increasing food and agricultural production while reducing the environmental load with innovative technologies such as digital technologies.

The ASEAN Guidelines on Promoting the Utilisation of Digital Technologies for ASEAN Food and Agricultural Sector are the first guidance on digitalisation focusing on the food and agriculture sector, and will be a benchmark for digital transformation of the ASEAN food and agriculture sector. In the near future, each AMS may consider formulating a country- and sector-specific road map for the digitalisation of food and agriculture, taking into consideration the domestic agriculture situation and development strategy of each country.

Another important technology for adding value to food and agricultural products while reducing the environmental load is the cold chain system. We should pay attention to the important role of the cold chain system in reducing post-harvest loss and food loss, which results in reducing environmental load. The development of a modern cold chain and the engagement of smallholders face several difficulties in many developing countries. The most important way to change the situation, especially for LDCs, is to showcase a successful model case to convince smallholders and other stakeholders that they could reap multiple benefits from engagement in cold chains. This would raise the awareness of stakeholders about the positive impacts of cold chains and change the mindset of smallholders.

A sustainable food system is one of the key concepts that has been attracting global attention in recent years. There are various important topics around this concept such as smart farming, smart food chains, farming with low GHG emissions, organic farming, a competitive food industry with decarbonised and environmentally friendly technologies, food loss reduction, sustainable sourcing of materials, investment for development, and the diffusion of innovative technologies. Some countries and regions, especially developed countries, have already built comprehensive strategies and plans for building a sustainable food system. ASEAN is expected to develop comprehensive region-specific guidelines, strategies, or plans towards the realisation of a sustainable agriculture and food system in cooperation with dialogue partners and international organisations as needed.

References

ADB (2021), *Cambodia Agriculture, Natural Resources, and Rural Development Sector Assessment, Strategy, and Road Map*. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/publication/718806/cambodia-agriculture-rural-development-road-map.pdf (accessed 21 September 2021).

Ali, I., S. Nagalingam, and B. Gurd (2018), 'A Resilience Model for Cold Chain Logistics of Perishable Products', *International Journal of Logistics Management*, 29(30), pp.922–41. https://www.emerald.com/insight/content/doi/10.1108/IJLM-06-2017-0147/full/html (accessed 15 January 2022).

APTERR (n.d.), ASEAN Plus Three Emergency Rice Reserve. https://www.apterr.org/history (accessed 3 November 2021).

ASEAN (2015a), 'ASEAN Integrated Food Security (AIFS) Framework and Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) 2015–2020'. Jakarta: ASEAN Secretariat'. https://www.asean-agrifood.org/?wpfb_dl=58#:~:text=To%20systematize%20its%20approach%20to%20food%20security%2C%20the,States.%20The%20goal%20of%20the%20AIFS%20Framework%20is (accessed 15 September 2021).

ASEAN (2015b), *Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Forestry* (2016–2025). Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/2021/08/08Sept_Vision-and-SP-FAF-final.pdf (accessed 15 September 2021).

ASEAN (2020a), 'ASEAN Comprehensive Recovery Framework'. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/2020/11/2-FINAL-ACRF_adopted-37th-ASEAN-Summit_12112020.pdf (accessed 18 September 2021).

ASEAN (2020b), 'ASEAN Integrated Food Security (AIFS) Framework and Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) 2021–2025'. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/2020/11/42-AIFS-Framework-SPAFS-Final-13-July-2020.pdf (accessed 15 September 2021).

ASEAN (2020c), 'Implementation Plan of ASEAN Comprehensive Recovery Framework'. Jakarta: ASEAN Secretariat. https://asean.org/wp-content/uploads/ACRF-Implementation-Plan_Pub-2020.pdf (accessed 15 September 2021).

ASEAN Food Security Information System (n.d.), http://aptfsis.org/ (accessed 3 November 2021).

European Commission (n.d.), A European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en (accessed 28 September 2021).

European Commission (n.d.), Farm to Fork Strategy. https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en (accessed 28 September 2021).

FAO (n.d.), FAOSTAT. http://www.fao.org/faostat/en/#data (accessed 18 September 2021).

FAO (2008), 'An Introduction to the Basic Concepts of Food Security'. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/3/al936e/al936e00.pdf (accessed 18 September 2021).

FAO (2021a), Sustainable Development Goals, Indicator 2.1.2 Prevalence of Moderate or Severe Food Insecurity in the Population, Based on the Food Insecurity Experience Scale. https://www.fao.org/sustainable-development-goals/indicators/212/en/ (accessed 17 January 2022).

FAO (2021b), 'United Nations Food Systems Summit 2021'. http://www.fao.org/3/cb1778en/cb1778en.pdf (accessed 3 October 2021).

FAO, IFAD, UNICEF, WFP, and WHO (2021), *The State of Food Security and Nutrition in the World 2021: Transforming Food Systems for Food Security, Improved Nutrition and Affordable Healthy Diets for All*. Rome: Food and Agriculture Organization of the United Nations. https://www.who.int/publications/m/item/the-state-of-food-security-and-nutrition-in-the-world-2021 (accessed 3 November 2021).

Gligor, D., A. Tan, and T.N.T. Nguyen (2018), 'The Obstacles to Cold Chain Implementation in Developing Countries: Insights from Vietnam', *International Journal of Logistics Management*, 29(3), pp.942–58. https://www.emerald.com/insight/content/doi/10.1108/IJLM-02-2017-0026/full/html (accessed 15 January 2022).

Global SDG Indicator Platform (n.d.), 2.1.1 Prevalence of Undernourishment. https://sdg.tracking-progress.org/indicator/2-1-1-prevalence-of-undernourishment/ (accessed 17 January 2022).

Islam, M.S. and E. Kieu (2020), 'Tackling Regional Climate Change Impacts and Food Security Issues: A Critical Analysis Across ASEAN, PIF, and SAARC', *Sustainability*, 12(3), 883. https://www.mdpi.com/2071-1050/12/3/883 (accessed 15 January 2022).

Kusano, E., ed. (2019), *The Cold Chain for Agri-food Products in ASEAN*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/uploads/media/RPR_FY2018_11.pdf (accessed 15 September 2021)

Ministry of Agriculture, Forestry and Fisheries, Japan (2021), 'Strategy for Sustainable Food System, MeaDRI'. Tokyo: Ministry of Agriculture, Forestry and Fisheries. https://www.maff.go.jp/e/policies/env/env_policy/meadri.html (accessed 15 January 2022).

Ministry of Land, Infrastructure, Transport and Tourism, Japan (n.d.), 'ASEANスマートコールドチェーン構想におけるビジョン及び戦略' (Vision and Strategy of the ASEAN Smart Cold Chain Plan'. Tokyo: Ministry of Land, Infrastructure, Transport and Tourism. https://www.mlit.go.jp/report/press/tokatsu01_hh_000434.html (accessed 21 September 2021).

OECD (2019), *Digital Opportunities for Better Agricultural Policies.* Paris: Organisation for Economic Co-operation and Development. https://www.oecd.org/publications/digital-opportunities-for-better-agricultural-policies-571a0812-en.htm (accessed 15 January 2022).

Shashi, P. Centobelli, R. Cerchione, and M. Ertz (2019), 'Food Cold Chain Management: What We Know and What We Deserve', *Supply Chain Management: An International Journal*, 26(1), pp.102–35.

Trendov, N.M., S. Varas, and M. Zeng (2019), 'Digital Technologies in Agriculture and Rural Areas', Briefing Paper. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/3/ca4887en/ca4887en.pdf (accessed 15 September 2021).

United Nations Department of Economic and Social Affairs (2022), Total Population. https://www.un.org/en/development/desa/population/publications/database/index.asp (accessed 15 January 2022).

United States Department of Agriculture (USDA) (2020), 'Agriculture Innovation Agenda'. https://www.usda.gov/aia (accessed 13 September 2021).

PART 4
Sustainability

Chapter 17

Energy Infrastructure Development

Shigeru Kimura
Special Advisor on Energy Affairs, ERIA

Venkatachalam Anbumozhi
Director of Research Strategy and Innovation, ERIA

Han Phoumin
Senior Energy Economist, ERIA

Alloysius Joko Purwanto
Energy Economist, ERIA

Keisuke Ueda
Senior Policy Advisor, Energy, ERIA

Overview of Energy Demand and Supply in East Asia

From the outset of this study, members of the working group on the Energy Outlook for ASEAN and East Asia, who are experts from the countries of the East Asia Summit (EAS)[1] plus the United States (US) (EAS17), aimed to predict the growth of medium- to long-term energy demand and supply in 2017–2050. At the time of writing, the world economy and energy demand have been hit hard by the coronavirus disease (COVID-19) pandemic, but energy demand is expected to bounce back strongly in 2021 as the economy recovers. The Economic Research Institute for ASEAN and East Asia (ERIA) will release the short-term energy outlook in a separate report.

In the medium to long term, population and economic growth in the EAS17 are the key drivers of projected increasing primary energy supply, from 7,625 million tons[2] of oil equivalent (Mtoe) in 2017 to 10,780 Mtoe under the business-as-usual (BAU) scenario and to 8,860 Mtoe under the alternative policy scenario (APS) by 2050, reflecting annual growth rates of 1.1% under BAU and 0.5% under the APS in 2017–2050. In the BAU scenario, the energy intensity in final energy consumption is expected to drop by 46% from 122 tons of oil equivalent (toe) per million US dollars in 2017 to 64 toe/$ million in 2050. In the primary energy consumption, the emission intensity is expected to drop from 0.70 tons of carbon (t-C)/toe in 2017 to 0.65 t-C/toe in 2050 for the BAU scenario. The economy will become more energy-efficient, but increasing energy demand will threaten the region's energy security. Potential energy saving is, therefore, key to reducing energy demand and carbon dioxide (CO_2) emissions.

In 2007, leaders from the Association of Southeast Asian Nations (ASEAN) Member States, Australia, China, India, Japan, the Republic of Korea (henceforth, Korea), and New Zealand adopted the Cebu Declaration on East Asian Energy Security (ASEAN, 2007). They agreed to promote energy efficiency, new forms of renewable energy, and the clean use of coal. The EAS Energy Ministers Meeting (EAS-EMM) formed the EAS Energy Cooperation Task Force in response to the declaration, and Japan proposed studying energy saving and the potential for reducing CO_2 emissions. The topic is an area of cooperation for which ERIA officially requested support through the EAS-EMM.

[1] The EAS is a regional forum held annually by leaders of, originally, 16 countries: the 10 Association of Southeast Asian Nations (ASEAN) Member States (Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam); Australia; China; India; Japan; the Republic of Korea; and New Zealand. EAS membership expanded to 18 countries, including Russia and the United States (US), at the Sixth EAS in 2011. EAS17 refers to the 10 ASEAN+7 countries: the original EAS plus the US. Since its establishment, ASEAN has led the forum. EAS meetings are held after the annual ASEAN leaders' meetings and play an important role in the regional architecture of Asia and the Pacific.

[2] tons of oil equivalent (toe) is a unit of energy, defined as the amount of energy released by burning one metric ton (1,000 kilograms) of crude oil. The toe is used to describe large amounts of oil or natural gas in transport or consumption, and a prefix of millions tends to be used to communicate this as Mtoe.

This study shows the energy saving potential of the BAU scenario and the APS. A BAU scenario was developed for each EAS country, outlining future sector and economy-wide energy consumption, assuming no significant changes to government policies. The APS was set to examine the potential impacts if additional energy-efficiency goals, action plans, or policies being considered or likely to be considered were developed. The difference between the BAU scenario and the APS in final and primary energy supply represents potential energy saving. The difference in the two scenarios' CO_2 emissions represents the potential to reduce them. The outlook's analysis covers the EAS17. Underlying the EAS energy cooperation initiative is the Energy Research Institutes Network, of which the US is a member. Therefore, the outlook's analysis includes the US.

The study's findings shed light on the policy implications for decision-making to ensure that the region can enjoy economic growth and investment without compromising energy security and producing harmful CO_2 emissions.

Economic Landscape of the EAS

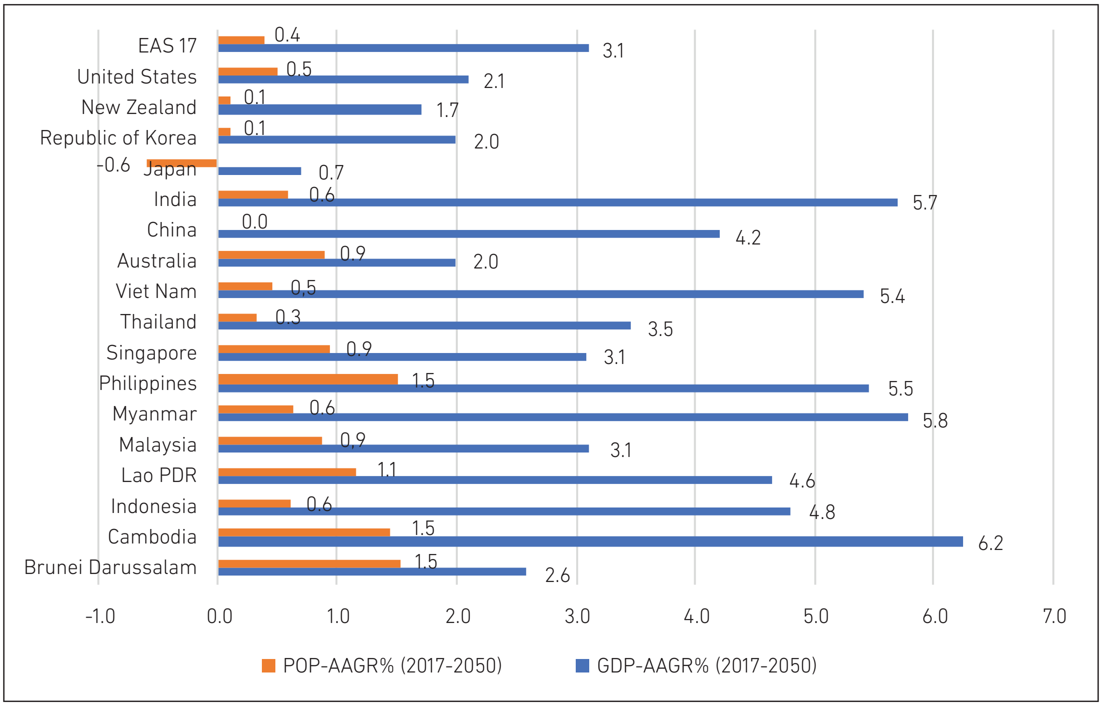
The EAS17 countries are diverse, with widely varying per capita incomes, standards of living, energy resources, climate, and energy consumption per capita. Some EAS17 countries are mature economies; most are developing. Several EAS17 countries had per capita gross domestic product (GDP) of less than $1,500 (in 2010 constant prices)[3] in 2017, whilst some mature economies had GDP per capita of more than $53,000. Mature economies have higher energy consumption per capita than developing ones. A large percentage of people in developing countries still meet their energy needs mainly with traditional biomass fuels.

These differences partly explain why energy efficiency and conservation (EEC) goals, action plans, and policies are assigned different priorities across countries. Developed economies might be keen to reduce energy consumption, whilst developing countries emphasise economic growth and improving standards of living. As developing economies grow, however, their energy consumption per capita is expected to grow as well.

In 2017, the total EAS17 population was about 3.89 billion. It is projected to increase at an average annual rate of about 0.4% to about 4.43 billion in 2050.

[3] All US dollars in this document are in constant 2010 values unless otherwise specified.

Figure 17.1 **Average Annual Growth Rate of GDP and the Population in EAS17 Countries**



ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit, GDP = gross domestic product, GDP-AAGR = annual average growth rate of the gross domestic product, POP-AAGR = annual average growth rate of the population.

Note: EAS17 refers to the 10 ASEAN+7 countries – the original EAS plus the United States.

Source: Authors.

Brunei Darussalam, Cambodia, the Lao People's Democratic Republic (Lao PDR), and the Philippines are generally assumed to have the fastest average annual population growth rate, at 1.1%–1.5%, in 2017–2050 (Figure 17.1). Indonesia, Malaysia, Singapore, Thailand, Viet Nam, Australia, India, and the US are expected to have a moderate average annual population growth rate, at 0.5%–0.9%. Korea and New Zealand are expected to have an extremely slow average population growth rate, at just 0.1%. Japan's population is assumed to decline slowly as it continues to age, resulting in an average annual population growth rate of –0.6%.

Long-term economic growth rates are assumed to be high in developing countries, with the highest in Cambodia, India, Myanmar, the Philippines, Viet Nam, and the Lao PDR (Figure 17.1). Economic growth in other developing countries is assumed to be rapid. Brunei Darussalam is expected to have a moderate average annual GDP annual growth rate of 2.6% in 2017–2050. The US, Japan, Korea, New Zealand, and Australia are expected to have a moderate annual GDP growth rate. Rapid growth in China, India, Indonesia, and the US is likely to be especially significant for energy demand in these large economies.

In 2017, total GDP in the EAS17 was about $42 trillion in 2010 US dollar constant prices and accounted for about 52% of global GDP. The region's GDP is assumed to grow at an average annual rate of about 3.1% in 2017–2050, implying that, by 2050, the region's total GDP will reach about $114.6 trillion in 2010 US dollar constant prices. China is projected to be the largest economy, with real GDP of about $39.7 trillion in 2010 US dollar constant prices, followed by the US with about $33.9 trillion by 2050. India and Japan are projected to be the next largest economies, with projected GDPs of about $16.3 trillion and $7.7 trillion, respectively, in 2010 US dollar constant prices by 2050 (Table 17.1).

Table 17.1 GDP and Population in EAS17 Countries, 2017–2050

Country	**GDP** (billion, 2010 US dollar constant prices)		**Population (million)**		**Per capita GDP**	**Per capita GDP**
	2017	**2050**	**2017**	**2050**	**2017**	**2050**
Brunei Darussalam	13.5	29.0	0.4	0.7	33,750.0	41,428.6
Cambodia	20.0	144.0	16.2	26.2	1,234.6	5,496.2
Indonesia	1,090.5	5,131.2	264.6	324.3	4,121.3	15,822.4
Lao PDR	12.6	80.6	7.1	11.4	1,774.6	7,070.2
Malaysia	364.6	992.5	31.1	41.4	11,723.5	23,973.4
Myanmar	79.5	510.9	53.4	65.8	1,488.8	7,764.4
Philippines	303.3	1,463.9	105.1	164.4	2,885.8	8,904.5
Singapore	318.4	871.1	5.6	7.7	56,857.1	113,129.9
Thailand	424.2	1,304.6	69.2	76.8	6,130.1	16,987.0
Viet Nam	175.3	995.7	93.7	108.9	1,870.9	9,143.3
Australia	1,432.7	2,776.2	24.6	32.8	58,239.8	84,640.2
China	10,161.1	39,687.5	1,386.4	1,403.2	7,329.1	28,283.6
India	2,650.8	16,319.9	1,339.1	1,639.8	1,979.5	9,952.4
Japan	6,157.7	7,786.5	126.8	105.2	48,562.3	74,016.2
Republic of Korea	1,345.9	2,299.9	51.5	50.1	26,134.0	45,906.2
New Zealand	181.1	314.6	4.8	6.1	37,729.2	51,573.8
United States	17,348.6	33,922.1	325.1	384.1	53,363.9	88,315.8
EAS17	42,079.8	114,630.2	3,904.7	4,448.9	10,776.7	25,766.0

ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit, GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic, US = United States.

Note: EAS17 refers to the 10 ASEAN+7 countries – the original EAS plus the United States.

Source: Authors.

Average real GDP (2010 US dollar constant prices) per capita in the EAS17 is assumed to increase from $10,776.70 in 2017 to $25,765.00 in 2050. However, there are, and will continue to be, significant differences in GDP per capita amongst EAS17 countries. In 2017, per capita GDP (2010 US dollar constant prices) ranged from $1,234.60 in Cambodia to more than $48,000.00 in Japan, the US, Singapore, and Australia. In 2050, per capita GDP is assumed to range from $5,496.20 in Cambodia to more than $113,000.00 in Singapore.

Rationale and Key Scenarios

This study analyses the potential impacts of proposed additional energy-saving goals, action plans, and policies in the EAS17 on energy consumption, by fuel, sector, and greenhouse gas (GHG) emissions. The study provides a platform for energy collaboration and capacity building amongst EAS17 countries on energy modelling and policy development.

The study supports the Cebu Declaration, the goals of which include the following:

i. Improve the efficiency and environmental performance of fossil fuel use.
ii. Reduce dependence on conventional fuels through intensified EEC programmes; increased share of hydropower; and expansion of renewable energy systems, biofuel production and/or utilisation, and, for interested parties, civilian nuclear power.
iii. Mitigate GHG emissions through effective policies and measures to help abate global climate change.

The Government of Japan asked ERIA to conduct a study on energy saving and CO_2 emission reduction potential in East Asia. Japan coordinates the energy-efficiency work stream under the Energy Cooperation Task Force. ERIA convened the working group to analyse energy saving potential. All EAS17 countries are represented in the working group.

Like the annual studies since 2007, the present study examines two scenarios: BAU, reflecting each country's current goals, action plans, and policies; and the APS, including additional goals, action plans, and policies reported every year to the EAS-EMM. The latest updated policies were reported at the 13th EAS-EMM on 5 September 2019 in Bangkok. One might be tempted to call the APS a 'maximum effort', but that would not be accurate. One reason is that goals, action plans, and policies for reducing energy consumption are still new in most countries. Many potential EEC policies and technological options have not been examined or incorporated in the APS.

In 2014, the APS assumptions were grouped into (i) more efficient final energy consumption (APS1), (ii) more efficient thermal power generation (APS2), (iii) higher consumption of new and renewable energy (NRE) and biofuels (APS3), and (iv) introduction or higher utilisation of nuclear energy (APS4). The APS is the total of APS1 to APS4.

The energy models can estimate the individual impacts of the assumptions on primary energy supply and CO2 emissions. The combination of the assumptions constitutes the APS assumptions. The main report highlights only the BAU scenario and APS. However, each country report will analyse all APS.

Detailed assumptions for each APS are as follows:

i. APS1 assumes the setting of reduction targets for sector final energy consumption, and the use of efficient technologies and implementation of energy saving practices in the industry, transportation, residential and commercial, and even agriculture sectors in some countries. This scenario results in less primary energy and CO_2 emissions in proportion to the reduction in final energy consumption.

ii. APS2 assumes the utilisation of more efficient thermal power plant technologies, resulting in lower primary energy supply and CO_2 emissions in proportion to thermal power efficiency improvement. The most efficient coal and natural gas combined-cycle technologies are assumed to be utilised for new power plant construction.

iii. APS3 assumes higher contributions of NRE to electricity generation and utilisation of liquid biofuels in transportation. The scenario results in lower CO_2 emissions as NRE is carbon-neutral or will not emit additional CO_2. However, the primary energy supply might not decrease because NRE, like biomass and geothermal energy, is assumed to be less efficient than fossil fuel-fired generation in converting electricity into primary energy equivalent.

iv. APS4 assumes the introduction of nuclear energy or a higher contribution of nuclear energy in countries already using it. The scenario produces less CO_2 emissions as nuclear energy emits minimal CO_2. However, as thermal efficiency in converting nuclear energy output into primary energy is assumed to be only 33%, the primary energy supply is not expected to be lower than under BAU.

All EAS17 countries are developing and implementing EEC goals, action plans, and policies, but progress has varied widely. Some countries are advanced in their efforts, while others are just getting started. A few countries have significant energy saving goals, action plans, and policies built into BAU, while others have only started to quantify their goals. However, significant potential exists in these countries at the sector and economy levels.

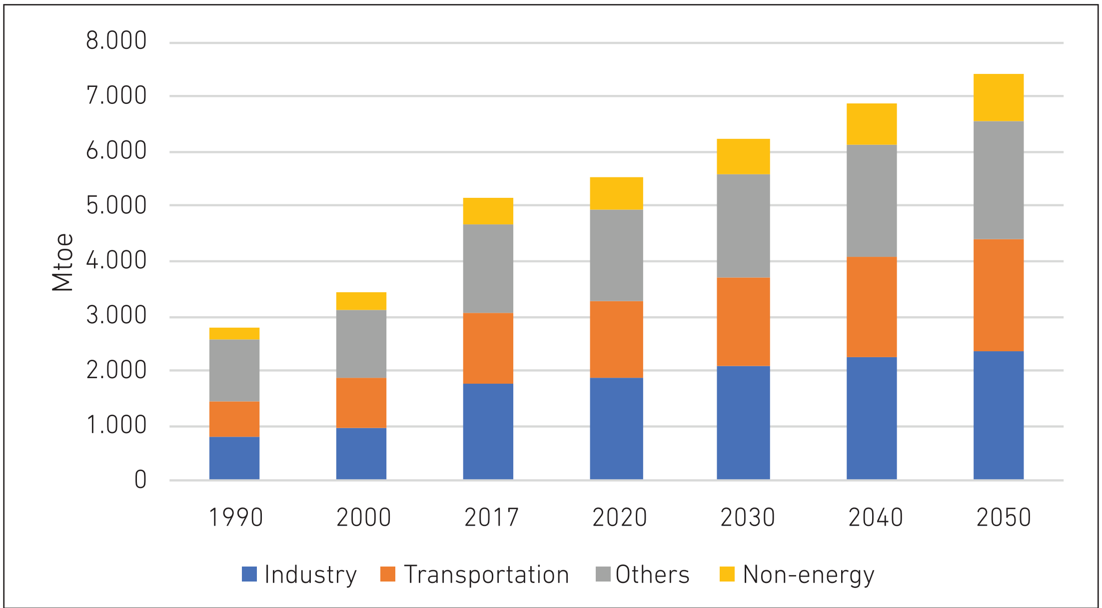
Every country still has a great deal to learn about what works and what does not. It is worthwhile updating this study periodically, as the quality and scope of national goals, action plans, and policies are likely to improve considerably, allowing for collaboration across countries.

Energy Demand/Supply and Power Generation (BAU)

Energy Demand: Final Energy Consumption

In 2017–2050, the total final energy consumption[4] in the EAS17 is projected to grow at an average annual rate of 1.1%, reflecting the assumed 3.1% annual GDP and 0.4% population growth. Final energy consumption is projected to increase from 5,159 Mtoe in 2017 to 7,416 Mtoe in 2050. Transportation energy demand is projected to grow moderately by about 1.4% per year, and its energy consumption share is projected to be 27.7% by 2050. Industry's annual growth rate in 2017–2050 is projected at about 0.9% per year, but its energy consumption share is projected to be the largest, at about 31.7%, by 2050. Commercial and residential demand will grow by 1.0% per year, higher than that of industry. However, the commercial and residential energy consumption share is projected to be 29.3%, the second largest after industry. Figure 17.2 shows the final energy consumption by sector under BAU in the EAS17 from 1990 to 2050, and Figure 17.3 shows details of the sector final energy consumption and its shares.

Figure 17.2 Final Energy Consumption by Sector, BAU, 1990–2050

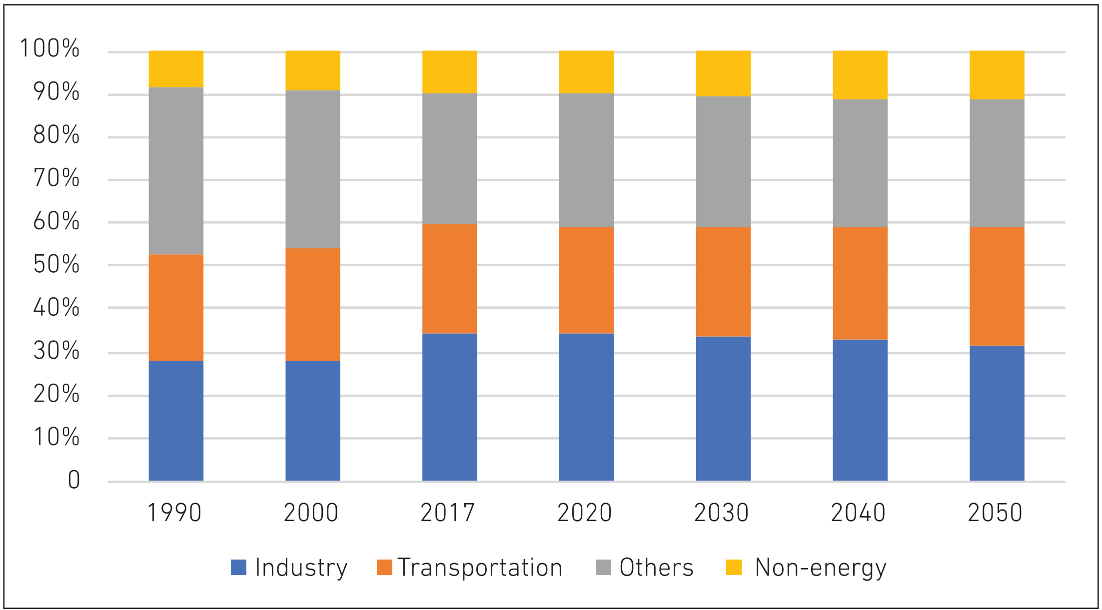


BAU = business as usual, Mtoe = million tons of oil equivalent.

Source: Authors.

[4] Refers to energy in the form in which it is consumed, i.e. including electricity but not including the fuels and/or energy sources used to generate electricity.

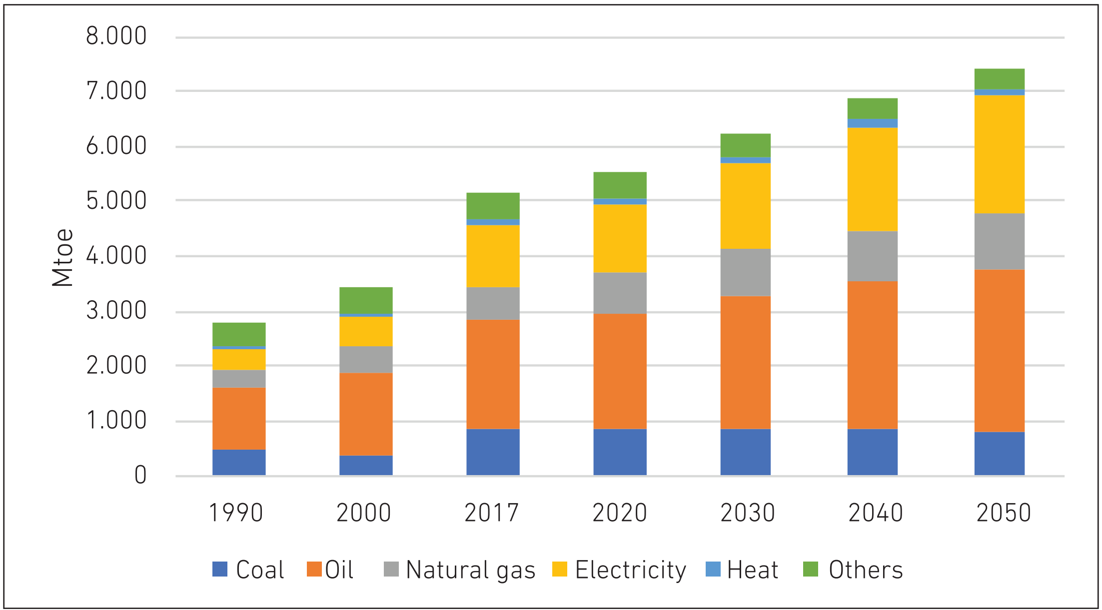
Figure 17.3 **Final Energy Consumption Share by Sector, 1990–2050**



Source: Authors.

Figures 17.4 and 17.5 show the final energy consumption and shares by fuel type in the EAS17 under BAU from 1990 to 2050. By energy source, electricity and natural gas demand under BAU are projected to show the fastest growth, increasing by 1.9% and 1.5% per year, respectively, from 2017 to 2050, but their shares are just 28.4% for electricity and 14.0% for natural gas. Although oil will retain the largest share, at 39.9% of total final energy consumption, it is projected to grow by only 1.2% per year in 2017–2050, reaching 2,960 Mtoe in 2050. Generally, the oil share increases slightly from 38.3% in 2017 to 39.9% in 2050. Coal demand will grow at –0.2% per year on average from 2017 to 2050, reaching 800.5 Mtoe in 2050. The share of other fuels such as biomass will decline from 9.2% in 2017 to 5.2% in 2050. The slow growth is due to the gradual shift from non-commercial biomass to conventional fuels such as liquefied petroleum gas and electricity in the residential sector.

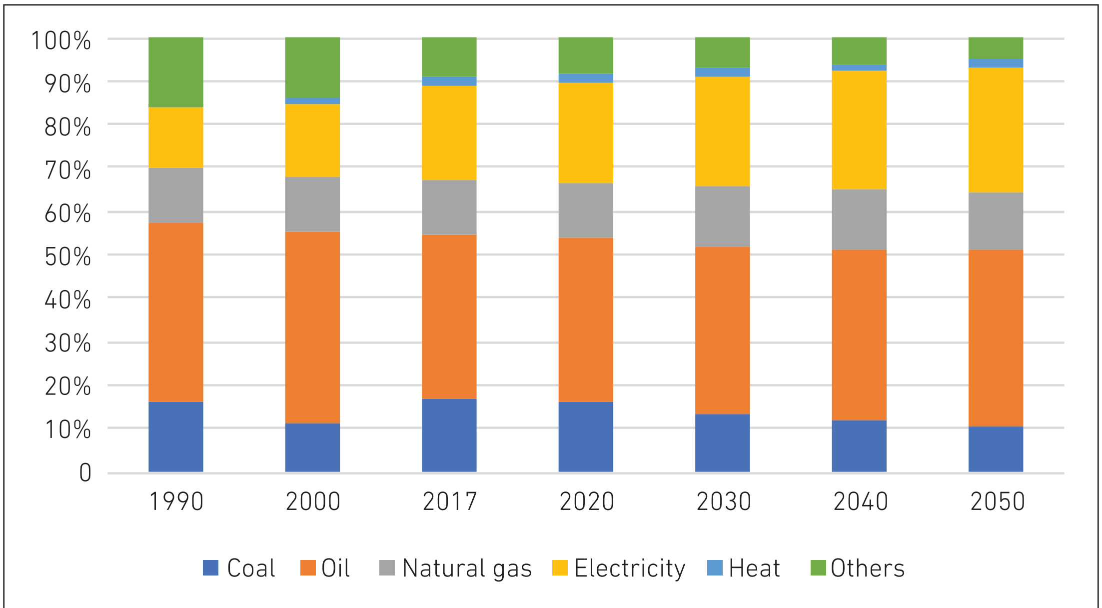
Figure 17.4 Final Energy Consumption by Fuel, 1990–2050



Mtoe = million tons of oil equivalent.

Source: Authors.

Figure 17.5 Final Energy Consumption Share by Fuel, 1990–2050

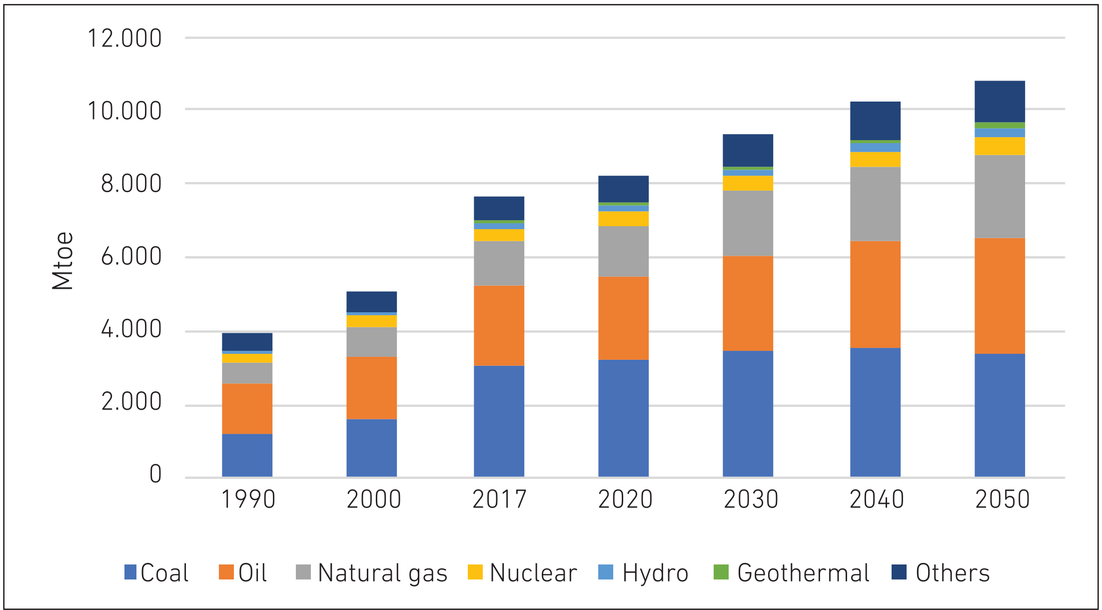


Source: Authors.

Energy Supply: Primary Energy Supply

Figure 17.6 shows the primary energy supply in the EAS17 from 1990 to 2050.[5] It is projected to grow slowly, at 1.1% per year, in 2017–2050 – the same growth rate of final energy consumption. EAS17 primary energy supply is projected to increase from 7,625 Mtoe in 2015 to 10,780 Mtoe in 2050. Coal will still comprise the largest share of primary energy supply, but its growth is expected to be slower, increasing by 0.3% per year in 2017–2050. Consequently, the share of coal in total primary energy supply (TPES) is forecast to decline from 40.2% in 2017 to 31.7% in 2050.

Figure 17.6 Primary Energy Supply in EAS17, 1990–2050



ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit, Mtoe = million tons of oil equivalent.

Note: EAS17 refers to the 10 ASEAN+7 countries – the original EAS plus the United States.

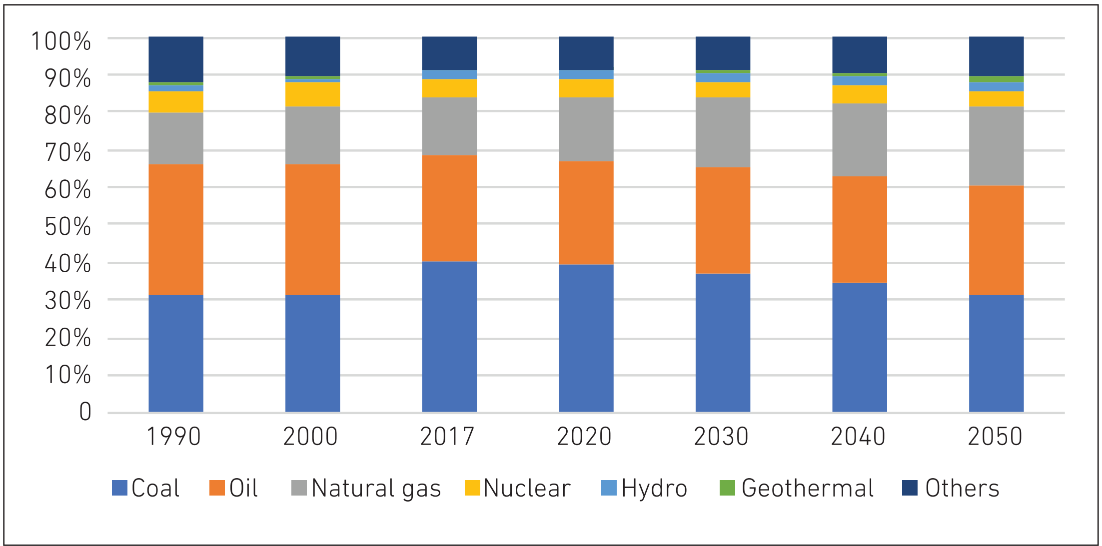
Source: Authors.

[5] Refers to energy in its raw form, before any transformation.

Amongst fossil sources of energy, natural gas is projected to see moderate growth in 2017–2050, increasing at an annual average rate of 1.9%. Its share in the total will consequently increase from 15.7% (equivalent to 1,199 Mtoe) in 2017 to 20.6% (2,217 Mtoe) in 2050. Nuclear and hydropower energy are projected to increase slowly, at 1.1% per year on average, in 2017–2050; the share of nuclear energy will stay at 4.5% and that of hydropower at 2.2%. It is assumed that nuclear power generation in Japan and the expansion of nuclear power generation capacity in China and India will resume. Geothermal energy is projected to grow at 3.3% per year in 2017–2050, but its share is projected to be small: about 1.3% by 2050, increasing from 0.6% in 2017.

Amongst the energy sources, 'others' – which are made up of solar, wind, and solid and liquid biofuels – will see a growth rate of 1.8% in 2017–2050, with their share increasing from 8.6% in 2017 to 10.8% in 2050. Most remarkably, wind and solar energy will see the largest average annual growth rate: 5.2% in 2017–2050, with their share in the primary energy supply increasing from 1.4% in 2017 to 5.4% in 2050. Figure 17.7 shows the share of each energy source in the total primary energy mix in 1990–2050.

Figure 17.7 Share of Primary Energy Mix by Source in EAS Countries, 1990–2050



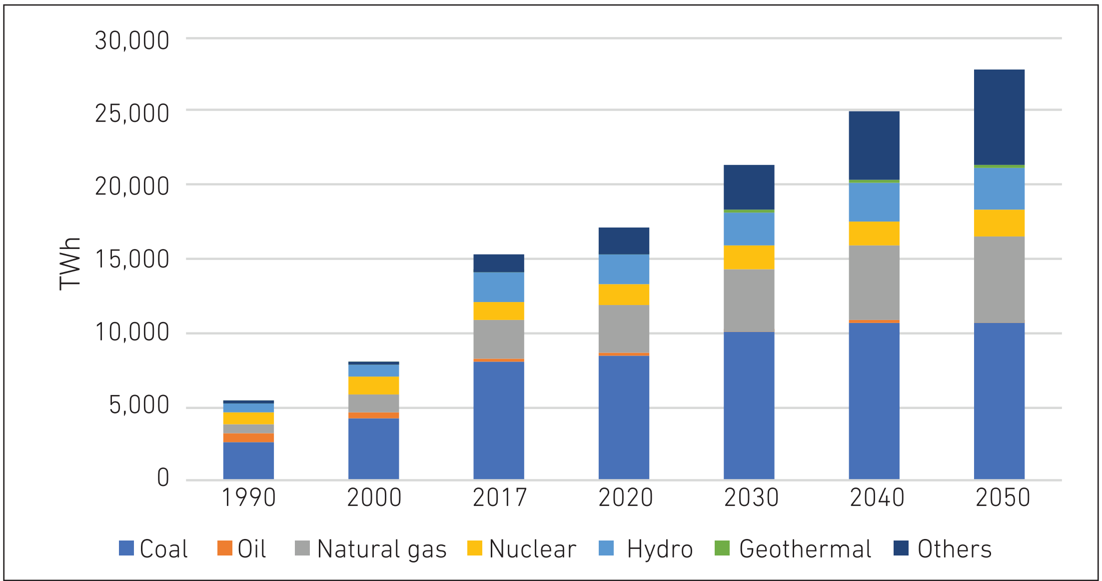
EAS = East Asia Summit.

Source: Authors.

Power Generation

Figure 17.8 shows the power generation output in the EAS17. Total power generation is projected to grow at 1.8% per year on average from 2017 (equivalent to 15,365 terawatt-hours [TWh]) to 2050 (27,812 TWh). However, the growth rate in 1990–2017 was 3.9%, more than twice that projected in 2017–2050.

Figure 17.8 Energy Mix of Power Generation in EAS17, 1990–2050



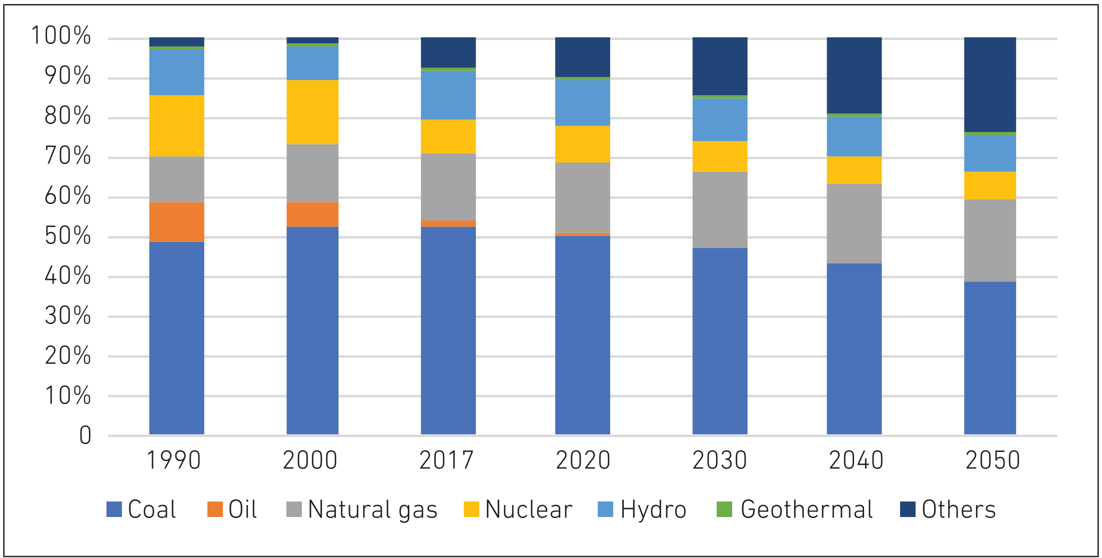
ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit, TWh = terawatt-hour.

Note: EAS17 refers to the 10 ASEAN+7 countries – the original EAS plus the United States.

Source: Authors.

Figure 17.9 shows the share of each energy source in electricity generation from 1990 to 2050. The share of coal-fired generation is projected to continue to be the largest, at 38.4% in 2050, a large drop from 52.7% in 2017. The share of natural gas is projected to increase from 16.8% in 2017 to 20.8% in 2050. The share of nuclear power (8.5% in 2017) is forecast to decrease to 6.7% in 2050. The share of geothermal energy was 0.3% in 2017 and is projected to increase to 0.6% in 2050. Other sources (wind, solar, biomass, etc.) will record the highest average annual growth rate, at 5.2%, in 2017–2050. The share of combined wind, solar, and biomass energy in the power mix is expected to be 23.6% in 2050, a large increase from 8.0% in 2017. The share of oil will drop from 1.2% in 2017 to 0.1% in 2050. Oil is expected to grow at an average annual rate of –4.4% in 2017–2050 due to its higher fuel cost. The share of hydropower is projected to decrease, from 12.4% in 2017 to 9.7% in 2050. The average annual growth rate of hydropower is expected to be slow, at 1.1%, in 2017–2050.

Figure 17.9 Share of Power Generation Mix in EAS17, 1990–2050



ASEAN = Association of Southeast Asian Nations, EAS = East Asia Summit.

Note: EAS17 refers to the 10 ASEAN+7 countries – the original EAS plus the United States.

Source: Authors.

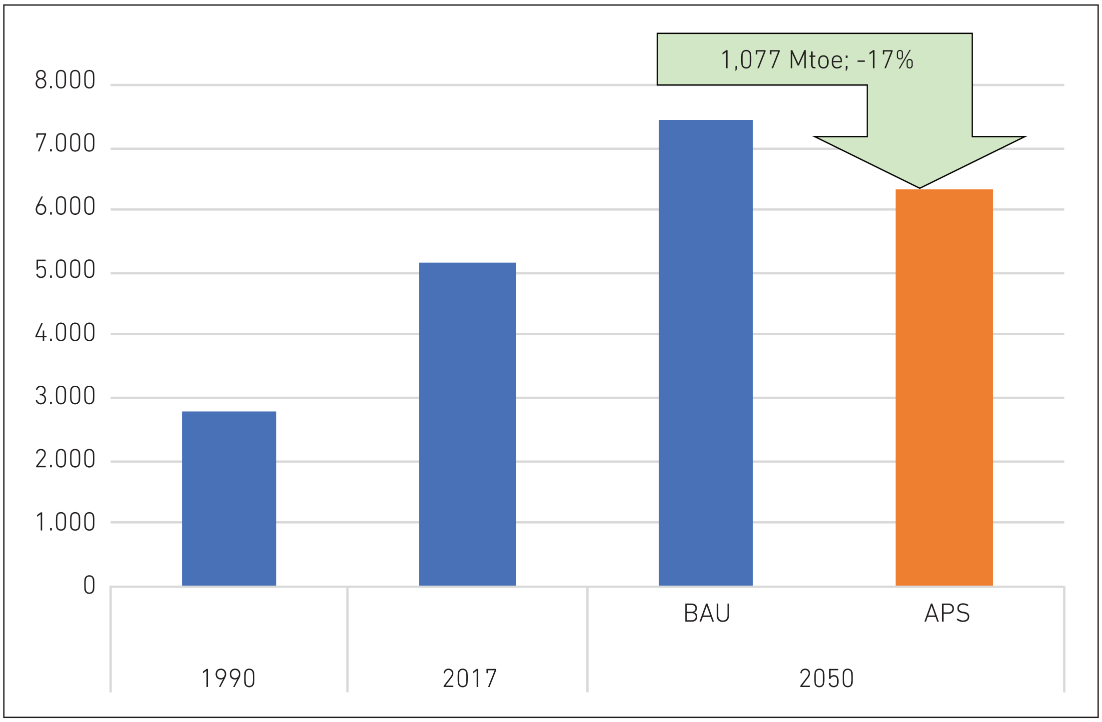
Comparison of Energy Demand and Supply (BAU vs APS)

Energy demand (BAU vs APS)

Under the APS, final energy consumption is projected to rise from 5,160 Mtoe in 2017 to 6,338 Mtoe in 2050. In 2050, the difference between the BAU scenario and the APS is 1,077 Mtoe, with the APS 17% lower than BAU because of energy-efficiency plans and programmes for the supply and demand sides to be implemented by EAS17 countries. Figure 17.10 shows final energy consumption in 1990–2050 under BAU and the APS.

Potential energy saving in total final energy consumption in the EAS17 (1,077 Mtoe) in 2050 is more than double ASEAN's total final energy consumption in 2017 (480 Mtoe). Energy saving in the EAS17 is expected largely from the transportation, industry and commercial, and residential sectors.

Figure 17.10 Total Final Energy Consumption, BAU and APS

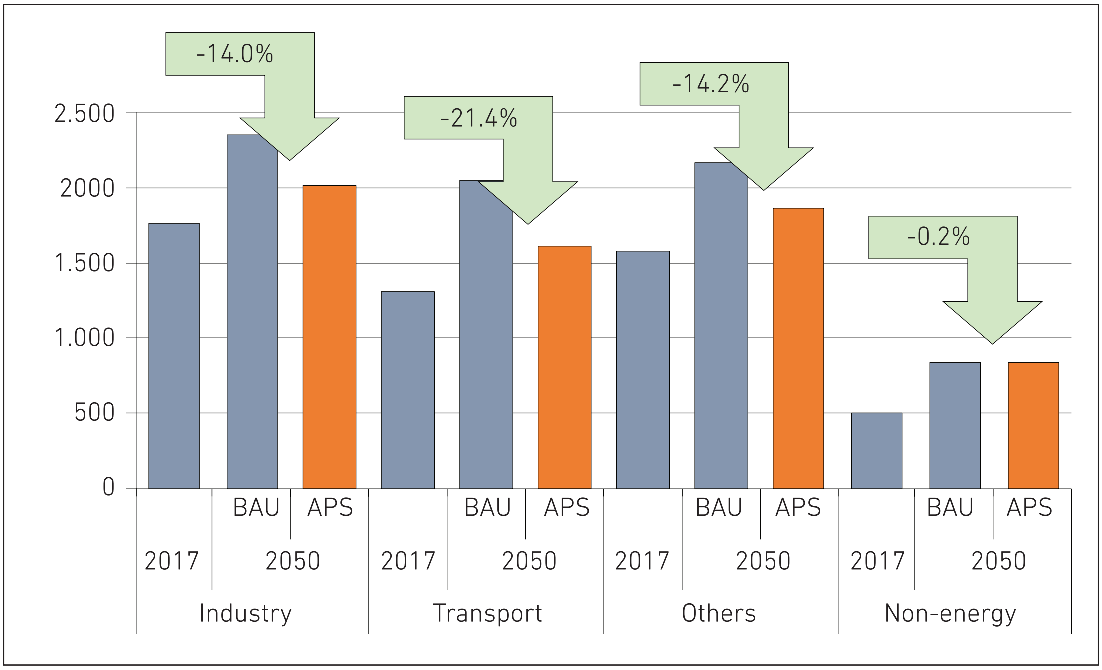


APS = alternative policy scenario, BAU = business as usual, Mtoe = million tons of oil equivalent.

Source: Authors.

Figure 17.11 shows the composition of final energy consumption by sector under BAU and the APS. Final energy consumption in most sectors is significantly more reduced under the APS than under BAU. The reduction is largest in transportation (21.4%), followed by 'others' (14.2%) and industry (14.0%). Non-energy demand will drop slightly by 0.2% from BAU.

Figure 17.11 Final Energy Consumption by Sector, BAU and APS



APS = alternative policy scenario, BAU = business as usual, Mtoe = million tons of oil equivalent.

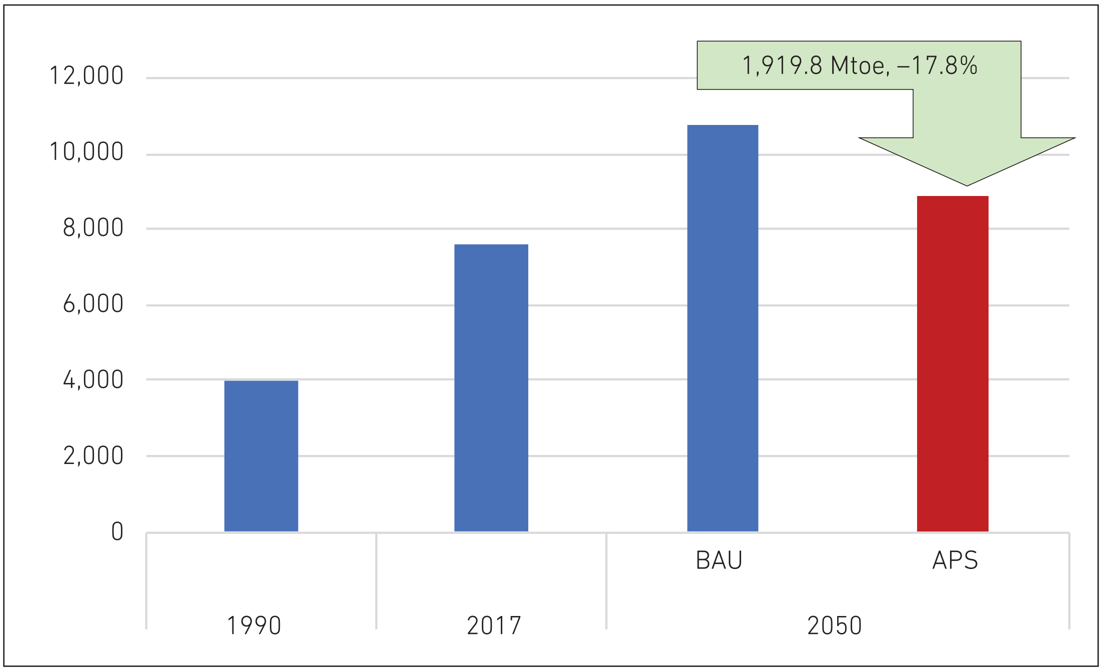
Source: Authors.

Energy Supply (BAU vs APS)

Figure 17.12 shows TPES of 10,779.6 Mtoe under BAU and 8,859.7 Mtoe under the APS in 2050. The total saving potential is the difference between BAU and the APS in 2050. The total saving potential in TPES is expected to be 1,919.8 Mtoe, representing a 17.8% reduction from BAU to the APS.

The energy saving potential results from improvements in the transformation sector, particularly power generation, and final energy consumption sectors such as transportation, industry, and the residential and commercial sector, where efficiencies are expected.

Figure 17.12 Total Primary Energy Supply, BAU and APS

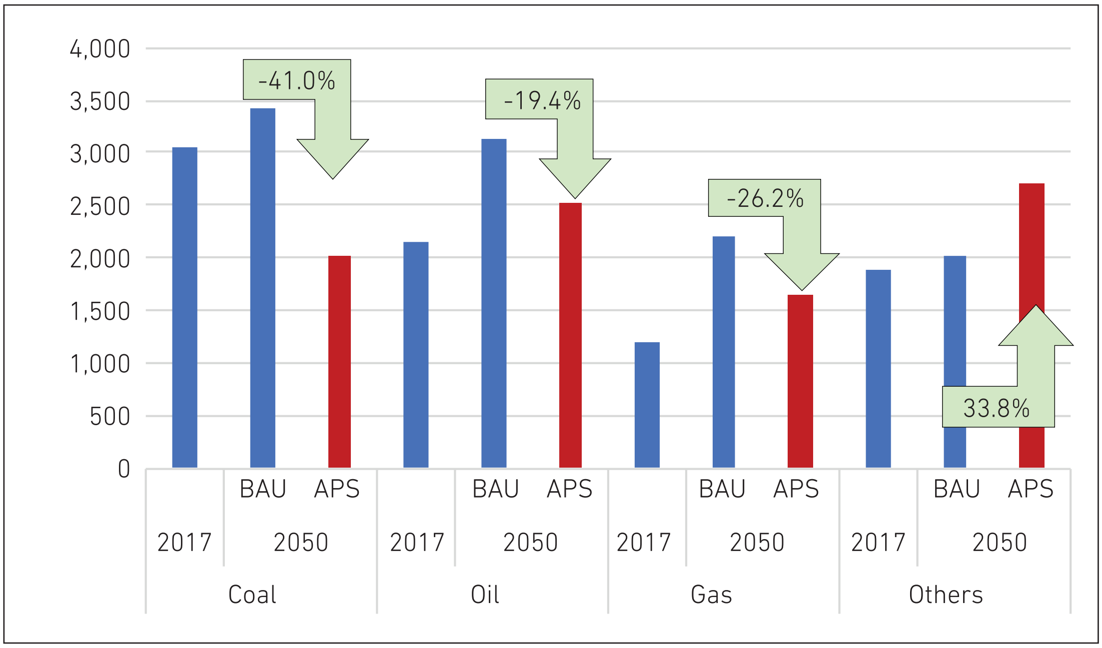


APS = alternative policy scenario, BAU = business as usual, Mtoe = million tons of oil equivalent.

Source: Authors.

Figure 17.13 shows primary energy supply by fuel source. Under the APS, growth in the primary energy supply for fossil fuels is lower than under BAU. The growth rate in the primary energy supply under the APS is projected at 0.5% per year on average in 2017–2050, which is lower than under BAU, projected at 1.1%. In absolute terms, the largest reduction will be in coal demand, by 1,401 Mtoe or 41% from 3,414.7 Mtoe under BAU to 2,013.7 Mtoe under the APS. Potential savings for other fuels are projected at 608.9 Mtoe for oil (equivalent to a 19.4% reduction under BAU) and 580.6 Mtoe for gas (26.2% reduction under BAU). Due to increased renewable energy in the primary supply, renewable energy supply, including solar wind and biomass, is projected to increase by 33.8% from BAU to an APS of aggressively including more renewables in the supply mix.

Figure 17.13 Primary Energy Supply by Source, BAU and APS



APS = alternative policy scenario, BAU = business as usual, Mtoe = million tons of oil equivalent.

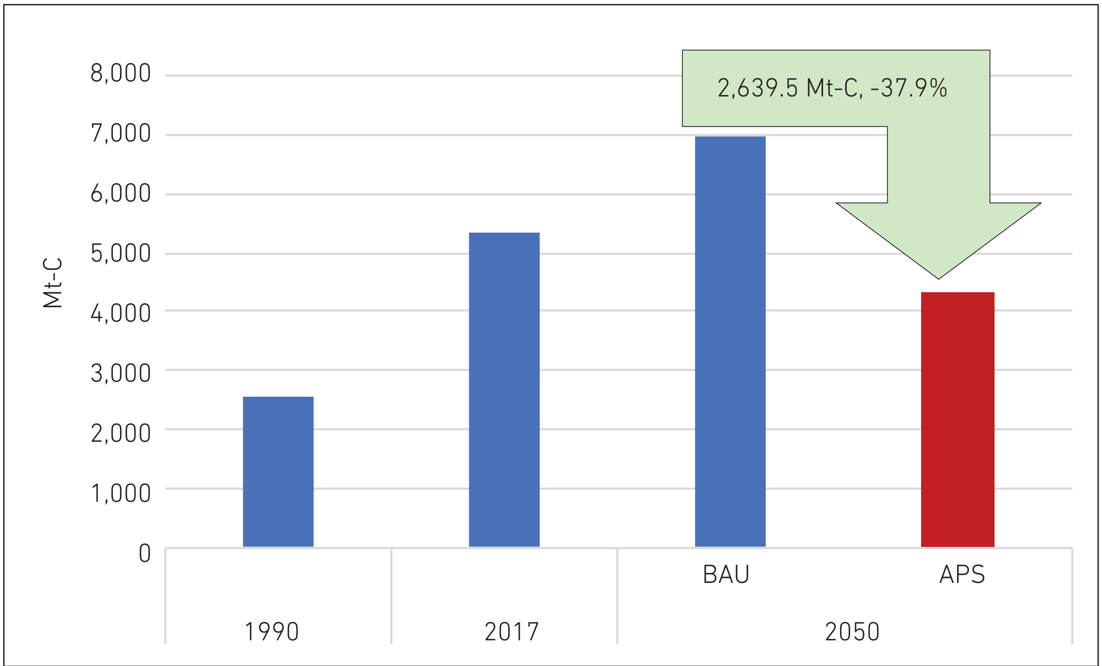
Source: Authors.

CO_2 Emissions from Energy Consumption (BAU vs APS)

Figure 17.14 shows CO_2 emissions under BAU and the APS. CO_2 emissions from energy consumption under BAU are projected to increase from 5,352.4 million tons of carbon (Mt-C) in 2017 to 6,957.3 Mt-C in 2050, implying an average annual growth rate of 0.8% in 2017–2050. The growth rate of emissions is lower than that of the TPES of 1.1% per year. This is because the share of renewables is increasing in the energy mix. Under the APS, CO_2 emissions are projected at 4,317.8 Mt-C in 2050, 37.9% lower than under BAU. At the 21st Conference of the Parties (COP21) in Paris in December 2015, 195 countries adopted the first universal binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2 degrees Celsius (°C) compared with pre-industrial levels. The Paris Agreement could bridge today's policies and climate neutrality before the end of the century.

The CO_2 emission reductions under the APS in 2050 are significant, but the emission level is still higher than in 2017. CO_2 emissions due to energy demand under the APS in 2050 will still be higher than 1990 levels. Scientific evidence suggests that these reductions will not be adequate to prevent severe climate change impacts. Analysis by the Intergovernmental Panel on Climate Change suggests that to keep the increase in global mean temperature to not more than 2°C compared with pre-industrial levels, global CO_2 emissions would need to fall by 45% from 2010 levels by 2030. Under the Paris Agreement, the parties will 'pursue efforts' to limit the temperature increase to 1.5°C, which will require zero emissions in 2030–2050 (IPCC, 2014). However, the EAS, especially the ASEAN Member States (AMS), will need to balance abating climate change with energy access and affordability. Thus, the clean use of fossil fuels through innovative technologies such as clean coal technology and carbon capture, utilisation, and storage (CCUS) will a play central role in developing carbon sinks around the globe.

Figure 17.14 Total CO_2 Emissions, BAU and APS



APS = alternative policy scenario, BAU = business as usual, CO_2 = carbon dioxide, Mt-C = million tons of carbon equivalent.

Source: Authors.

The transport sector plays an important role in the transition to a low-carbon economy. Under the BAU scenario in ASEAN during 2017–2050, the fastest average annual growth of final energy demand can be expected to happen in the transport sector (4.1%), followed by the industry sector (3.4%). By 2050, the share of transport sector energy use is projected to reach around 36% whilst that of industry and other sectors is projected to reach 33% and 22%, respectively (Purwanto, 2021). The objective of the ASEAN transport sector road map is to reduce the average fuel consumption per 100 kilometres of new light-duty vehicles sold in ASEAN by 26% between 2015 and 2025. More long-term objectives in ASEAN would be developing common indicators and methodologies and baseline data for a low-carbon fuel economy; building regional cooperation; aligning fuel economy labelling; enhancing CO_2 emission reductions based on fiscal policies; and adopting national fuel consumption standards in all markets, striving towards a regional standard in the long term. These strategic objectives in the road transport sector are embedded in the ASEAN (2019) and Global Fuel Economy Initiative (2021) blueprints.

Clean and Renewable Energy Technologies

Evolving Context of Clean and Low-Carbon Technologies

Under the Paris Agreement, each of the ASEAN and East Asian countries has made a voluntary pledge – nationally determined contributions (NDCs) – to reduce its GHG emissions. Implementation of the NDCs is not only a global commitment but also an opportunity for these countries to take decisive, inclusive, and coordinated actions for reshaping the economy and energy systems. The energy sector, accounting for some two-thirds of world GHG emissions, is the central pillar of NDC commitments. NDCs, bolstered by the Sustainable Development Goals (SDGs) and the ASEAN Economic Community, will impact the deployment of clean energy systems to a scale. Together, NDCs and SDGs provide a global, regional, and local agenda which is coherent and integrated for clean technology pathways. To seize this opportunity, their proposed plans must be translated into national policies and actions.

Table 17.2 shows the common but differentiated responsibilities of the NDCs submitted by the EAS16 countries. Their targets for emission reductions differ greatly in terms of their ambition and the way they are expressed as sectoral actions. The NDCs of Cambodia, Indonesia, the Philippines, and Viet Nam, as well as China, contain absolute targets – either for total emissions or for the year in which the emissions will peak. Other goals are expressed as a decrease in emissions against BAU baselines. The intended nationally determined contribution (INDC) commitments also take the form of a target for emissions intensity, or emissions per unit of GDP.

Table 17.2 **Composition of NDC and Energy Sector Targets in EAS16 Countries**

Country (Entry into force)	NDC target	Current renewable energy target	Scope of NDC target
Australia (9 Dec 2016)	Reduce emissions 26%–28% by 2030 (Reference: 2005)	- 33,000 GWh by 2020 - 23.5% of electricity generation in 2020	Targets include energy, industrial processes and product use, waste, agriculture, and LULUCF sector
Brunei Darussalam (4 Nov 2016)	Reduce energy consumption 63% by 2030 (Reference: BAU)	- 10% of power generation by 2035 - Total power generation mix: 954,000 MWh by 2035	- Reduce CO_2 emissions from morning peak hour vehicle use by 40% by 2035 - Increase the total forest reserves to 55% of total land area
Cambodia (8 March 2017)	Reduce emissions, conditional 27% by 2030 (Reference: BAU) Reduction of 3,100 $GtCO_2$ from baseline of 11,600 $GtCO_2$ by 2030	Hydro 32,500 MW by 2020	Emissions reduction by 2030: - Energy industries 16% - Manufacturing industries 7% - Transport 3% - Other 1% - Total savings 27%
China (4 Nov 2016)	Reduce emission intensity by 60%–65% by 2030 (Reference: 2005)	Increase the share of non-fossil fuels in primary energy consumption to around 20%	Increase forest stock volume by around 4.5 billion cubic meters on the 2005 level
India (4 Nov 2016)	Reduce emission intensity by 33%–35% by 2030, conditional (Reference: 2005)	40% electric power installed capacity from non-fossil fuel by 2030	An additional carbon sink of 2.5 billion–3.0 billion tCO_2e through additional forest and tree cover by 2030
Indonesia (30 Nov 2016)	Reduce emissions by 29% and 41% conditionally by 2030 (Reference: BAU)	23% energy from new and renewable energy (including nuclear) by 2025, at least 31% by 2050	12.7 million hectares of forest area have been designated for forest conservation
Japan (8 Dec 2016)	Reduction by 26% by 2030 (Reference: 2013)	Renewables of power supply account for 22%–24% by 2030	Removal target by LULUCF is 37 million tCO_2e
Lao PDR (4 Nov 2016)	Increase share of small-scale renewable energy to 30% of energy consumption by 2030, estimated to reduce emissions by 1,468,000 $ktCO_2$ by 2025	Increase the share of renewable energy to 30%	Increase forest cover to 70% of land area by 2020

Country (Entry into force)	NDC target	Current renewable energy target	Scope of NDC target
Malaysia (16 Dec 2016)	Reduce emissions intensity by 35% and conditional 45% by 2030 (Reference: 2005	Cumulative total renewable energy (MW): - 2020: 2,065 (9%) - 2030: 3,484 (10%) - 2050: 11,544 (13%)	Targets include energy, industrial processes, waste, agriculture, and LULUCF sector
Myanmar (yet to be ratified)	By 2030, boost hydropower capacity by 9.4 GW to achieve rural electrification, using at least 30% renewable energy sources; expand forest area to 30% by 2030	Increase the share of hydroelectric generation to 9.4 GW by 2030	- Reserved forest and protected public forest: 30% of total national land area - Protected area systems: 10% of total national land area
New Zealand (4 Nov 2016)	Reduce emissions by 30% by 2030 (Reference: 2005)	Increase renewable generation to 90% by 2025	Continue to achieve a rate of energy intensity improvement of 1.3% per annum
Philippines (yet to be ratified)	Conditional reductions up to 70% by 2030 (Reference: BAU)	Capacity installation targets by 2012–2030: 8,902 MW	Targets cover all sectors, including LULUCF
Republic of Korea (3 Dec 2016)	Reduce emissions 37% by 2030 (Reference: BAU)	22%–29% of electricity generation from nuclear by 2035	Reduce energy intensity by 46% between 2007 and 2030
Singapore (4 Dec 2016)	Reduce emission intensity by 36% by 2030 (Reference: 2005)	Raise solar power in the energy system up to 350 MW by 2020	Energy intensity improvement (from 2005 levels) target of 35% by 2030
Thailand (4 Nov 2016)	Reduce emissions by 20% and conditional 25% by 2030 (Reference: BAU)	Targeted renewable generation: 13,927 MW by 2021	Reduce energy intensity by 25% in 2030
Viet Nam (3 Dec 2016)	Reduce emissions by 8% and conditional 30% by 2030 (Reference: BAU)	Targeted capacity by 2030 - Wind power: 6,200 MW - Biomass power: 2,000 MW - Other renewables: 5,600 MW	Forest cover will increase to the level of 45%

BAU = business as usual; CO_2 = carbon dioxide; EAS = East Asia Summit; $GtCO_2$ = gigaton of carbon dioxide; GW = gigawatt; GWh = gigawatt-hour; $ktCO_2$ = kiloton of carbon dioxide; LULUCF = land use, land-use change, and forestry; MW = megawatt; MWh = megawatt-hour; NDC = nationally determined contribution; tCO_2e = ton of carbon dioxide equivalent.

Source: UNFCCC (n.d.), INDCs as Communicated by Parties.

https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx (accessed 17 January 2022).

Most of the NDCs come with a conditional or contingent component, meaning a further reduction in emissions will come with international technology and financial support. This clause of the Paris Agreement is important because international support measures, including capacity building, will help emerging EAS countries to implement their NDCs in a more ambitious way. For example, Indonesia intends to reduce GHG emissions unconditionally by 29%, while pledging to reduce up to 41% with bilateral and multilateral provision of technology, finance, and capacity building support. Thailand emphasises its intention to reduce carbon emissions by 20% by 2020. Singapore commits to reducing carbon emissions unconditionally by 36%. The Philippines' INDCs plan to reduce carbon emissions by 70% by 2030. This commitment is conditional on international support and will rely heavily on the renewable energy, waste, transport, and forestry sectors.

The pledges by EAS countries under the Paris Agreement and the commitment to implementing INDCs are important for global emission reductions by 2030. Historically, this region's GHG emissions have been relatively low, but following a period of rapid economic development and increased energy use, the region has become a substantial source of global emissions. A transition to a global low-carbon economy requires Asia's positive engagement in implementing clean technology and renewable energy technology options.

Assessing the Role of Low-Carbon Energy System Technologies

Low-carbon energy systems are processes or technologies that produce power with substantially lower amounts of CO_2 emissions than emissions from conventional fossil fuel power generation. They include renewable energy systems such as solar and wind power, biomass, hydropower, and clean coal, coupled with carbon capture and storage systems and energy efficiency improvements across the sectors. The term 'clean energy systems' largely excludes other subsets of fossil fuel power sources like nuclear, oil, and gas. Since 2016, tremendous strides have been made to advance low-carbon energy systems – innovating, scaling up investment, reducing system costs, implementing appropriate policy frameworks, and interconnecting large amounts of variable renewable energy supply into the grid. Reflecting this, many countries have put forward ambitious plans to increase renewable energy in their NDCs (Anbumozhi and Kalirajan, 2017).

In addition, a number of promising initiatives that are being implemented have the potential to buttress the NDC implementation. Some 40 implementing agreements are being carried out in the areas of renewable energy (solar, wind, bioenergy, and geothermal); fossil fuels (clean coal, enhanced oil recovery, and carbon capture and storage); fusion power (tokomaks, materials, technologies, and safety); and energy efficiency (building, electricity, industry, and transport). Technology-focused alliances, such as the International Solar Alliance, Global Geothermal Alliance, and Mission Innovations, will play an important role in enabling countries to harness the full potential of low-carbon energy resources at their disposal.

The movement towards 100% low carbon is growing, with more than 600 cities having committed to this target, and an increasing number of companies joining this initiative. Thus, NDCs can provide an important impetus to enhance global efforts to mitigate carbon emissions, double the share of low-carbon energy in the supply mix, and accelerate green growth. To find solutions, the public and private sectors must work together to stimulate accelerated absorption of low-carbon technologies, which is the key to achieving NDC targets.

INDCs can and must change the current trends in energy supply and use, which are patently carbon-intensive. This will require a revolution, and low-carbon technologies will have a crucial role to play. However, although energy-related goods account for more than 10% of international trade, policymakers, academics, and the business community perceive several barriers to the diffusion of these low-carbon technologies at the national, regional, and global level. This chapter aims to identify opportunities and barriers within NDCs for effective diffusion of low-carbon energy technology and to propose the incentive mechanisms required at different levels. To ensure that critical aspects are covered, the following questions need a closer look:

- What are the key low-carbon technologies that can significantly influence the INDC targets in the short and medium term?
- Will the transition to a low-carbon energy future by 2030 be economically feasible and viable under NDCs?
- How could regional and international technology cooperation accelerate investments on the scale required for achieving the NDC targets?

A Critical Analysis of NDC and Low-Carbon Technology Deployment Scenarios

Developing countries of ASEAN and East Asia have much to gain from NDCs. Emissions will be reduced mainly from transforming their energy sectors. The required energy transition has substantial implications for countries with vast fossil fuel reserves such as coal. NDC targets imply more energy supply in 2030 from low-carbon resources that will replace conventional coal and gas. The rise of low-carbon energy in the mix depends on the declining cost of technology over time. This complexity makes it difficult to define detailed development and deployment scenarios for low-carbon technologies. On the other hand, NDC targets motivate countries in prioritising, choosing, and adopting a combination of technologies such as solar, wind, bioenergy, and clean coal. Indeed, they aim to reduce the emission intensity of the economy (TPES/GDP) and the carbon intensity of the economy (CO_2/GDP).

In general, for ASEAN, China, and India, the energy and carbon intensity decreased by 18% and 27%, respectively, between 1990 and 2015. The decreasing trend is, however, not enough to compensate for the increase in economic activity, so the absolute effect is an increase in total emissions in those 12 countries, making it difficult to meet NDC targets by 2030. The carbon intensity of the energy sector (CO_2/TPES) in those countries is increasing slightly – a consequence of the still strong, and in some cases even growing, role of coal in the energy sector. This trend may not continue, as fluctuations in the energy and electricity market can strongly influence the use of fossil fuels.

The NDCs analysed are heterogeneous mitigation targets that feature different ambitions in energy transformation. In essence, they are concerned with the diffusion of low-carbon technologies. Table 17.3 summarises the current level of low-carbon technology deployment in the emerging economies of Asia. A substantial and thriving market already exists for wind and solar technology. Greater deployment of other low-carbon technologies would create new pathways for achieving NDC targets. This would result in a low-carbon technology paradox – a situation in which the potential of technology is understood but its connection with socioeconomic development is not recognised. This paradox arises when technological progress leads to the development of backstop technology that substitutes fossil fuels perfectly. Developing economies of the EAS have a good record of technological innovation in low-carbon energy. Breaking down the regional strengths by specific technologies suggests that renewables, clean coal, energy-efficient lighting, and energy storage offer comparative advantages at the global level.

Table 17.3 Development and Deployment Characteristics of Various Low-Carbon Technologies in Asia

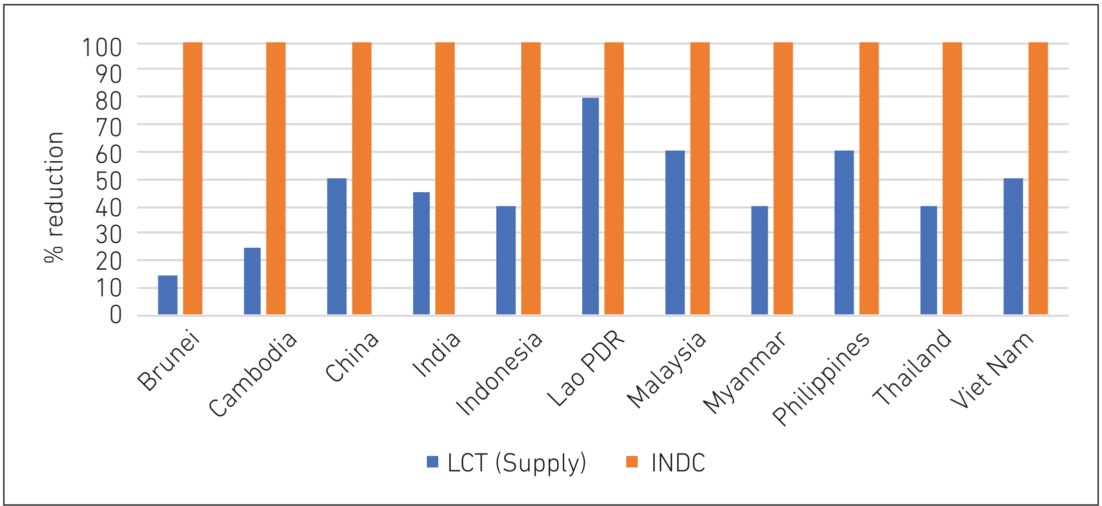
Technology	Cost	Stage of development	Diffusion in advanced countries	Diffusion in developing countries	Technology competition
Solar PV	Medium to high	Commercial	Low to medium	Low	Diffuse
Solar CSP	High	Commercial	Low	Low	Diffuse
Wind onshore	Low to medium	Commercial	Medium	Low	Diffuse
Wind offshore	Medium to high	Commercial	Low	Low	Concentrated
Hydropower	Low to medium	Commercial	High	High	Diffuse
Wave and tidal	Medium to high	Research	Low	Low	Concentrated
Geothermal	Medium to high	Commercial	Low	Low	Diffuse
Biomass steam turbine	Medium	Commercial	Medium	Low	Diffuse
Cook stoves	Low	Commercial	Low	High	Diffuse
Distributed fuel cells	High	Research	Low	Low	Concentrated
Electric vehicles	High	Near mature	Low	Low	Concentrated
Bioethanol from sugar and starch	Medium	Commercial	Medium	Low	Diffuse
Biodiesel from oil crops	Medium	Commercial	Medium	Low	Diffuse
Next-generation biofuels	High	Research	Low	Low	Concentrated
Supercritical pulverised coal combustion	Medium	Mature	High	Low	Diffuse
Ultra-supercritical	Medium	Mature	Medium	Low	Concentrated
Integrated gasification combined cycle	High	Research	Low	Low	Concentrated
Natural gas combined cycle	Low	Commercial	High	Low to medium	Moderately concentrated
Nuclear	Medium	Mature	High	Low	Concentrated

CSP = concentrated solar power, PV = photovoltaic.

Source: Modified by the authors based on Rai, Schultz, and Funkhouser (2014).

Using a harmonised set of BAU projections across the countries, Figure 17.15 shows the estimated Asian NDC scenario, reflecting the cuts in emissions by 2030. The potential reductions vary across the countries. Indonesia has the potential for a reduction of more than 30% by exploiting the available low-carbon energy supplies. Thailand and the Lao PDR have high reduction potential, while the remaining countries have lower targets. The variability in reductions by the employment of technologies suggests that several countries may have the scope for larger ambitions, especially with demand-side energy modifications. Furthermore, their energy consumption per capita is still low, offering further opportunities to achieve INDC targets in a much more cost-effective way. In other words, if today's energy investment decisions do not consider low-carbon technology deployment options, developing ASEAN and East Asia countries may find themselves on a high emissions trail of no return.

Figure 17.15 Carbon Emission Reductions under INDC and Low-Carbon Energy Supply Scenarios



INDC = intended nationally determined contribution, LCT = low-carbon technology.

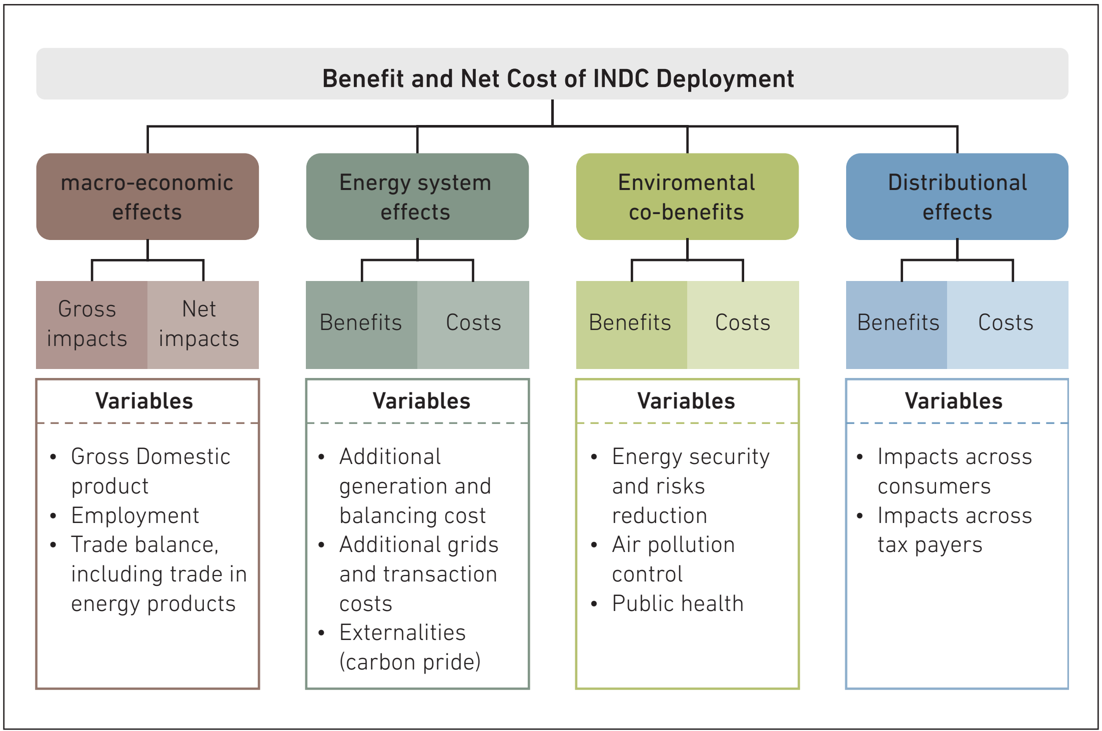
Source: Anbumozhi and Kalirajan (2017).

Estimating Low-Carbon Technology Deployment Costs

High-level cost analysis is vital for the deployment of low-carbon technologies that meet the NDC targets. It is related to technology needs assessments, which provide the foundation for NDC cost analysis by identifying the barriers to the access of technologies and the additional costs involved in removing those barriers. Achieving the NDC targets at the regional and national levels requires a fundamental shift in the energy mix through large-scale investments in low-carbon energy technologies such as wind, solar, biomass, clean coal, and carbon capture and storage. It also depends on investment in energy efficiency.

Environmental and social benefits need to be taken into account when estimating the total cost of low-carbon technologies that will help attain the NDC targets. The implementation of NDCs offers immense benefits through effects other than emission reductions and energy security. Despite short-term economic costs, the diffusion of low-carbon technologies to meet NDC targets can create substantial co-benefits, including the environment and health. The main co-benefits are better air quality, less traffic congestion, a healthier environment, and diversified and enhanced energy security. The socio-economic costs and benefits of low-carbon technology deployment and NDC implementation are shown in Figure 17.16.

Figure 17.16 Estimating the Net Cost of Clean Technology Adoption under INDC Scenarios



INDC = intended nationally determined contribution.

Source: Anbumozhi and Kalirajan (2017).

For low-carbon technology deployment, all stakeholders must bear their share of costs, benefits, and risks. This can happen through appropriate market design and regulations that involve a certain level of administrative costs (Baker et al., 2015). This study used an integrated financial and cost assessment model to estimate the deployment costs of a specific low-carbon technology or combination of low-carbon technologies at the national economy level. That approach also used case study analysis to identify the barriers to and incentives for low-carbon technology diffusion. While there are many studies in the literature, they tend to tilt thinking towards causal factors that are readily measurable and neglect regulatory factors and their feedback – which are more difficult to quantify. The main advantage of combining the case study approach with cost analysis is the ability to examine and reconstruct the process of low-carbon technology acquisition and diffusion in the INDC context. By conducting detailed case studies, it is possible to identify causal factors that prevail across sub-sectors of the energy industry.

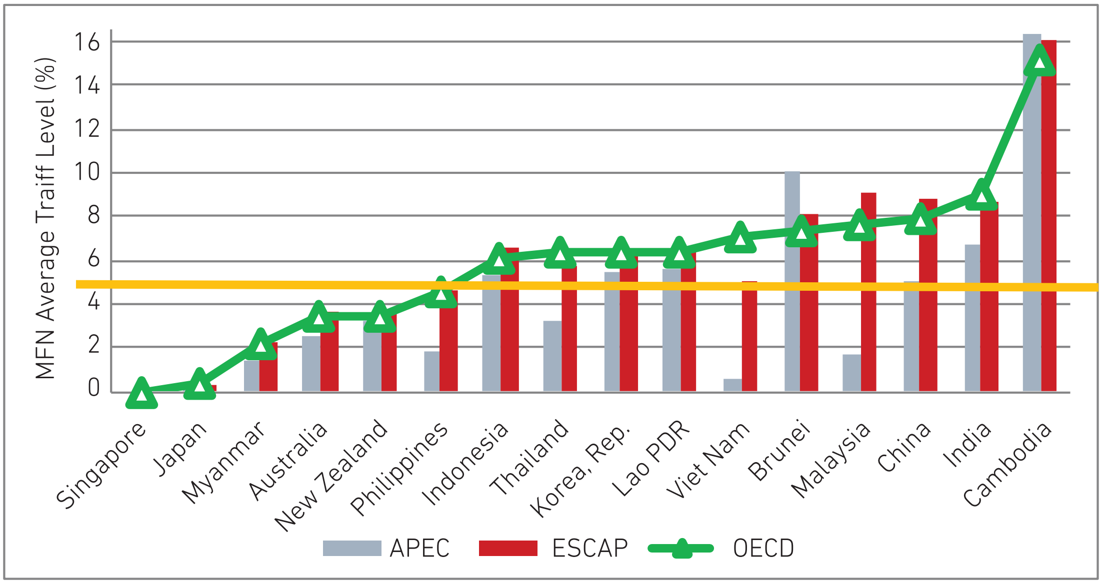
Model simulations demonstrate that for Southeast Asia, new low-carbon energy supply investments from 2016 to 2030 will cost $0.194 billion–$3,527 billion net present value. On average, it will be around $500 billion. Further cost estimation needs to include both the expenditures and benefits in the deployment of low-carbon technologies to meet the INDC targets. Additional investments in energy production using renewables and energy efficiency total $15 billion under the INDC, but about $5 billion of this is offset by reduced investment in fossil fuels, leaving a net increase of $10 trillion, or $300 billion per year. The deployment of other low-carbon energy generation technologies – such as carbon capture and storage, smart grid, and energy storage – could increase the need for investment in new infrastructure, which raises capital expenditure at the economy and sector levels.

Globalisation of Clean Energy Technologies

Most of the countries' submissions to the Paris Agreement assume international support to achieve ambitions targets – encouraging the use of market and non-market measures for instituting technology transfer agreements and setting standards. Developing EAS countries are already large exporters of low-carbon technologies and related services, and in some economies, significant innovators.

Trade policy has an important role to play in securing the low-carbon technologies necessary to facilitate the energy shift, and thus helping countries achieve their NDC targets. Trade data show that emerging Asian economies already account for 35% of low-emission products and services, which is a slightly smaller percentage than Europe, but substantially higher than that of the US. Within the region, China is the leading exporter, followed by Japan, Korea, the Philippines, and India. Removing traditional trade barriers such as tariffs and restrictions to trade in services would help to decrease the cost of low-carbon technologies, making them more affordable for all, and create a viable alternative to high-carbon low-cost fossil fuels. Figure 17.17 illustrates the border obstacles to low-carbon technologies.

Figure 17.17 Tariff Levels on Low-Carbon Technologies in Major Asian Countries, 2016



APEC = Asia-Pacific Economic Cooperation, ESCAP = Economic and Social Commission for Asia and the Pacific, MFN = most favoured nation, OECD = Organisation for Economic Co-operation and Development.

Source: Anbumozhi and Kalirajan (2017).

Tariff barriers can largely be removed on a unilateral basis. Collaboration between countries is, however, needed to address more complex issues such as cumbersome and uncoordinated standards and their associated testing and certification requirements; or various energy subsidy and pricing schemes, many of which are far more trade restrictive than tariffs. Trade talks on an Environmental Goods Agreement by WTO members could play an important role in the implementation of zero tariffs for low-carbon technologies, despite current limitations. Regional trade agreements such as the

Regional Comprehensive Economic Partnership (RCEP) offer another promising avenue for the diffusion of low-carbon technologies. Whereas mega free trade agreements such as the RCEP could have done more for the globalisation of low-carbon technology diffusion, bilateral agreements such as the European Union (EU)–Viet Nam free trade agreement are more proactive on this matter, and could serve as an inspiration for future regional trade agreements.

Globalisation of low-carbon technologies increases the forms of voluntary cooperation amongst governments and reduces the innovation and investment risks. Investments in the low-carbon energy transition are often perceived as high-risk, mainly due to the uncertainty of public policies. Country reports for an Asian Development Bank Institute study (ADBI, 2013) pointed to problems varying from intellectual property concerns and developing countries' limited access to knowledge and finance. The biggest barrier to the global commercialisation of low-carbon technologies is the failure of governments to create an effective policy incentive structure. Since the benefits of low-carbon technologies mainly accrue to the public, private markets have difficulties in valuing them. It is therefore essential that governments step up in the technology marketplace. Regional institutions such as the Asian Development Bank (ADB) could play an important catalytic role in this regard.

The Paris Climate Agreement and NDCs with contingency clauses for international support also provide a hook for the formation of carbon markets at the national level as well as across borders. The Paris Agreement provides for a carbon club arrangement, whereby a group of countries agrees on a set of common rules and standards in exchange for the right to trade emissions amongst themselves. For EAS developing economies, it provides an additional stepping stone for the formation of an integrated carbon market that will accelerate the pace of achieving the INDC targets. However, the following issues require deep consideration: (i) coordination between INDC executive committees and technology trade centres, (ii) identifying conflicting policies, and (iii) unlocking the potential of regional economic and financial cooperation. Progress on these parameters will also determine the speed of technology transfer.

Various studies (Kennedy and Basu, 2013; Rai and Funkhouser, 2015; Anbumozhi, 2021) have shown that capital flows to low-carbon technology investments are hampered by imperfections and misperceptions in financial markets, as they tend to be prone to risks and their returns are conditional on government policies such as carbon pricing. Moreover, low-carbon investments require high initial capital costs with long paypack periods. To compensate for this, NDC implementation plans should include de-risking instruments and supplementary finance for the globalisation of low-carbon technologies.

Integrated Policies for Low-Carbon Clean Energy Technology Deployment

The Paris Agreement indicates that INDCs present both opportunities and challenges for the emerging EAS economies. A universal commitment to ambitious targets has created momentum in the region for a massive energy shift towards a low-carbon economy. In addition to avoid the worst impacts of global warming, the implementation of INDCs could result in many other benefits – from new economic opportunities to improved health. At the same time, meeting the INDC targets will not be simple. The bottom–up nature of the Paris Agreement, the diversity of the energy sector targets, and the requirements for low-carbon technology transfer raise doubts about the ability of NDCs to achieve ambitious targets at the regional and global levels. In addition, the absence of a strong enforcement and monitoring mechanism poses a challenge for rapid implementation of NDCs.

Implementing the Paris Agreement must also look at increased interactions between the energy and economic policy regimes for effective absorption of low-carbon technologies. Energy sector reforms under the INDC framework will likely test the limits of these policies, along with existing trade, technology, innovation, and financing rules, some of which policymakers need to consider and deal with. Hence, action plans on NDCs should actively mobilise trade policy, including by liberalising trade in low-carbon technologies, fostering innovation, and accelerating technology transfer, as well as informing and facilitating regional carbon markets.

Government commitment to INDCs could take the form of credible and time-bound renewable energy, clean coal, and energy efficiency targets for the absorption of low-carbon technologies – to anchor the confidence of the international community in emerging Asia. Low-carbon technology deployment policies need to be part of a range of cross-cutting energy and economic policy instruments. Tailored to specific country conditions and the level of maturity of the energy and economic sectors, the policy mix should focus on adopting a system level approach, building institutional and human capacity for the globalisation of low-carbon technologies, strengthening domestic industry, and creating a market-friendly environment. The following recommendations are made towards that objective:

- **Integrated energy and economic approach to NDCs:** With greater competitiveness, support will be needed for low-carbon technologies to shift from an exclusive focus on financial incentives to ensure deep integration with the overall design and functioning of the regional economies. Growing low-carbon technology deployment is already transforming the energy sector in some countries. Accelerated transformation under the NDC agenda means that economy-wide effects of the low-carbon energy transition would be distributed across sectors and multiple stakeholders. Taking these developments into account, policymaking will have to adopt an economy-wide approach involving trade, innovation, fiscal, and social development to drive the NDC cost down. This will ensure accelerated absorption of low-carbon technologies.

- **Institutional development to support NDCs:** The pace of low-carbon technology diffusion will be strongly influenced by the ability of individuals and institutions to make informed and effective decisions on the implementation of low-carbon technology road maps. In many countries in the region, the institutional capacities of energy, environment, and economic ministries remain weak – affecting the awareness, policy design, and implementation of NDCs. Where such capacities exist in some developed countries, they are commonly restricted by lack of resources and consensus in mobilising additional resources. Cross-sectoral needs assessments should guide the elaboration of national capacity building programmes for NDCs. Such initiatives should focus on establishing an appropriate steering process, institutionalising inter-sectoral coordination mechanisms, and creating or strengthening specialised institutions for low-carbon technology innovation and transfer.

- **Skills development through education and training:** This requires systematic access across all sectors and layers of the economy to education and training in low-carbon technologies prioritised in each country. Professional training and university curricula must evolve to cover prioritised low-carbon technologies and their integration into NDC implementation. Vocational training programs can also offer opportunities to acquire specialisation and take advantage of the growing low-carbon job market. Planning that integrates innovation, education, and training policies within NDC strategies should be accompanied by continued collaboration between industry, policymakers, and academia.

- **Strengthening regional private sector capabilities and boosting the development of local industries to reduce the cost of NDCs**: As a result of increasing low-carbon technology deployment, new markets will emerge across countries, creating new international trade flows while providing opportunities for all economies to localise different segments of the low-carbon technology value chain. The segments that can be localised depend on the state and competitiveness of local complementary industries as well as the projected demand for low-carbon energy goods and services. Cross-cutting policy interventions such as industrial updates, supplier development programs, and industrial cluster formation, can contribute to increased competitiveness and production quality. Nascent industries can be supported through measures that create demand for local goods and services. However, these measures need to be planned with 2030 NDC target deadlines and designed in a way that ensures technology transfer which leverages existing domestic industrial capacity.

- **Market-friendly environment to overcome financing barriers and attract investors.** To attain the INDC targets, regional annual investments in the low-carbon energy sector need to be \$500 billion–\$750 billion per year between 2020 and 2030. Most of the investments in low-carbon technologies need to come from private sources. As low-carbon technology deployment grows and new markets emerge, financiers could more accurately assess the risk and design financing products suited for NDC products. Nevertheless, actual and perceived risks continue to slow investment growth. Public funding will continue to remain an important catalyst and will need to increase. Ample evidence shows that public finance can de-risk investment and thus leverage considerable funding from private sources, both domestic and international. Investment strategies on low-carbon technologies need to be tailored to each phase of the NDCs. The success of any investment strategy in low-carbon technologies will rely on the participation of a broad spectrum of private and finance actors, including development finance institutions, private equity funds, institutional investors, export credit agencies, and commercial banks.

Power Grid Connection in ASEAN

Significance of the ASEAN Power Grid

To meet the growing electricity power demand in ASEAN, huge investments in power generation capacity and power system expansion are required. In addition, the ASEAN region has an abundance and diversity of not only fossil energy resources such as natural gas, coal, and oil, but also renewable energy potential such as hydropower, solar power, wind power, and biomass. The Heads of ASEAN Power Utilities/Authorities (HAPUA) recognised this and established a plan for the ASEAN Power Grid (APG) in 1997 as a flagship program under the ASEAN Vision 2020 to enhance cross-border electricity trade. This aims to provide benefits to meet the rising electricity demand and improve access to energy services in the ASEAN region. The HAPUA have vitally promoted the ASEAN Interconnection Masterplan Study (AIMS) to formulate a strategy to accelerate the realisation of the APG.

The study consists of two phases – AIMS I and AIMS II – successfully completed in 2003 and 2010, respectively. The strategy, based on these studies, aims to encourage participation on a cross-border bilateral basis, then gradually expand to a subregional basis (northern subsystem, southern subsystem, and eastern subsystem), and finally move to an integrated APG system. It is expected that power exchanges and purchases will triple the capacity during 2014–2025 and increase to 17,000 megawatts (MW) after 2025.

A fully functioning regional grid brings many benefits. Through such interconnection, cheaper renewable energy resources, which are abundant in the region – especially hydropower in the Greater Mekong Subregion (GMS) – could be developed. A synchronised regional grid could take advantage of the varying peak and non-peak hours in different countries and thus save a large portion of the investment in expensive peak power generation capacities. However, the high up-front cost of new transmission lines for cross-border interconnection and the uncertainty of future demand for electricity imports and exports through these transmission lines complicate financial decisions to invest. The financial feasibility of each proposed cross-border transmission line needs to be studied carefully.[6]

Since 2016, however, the energy landscape in the region has changed. AMS have faced challenges in fulfilling the energy demand, which has increased significantly and will continue to grow at a rate of 5%–6% per year in the coming decades. In addition, the AIMS II study was not able to identify paths to maximise the use of indigenous renewable energy resources in ASEAN, in response to the direction from the ASEAN Plan of Action for Energy Cooperation 2016–2025 that the 33rd ASEAN Ministers on Energy Meeting endorsed in September 2015 in Kuala Lumpur, Malaysia.

[6] Kutani (2013) estimated $11 billion net savings in the cost of electricity generation for all AMS plus two southwest China provinces and northeast India in 20 years, despite the high initial costs of investment in interconnecting transmission lines. The other independent estimation by Chang and Li (2012) projected net savings of $20.9 billion for ASEAN alone in 20 years.

Various studies (ADBI, 2013; Anbumozhi, 2021; ASEAN, 2019; IEA, 2019; and Thincraft, 2019) have asserted that, to integrate a variable renewable energy power source such as solar and wind power generation into a power system in a stable manner, it is necessary to absorb the fluctuation and maintain the balance between supply and demand. This requires synchronous generators to respond more sensitively to the system frequency fluctuation and be prepared to cover the cost. If the APG is properly developed, reserves for supply–demand adjustment and frequency regulation provided from synchronous generators can be widely shared or exchanged throughout the ASEAN region. This would make it possible to maximise economic benefits through effective utilisation of renewable energy sources and reduce the comprehensive generation cost. Moreover, all AMS could enjoy benefits such as the mitigation of environmental pollution and global warming.

Development of Multilateral Power Trade in ASEAN

In 2020, cross-border interconnections amongst AMS, especially in the GMS, were already in place. These interconnections mainly consist of medium/low voltage (115-kilovolt (kV) or less) transmission lines and a few high-voltage transmission lines (500 kV, 230/220 kV). Electricity power trade has been carried out amongst GMS countries, mostly on a bilateral basis or based on power purchase agreements under which independent power producers sell electricity to power utilities via dedicated transmission lines. The cross-border interconnection of a 500 kV transmission line is only installed to dedicated transmission lines for power purchase agreements. Therefore, the electricity power trade in ASEAN has been limited.

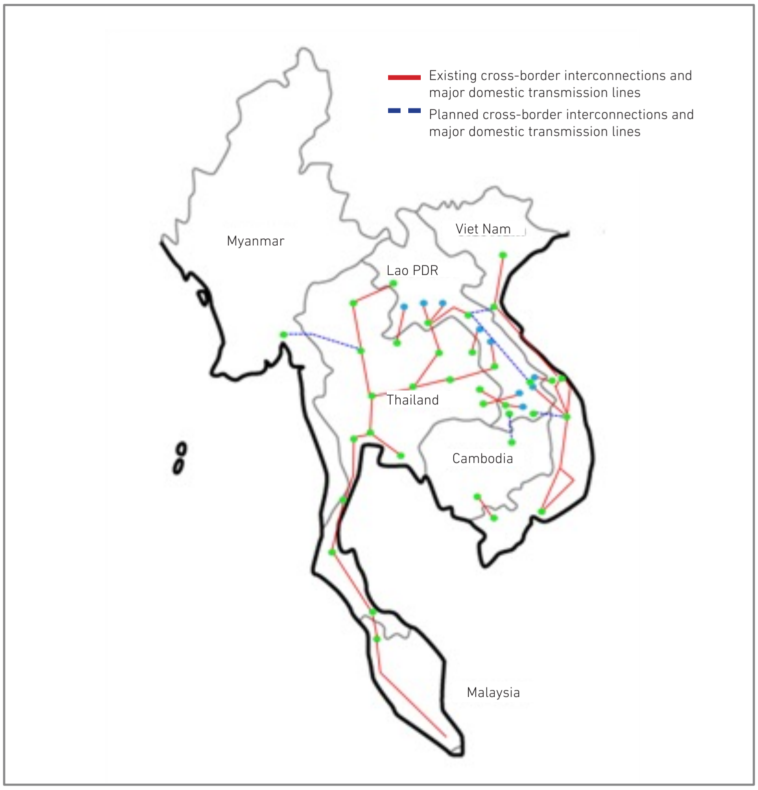
AMS have long recognised the necessity of the APG. To fully unlock the benefits of the APG, they will need to establish multilateral power trade in the ASEAN region. Generally, utilising the value of difference is one of the key reasons for regional integration and cooperation, creating positive effects on the security of supply and hence grid stability. In addition, the economic benefit of having complementary production is one of the main drivers and reasons for building interconnections. As explained in the ASEAN Plan of Action for Energy Cooperation, 2016–2025, an interconnected APG brings multiple benefits (ERIA, 2018).

Multilateral power trade aims to optimise resources on a regional basis instead of a national basis to meet the demand for electricity in the region as a whole at the least possible cost. When it comes to regional cooperation, it is important to emphasise that increasing regional cooperation does not directly correlate to losing national control of the electricity sector (ERIA, 2018). Some key points on the potential benefits of multilateral power trade are:

(i) More efficient use of the region's energy resources, leading to lower overall production costs in the APG since optimal investments can be made on the regional scale instead of suboptimal solutions separately in each country.
(ii) Help utilities in the region to balance their excess supply and demand, improve access to energy services, and reduce the costs of developing energy infrastructure.
(iii) Accelerate the development and integration of renewable power generation capacity into the regional grid.
(iv) Reduce the need for investment in power reserves to meet peak demand, thereby lowering operational costs while achieving a more reliable supply and reducing system losses.
(v) Attract additional investment in the region's interconnection, by providing a price signal as a key catalyst to investors for their financial returns.

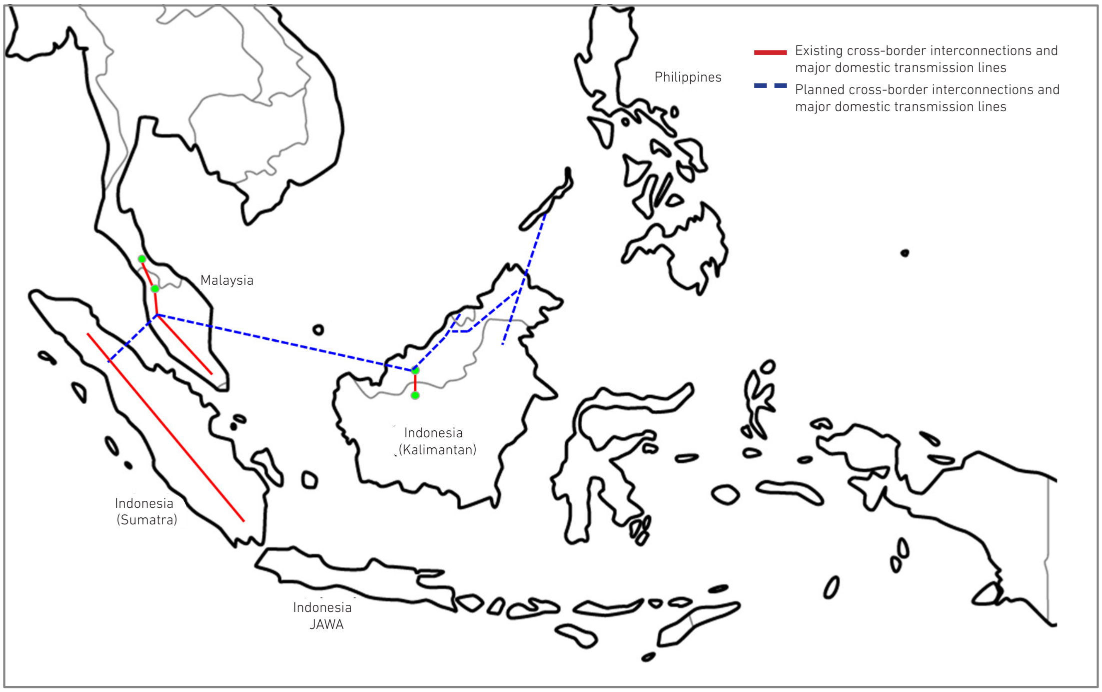
To realise multilateral power trade in ASEAN, AMS are carrying out the Lao PDR, Thailand, Malaysia, Singapore Power Integration Project (LTMS-PIP), the first pilot multilateral power trade project in ASEAN (Figure 17.18 a and b).

Figure 17.18a Existing and Planned High-Voltage Interconnections and Transmission Grid



Source: Diagram based on IEA (2019) and Thorncraft et al. (2019), with modifications by ERIA.

Figure 17.18b Existing and Planned High-Voltage Interconnections and Transmission Grid



Source: Diagram based on IEA (2019) and Thorncraft et al. (2019), with modifications by ERIA.

First Step for Multilateral Power Trade in ASEAN

A study by ERIA (Fukasawa, Kutani, and Li, 2015) identified that a power grid interconnection amongst the Lao PDR, Malaysia, Singapore, Thailand, and Viet Nam is financially feasible and should be prioritised (Table 17.4). This finding coincides with the initiative by the governments of the Lao PDR, Thailand, Malaysia, and Singapore to develop interconnections and demonstrate a multilateral framework for cross-border trade in power.

Table 17.4 Possible Interconnection and Cumulative Costs and Benefits, 2025–2035

Case	Gross benefit (A)		Cost (B)		Net benefit (C) = (A) – (B)		Benefit–cost ratio (D) = (C)/(B)
	($ million)	(US¢/ kWh)	($ million)	(US¢/ kWh)	($ million)	(US¢/ kWh)	[-]
Thailand–Lao PDR	21,387	3.77	1,506	0.26	19,881	3.51	13.2
Viet Nam–Lao PDR–Thailand	24,707	3.68	2,097	0.32	22,610	3.36	10.8
Lao PDR–Thailand–Malaysia–Singapore	27,490	3.88	2,000	0.28	25,490	3.60	12.7

kWh = kilowatt-hour, US = United States.

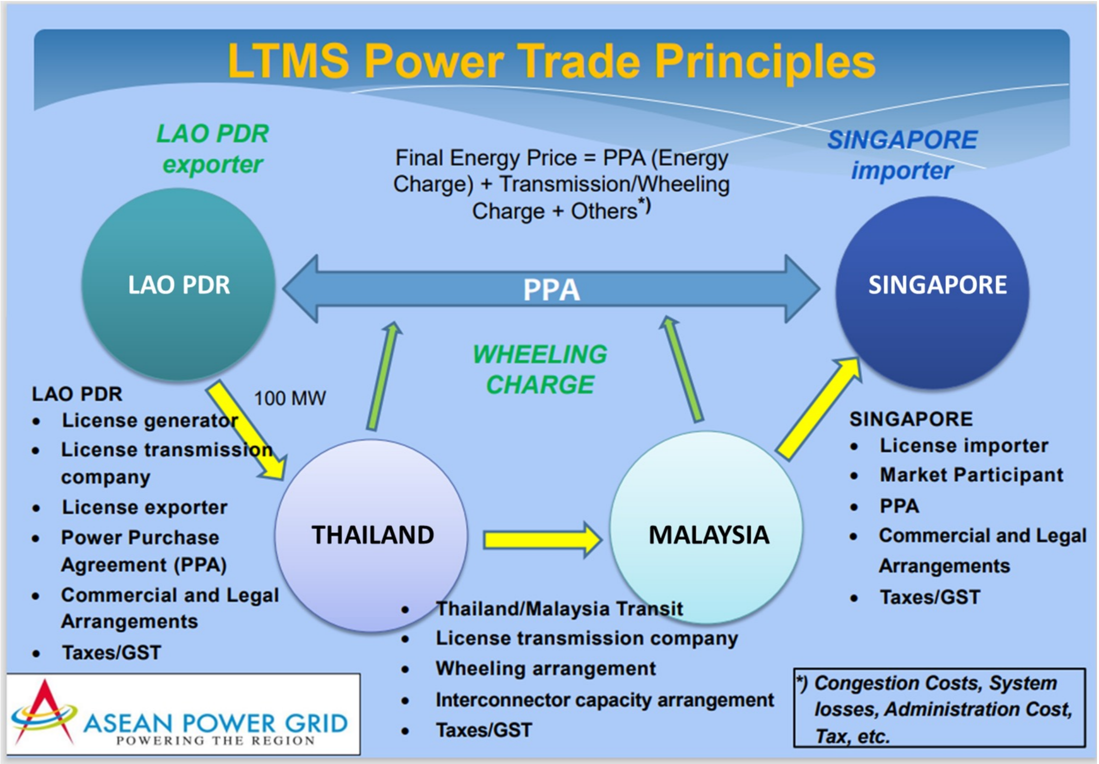
Source: Fukasawa, Kutani, and Li (2015).

The Ministry of Energy and Mines of the Lao PDR, Ministry of Energy of Thailand, and Ministry of Energy and Green Technology and Water of Malaysia signed the memorandum of understanding of the Lao PDR, Thailand, Malaysia Power Integration Project (LTM-PIP) at the 34th ASEAN Ministers on Energy Meeting in September 2016. This memorandum of understanding facilitated multilateral cross-border power trade up to 100 MW from the Lao PDR to Malaysia via Thailand's transmission grid. The original aim of this project is to transfer electricity from the Lao PDR to Singapore under the LTMS–PIP. The LTMS–PIP will serve as a pathfinder to complement existing efforts towards realising the APG and the ASEAN Economic Community by creating opportunities for electricity trading beyond neighbouring borders. As a pilot project, the focus is primarily on identifying and resolving issues that could affect cross-border electricity trade amongst the AMS more broadly (Thorncraft et al., 2019).

Phase I of the LTMS–PIP started in January 2018, and 17 GWh of energy was transferred from the Lao PDR to Malaysia in cross-border trade. The ASEAN Ministers on Energy welcomed the Joint Statement of the LTM–PIP Phase II announced by the three countries when Thailand chaired the 37th ASEAN Ministers on Energy Meeting in September 2019, where the three countries confirmed the increase in the maximum committed energy capacity trading of the LTM–PIP up to 300 MW. The LTMS–PIP is a multilateral trading arrangement insofar as it includes more than two countries. However, it is also a unidirectional trade, so it is more limited than multilateral trading as defined by this study. However, certain key elements of the LTMS–PIP are very relevant to the broader goals of the APG. Two stand out in particular: the development of the wheeling charge and the underlying process for developing the LTMS–PIP in the first place.

To establish multilateral power trading in the region, it will be necessary to develop a common wheeling methodology. The LTMS–PIP wheeling methodology could be an appropriate start. The LTMS–PIP wheeling charge is based on the following elements: the distance of the trade (MW per mile), a loss charge (charged per megawatt-hour), a balancing charge (per megawatt-hour), and a fixed administrative charge. To generalise this methodology for ASEAN as a whole, the LTMS partner countries will need to share additional details on how each of these components are calculated. It should be emphasised, however, that this can be done without sharing the actual wheeling charge applied to the LTMS–PIP trade, should this information be considered too sensitive to share publicly (Figure 17.19).

Figure 17.19 Conceptual Diagram of LTMS–PIP



GST = goods and services tax; LTMS-PIP = Lao PDR, Thailand, Malaysia, Singapore Power Integration Project; MW = megawatt; PPA = power purchase agreement.

Source: Hermawanto (2017).

The underlying process used to develop this project is also very relevant to the ASEAN-wide discussion. In particular, work on the project was divided across four working groups, which looked at (i) the tax and tariff structure, (ii) commercial arrangements, (iii) a technical viability study, and (iv) regulatory and legal arrangements, each of which was led by a different country. There are two key lessons from this arrangement. First, dividing work across the participating countries is a good way of giving everyone a stake in, and a sense of ownership over, the underlying process and therefore the overall project. Second, it is possible for a particular AMS to be actively involved in the development process even if it does not take part in the trading arrangement itself. This is an important lesson for ASEAN as a whole, because some AMS will participate in multilateral power trade early on (IEA, 2019).

Challenges to ASEAN Grid Connectivity

Significant developments have slowly taken place within the ASEAN region to increase regional trading based on bilateral deals and use the existing infrastructure to move power throughout the region. But there is still a long way to go to establish a full-fledged regional ASEAN power market. One of the reasons for the slow progress is the multitude of types of power sector structures and markets throughout ASEAN, creating problems and barriers on all levels of collaboration. Challenges remain in setting up the following: (i) a regional regulators group/regional regulatory body to harmonise regulations and standards relevant to grid interconnection; (ii) a regional operators group or regional system operator to synchronise actions in balancing the grid and the cross-border power exchange systems; and (iii) a regional system planners' group to coordinate and optimise the future investment plan of power stations and the grid.

To solve these issues, several studies have been conducted by HAPUA, the ASEAN Centre for Energy, and ADB. The findings suggest the need to harmonise the legal and regulatory frameworks and create technical standards and codes relating to planning, design, system operation, and maintenance. ERIA also carried out two research projects.

The first is a 'Study on the Formation of the ASEAN Power Grid Transmission System Operators (ATSO) Institution' (Li, Wada, and Söderström, 2018). There are two layers of objectives: (i) to establish the roles, structures, operational guidelines, and processes of the ATSO institution; and (ii) to provide a detailed implementation plan for the creation and operation of the ATSO. This study provides an overview of the international case examples that have been used as the basis for creating the ATSO, the ASEAN Power Pool (APP) guideline, and the APP Implementation Plan and Roadmap. The second is a 'Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning (AGTP) Institution' (Li, Wada, and Shinozaki, 2018). The objective is to propose applicable procedures, structures, roles, and mechanisms to establish and maintain the AGTP. The ATSO and the AGTP institutions, once achieved, will be symbolic of the regulatory connectivity in ASEAN. This study provides experiences about this field in Japan, Europe, and the Southern African region refer to and learn from the AGTP guideline and the AGTP implementation plan (ASEAN, 2019).

Necessity of New Regional Institution for Multilateral Power Trade

Multilateral power trade has operated in many regions, such as the Pennsylvania–New Jersey–Maryland Interconnection, Nord Pool, European Network of Transmission System Operators for Electricity, and South African Power Pool. These regions have regional institutions to support multilateral power trade. In the ASEAN region, additional institutional arrangements will be necessary to establish full multilateral power trade at the regional level.

Those two ERIA studies aim to help the AMS achieve consensus on the principles, building blocks, and framework of an integrated regional electricity market. The output from the studies concluded that the function of the AGTP and ATSO should be placed in the same organisation to secure a close relationship between the planning and power system operation. After discussions during the workshops of the AGTP and ATSO studies, the ASEAN Power Grid Consultative Committee and AMS agreed that the functions of the AGTP and ATSO should be merged into one organisation, and the new organisation was named the APP.

The primary role of the APP is to act as a coordinating body between the AMS transmission system operators, focusing on harmonising operational standards across ASEAN to achieve more efficient operation of the future APG. More efficient operations are anticipated to come from better coordination and alignment of the system operation and generation within the region. The APP is expected to be a key institution to enable multilateral trading of electricity amongst AMS, whilst maintaining the balance, stability, and reliability of the interconnected power grids across borders. In addition, the role of coordinating the APG system planning and grid developments will be of great importance to make the APG more efficient and better coordinated.

The APP will resemble a forum where operational, technical, and multilateral trading topics can be discussed and agreed. It will also have an important information-sharing role for the region. The suggested responsibilities of the APP will be to lead and coordinate the development of the regional market, establish and own the APG network codes and guidelines, and produce a regional system planning and development plan which will be continuously revised. The development of the codes by the APP and overall activity will focus on interconnections and how these are to be utilised in the best way. The APP will not have an operational role within the different AMS national transmission grids. The APP is proposed to hold responsibility for operational coordination of the system in the APG, which will be achieved through the 'Control Block Coordination Centre'. The point is that there should be only one coordination centre in ASEAN.

New Integrated Energy System for Smart City

Urban Energy Use

Asia is the world's largest continent, where renewable energy use is expanding fastest (IRENA, 2017). However, until at least 2023, Asia will see growing coal demand, especially in India and Southeast Asian countries (IEA, 2018). The United Nations (2018) projected Asia's level of urbanisation to increase from 45% in 2011 to 64% in 2050, which is faster than other continents' urbanisation rates. In 2050, more than 1.4 billion people in Asia will be living in cities. Compared with rural areas, Asian cities do not only have higher final energy use, but they also generally have much higher incomes.

Looking at the above challenge and current trend, Asia is certainly the continent where governments can most decisively help to curb carbon emissions and mitigate climate change and where the ability of managing rapid urbanisation through the creation of smart cities, amongst others, would have significant and lasting consequences for the environment and human well-being. In this section, we will show some of the main policy trends in Asian countries concerning the new energy system, especially those related to the rapid urbanisation phenomenon in the region which leads to the development of smart cities.

Urban Energy Strategies in Asia

Countries' energy objectives, synthesised in the United Nations SDGs, and the objectives to meet countries' NDCs, signed as parts of the Paris Agreement in 2015, have led Asian countries to decarbonise their energy systems. For that purpose, governments in Asian countries have elaborated policies that can be categorised into two main types: (i) policies that aim at improving energy efficiency, and (ii) policies that aim at increasing the share of renewable energy uses.

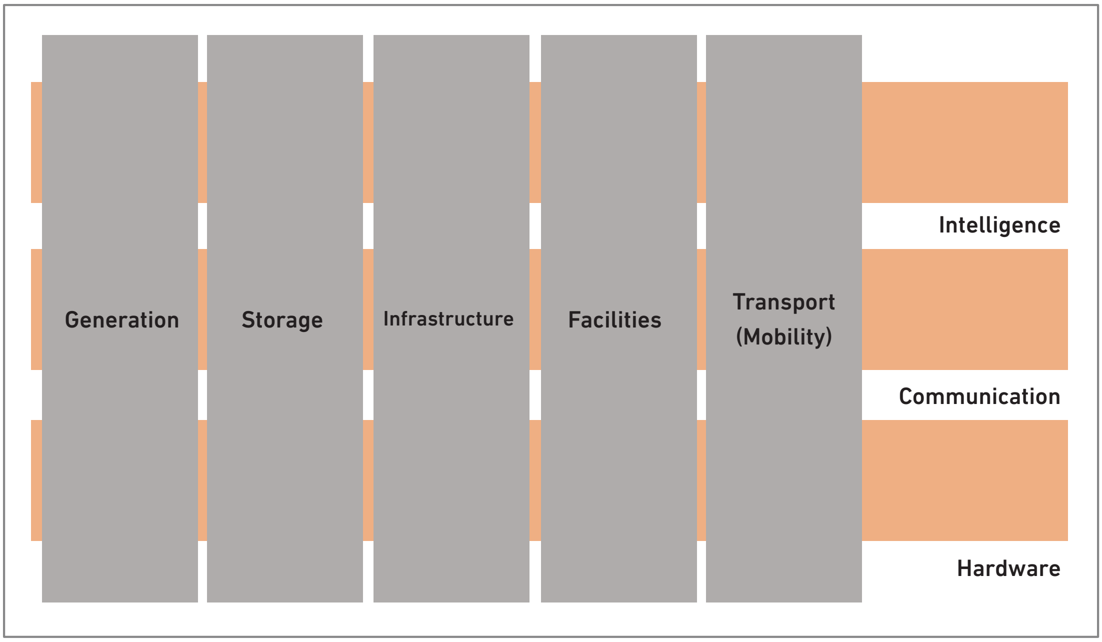
These policies in Asian countries clearly cover urban energy issues. Furthermore, they are consistent with the definition of a modern sustainable urban energy system given by the Asia Pacific Urban Energy Association (APUEA, 2019) – integrated multi-fuelled energy systems that incorporate energy efficiency, renewable energy, and demand-side management. Nevertheless, governments need to overcome many challenges to achieve modern sustainable energy systems in urban areas and cities; and faster transformation can be expected with the deployment of technological and digital solutions in creating smart cities, such as the use of geospatial databases, urban spatial data information systems, data analytics to support city operations and drive innovation, information and communication technology (ICT) networks, automation, and e-payments and digital platforms (Centre for Liveable Cities, 2018). Smart cities also aim to be sustainable cities with modern sustainable energy systems that are to be developed with respect to the economic, social, and environmental needs of the present and the future.

Adhering to this strategy of coping with rapid urbanisation and problems it causes – such as congestion, strained infrastructure, pollution, lack of affordable housing, and socio-economic inequality – the ASEAN Leaders established the ASEAN Smart Cities Network (ASCN) at the 32nd ASEAN Summit in April 2018. The ASCN is a collaborative platform where 26 pilot cities from the 10 AMS work towards the common goal of smart and sustainable urban development (see also chapter 5). A new energy system, together with smart mobility and transportation, is one of the utilities in the 'Built Infrastructure' development focus area.

Development Plans or Actions in the Main Energy-Related Components of Smart Cities

Providing more focus on the energy aspect, Calvillo, Sánchez-Miralles, and Villar (2016) suggested that smart cities are intended to deal with or mitigate, through the highest efficiency and resource optimisation, the problems generated by rapid urbanisation and population growth, such as energy supply, waste management, and mobility. The same authors also classify energy intervention areas that consist of generation, storage, infrastructure, facilities, and transport (mobility) (Figure 17.20). In brief, all these areas are related to each other but contribute to the energy system in different ways.

Figure 17.20 Classification of Energy Intervention Areas in the Smart City



Source: Calvillo, Sánchez-Miralles, and Villar (2016).

Generation provides energy, and this area can be seen in two main activities: (i) the use of renewable energy sources, and (ii) the development of distributed power generation applications and tools (systems). Energy storage systems can be used to store several kinds of energy (e.g. electric, thermal, and kinetic). In the context of smart cities, the systems are expected to serve two purposes: (i) the integration of renewable sources, and (ii) the delivery of demand-response schemes. Infrastructure consists mainly of urban power grids, and this involves the distribution of energy and user interfaces. Finally, facilities (commercial and residential buildings and small-scale infrastructure) and transport are the main final consumers of energy, as they need it to operate.

The strategy of reaching the highest efficiency and resource optimisation could be translated in terms of measures that (i) increase energy efficiency through saving and technological measures, (ii) reduce GHG emissions and/or carbon footprints, and (iii) maximise the use of renewable energy sources to reduce the burning of fossil fuels.

Smart Electricity Grids

Overview of Smart Grid

A power system in a sustainable society integrates more renewable energy to emit less CO_2 through the interaction of several defined components – distributed generation (wind power plants, mega-solar photovoltaic (PV) plants, and rooftop solar PV systems on buildings); a market system; demand response technologies; and information technology (data acquisition and communication).

The power system which enables the coordination of the interplay amongst the above-mentioned components is also known as a 'smart grid system'. The IEA defines a smart grid as an electricity network system that uses digital technology to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users (OECD, 2015). Such grids can coordinate the needs and capabilities of end-users and electricity market stakeholders in such a way that they can optimise asset utilisation and operation and, in the process, minimise both costs and environmental impacts while maintaining system reliability, resilience, and stability.

Main components and features of a smart grid

A smart grid system involves a complex arrangement of infrastructure whose functions depend on many interconnected elements. A smart grid system can be visualised as having four main layers whose elements are combined to create grid features that improve the grid's ability to achieve certain goals, such as integrating more renewables, improving reliability, and reducing energy consumption (Madrigal and Uluski, 2015):

(i) The first layer is the hard infrastructure, which is the physical component of the grid. This covers generation, transmission, and the distribution network as well as energy storage facilities.

(ii) The second layer is telecommunications, which represent the telecommunication services that monitor, protect, and control the grid. This includes wide area networks, field area networks, home area networks, and local area networks.

(iii) The third layer is data management, which ensures proper data mining and utilisation of data to facilitate smart grid applications.

(iv) The fourth layer consists of tools and software technologies that use and process collected information from the grid to monitor, protect, and control the hard infrastructure layer and reinforce the grid to allow the integration of renewable energy.

The integration of renewable energy – including wind power, solar power, hydropower, biomass, and geothermal – into the power system to reduce the consumption of fossil fuels has been increasing in recent years and is an essential feature of smart grids as it comes with distributed power generation. Wind and solar power have a characteristic not possessed by other renewables – output fluctuation – which makes this type of power difficult to integrate into conventional power systems.

In conventional systems, load fluctuations are caused by fluctuations in demand, and the load balance is restored by thermal and hydropower plants. When wind power and rooftop solar PV power are integrated, load fluctuations increase as this characteristic of wind and solar PV power combines with demand fluctuations. If thermal and hydropower plants do not have enough balancing capability, large electric storage devices such as batteries are required. However, if demand-side management is introduced, electric storage on a moderate scale suffices to restore load balance. This implies that managing demand introduces additional balancing capability to the supply side of the system.

Policies and Implementation of Smart Power Grids in Asia

In this subsection, we describe smart power grid policies and their implementation in selected Asian countries. We give an overview of the situation in both developed and developing countries of Asia.

Japan

Japan aims to reduce its GHG emissions by 26% by fiscal year 2030 compared to fiscal year 2013, and by 80% by fiscal year 2050,[7] and to meet 35% of its electricity needs with renewable by 2030 while in 2017, about 15% of Japan's total energy consumption is from renewables (Buckley and Nicholas, 2017). Solar PV could grow to reach 12% of the total electricity generation mix by 2030 from the current 4% share.

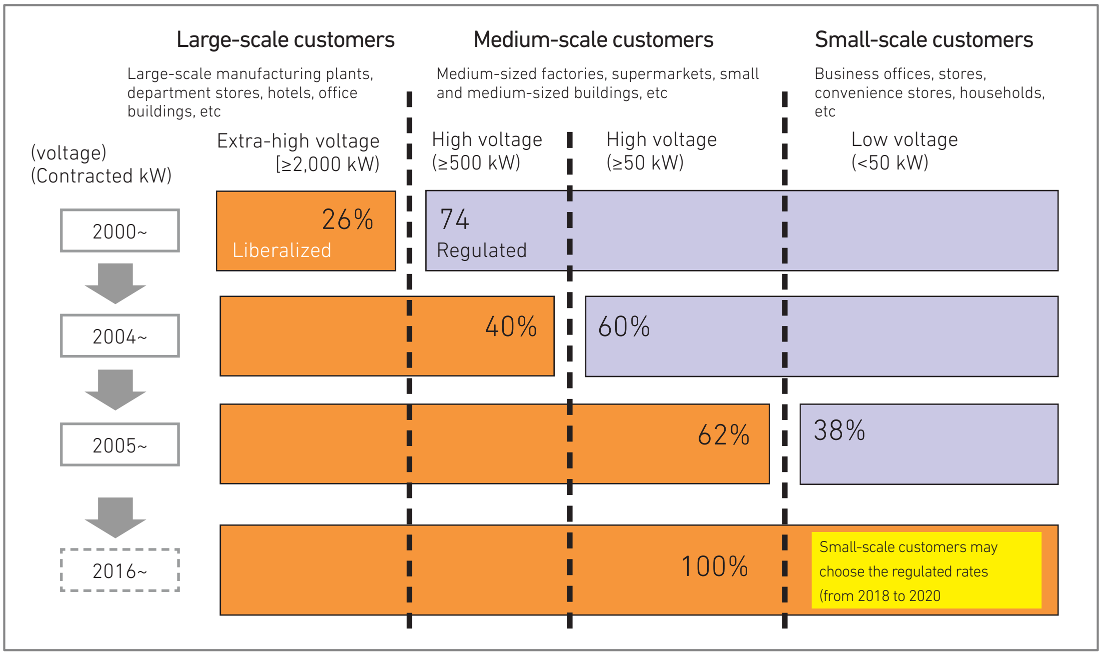
According to Ling, Kokichi, and Masao (2012), Japan's focus on smart grid development should be on how to stabilise power supplies nationwide as large amounts of wind and solar power start entering the grid. The main objective of smart grid technology adoption is to achieve a total shift from fossil fuels to renewable energy (Ito, 2009). Smart grid development in Japan cannot be separated from the concept of smart community, which refers to a community where various next-generation technologies and advanced social systems are effectively integrated and utilised – including the efficient use of energy, utilisation of heat and unused energy sources, improvement of local transportation systems, and transformation of the everyday lives of citizens. [8]

[7] Cabinet Decision on the New Strategic Energy Plan dated 3 July 2018.

[8] Japan Smart Community Alliance (n.d.).

The approval of the fourth Basic Energy Plan in April 2014 marked the major reform of Japan's energy sector. This plan, aimed at establishing a national grid and fully liberalising the electricity markets, presents the basic energy policy principles of Japan, including energy security, reliability, efficiency, affordability, reduced emissions, and increased consumer choice. In brief, the chronological deregulation process of Japan's power sector began with liberalisation of large-scale customers market in 2000 and completed with small-scale customer market liberalisation in 2016 (Figure 17.21). According to Motoaki (2017), the widescale adoption of internet technologies, combined with deregulation and energy storage improvements, opens the door for Japan to walk into the world of smart grids.

Figure 17.21 Japan's Power Sector Deregulation Timeline



kW = kilowatt.

Source: Author's compilation based on Shinkawa (2018).

Source: Prepared by TEPCO based on METI publications

The Ministry of Economy, Trade and Industry (METI) has played a very important role in implementing smart grids in the framework of smart city projects in Japan. The promotion of smart energy initiatives is amongst the objectives set in the Fourth Strategic Plan released in April 2014 (ANRE, 2014) – to realise an advanced energy saving society and smart and flexible consumer activities. Following this approval, METI established two regulatory government bodies in 2015: the Organization for Cross-Regional Coordination of Transmission Operators and the Electricity Market Surveillance Committee (Brown, Zhou, and Ahmadi, 2018). The Organization for Cross-Regional Coordination of Transmission

Operators oversees utility power generation and exchange as well as the development of regional transmission grids, while the Electricity Market Surveillance Committee monitors the electricity market and is responsible for Japan's smart meter rollout.

According to Shinkawa (2018), the electricity market system in Japan also experienced an important change in April 2016 with the switching from the third-party access model to the balancing group model. In the previous third-party access model, new power generation entrants operated their plants to keep the balance of supply and demand on a 30-minute basis, complementary to the power already supplied by the general electricity utilities. However, in the new balancing group model, both new entrants and general electricity utilities operate their power plants to keep the balance of demand and supply on a 30-minute basis.

One of the most significant developments in smart grid implementation in Japan is the massive deployment of smart meters. According to the Tokyo Electric Power Company (TEPCO) smart meter project, unlike conventional meters, smart meters provide at least three benefits: (i) smart meters have an electricity meter information transmission service that permits the transmission of the meters' measured values to the home energy management systems controller in real time; (ii) with smart meters, it is possible to understand the amount of current by analysing the electricity usage in 30-minute time intervals, which gives higher accuracy on the calculation of the expected load current compared with the conventional system, where estimation is based on a consumer's individual contract; and (iii) smart meter use improves work efficiency, as meter reading is no longer performed manually.

The Government of Japan aims to complete smart meter installation throughout the country in the mid-2020s. However, the current completion rate is just over 35% (Table 17.5).

Table 17.5 Deployment Status of Smart Meters in Japan

Electric power companies	Smart meters to be installed (in million)	Cummulative installation results as of 31 March 2017 (in million)	Percentage of installation results	Completion of installation (scheduled)
Hokkaido	3.70	0.767	20.7%	End of FY2023
Tohaku	6.66	1.480	22.2%	End of FY2023
Tokyo	27.00	10.604	39.3%	End of FY2020
Chubu	9.50	2.898	30.5%	End of FY2022
Hokuriku	1.82	0.373	20.5%	End of FY2023

Electric power companies	Smart meters to be installed (in million)	Cummulative installation results as of 31 March 2017 (in million)	Percentage of installation results	Completion of installation (scheduled)
Kansai	13.00	7.500	57.5%	End of FY2023
Chugoku	4.95	0.909	18.3%	End of FY2023
Shikoku	2.65	0.435	16.4%	End of FY2023
Kyushu	8.10	2.571	31.7%	End of FY2023
Okinawa	0.85	0.110	12.9%	End of FY2024
Nationwide	**78.23**	**27.647**	**35.3%**	**-**

Source: Shinkawa (2018).

Korea

According to the Korean Ministry of Knowledge Economy and the Korea Smart Grid Institute (2011), Korea's 'Smart Grid Road Map 2030', launched in January 2010, is to be implemented in five sectors: (i) smart power grid, (ii) smart consumers, (iii) smart transportation, (iv) smart renewables, and (v) smart electricity services. The following sectoral targets have been set:

(i) Smart power grid: to reduce the blackout time per household from 15 minutes (2012) to 9 minutes (2030) and to reduce the power transmission and distribution loss rate from 3.9% (2012) to 3% (2030).

(ii) Smart consumer: to reach the maximum power reduction by 5% (2020) and 10% (2030) and to reach a penetration rate of advanced metering infrastructure by 5.6% (2012) and 100% (2020).

(iii) Smart transportation: to reach a total number of electric vehicles (EVs) of 152,000 units (2020) and 2.4 million units (2030) while increasing the number of quick-charging stations from 100 units (2012) to 4,300 units (2020) and 27,140 units (2030).

(iv) Smart renewables: to increase the share of renewable energy use in the power sector from 3.1% (2012) to 11.0% (2030) and to increase the household electricity energy self-sufficiency ratio to 10% (2020) and 30% (2030).

(v) Smart electricity service: to allow consumers to choose their electricity rate plan by 2020 and to increase consumers' market participation rate to 15% (2020) and 30% (2030).

Korea's smart grid goals are to build a smart grid test bed, e.g. Jeju Carbon Free Island project (Korea Smart Grid Institute, 2011) for the five aforementioned implementation areas by 2012; to build a smart grid across Korea's metropolitan areas by 2020; and to build a nationwide smart grid by 2030. From 2010 to 2030, around W7 trillion ($6.6 billion) is allocated for technology development and another W20.5 trillion ($19.3 billion) for the construction of infrastructure. Amongst the main expected effects by 2030 are the 230 million tons of GHG reduction and about W47 trillion ($44.2 billion) of energy import reduction.

Jensterle et al. (2019) reported that apart from deploying micro-grids at the national level and accomplishing several complex smart grid experiences (islands and cities), Korea is pushing the penetration rate of smart meter use: by 2018, 6.8 million households in Korea were equipped with smart meters, while the 2020 target was to reach 22.5 million households, equal to 66% market penetration. Korea is also developing an integrated power control system that can better handle power supply from renewable sources, developing integrated top-level platforms that can connect various transmission and distribution systems in real time and significantly increasing its grid-connected battery energy storage, while developing quick EV chargers nationwide.

India

Sinha et al. (2011) documented three major drivers of smart grid development in India: (i) reducing power losses across its electricity system, (ii) providing varying electricity price signals to consumers, and (iii) integrating renewable energy sources. Based on the Central Electricity Authority's strategy blueprint issued in 2016, 57% of India's total electricity capacity will come from non-fossil fuel sources by 2027, which means a total installed renewable power generation capacity of 275 gigawatts by 2027 or 175 gigawatts by 2022. This estimated renewable share in power generation by 2027 is significantly higher than the Paris climate accord target for India, which was 40% by 2030.

Policy goals for smart grids in India's 12th Five Year Plan consist of the deployment of smart meters and advanced meter infrastructure, substation renovation and modernisation, deployment of micro-grids and distributed renewables, creating EV charging infrastructure, provision of harmonic filters and other power quality improvement measures, and real-time monitoring and control of distribution transformers.

The National Tariff Policy of 2006 requires utilities to introduce two-part tariffs and time-differentiated tariffs for large consumers with demand exceeding 1 MW. In January 2016, the Government of India revised the tariff policy, aimed at accelerating the deployment of renewable energy in the country. This included provisions for an 8% solar renewable purchase obligation by 2022, a renewable generation obligation on new coal/lignite based thermal plants, etc. (Ministry of Power, India, 2016). In 2013, the Ministry of Power also developed the 'Smart Grid Vision and Roadmap for India' drafted by the India Smart Grid Task Force (Smart Energy International, 2013). The National Smart Grid Mission, housed in the Ministry of Power, is the major government body that oversees smart grid implementation.

Smart Grid Progress in Asian Developing Countries

According to Brown, Zhou, and Ahmad (2018), in East Asia, the mega smart grid project in Malaysia and the Provincial Electricity Authority smart grid in Thailand are two major smart grid initiatives, but they both face technological challenges.

In Malaysia, RM2.7 billion (more than $650 million) will be invested in the 'Grid of the Future' (GoTF) – a modern grid and smart network that has robust capability for bidirectional flows of electricity, dynamic operations, and self-healing (Suruhanjaya Tenaga, 2018). Apart from advanced metering infrastructure, the GoTF includes other projects such as distribution automation, mobility solutions, geospatial information system, light-emitting diode streetlighting, and volt-vAR optimisation. These projects should increase the grid efficiency, reliability, and resiliency, as well as providing seamless integration with the distributed generation and the emergent technologies of energy storage and micro-grids. Amongst its plans on deploying smart meters, the GoTF will install 340,000 smart meters in Melaka and an additional 1.2 million smart meters in the Klang Valley.

According to Nhede (2017), Thailand's National Energy Policy Council approved a national smart grid plan to enhance the country's grid reliability. Under this plan, state-owned utilities will spend up to 200 billion ($5.6 billion) on implementing smart grid projects to 2036 to reduce utility firms' energy use by 350 MW by that year. The $5.6 billion will fund the deployment of up to five smart grid pilot projects under the guidance of Thailand's Ministry of Energy. Utility firms set to trial smart grid technologies under the approved plan include the Electricity Generating Authority of Thailand, the Provincial Electricity Authority, and the Metropolitan Electricity Authority. The pilot program included in the expedition plan of the Ministry of Energy administration by the Energy Planning and Policy Office comprises three pilot projects, i.e. two district projects in Mae Hong Son Province operated by the Electricity Generating Authority of Thailand, which consists of Muang and Mae Sariang Districts; and a smart grid project in Pattaya area, Chonburi Province, operated by the Provincial Electricity Authority.

The two projects in Mae Hong Son Province, which is mostly preserved forest area, are considered appropriate for the implementation of the pilot program. A total budget of nearly ฿2 billion ($72 million) has been allocated in the two districts aimed at ensuring the delivery of a stable electricity supply and adequate generation capacity. Power in the two districts comes from various sources and generation types previously considered as unstable. The system is expected to maximise the potential of the power system to increase its security, and to ensure reliability and overall power quality.

The smart grid project in Pattaya City Area covers major cities with high electricity demand, wide distribution of power consumers, and integrated communication and technologies. A total budget of ฿1.508 billion ($50 million) has been allocated, and Pattaya City has a policy to develop into a smart city. The Pattaya smart grid project is registered as one of the action plans of the ASCN. According to ASCN (2018a, 2018b), this project aims to move Chonburi forward to be a self-reliant, energy-efficient city with renewable energy sources and sustainable environmental management. It entails the management of electrical networks, generation systems, transmission systems, and power distribution systems, with a systematic energy management and energy storage structure.

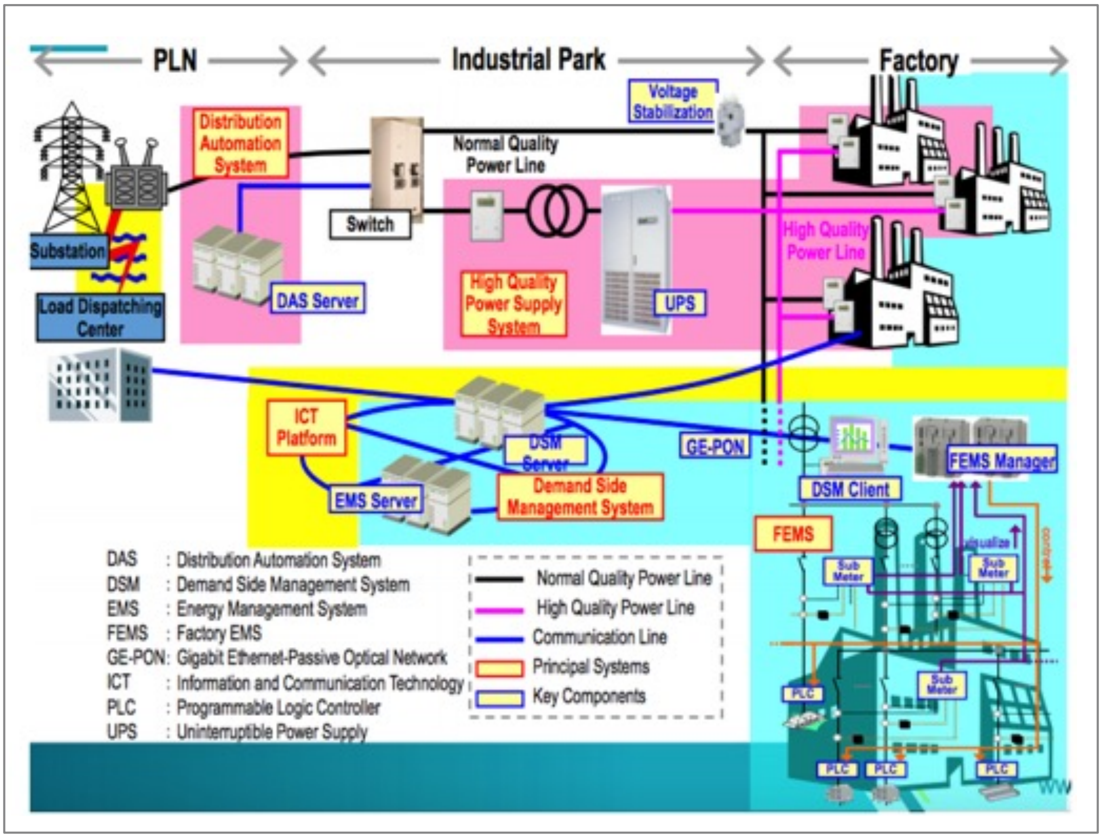
As of 8 July 2018, only two electricity utilities-related projects were registered in the action plans of the ASCN – the Pattaya city smart grid project and a waste-to-energy plant project in Chonburi Province. The latter project aims to address the waste treatment and management issues arising from the generated waste at Chonburi, and to source renewable energy integration and regional smart micro-grids, in line with the relevant national plans on built infrastructure development in Thailand.

In Indonesia, the state-owned electricity utility, PLN, is coordinating the plan, strategy, and implementation of smart grid development in the country. According to Arifin (2019), amongst the power sector issues in Indonesia are: transmission and distribution losses of around 8.75% (2017), which are higher than the ASEAN average of 7.24% (2016); data and information inaccuracy over the situation and functioning of the low-voltage network; service reliability, e.g. under 30% reserve margins in small systems outside Java and Bali; and the delivery of low-carbon energy and sustainability, e.g. limited reserve of fossil fuel based energy sources and low penetration rate of renewable energy use. Arifin (2018) divided the PLN smart grid road map into two phases:

(i) 2016–2021: PLN will focus on the formulation of strategies, introductory and pilot projects, defining standard capacity, and process building, as well as putting in place ICT and smart metering as the foundation of the smart grid.
(ii) 2021–2026: PLN will focus on more advanced features of the smart grid.

In collaboration with certain third parties, PLN is developing several pilot projects, most of which are in remote areas such as islands, with the deployment of micro-grid systems in combination with renewable-based power generation, e.g. the use of solar PV power generation. Amongst the most relevant smart city themes is the deployment of Advanced Metering Infrastructure (AMI) for customers in Jakarta and the development of a smart community in Karawang Industrial Estate in West Java. The project aims to find an appropriate business scheme that enables demand response management, which should result in better reliability and productivity of the system (Figure 17.22).

Figure 17.22 Smart Community of Karawang Industrial Estate



Source: Arifin (2018).

Conclusions and Recommendation

Based on the above analysis, we conclude that energy consumption in the EAS region will increase remarkably due to stable economic and population growth. It will continue to depend largely on fossil fuel energy, such as coal, oil, and gas until 2040 (BAU) even under a tough scenario of higher crude oil prices (about $120 per barrel in 2040 at 2016 constant prices). But the COVID-19 pandemic outbreak will have many short- and medium-term implications on energy infrastructure investment and the climate agenda in the ASEAN and East Asia region. The economic downturn is already contracting energy demand by 10%–15% in major economies and CO2 emissions in the short term (IEA, 2020). However, there will certainly be a rebound when the economy recovers. This effect is compounded by extremely low oil prices, which were triggered by rivalries amongst the major oil producing countries, damaging the supply capacity of several small producers in the region. While low oil prices could push down liquefied natural gas (LNG) bills, this would also bring down the production cost of domestic coal. Cheaper fossil fuels would make renewable energy less competitive.

Governments that are preoccupied with fighting the pandemic, and restoring jobs and the economy, are likely to treat energy conservation and climate change issues as lower priorities. Revisiting technology dependence on China could affect the high reliance on Chinese solar modules. The surge of nationalism and retreat of globalism will also have a negative impact on national, regional, and global endeavours for tackling climate change. Since governments prioritise public expenditure on fighting the pandemic and rescuing impacted families and small businesses, the financial resources available for clean energy investment or subsidies will become extremely limited. Since cheap energy would be an even higher priority in economic difficulties, reliance on domestic energy resources and coal could last longer than expected before the pandemic.

On the other hand, ongoing social distancing practices – such as moving almost all activities to the internet (e.g. meetings, works, and shopping), the modal shift from mass to private transport, and avoidance of long-distance air travel – could change the energy consumption pattern and lessen energy use, air quality, and carbon emissions. The ASEAN and East Asian region should have been able to take advantage of the low fossil fuel prices, especially during 2020, to initiate efforts for phasing out inefficient fossil fuel subsidies.

Nevertheless, if the countries dedicate themselves to implementing their EEC policies and increase low-carbon energy technologies, such as nuclear power generation and solar PV/wind, the region could achieve remarkable energy savings – especially through lower use of fossil fuels – and significantly reduce carbon emissions. The APS of many countries in the region is very appropriate because its expected carbon reduction is the same or larger than the countries' INDC targets. Therefore, ASEAN and East Asian countries need to apply the Plan-Do-Check-Act (PDCA) cycle approach to promote their EEC and renewable energy policies, specifically energy saving targets and action plans according to their respective timetables.

Natural gas will grow at the highest rate up to 2040 amongst the fossil fuels, and will be an important fuel as the transition to a new energy system occurs because of lower prices than crude oil, various import sources, and lower carbon emissions compared with oil and coal. To realise this increase, the establishment of a transparent LNG market in Asia, the removal of the destination clause, and consumers' participation in LNG development, amongst others, are recommended.

The outlook analysis of future energy demand also shows that a lot of energy savings, especially on oil and electricity consumption by final users, will come from energy efficiency activities. So, the following EEC policies are recommended: (i) standardise the labelling system for appliances and energy facilities such as boilers and compressors; (ii) develop energy saving companies; (iii) increase next-generation vehicles including hybrid vehicles, EVs, plug-in hybrid vehicles, and fuel cell vehicles; (iv) establish and implement a green building index; and (v) develop an advanced energy management system.

Increasing the share of renewable energy – such as hydro, geothermal, solar PV, wind, and biomass – will contribute to reduced fossil fuel consumption and mitigate carbon emissions, and thus contribute to global trends, via the INDCs and SDGs. This will require appropriate government policies such as renewable targets, legal approaches such as feed-in tariffs/Renewable Portfolio Standards, and revised feed-in tariffs to include bidding and tendering processes.

Energy supply security in the EAS17 region is a top-priority energy issue. EEC and renewable energy contribute to maintain regional energy security by reducing fossil fuel consumption and increasing the use of domestic energy. Moreover, energy supply sources can be diversified through regional energy networks such as the Trans-ASEAN Gas Pipeline, including LNG transportation as a virtual pipeline, and the APG with the region-wide electricity trade market. The LTM (Lao PDR, Thailand, and Myanmar) is a starting point of the APG. Oil stockpiling and nuclear power generation is another option to secure energy supply in the region. Greater use of clean coal technology and the development of carbon capture and storage technology is also critical for the region because it will make coal power plants in the region carbon-free. Hydrogen technology also has a key role as an alternative to the use of fossil fuels, as it can be applied across sectors, such as in the power generation, industry, and road transport sectors.

The EAS countries will need around $4 trillion for the construction of power plants, refineries, and LNG-receiving terminals under BAU, but power generation plants will be the largest share – estimated at around $3.5 trillion. ASEAN needs about $686 billion under BAU for the total energy infrastructure of combined power generation, refineries, and LNG-receiving terminals, and $605 billion in the APS. The difference comes from refineries and LNG-receiving terminals due to savings in oil and gas consumption. Under

BAU, a lot of money will be allocated to coal power plants (clean coal technology), whereas under the APS, more money will be allocated to low-carbon energy electricity, such as nuclear, geothermal hydropower, solar PV/wind, and biomass.

Consequently, financing schemes to develop energy infrastructure – such as public–private partnerships, public financing by international/regional banks, the Clean Development Mechanism, and/or the Joint Credit Mechanism – will be essential. Moreover, economic stimulus packages being designed by governments as part of the COVID-19 recovery could offer opportunities for high-quality low-carbon infrastructure investments that will bring more socio-environmental benefits. AMS should capture this opportunity. A domestic and cross-border electricity network could be a promising candidate, offering both energy security and climate benefits.

References

ADBI (2013), *Low-Carbon Green Growth in Asia: Policies and Practices.* Tokyo: Asian Development Bank Institute. https://www.adb.org/sites/default/files/publication/159319/adbi-low-carbon-green-growth-asia.pdf (accessed 17 January 2022).

APUEA (2019), Introduction to Sustainable Urban Energy Systems. https://www.apuea.org/index.php/urban-energy-systems (accessed 11 March 2022).

Anbumozhi, V. (2021), 'Mobilizing Private Finance for Low-Carbon Energy Transition', in B. Sustantono, Y. Zhai, R.M. Shreshta, and L. Mo (eds.) *Financing Clean Energy in Developing Asia – Volume 1*. Manila: Asian Development Bank, pp.291–338. https://www.adb.org/sites/default/files/publication/706641/financing-clean-energy-developing-asia.pdf (accessed 17 January 2022).

Anbumozhi, V. and K. Kalirajan (2017), 'Paris Agreement and Globalization of Low-Carbon Technologies: What's Next for Asia?', in V. Anbumozhi and K. Kalirajan (eds.) *Globalization of Low-Carbon Technologies: The Impact of the Paris Agreement.* Singapore: Springer, pp.1–17.

ANRE (2014), 'Long-Term Measures Regarding Energy Supply and Demand to be Implemented in a Comprehensive and Systematic Manner', in ANRE, *Strategic Energy Plan*. Tokyo: Agency for Natural Resources and Energy, Chapter 3, pp.11–138. www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/4th_strategic_energy_plan.pdf (accessed 17 January 2022).

Arifin, Z. (2018), 'Current Status and Planning for Smart Grid Investment of Indonesia Electricity State Company (PLN)', The 9th Korea Smart Grid Week, International Smart Grid Conference and Exhibition, Seoul, 10–12 October. https://www.researchgate.net/profile/Zainal_Arifin26/publication/337672582_CURRENT_STATUS_AND_PLANNING_FOR_SMART_GRID_INVESTMENT_OF_INDONESIA_ELECTRICTY_STATE_COMPANY_PLN/links/5de4b0dca6fdcc2837fd22e1/CURRENT-STATUS-AND-PLANNING-FOR-SMART-GRID-INVESTMENT-OF-INDONESIA-ELECTRICTY-STATE-COMPANY-PLN.pdf (accessed 17 January 2022).

Arifin, Z. (2019), 'Smart Grid Implementation and Its Current Status in Indonesia', BIXPO 2019 – KEPCO Smart Grid Seminar: Trends in Asia, Gwangju, 6 November. https://www.smartgrid.or.kr/IMAGE/sub/pdf/Indonesia.pdf (accessed 17 January 2022).

ASCN (2018a), 'ASEAN Smart Cities Network – A Concept Note'. https://asean.org/asean/asean-smart-cities-network/ (accessed 17 January 2022).

ASCN (2018b), 'Smart City Action Plans'. https://asean.org/asean/asean-smart-cities-network/ (accessed 17 January 2022).

ASEAN (2007), 'Cebu Declaration on East Asian Energy Security', Cebu, Philippines, 15 January. https://asean.org/tag/cebu-declaration-on-east-asian-energy-security/ (accessed 17 January 2022).

ASEAN (2019a), *ASEAN Fuel Economy Roadmap for the Transport Sector 2018–2025: With Focus on Light-Duty Vehicles*. Jakarta: ASEAN Secretariat. https://asean.org/book/asean-fuel-economy-roadmap-for-the-transport-sector-2018-2025-with-focus-on-light-duty-vehicles/ (accessed 17 January 2022).

ASEAN (2019b) ASEAN Power Pool: guideline, implementation plan and roadmap

ASEAN Fuel Economy Roadmap for the Transport Sector 2018–2025: With Focus on Light-Duty Vehicles. Jakarta: ASEAN Secretariat. https://asean.org/book/asean-fuel-economy-roadmap-for-the-transport-sector-2018-2025-with-focus-on-light-duty-vehicles/ (accessed 17 January 2022).

Baker, E., V. Bosetti, L.D. Anadon, M. Henrion, and L.A. Reis (2015), 'Future Costs of Key Low-Carbon Energy Technologies: Harmonization and Aggregation of Energy Technology Expert Elicitation Data', *Energy Policy*, 80, pp.219–32.

Brown, M.A., S. Zhou, and M. Ahmadi (2018), 'Smart Grid Governance: An International Review of Evolving Policy Issues and Innovations', *WIREs Energy and Environment*, 7(5), e290.

Buckley, T. and S. Nicholas (2017), 'Japan: Greater Energy Security Through Renewable – Electricity Transformation in a Post-Nuclear Economy', Institute for Energy Economics and Financial Analysis. https://ieefa.org/wp-content/uploads/2017/03/Japan_-Greater-Energy-Security-Through-Renewables-_March-2017.pdf (accessed 25 April 2022).

Calvillo, C.F., A. Sánchez-Miralles, and J. Villar (2016), 'Energy Management and Planning in Smart Cities', *Renewable and Sustainable Energy Reviews*, 55, pp.273–87.

Centre for Liveable Cities (2018), *ASEAN Smart Cities Network*. Singapore: CLC Publications.

Chang, Y. and Y. Li (2012), 'Power Generation and Cross-Border Grid Planning for the Integrated ASEAN Electricity Market: A Dynamic Linear Programming Model', *Energy Strategy Reviews*, 2(2), pp.153–60.

ERIA (2018), ASEAN Power Pool: Guideline, Implementation Plan and Roadmap. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://asean.org/book/asean-power-pool-guideline-implementation-plan-and-roadmap/ (accessed 23 July 2022).

Fukasawa, K., I. Kutani, and Y. Li, eds. (2015), 'Study on Effective Power Infrastructure Investment Through Power Grid Interconnections in East Asia'. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/publications/study-on-effective-power-infrastructure-investment-through-power-grid-interconnections-in-east-asia/ (accessed 17 January 2022).

Global Fuel Economy Initiative (2021), 'ASEAN Countries Begin Process of Implementing Fuel Economy Roadmap', 5 February. https://www.globalfueleconomy.org/blog/2021/february/asean-countries-begin-process-of-implementing-fuel-economy-roadmap (accessed 17 January 2022).

Hermawanto, B. (2017), 'ASEAN Power Grid: Multilateral Power Trade', ADB Workshop, Seoul, 14 November. http://www.bigconnectivity.org/beta/sites/default/files/2018-03/Session1_1_171110-ADB%20WORKSHOP%202017-SEOUL%20ASEAN%20MULTILATERAL%20ENERGY%20TRADE%20V3.pdf (accessed 17 January 2022).

IEA (2018), *Market Report Series: Coal 2018, Analysis and Forecast to 2023*. Paris: International Energy Agency. https://webstore.iea.org/market-report-series-coal-2018 (accessed 17 January 2022).

IEA (2019), *Establishing Multilateral Power Trade in ASEAN*. Paris: International Energy Agency. https://www.iea.org/reports/establishing-multilateral-power-trade-in-asean (accessed 17 January 2022).

IEA (2020), *World Energy Investment 2020*. Paris: International Energy Agency. https://www.iea.org/reports/world-energy-investment-2020 (accessed 17 January 2022).

IPCC (2014), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar5/syr/ (accessed 25 July 2022)

IRENA (2017), 'Renewable Energy Rises Across Asia', IRENA Quarterly, https://www.irena.org/-/media/Files/IRENA/Agency/Quarterly/IRENA_Quarterly_2017_Q4.pdf. (accessed 25 July 2022

Ito, S. (2009), 'Japan's Initiative on Smart Grid – A Proposal of Nature Grid', Information Economy Division, Ministry of Economy, Trade and Industry (METI), December.

Japan Smart Community Alliance (n.d.), www.smart-japan.org/english/ (accessed 17 January 2022).

Jensterle, M., R.Y. Soh, M. Venjakob, and O. Wagner (2019), 'System Integration of Renewables and Smart Grids in Korea – Supporting Germany's Energy Dialog with Japan and Korea'. Wuppertal, Germany: Wuppertal Institute.

Kennedy, M. and B. Basu (2013), 'Overcoming Barriers to Low-Carbon Technology Transfer and Deployment: An Exploration of the Impact of Projects in Developing and Emerging Economies', *Renewable and Sustainable Energy Reviews*, 26, pp.685–93.

Kimura, S. and P. Han, eds. (2019), *Energy Outlook and Energy Saving Potential in East Asia 2019*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/publications/energy-outlook-and-energy-saving-potential-in-east-asia-2019/ (accessed 17 January 2022).

Korea Smart Grid Institute (2011), 'Smart Grid Initiatives of Korea'. https://microgrid-symposiums.org/wp-content/uploads/2014/12/jeju_yang.pdf (accessed 17 January 2022).

Kutani, I., ed. (2013), 'Study on Effective Investment of Power Infrastructure in East Asia through Power Grid Interconnection'. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/publications/study-on-effective-investment-of-power-infrastructure-in-east-asia-through-power-grid-interconnection/ (accessed 17 January 2022).

Li, Y., J. Wada, and M Shinozaki (2018), 'Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution'. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Li, Y., J. Wada, and W. Söderström (2018), 'Study on the Formation of the ASEAN Power Grid Transmission System Operator Institution', ERIA Research Project Report, No. 17. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).

Ling, A.P.A., S. Kokichi, and M. Masao (2012), 'The Japanese Smart Grid Initiatives, Investments and Collaborations', *International Journal of Advanced Computer Science and Applications*, 3(7), pp.44–54.

Madrigal, M. and R. Uluski (2015), *Practical Guidance for Defining a Smart Grid Modernization Strategy: The Case of Distribution*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/21001 (accessed 25 March 2022).

Motoaki (2017), 'TEPCO: A Quiet Emergence of Smart-Grid in Japan (Digitization)', Assignment: RC TOM Challenge 2017, Harvard Business School. https://digital.hbs.edu/platform-rctom/submission/tepco-a-quiet-emergence-of-smart-grid-in-japan-digitization/ (accessed 31 December 2019).

Ministry of Power, India (2016), Tariff Policy No. 23/2/2005-R&R (Vol-IX), *The Gazette of India*, Extraordinary – Part 1: Sect 1, 28 January. https://www.wberc.gov.in/sites/default/files/tariff-policy-28.01.2016.pdf (accessed 1 April 2022).

Nhede, N. (2017), 'Thailand Okays $5.6bn Budget to Enhance Grid Systems', Smart Energy International, 17 January. https://www.smart-energy.com/regional-news/asia/smart-grid-plan-thailand/ (accessed 17 January 2022).

OECD (2015), *Enhancing the Contributions of Digitilisation to the Smart Cities of the Future*. Paris: Organisation for Economic Co-operation and Development (OECD). http://www.oecd.org/cfe/regional-policy/Smart-Cities-FINAL.pdf (accessed 17 January 2022).

Purwanto, A.J. (2021), 'Energy Outlook Results of Total ASEAN', in P. Han and S. Kimura (eds.), *Energy Outlook and Energy Saving Potential in East Asia 2020*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.313–27.

Rai, V. and E. Funkhouser (2015), 'Emerging Insights on the Dynamics Drivers of International Low-Carbon Technology Transfer', *Renewable and Sustainable Energy Reviews*, 49(C), pp.350–64.

Rai V., K. Schultz, and E. Funkhouser (2014), 'International Low Carbon Technology Transfer: Do Intellectual Property Regimes Matter?', *Global Environmental Change*, 24, pp.60–74.

Sinha, A., S. Neogi, R.N. Lahiri, S.P. Chowdhury, N. Chakraborty (2011), 'Smart Grid Initiative for Power Distribution Utility in India', Paper presented at the 2011 IEEE Power and Energy Society General Meeting, Detroit, MI, 24–29 July.

Shinkawa, T. (2018), 'Electricity System and Market in Japan', Presentation, 22 January. https://www.emsc.meti.go.jp/english/info/public/pdf/180122.pdf (accessed 17 January 2022).

Smart Energy International (2013), 'Smart Grid Vision and Roadmap for India', 13 September. https://www.smart-energy.com/regional-news/asia/smart-grid-vision-and-roadmap-for-india/ (accessed 25 July 2022).

Suruhanjaya Tenaga (2018), *Energy Malaysia*, 15. https://www.st.gov.my/en/contents/files/download/112/Energy_Malaysia_Vol_15.pdf (accessed 17 January 2022).

Thorncraft, S. et al. (2019), 'Greater Mekong Subregion Power Market Development: All Business Cases including the Integrated GMS Case'. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/541551554971088114/Greater-Mekong-Subregion-Power-Market-Development-All-Business-Cases-including-the-Integrated-GMS-Case (accessed 17 January 2022).

United Nations (2018), '2018 Revision of World Urbanization Prospects'. https://population.un.org/wup/ (accessed 17 January 2022).

World Bank (2018), *World Development Report 2018*. Washington, DC: World Bank. https://www.worldbank.org/en/publication/wdr2018 (accessed 17 January 2022).

Chapter 18

Environment and Sustainability

Venkatachalam Anbumozhi
Director of Research Strategy and Innovation, ERIA

Michikazu Kojima
Senior Advisor to the President on Environmental Issues, ERIA

Introduction

Many economies of Asia are in the midst of the great information and communication technology (ICT) revolution. Over the last five decades, the Association of Southeast Asian Nations (ASEAN) as an economic bloc has successfully transformed its member economies by investing in the continuous upgrading of their industrial infrastructure, technical expertise, knowledge, and skills. As a result of historical economic development driven by industrialisation and population growth, ASEAN Member States (AMS) have also witnessed an unprecedented increase in carbon emissions and other resource consumption, pollution, and consequent environmental system change.

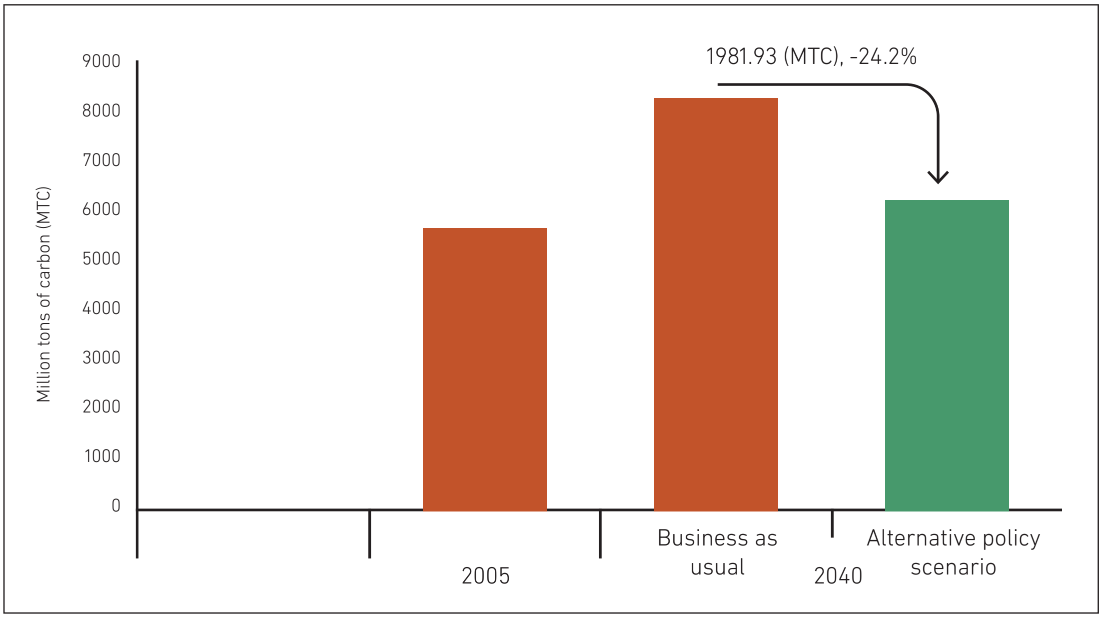
The third unbundling – which will encompass clusters of transformative technologies in the domain of information technology (IT) and communication technology, such as artificial intelligence (AI), the internet of things (IoT), robotics, 3D printing, neurotechnology, drones and autonomous vehicles, biotechnology, virtual and augmented reality, and blockchain, along with the evolution of big data – could offer innovative approaches to managing environmental footprints and improve livelihood conditions. The region must take advantage of this rapid technological change to make the industrialisation and development more sustainable. While the environmental challenges faced by the region are multiple and complex, and need stronger commitment, rapid technological change provides opportunities that were previously out of reach for governments, the private sector, and the poor. This section outlines the environment and sustainability challenges posed to the fast-growing economies, which would undermine the quality of life, and discusses the opportunities available with an emerging set of smart technologies.

Environmental Sustainability Challenges in ASEAN

Southeast Asian countries are not only rich in natural biodiversity and culture but also have some of the fastest growing regional economies in the world. A combination of rapid economic development, demographic shifts, and rising living standards is posing a new set of environmental sustainability challenges to meet increased food, energy, and material demand. A range of socio-economic mechanisms (e.g. trade, migration, and demand for goods and services) as well as natural phenomena such as climate change and disaster transmits the pressures from country to country. The following issues need to be addressed urgently from an environmental perspective:

- **Greenhouse gases:** ASEAN accounts for 1,666 million tons (Mt) of carbon dioxide (CO2) emissions – 4% of the world total – mostly from fossil fuel use, which accounts for 550 million tons of oil equivalent (Mtoe) or 5% of the world total (Figure 18.1).

Figure 18.1 Total Carbon Emissions from the Region



Source: Kimura and Han (2021).

- **Biodiversity:** The region – the second richest – is rapidly losing its biodiversity at mass extinction rates, such that 40% of its genetic biodiversity has become extinct.

- **Deforestation:** The current deforestation rate in tropical forests leads to a 7% drop in regional rainfall. As the region rapidly urbanises, more people than ever before demand land, wood, mineral, and other resources. Table 18.1 shows some indicators related to deforestation, climate risk, and resource use.

Table 18.1 Selected Indicators of Sustainability and Resilience in ASEAN

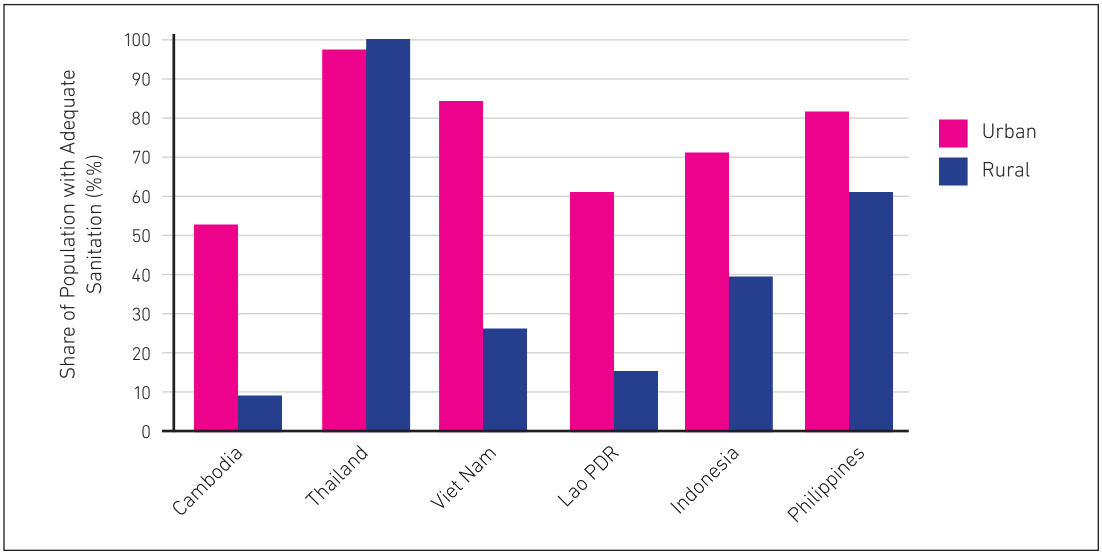
Country	Proportion of population practising open defecation (%)		Material footprint per capita (ton)		Forest area as a proportion of total land area (%)		Climate Risk Index score (rank)
	2000	2015	2000	2017	2000	2015	2016
Brunei Darussalam	2.5	2.6	12.60	19.09	75.33	72.11	109.50 (120)
Cambodia	82.7	40.6	1.66	3.57	65.41	53.57	95.17 (111)
Indonesia	32.2	12.4	3.36	6.23	54.87	50.24	46.17 (37)
Lao PDR	62.0	22.1	1.26	7.37	71.60	81.29	109.50 (120)
Malaysia	1.6	0.3	19.19	22.61	65.72	67.55	65.50 (72)
Myanmar	11.2	4.7	0.53	1.50	53.39	44.47	57.17 (53)
Philippines	10.9	5.7	4.00	4.34	23.57	29.96	31.33 (16)
Singapore			51.14	73.04	23.06	23.06	109.50 (120)
Thailand	1.0	0.3	7.75	14.90	33.30	32.10	37.50 (20)
Viet Nam	17.7	3.9	3.42	10.01	37.82	47.64	15.33 (5)

ASEAN = Association of Southeast Asian Nations.

Source: United Nations (n.d.), SDG Indicators Database. https://unstats.un.org/sdgs/indicators/database/ (accessed 5 August 2018).

- **Water cycle:** Fresh water bodies such as lakes, rivers, and irrigation tanks are facing severe impacts in terms of water availability and quality, mainly because of over-abstraction of groundwater and uncontrolled pollution. This could result in a 30% shortfall in fresh water in 2030 (Raghavan et al., 2019). Changes in water availability and quality have profound effects on sanitation conditions in both urban and rural areas (Figure 18.2).

Figure 18.2 Share of Population with Adequate Sanitation
(%)



Source: ADBI (2014).

- **Solid and industrial waste:** As economies grow, individuals become rich and consume and discard more. ASEAN, China, and India account for one-third of the world's population but produce 29% of its waste; this is expected to double by 2050. Jambeck et al. (2015) calculated the quantity of plastic marine debris in each country, based on the population within 50 kilometres of the coast, waste generation per capita, the percentage of plastic waste, and the percentage of mismanaged waste. They pointed out that China was the top generator of marine plastic litter, followed by Indonesia, the Philippines, and Viet Nam (Table 18.2), while Thailand, Malaysia, and Myanmar are also in the top 20. Growing Asian countries are regarded as a major source of land-based plastic marine debris because of the increased use of plastics and insufficient waste collection services.

Table 18.2 Marine Plastic Debris Challenges in ASEAN and East Asia

	Country	**Coastal population** (million)	**Waste generation** (kg/ppd)	**Percent of plastics**	**Percent of mismanaged waste**	**Plastic marine debris** (MMT/year)
1	China	262.9	1.10	11	76	1.32–3.53
2	Indonesia	187.2	0.52	11	83	0.48–1.29
3	Philippines	83.4	0.50	15	83	0.28–0.75

	Country	Coastal population (million)	Waste generation (kg/ppd)	Percent of plastics	Percent of mismanaged waste	Plastic marine debris (MMT/ year)
4	Viet Nam	55.9	0.79	13	88	0.28–0.73
6	Thailand	26.0	1.20	12	75	0.24–0.64
8	Malaysia	22.9	1.52	13	57	0.14–0.37
12	India	187.5	0.34	3	87	0.09–0.24
17	Myanmar	19.0	0.44	17	89	0.05–0.12

ASEAN = Association of Southeast Asian Nations, kg = kilogram, MMT = million metric tons, ppd = per person per day.
Source: Jambeck et al. (2015).

- **Climate change and disasters:** The impacts of natural disasters are more pronounced in ASEAN than in other parts of the world. By 2050, the impact of climate change is projected to reduce the annual gross domestic product (GDP) of ASEAN by up to 6% per year.

The policy community is also concerned that these impacts might interconnect to trigger cascading negative feedback loops, which could flip the economic and social systems into a wholly new state. If no concrete actions are taken, the future is likely to begin a period of sustainability disequilibrium that could affect the quality of life.

Circular Economy: Motivating Sustainability Through Resource Efficiency

'Circular economy' is an umbrella term used for industrial processes and business models which do not generate pollution and waste but, rather, reuse natural resources repeatedly. At its core, the circular economy is about economics and competitiveness. Its approach to resource efficiency integrates cleaner production and industrial ecology in a broader system, encompassing industrial firms or networks of firms to support resource optimisation. At the individual firm level, higher resource efficiency is sought through the '3Rs' – 'reduce' consumption of resources, 'reuse' resources, and 'recycle' the by-products. Sustainable product and process design are important circular economy plans. In such a business model within the circular economy, instead of selling products to consumers, companies can retain ownership of the physical products and consumers only pay for the use they derive from them.

At a national level, emerging economies of Asia can boost environmental sustainability by supporting shifts towards a new industrial process which minimises waste and focuses instead on resource recovery. This has similarities with Industry 4.0, which is often cited as the fourth major upheaval in modern manufacturing – following the lean revolution in the 1970s, the outsourcing phenomenon of the 1990s, and the automation that took off in the 2000s. It is also defined as the next phase of powerful technologies that have strong potential to step up competitiveness and create differentiated products.

The basket of new digitally enabled technologies that include advances in production equipment are 3D printing; advanced robotics; smart finished products such as connected cars and home appliance systems using IoT; advanced analytics such as big data analytics and analytics across the global value chain; human–machine interfaces such as technology using augmented reality; and AI. These transformative technologies, included under the Industry 4.0 framework with data analytics as a core capability, have the potential to speed up the circular economy transition as illustrated in Table 18.3. If the elements of these two framework notions (Industry 4.0 and circular economy) are compared, it is striking that similar concepts emerge. Both the circular economy and Industry 4.0 are based on (i) a change in the approach of producers and customers, (ii) new product and process offerings, and (iii) the integration of value chains.

Table 18.3 Technological Developments for Industry 4.0 and the Circular Economy

Technological developments for industry 4.0	Transformative technologies for the circular economy
• Information and communication technology • Cyber-physical systems • Network Communications – internet of things (IoT) • Simulation • Advanced data analytics • Robits, augmented reality, and intelligent tools for support of human workers	• Mobile technology • Machine-to-machine communication • Cloud computing • Social media for business • Big data analytics • Modular design technology • Advanced recycling technology • Trace and return systems • 3D printing

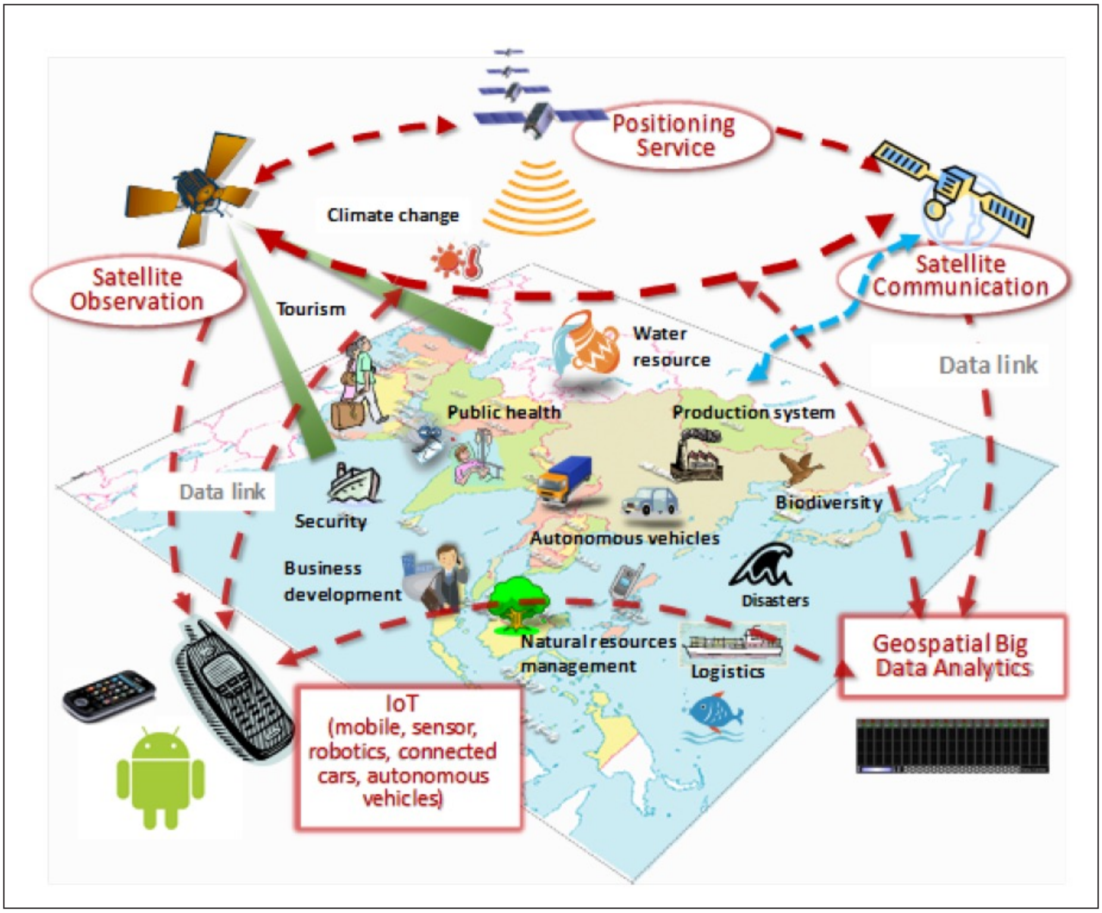
Source: Anbumozhi and Kimura (2018).

This is because the circular economy, with its focus on recycling, innovation, and skills development, is inherently more labour-intensive than the linear industrial production model of 'take, make, waste', but uses less energy and raw materials. Through this systemic approach and the integration of technologies, the circular economy has the ambition to minimise the material usage per unit of functionality and to manage materials in the system in such a way that losses and emissions are minimised. In many countries of Asia, resource use policy is typically based on the 3Rs: reuse, reduce, recycle. Waste management is considered to be an important and urgent environmental challenge under this paradigm, wherein waste handling and disposal becomes a key policy agenda. On the other hand, the concept of the circular economy creating economic value for the resource use adds upstream measures (e.g. in the product design) to this 3Rs principle. Closing the cycle of production and waste disposal keeps products in use longer, recycles products endlessly, and ultimately uses less to produce more. In the circular economy vision, all products are ultimately broken down into either technical nutrients which are made into new products, or biological ones which return to the soil.

Potential of Integrated Smart Digital Technologies for Improved Environmental Sustainability

The rise of AI and smart digital technologies has resulted in three domains: satellite-based earth observation technology, positioning technology, and communication technology (Shibasaki et al., 2018). This integrated technology system can be seen as global IT, providing communication services anywhere using dynamic information on the physical, socio-economic and demographic, and environmental aspects of regions such as Southeast Asia. This technology is easily enhanced by space infrastructure, as illustrated in Figure 18.3, to cover ASEAN and East Asia in a seamless manner.

Figure 18.3 Data Infrastructure and Supporting Smart Technologies to Address Environmental Challenges



IoT = internet of things.

Source: Shibasaki et al. (2018).

This integrated intelligence system could provide diverse data and information services using 'real-world data'. More concretely, the four major services and contributions of such systems may be summarised as follows:

(i) Real-time localisation and tracking of people: cargo and vehicles (air, sea, and land).
(ii) Real-time monitoring of environmental and contextual information covering all land and sea: dynamic maps (e.g. traffic, congestion, people flow, and city changes) or environmental changes (e.g. weather, water and air quality, deforestation, solid waste generation, and greenery) from which events, accidents, and disasters can be extracted. Silent but meaningful changes such as climate change, marine debris, sanitation, and crustal deformation can be included.
(iii) 'Ubiquitous' data communications at any time/anywhere with small IoT devices to collect data from and to send instructions/guidance to people and machines in the field.
(iv) High-precision mapping of 3D space and landscape framing activities of people and autonomous vehicles/machines, which could include very slowly moving phenomena such as crust movement monitoring.

The following steps describe how those smart technologies would contribute to climate change adaptation and disaster resilience via real-time tracking, monitoring, mapping, and ubiquitous data communication capabilities:

- Monitoring and forecasting natural hazards at the local to regional scale – typically heavy rainfall, flooding, typhoons, droughts, and tsunami – to let governments and people know what could happen.
- Anticipating risks or damage to human lives and economic activities by overlaying the hazard prediction based on the data of people distribution/activity information, vehicle movement, and economic activity distribution/intensity.
- Mitigating damage by guiding the evacuation of people based on population distribution data and helping the reconstruction of people's lives and economic activities.
- Improving preparedness by providing realistic simulations and training on disaster risk management based on historical records of disasters and reconstruction processes.

The steps outlined above are made possible by sharing data amongst governmental agencies, private industries, non-profit organisations, and people. In this regard, data sharing can play a prominent role, as clearly stated in the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) Work Programme, 2016–2020 (ASEAN, 2016: 11): 'Promote regional standards, including methodologies and tools to assess, record, calculate the disaster losses and damages, and share non-sensitive data and create common information system, to enhance interoperability, ensure unity of action, and strengthen resilience'.

Further, in June 2018, ASEAN leaders adopted the Bangkok Declaration on Combating Marine Debris in ASEAN Region (ASEAN, 2018), which declared that AMS should strengthen actions at the national level as well as through collaborative action amongst the AMS and partners to prevent and significantly reduce marine debris, particularly from land-based activities, including environmentally sound management. In the past, improper waste management was regarded as a local environmental problem. But due to the marine debris issue, waste management is becoming part of the solution to the emerging global environmental problem, i.e. marine plastic issue, in addition to other measures such as reducing single-use plastics.

Real-time positioning by remote sensing satellites can be performed by compact and inexpensive portable terminals, currently installed in almost all smartphones as well as in most vehicles, airplanes, or ships. The mobility data of people, vehicles, ships, and aircraft are widely available. Geostationary satellites are commonly used in ASEAN and East Asia for data communication. However, adequate miniaturisation of ground transceivers, combined with the use of low earth orbit satellite constellations, will increase access to efficient communication and dramatically reduce costs in the near future.

Therefore, the digital, ICT, and big data systems should be smartly and strongly designed to capitalise on the potential multiple benefits of their use to bring community resilience. On the other hand, they also represent a technology system that is a highly efficient and inclusive information system. In reality, all three components of the system are addressed through separate initiatives, requiring close cooperation and coordination amongst academia, industry, and government. Such complexity and uncertainty typically confront the challenge of total costs, which have to be reduced as much as possible.

Readiness of ASEAN and East Asia to Embrace Industry 4.0 or Smart Technologies

The potential to harness smart, digital, and Industry 4.0 technologies to achieve environmental sustainability and resilience – or, more fundamentally, redesign how human, technological, and economic systems interact with the natural environment through cities, transport and energy networks, agricultural production systems, industrial value chains, waste management, and disasters preparedness – appears to be boundless. Table 18.4 illustrates the development level of new technological applications that address the challenges of the circular economy, sustainability, and resilience in the emerging markets of ASEAN.

Table 18.4 Development Level of Smart Technologies to Address Sustainability Challenges in ASEAN

Industry 4.0/ smart/digital ICT technologies	Emission reductions and the sharing economy	Resource management and the circular economy	Preventing pollution	Protecting biodiversity	Resilience and climate change adaptation
3D printing	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets
Artificial intelligence	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale
Advanced materials	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets	Potential being explored extensively in some markets
Advanced sensor platforms	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale
Biotechnologies	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets	Potential being explored extensively in some markets
Blockchain	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets
Drones and autonomous vehicles	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets
Internet of things	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets	Potential being explored extensively in some markets	Potential being explored extensively in some markets
Robotics	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale
Augmented reality and new computing technologies	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Being introduced in some niche markets but not to scale	Potential being explored extensively in some markets	Potential being explored extensively in some markets

Potential being explored extensively in some markets

Being introduced in some niche markets but not to scale

ASEAN= Association of Southeast Asian Nations. ICT = information and communication technology.

Source: Authors.

In exploring this transformation, however, the debate needs to focus not just on technological applications, but also on reshaping mindsets, incentives, policies, and institutions. The implications of these smart digital technologies in realising the environmental sustainability benefits and managing the market risks will depend on the countries' ability to meet the formidable challenges of governance and finance. These challenges loom large in developing countries because natural resources are often poorly managed by the existing institutions and inadequately served by the markets. Success will require institutions that are not only open to new ideas and agile, but also supported by strong regulations when needed. Success will also depend on innovation in finance, with new business models and new investment vehicles that can enable and incentivise technological solutions and be applied at scale. Full-scale adoption also requires investment in continuous assessment of these technologies and learning so that stakeholders can better understand and address the sustainability benefits and social effects of these often disruptive technologies.

Many contributions of integrated ICT, digital, and space technologies to date are centred on fostering productivity, efficiency, and growth. Digital e-commerce platforms may be supported by data mining tools and weak AI, which are useful for identifying behavioural patterns and understanding consumer profiles. Integrated digital systems also have the potential to supply a broader variety of environmental goods and green services such as disaster-related information, which are individually tailored to lower costs, benefitting consumers around the region – across the national boundaries of the AMS. However, the net costs and benefits depend on a number of factors. If societies are not prepared to cope with these technological systems, this could increase inequality, reduce the environmental benefits, and hamper the achievement of the Sustainable Development Goals (SDGs). Table 18.5 summarises the current achievements of the SDGs in AMS.

Several studies (Anbumozhi et al., 2021a, 2021b, 2021c) have indicated the potential of smart technologies when combined with big data and blockchain approaches in promoting green jobs and circular enterprises, non-dangerous safety works, extending environmental protection, and promoting sustainability; and thus could become an accelerator of the 17 SDGs.

Table 18.5 Progress in Meeting the SDG Targets in AMS, Japan, China, and India

Country	SDGI	SDG1	SDG2	SDG3	SDG4	SDG5	SDG6	SDG7	SDG8	SDG9	SDG10	SDG11	SDG12	SDG13	SDG14	SDG15	SDG16	SDG17
Japan	80.2	99.3	74.6	94.3	96.4	60.7	94.3	87.8	92.1	87.3	81.2	95.1	55.5	80.0	59.0	64.9	88.3	52.3
Malaysia	69.7	98.2	54.1	83.1	88.1	51.2	99.0	84.1	71.2	60.8	40.7	94.5	69.7	82.4	45.9	31.6	79.0	59.9
Thailand	69.5	100.0	55.0	76.2	76.2	65.7	95.1	76.9	85.2	39.8	64.8	75.1	70.4	73.0	45.0	63.2	58.0	62.6
Singapore	69.0	98.6	71.1	93.8	92.3	68.3	88.9	90.7	95.0	85.7	37.7	92.9	43.3	48.1	21.2	26.2	89.8	28.7
Viet Nam	67.9	99.0	62.1	74.6	81.3	76.4	90.7	72.4	60.8	24.9	65.5	66.4	71.2	73.4	51.8	46.6	65.6	71.4
China	67.1	99.5	66.8	79.5	74.1	74.8	88.2	67.7	71.9	57.7	52.4	61.6	74.8	58.7	31.1	58.5	69.1	54.5
Philippines	64.3	92.5	50.2	61.1	84.0	64.5	85.5	64.6	60.8	24.5	49.9	68.0	82.2	88.5	50.7	51.5	61.1	53.9
Indonesia	62.9	94.6	46.9	60.7	76.2	59.3	81.6	64.8	67.7	25.4	60.2	58.7	79.3	88.5	44.5	44.2	69.9	46.5
Lao PDR	61.4	86.1	51.4	55.8	64.2	68.3	79.3	38.1	66.0	12.9	64.7	67.4	78.8	81.8	–	51.8	63.6	52.3
Myanmar	59.5	87.5	52.2	56.7	67.9	67.8	84.9	36.9	51.5	13.3	–	27.7	77.6	81.6	38.4	51.3	57.6	100.0
India	58.1	93.4	36.9	55.2	65.3	33.3	73.7	54.0	68.3	33.1	72.5	34.3	81.6	74.7	42.9	47.0	69.4	51.7

AMS = ASEAN Member States, ASEAN = Association of Southeast Asian Nations, SDG = Sustainable Development Goal, SDGI = Sustainable Development Goals Index.

Source: Anbumozhi, Kalirajan, and Kimura (2022).

Challenges in Embracing the Third Unbundling and Smart Digital Technologies for Sustainability Gains

Perceived risks in AMS for the marketability of these technologies are also high, where market-based mechanisms to finance sustainability initiatives are in the early stage of development. Producer and consumer responsibilities are low, with subsidies remaining, and they do not reflect the full costs including environment externalities. Regulatory regimes are also complicated, creating additional uncertainties. These conditions do not provide adequate incentives for private investment, resulting in different levels of readiness in terms of sustainability, such as the circular economy (Table 18.6).

Table 18.6 Enablers and the Readiness Rating of AMS for Integrating Smart Technologies into the Circular Economy

Country	Higher education and training	Goods market efficiency	Labour market efficiency	Financial market development	Technological readiness	Market size	Overall rating
Cambodia	2.8	4.2	4.5	3.9	3.0	3.0	3.6
Indonesia	4.5	4.4	3.7	4.2	3.5	5.7	4.3
Lao PDR	3.2	4.3	4.5	3.8	2.8	2.9	3.6
Malaysia	5.0	5.4	4.9	5.2	4.6	5.0	5.0
Myanmar	2.5	3.6	4.2	2.4	2.2	4.2	3.2
Philippines	4.5	4.2	4.1	4.2	3.9	4.9	4.3
Singapore	6.2	5.7	5.7	5.6	6.2	4.8	5.7
Thailand	4.6	4.7	4.2	4.4	4.2	5.2	4.6
Viet Nam	3.8	4.2	4.4	3.7	3.3	4.8	4.0

AMS = Association of Southeast Asian Nations Member States.

Source: Viswanathan and Anbumozhi (2018).

Despite the potential of smart and digital technologies, they pose various risks. As can be seen in Table 18.6, the application of new ICT to preserve the environment and tackle vulnerability seems to be imminent, and data will be the foundation of the revolution as all the digital technologies will be built upon it. Individuals, companies, and governments will increasingly rely on the ability to move, process, and store data through ASEAN to provide the green products and services necessary to reap sustainability benefits.

If data become a prized commodity, the important question is who owns the data and has access to which piece of data. Disconnected data platforms and competing networks of data provision and management may also emerge, using their own data protocols and standards. Common protocols and standards need to be created at the regional level in conformation with evolving global standards. If environmental preservation and resilience is a public good, who could become the curators of regional environmental information? How can private companies avoid being monopolies, holding environmental and social data for their own profit, rather than being platforms for promoting widespread and open innovation. These questions will need to be addressed by communities, countries, and ASEAN and East Asia as a whole.

Nevertheless, these technological systems also have the potential to disrupt the old institutional and governance systems built around the three pillars of the ASEAN Community – the ASEAN Economic Community, ASEAN Socio-Cultural Community, and ASEAN Political–Security Community. For example, a rich new stream of information about deforestation and endangered species could help improve the sustainable management of forests. Such data could also radically improve the transparency and traceability of the haze problem, providing new tools in the fight against illegal deforestation. However, if a regional organisation that hosted this data was hacked, these same data innovations could enable even more illegal deforestation or hunting of endangered species.

However, markets need to evolve to meet the specific needs of these new technologies. The phenomenon of leapfrogging implies jumping to a new set of highly efficient technologies and services – skipping the old, inefficient, and polluting ones. But if leapfrogging is to become a dominant pattern, rapid institutional innovations are needed to create the business practices and policy frameworks to make that happen, both at the systemic level – i.e. new business models, market design, regulation and policy instruments, and financing – and at the operational level – consumer engagement, supply-side management, and demand response. Further, flexibility is needed in policy design, as the end points of absorbing these technologies will differ in countries, sectors, and communities; and the pathways to get there could vary.

Conclusion

As Asian governments are slowly turning their focus from raw GDP-driven measurement of economic growth towards well-being criteria of sustainable and inclusive growth, the demand for new technologies that provide environmental solutions is increasing. The potential to create transformative changes is immense, but realising the opportunities will not happen automatically. Proactive and collaborative processes with policymakers, technology champions, academia, and international institutions will be required at the regional level, so that commonly agreed national policies and regional protocols are developed to bring maximised sustainability benefits and strengthen resilience.

Governments and important stakeholders, such as international organisations, academia, and business, each have roles to play. When it comes to the application of new digital technologies, markets alone will not offer adequate incentives in the early stages of technology adoption. Most AMS are low- and middle-income countries, and governments must find ways to arrest the deterioration of the environment with current regulations that must also find a way to keep up with the rapid penetration of these technological systems. That means creating room for experimentation by allowing states and communities to take advantage of the new technological potential to find better or alternative ways of managing environmental challenges. It means reforming long-established regulatory regimes to take advantage of the digital tools becoming available for better understanding and control of environmental risks and resilience challenges.

Technology companies and entrepreneurs have a central role to play and create business models that can support the development and global application of innovations for environmental sustainability and resilience. Whether for fleets of satellites and drones that can provide vital new data streams, or for algorithms and computer applications that can translate those streams into planning tools for better natural resources management, pollution control, and climate resilience, new business models are needed. Such business models provide a viable proposition for governments and communities to consider them as public goods.

The following collaborative frameworks will be particularly important as part of the Comprehensive Asian Development Plan (CADP) 3.0:

- Dialogues and partnerships that bring Industry 4.0/digital/smart technology developers and providers together with environmental experts to co-develop these innovations and ensure that they are developed for public goods, i.e. sustainability, while minimising common cybersecurity risks.
- Innovative investment platforms, financing structures, and business models that can accelerate the scaling of promising eco-innovations that could be supported by a combination of smart technologies, regardless of whether they have a clear commercial proposition or less profitable sustainability benefits.
- Partnership with other and international institutions to enable the development of common and agile institutions and governance systems, including the championing of common policy principles for managing new technologies and specific data protocols and transparency mechanisms.
- Regularly reviewing and, where appropriate, revising the emerging legislative and regulatory framework to clarify and explicitly articulate the precise roles of new types of technologies that increase environmental benefits and strengthen the resilience capability of individual households and vulnerable communities.

References

ADBI (2014), *ASEAN 2030: Toward a Borderless Economic Community.* Tokyo: Asian Development Bank Institute. https://www.adb.org/adbi/research/asean-2030-toward-borderless-economic-community (accessed 26 February 2022).

Anbumozhi, V., S Babu, C.A. Bolino, W.Carig, P.Kulandaivelu, F.M. Borrios, and E.Yamaji (2021a), 'Enhancing Food Supply Chain Resilience Through the Utilisation of the Digital and Sequence Information Technologies', *T20 Italy Task Force 4 Policy Brief.* Milan: Italian Institute for International Political Studies. https://www.ispionline.it/it/pubblicazione/enhancing-food-supply-chain-resilience-through-utilisation-digital-and-sequence-information-technologies-31706 (accessed 23 July 2022).

Anbumozhi, V. et al. (2021b), 'Localising the Circular Economy Imperative in a Post COVID-19 Era: Place, Trade and Multilateralism', *T20 Italy Task Force 9 Policy Brief.* Milan: Italian Institute for International Political Studies. https://www.ispionline.it/it/pubblicazione/localising-circular-economy-imperative-post-covid-19-era-place-trade-and-multilateralism-31802 (23 July 2022).

Anbumozhi, V. et al. (2021c), 'Resetting Low Carbon Green Growth Policies Through Stimulus Packages in the Aftermath of COVID-19 Pandemic', *T20 Italy Task Force 2 Policy Brief.* Milan: Italian Institute for International Political Studies. https://www.ispionline.it/it/pubblicazione/resetting-low-carbon-green-growth-policies-through-stimulus-packages-aftermath-covid-19-pandemic-31800 (accessed 23 July 2022).

Anbumozhi, V., K. Kalirajan, and F. Kimura, eds. (2022), *Sustainable Development Goals and Pandemic Planning: Role of Efficiency Based Regional Approaches*. Singapore: Springer.

Anbumozhi, V. and F. Kimura (2018), 'Industry 4.0: What Does It Mean for the Circular Economy in ASEAN', in V. Anbumozhi and F. Kimura (eds.) *Industry 4.0: Empowering ASEAN for the Circular Economy*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.1–35. https://www.eria.org/research/industry-40-empowering-asean-for-the-circular-economy/ (accessed 26 February 2022).

ASEAN (2016), 'AADMER Work Programme: 2016–2020'. Jakarta: ASEAN Secretariat. https://asean.org/asean-socio-cultural/asean-agreement-on-disaster-management-and-emergency-response-cop-to-aadmer/aadmer-work-programme/ (accessed 26 February 2022).

ASEAN (2018), 'Bangkok Declaration on Combating Marine Debris in ASEAN Region', 22 June. Jakarta: ASEAN Secretariat. https://asean.org/bangkok-declaration-combating-marine-debris-asean-region/ (accessed 26 February 2022).

Jambeck, J.R. et al. (2015), 'Plastic Waste Inputs from Land into the Ocean', *Science*, 347(6223), pp.768–71.

Kimura, S. and P. Han, eds. (2021), *Energy Outlook and Energy Saving Potential in East Asia 2020*. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/publications/energy-outlook-and-energy-saving-potential-in-east-asia-2019/ (accessed 26 February 2022).

Raghavan, S.V., J. Ze, J. Hur, L. Jiandong, N.N. Son, and L.S. Yui (2019), 'ASEAN Food Security under the 2˚ C–4˚ C Global Warming Climate Change Scenarios', in V. Anbumozhi, M. Breiling, and V.R. Reddy (eds.) *Towards a Resilient ASEAN, Volume 1: Disasters, Climate Change, and Food Security: Supporting ASEAN Resilience*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.37–52. https://www.eria.org/publications/towards-a-resilient-asean-volume-1-disasters-climate-change-and-food-security-supporting-asean-resilience/ (accessed 26 February 2022).

Shibasaki, R., T. Fukuyo, H. Miyazaki, Q. Verspieren, and V. Anbumozhi, eds. (2018), *Integrated Space-Based Geospatial System: Strengthening ASEAN's Resilience and Connectivity*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA). https://www.eria.org/publications/integrated-space-based-geospatial-system-strengthening-aseans-resilience-and-connectivity/ (accessed 26 February 2022).

Viswanathan, C. and V. Anbumozhi (2018), 'Evolutionary Acts and Global Economic Transition: Progress of the Circular Economy in ASEAN', in V. Anbumozhi and F. Kimura (eds.) *Industry 4.0: Empowering ASEAN for the Circular Economy*. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA), pp.67–105. https://www.eria.org/publications/industry-40-empowering-asean-for-the-circular-economy/ (accessed 26 February 2022).