Review of Sustainable Transport Connectivity in Asia and the Pacific 2019

Addressing the Challenges for Freight Transport

UNITED NATIONS
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Economic and Social Commission for Asia and the Pacific

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Values are in United States dollars unless specified otherwise.

The term "billion" signifies a thousand million.

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
CAREC	Central Asia Regional Economic Cooperation
CO_2	carbon dioxide
ECO	Economic Cooperation Organization
ESCAP	Economic and Social Commission for Asia and the Pacific
FTKs	freight ton-kilometres
GDP	gross domestic product
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
LSCI	Liner Shipping Connectivity Index
Mtoe	million tons of oil equivalent
NOx	nitrogen oxide
OECD	Organization for Economic Cooperation and Development
Sox	Sulphur oxide
TEU	twenty-foot equivalent unit
UNCTAD	United Nations Conference on Trade and Development
WMO	World Meteorological Organization
WTO	World Trade Organization

INTRODUCTION

Among all the factors directly influencing the capacity of Asia and the Pacific to deliver on the 2030 Sustainable Development Agenda, freight transport stands out as a continuous challenge and a tremendous opportunity for the transition to economic, social and environmental sustainability.The demand for transport and mobility, as compounded by the emergence and continued development of geographically dispersed supply chains, while already consuming a major part of the region's natural resources, is continually on the brink of exceeding capacity. Within the transport sector in Asia and the Pacific, freight and logistics account for a significant portion of total energy use – in many countries upward of 40% – and a correspondingly large share of carbon dioxide (CO_2) emissions. Furthermore, on account of economic development and population growth, the region is expected to face substantial increases in trade shares and, thus, freight volumes. Accordingly, some estimates suggest that in Asia, ton-kilometres from surface freight will increase by 261% from 2015 to 2050, accounting for more than two-thirds of all surface freight globally. From an infrastructure perspective alone, ESCAP estimates that the Asia and Pacific region requires a total investment of $126 billion to upgrade the regional transport systems and construct missing links in the identified rail, road and intermodal network.

Increasing pressures arising from the fact that transport remains a leading contributor to greenhouse gas emissions and a major consumer of fossil fuels, as well as from emerging and potentially disruptive technologies, indicate that traditional thinking around transport policies and actions need to be reassessed. Notably, the understanding of how low-carbon transport and energy technologies will evolve is still not well developed, and assessing this gap remains challenging for the transport sector. The onset of climate change and growing frequency of extreme weather events and natural disasters also increase the vulnerability of transport networks and call for leaps in the quality and reliability of transport connectivity across the region.

In this context, freight transport and, especially, the sustainability thereof is of paramount importance. While environmentally friendly mobility and public transport may be gaining ground with more affordable vehicle technologies and policies supporting shared mobility, walking, cycling and smart public transport, freight transport continues to rely heavily on oil for propulsion and is not yet in a position to be fully adapted to using other cleaner alternative energy sources. In addition to this making the contribution of transport to mitigating emissions much harder to effectively address, it also exacerbates traditional development challenges, such as the exposure to freight rates and transport costs and delays, in particular for landlocked developing countries and small island developing States.

Against this background, the *Review of Sustainable Transport Connectivity in Asia and the Pacific: Addressing the Challenges for Freight Transport*, will provide an overview and insight for policymakers in the region for accomplishing sustainable freight transport connectivity, taking into consideration key economic, social and environmental dimensions. Building on available data and indicators for the region, ESCAP analysis shows that, indeed, intermodality can increase the sustainability of connectivity by reducing transport related CO_2 emissions and road traffic crashes, in part owing to expected changes in the modal split. At the same time, the issue of the modal split is not only a consideration of public policy and infrastructure provision; conversely business models and practices can also have a profound impact. This is basically the fundamental notion of connectivity that is sustainable as opposed to, a reactive expansion of infrastructure provision in response to increasing demand.

This analysis lends further support to the established role of ESCAP as an intergovernmental platform for promoting seamless and sustainable transport connectivity through better integrated infrastructure across modes and a more balanced modal split that would enable growing demand to be accommodated on proportionately less infrastructure and fewer transport operations, with materially better service to users and significant energy savings. Transition to sustainable transport connectivity, especially when it comes to freight, is, therefore, seen as a major stepping stone in moving towards a truly sustainable development.

CHAPTER

1

REFRAMING THE DISCUSSION ON SUSTAINABLE TRANSPORT CONNECTIVITY

The role of transport for sustainable development and, indeed, the need for sustainable transport as such are neither new nor emerging concepts. In 1992, the United Nations Earth Summit recognized the role of transport for sustainable development[1]; since then, United Nations member States have repeatedly affirmed transport and mobility as being central to achieving sustainability. The 2030 Agenda for Sustainable Development and its Sustainable Development Goals further call for ambitious, cross-sectoral and concerted actions at the national, regional and global levels to ensure sustainable development as defined by the United Nations World Commission on Environment and Development: "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*"[2]. Transport is not represented by a stand-alone goal, but the dimensions of sustainable transport and corresponding challenges are embedded as a cross-cutting issue, the importance of which has been extensively discussed and broadly recognized, in particular in recent years.

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[1] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June 1992,* vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annexes I and II.
[2] Report of the United Nations World Commission on Environment and Development: "*Our Common Future", 1987.*

At the global level, United Nations-wide initiatives, such as the High-Level Advisory Group on Sustainable Transport, the first United Nations Global Sustainable Transport Conference, held in 2016 in Ashgabat, and the Sustainable Mobility for All initiative,[3] have helped raise awareness of the contribution of sustainable transport towards achieving most of the Sustainable Development Goals. In turn, within the regional intergovernmental mechanism of the Economic and Social Commission for Asia and the Pacific (ESCAP), member States have endorsed the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific in resolution 73/9. Importantly, the Ministerial Conference on Transport at its third session (Moscow, 2016) identified transport connectivity as a key priority for the ESCAP region to achieve its sustainability objectives and adopted the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017-2021). In doing so, ESCAP member-States placed connectivity at the centre of sustainable transport.

At this stage of implementation of the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017-2021), further consideration and analysis of the exact relationship between transport connectivity, sustainability and resilience seems warranted to take into account the cross-cutting impact of transport on human society, the new challenges arising in line with the region's development agenda and the inevitable links to the issues of climate change and resilience. This chapter will consider these links, provide an analysis of the regional and subregional state of connectivity as it relates to these concepts and present the key sustainability implications of connectivity for freight transport in the region.

1.1. Transport connectivity, sustainability and resilience: from concepts to tangible impacts

Revisiting the connectivity discussion

Conceptually, connectivity can be perceived as the purpose and the consequence of transport. In this context, connectivity is synonymous with networks. Networks, in turn, are a set of interconnected nodes. One of the most succinct descriptions of connectivity among the references for this report refers to connectivity as being an attribute of a network and a measure of how well connected any one node is to all other nodes in the network. It could, therefore, be argued that the value and significance of connectivity is found in the role a node and its hinterland plays, the cost of accessing that node and the reliability of connecting to the node.[4] Accordingly, connectivity has hard and soft dimensions and, importantly, is associated with concepts of access.[5] This relates to the inherent nature of transport as an engine of economic growth and social development.

When it comes to freight transport, the dimension of access typically entails referring to trying to quantify the ease of access to markets. Such access is initially a function of geographic heterogeneity and space, but, importantly, it is also a function of the quality and speed of infrastructure connections. In this sense, accessibility is a function of natural geography and of an outcome of the transport system, both of which determine the locational advantage of a region relative to all regions. To assess the degree of accessibility of markets and population agglomerations, economists and economic geographers have formulated indicators of relative accessibility from which locations can be ranked. These indicators of accessibility measure the benefits households and firms in a region enjoy both from the infrastructure they have access to, and the travel costs imposed by the exogenous geographic conditions they face. Accordingly, they are a measure of relative potential accessibility of markets or agglomerations.[6]

It follows that infrastructure is a necessary, but not sufficient condition for accomplishing the objectives of connectivity. In other words, while views generally coincide as to the necessity of investing resources in connectivity, the perceptions of what connectivity is intended to achieve are markedly diverse. Consequently, this makes attempts at measuring connectivity a very complicated endeavour. As pertinently observed by Guo and Schwarz, *most indices do not make a distinction between globalisation and connectivity: while connectivity indices tell us how globalised we are, globalisation indices tell us how connected we are.*[7] At the same time,

[3] See https://sum4all.org/

[4] Japan G20 Development Working Group background paper, "Infrastructure connectivity", (World Bank Group) (2019), available at: https://www.oecd.org/g20/summits/osaka/G20-DWG-Background-Paper-Infrastructure-Connectivity.pdf

[5] Ibid.

[6] Ibid.

[7] Asia-Europe Foundation, Facts and Perspectives, Volume II: Connecting Asia and Europe, ASEF Outlook Report 2016-2017, Connectivity (Singapore, Asia-Europe Foundation, 2016) p. 4.

one of the most notable shortcomings of connectivity indices is that they are invariably influenced by the designers' choice (or availability) of components, and the substitutability and weighting of these components. Accordingly, different connectivity indices, some examples of which are listed in table 1.1, can potentially give varying results, all credible to a certain degree, but also possibly offering incomplete or even incompatible insights.

Table 1.1. Selected connectivity indices

Name	Content	Provider
Globalization Index	It measures openness to trade, capital movements, exchange of technology and ideas, labor movements and cultural integration.	EY and Economist Intelligence Unit
Global Connectedness Index	It measures flows of trade, capital, information and people.	Deutsche Post DHL Group
KOF Index of Globalization	It measures economic, social and political globalization.	ETH Zurich
The Global Competitiveness Index	It measures institutions; infrastructure; ICT adoption; macroeconomic stability; health; skills; product market; labour market; financial system; market size; business dynamism; and innovation capability.	World Economic Forum
The Liner Shipping Connectivity Index	It measures the connectivity of a country or a port and indicates a country's integration level into global liner shipping networks.	United Nations Conference on Trade and Development
Global Connectivity Index	It measures connectivity as the ease of access to GDP.	International Transport Forum
The Logistics Performance Index	It measures performance in trade logistics.	The World Bank
Connectedness Index	It measures connectedness by flows of goods, services, finance, people and data.	McKinsey Global Institute

Source: Compiled from various sources by the ESCAP secretariat.

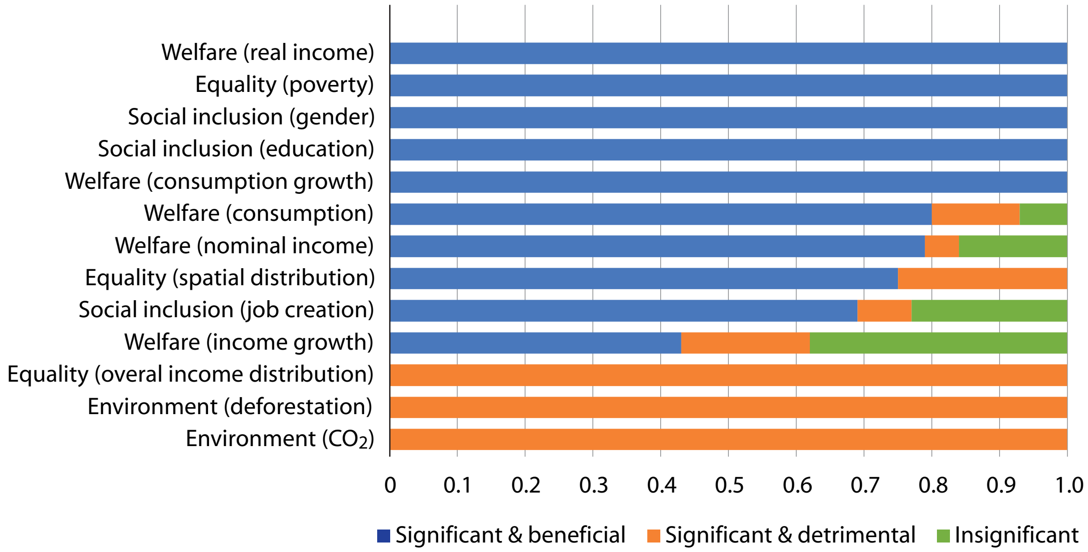
Most index publishers view economic growth as the main benefit of connectivity: the better a country's ranking, the better its ability to capture some of that growth. Linked to this, and an equally recognized and undisputed benefit of connectivity is its contribution to supply chain efficiency. However, taking into account the sustainability of connectivity, this approach raises further questions, for example, whether the connectivity gains of some countries are made at the expense of others or at the expense of other factors not measured by the indices, such as environmental performance, energy consumption and social impacts, such as road safety.

Beyond this, the most recent connectivity assessments tend to conclude that current infrastructure plans in Asia tend to be focused on corridor development.[8] It follows that, while being critical to overall connectivity, these corridors are not always aligned with the objective of ensuring the connectivity of local businesses, which is crucial for realizing benefits from agglomeration economies and for positive social impacts. In addition, project selection methodologies often do not systematically incorporate comprehensive cost-benefit analysis, multiple-criteria analysis or the risk and uncertainty analysis.[9] Finally, there is an observed limited use of quantitative models and the most frequently cited limitation is the shortage of available and reliable data, especially with regard to measuring the social, spatial and environmental impacts of enhanced transport connectivity.

A recent report also highlights that interest is rising in the wider economic benefits of large transport projects, which include impacts on development outcomes such as:[10] (a) economic welfare (income, wages, consumption) (b) social inclusion (jobs, gender); (c) equity (poverty, inequality); (d) environmental quality (pollution, deforestation); and (e) economic resilience (unexpected losses resulting from large shocks or protracted trends). Deciding, therefore, on how to enhance transport connectivity often involves trade-offs between different types of variables (figure 1.1).

[8] International Transport Forum, "Enhancing connectivity and freight in Central Asia", International Transport Forum Policy Papers, No. 71 (Paris, OECD Publishing, 2019).
[9] Ibid.
[10] Asian Development Bank, Department for International Development, Japan International Cooperation Agency and World Bank, *The WEB of Transport Corridors in South Asia* (Washington, D.C., World Bank, 2018).

Figure 1.1. Wider economic benefits of corridor investments



Source: Mark Roberts and others, "Transport corridors and their wider economic benefits: a critical review of the literature", Policy Research Working Paper, No. 8302 (Washington, D.C., World Bank, 2018).

For instance, boosting income can come at the expense of rising inequality. In planning international transport corridors, there may also be divergent interests in terms of international and domestic connectivity, as, for example, the shortest route may be more cost-efficient and, accordingly, more competitive, but a longer transport corridor may offer benefits in terms of domestic connectivity and territorial integration at the country level. Along those lines, scholars and institutions are increasingly incorporating social considerations in their assessments of corridor projects and stressing the varied impacts of transport investments across multiple economic and other actors.[11]

In the light of these considerations, ESCAP has long supported the countries in the region in progressing towards seamless and sustainable connectivity through better integrated infrastructure across modes and a more balanced modal split which enables growing transport demand to be accommodated on proportionately less infrastructure, with materially better service to users and significant energy savings, in sum, integrated intermodal transport. This is basically the fundamental notion of connectivity that is sustainable as opposed to a reactive expansion of the provision of infrastructure in response to increasing demand.

As intermodal transport and connectivity has gained acceptance as an integral component of the systems approach of conducting business in an increasingly competitive and interdependent global economy, the availability of technology and better information systems are also providing enhanced capacity to coordinate services across modes and between modes and terminals. In other words, current trends point to emerging opportunities for intermodal transport to become a key driver of sustainable development by allowing each mode to be played to its specific strengths, while complementing others in offering seamless transport solutions. Through intermodal transport, existing capacities and infrastructure can be used more effectively, serve more adequately the requirements of global supply chains and promote a better balance between modes. At the same time, the issue of the modal split is better understood if discussed at the point in which public policy, the provision of infrastructure, and business models and practices intersect.

The premise of seamless intermodal connectivity, however, also brings into the discussion the aspects of resilience and the importance of investing in diversified connectivity links.

Resilience and connectivity: traditional approaches and new focus

Resilience is, perhaps, one of the most complex terms to comprehensively define and one which is most commonly associated with disaster risk reduction strategies. The concept was introduced in ecology in the 1970s as *a measure of the persistence of systems and their ability to absorb change and disturbance and still*

[11] J. Rozenberg and M. Fay, *Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet – Sustainable Infrastructure Series* (Washington, D.C., World Bank, 2019).

maintain the same relationships between populations or state variables.[12] In the context of transport, resilience entails ensuring transport system integrity, service reliability, functionality, and rapid recovery after acute shock or chronic stresses,[13] such as what may be caused by natural or climate-change related disasters, cyberattacks, or ageing infrastructure.

There are two schools of thought on network resilience. The first one considers instances in which a node is connected to the rest of the network by one major link or is reliant on one other node for access to the rest of a network. The other perspective considers a highly connected network in which agglomeration forces or other scale effects have encouraged a concentration of activity in one of the nodes or along one link. While the causes may be very different, both types of networks face similar risks of vulnerability to disruptions to the node or link on which they are dependent. In the first instance, however, the effects are isolated to one node, while in the other, the effects can be transmitted to the rest of the network and over a large area. One such example is the flooding that occurred in Thailand in 2011 from which it is estimated that the disruptions reduced the country's gross domestic product (GDP) growth rate from an expected 4% to 2.9%[14] and reduced global industrial production by 2.5%.[15] Based on this, disruption, even a short-lived one, in one location can have ramifications around the world. At the same time, understanding network resilience is increasingly important for landlocked countries, especially those that are dependent on one major trade route for access to overseas markets. For example, in 2015, a blockade of the Nepal-India border crossing at Birgunj, resulted in prices spiking within short periods, and significant economic losses.[16]

Nonetheless, it cannot be overlooked that transport is one of the sectors in which at least basic considerations of resilience have been incorporated into its infrastructure and operations. Infrastructure built to have a lifespan of decades is expected to be robust and able to withstand an array of conditions. Meanwhile, the transport industry is known for employing diverse and creative methods to "make it work" while adapting to changing conditions. One such example is that since 1995, more than 400 free trade agreements have been notified to the World Trade Organization (WTO), while from 2008 to 2016, 1,583 trade-restrictive measures were imposed by WTO members.[17] In the period from October 2017 to May 2018, G20 economies applied an average of six trade-restrictive measures per month.[18] The impact of this does not only affect international trade, but it also influences the related freight transport flows. Accordingly, companies adapt by reconfiguring their supply chains in order to take advantage of the prevailing portfolio of free trade agreement privileges. To ensure the lowest possible duties and taxes, companies are "tariff-engineering" the movement of export-import goods in relation to the most advantageous free trade agreement frameworks.

It follows that transport is, inherently, a resilient sector because it needs to be, even in the best of conditions. The issue is that, in recent years, the transport sector in Asia and the Pacific is increasingly being called upon to become resilient to factors and conditions previously unknown or, at least, underestimated. The onset of climate change and growing frequency of extreme weather events and natural disasters had not been anticipated decades earlier when infrastructure that is still in use today, was being built. In a study published in 2017,[19] the Asian Development Bank (ADB) estimated that in its 45 developing member countries, disaster losses averaged $126 million a day between 2006 and 2015.

Photo credit: lovingyou2911 / istockphoto

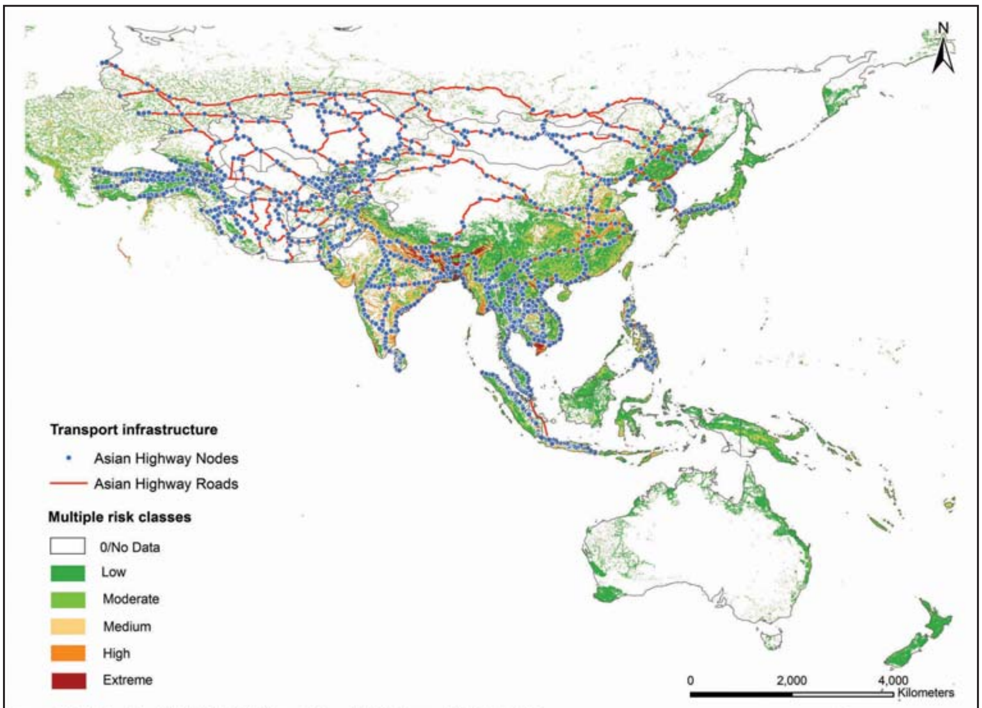
[12] C.S. Holling, "Resilience and stability of ecological systems" *Annual Review of Ecology and Systematics*, vol. 4, pp 1-23 (1973).
[13] J. Wang, 2015, "Resilience thinking in transport planning", *Civil Engineering and Environmental Systems*, vol. 32, No.1-2, pp. 180-191.
[14] The World Bank, "Thai flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning" (2012). Available at: http://documents.worldbank.org/curated/en/677841468335414861/pdf/698220WP0v10P106011020120Box370022B.pdf.
[15] United Nations Office for Disaster Risk Reduction (UNISDR), "Towards a post-2015 framework for disaster risk reduction" (2012). Available at: https://www.unisdr.org/files/25129_towardsapost2015frameworkfordisaste.pdf.
[16] Japan G20 Development Working Group background paper, "Infrastructure connectivity", (World Bank Group) (2019). Available at: https://www.oecd.org/g20/summits/osaka/G20-DWG-Background-Paper-Infrastructure-Connectivity.pdf.
[17] World Trade Organization, "Report on G20 trade measures" (2016). Available at: https://www.wto.org/english/news_e/news16_e/g20_wto_report_june16_e.pdf.
[18] World Trade Organization, "Report on G20 trade measures" (2018). Available at: https://www.wto.org/english/news_e/news18_e/g20_wto_report_july18_e.pdf.
[19] Asian Development Bank *"Meeting Asia's Infrastructure Needs", (*Manila, ADB, 2017) p. 44.

The surge in economic development in Asia and the Pacific over the past 20 years has also led to a sharp increase in infrastructure spending and construction, which is projected to continue in order to respond to growing demand in line with the region's prioritized economic growth. As a result, a large portion of the regional network is most probably not sufficiently equipped to respond to these factors. This, in turn, has led to multitude of estimates on the costs of climate proofing transport infrastructure to adapt it to new realities, such as accelerated coastal erosion, port and coastal road inundation and submersion, water supply problems, access restrictions to docks and marinas and deterioration of the condition and structural integrity of road pavements, bridges and railway tracks.[20] Such adaptation measures enhance the physical robustness of infrastructure and increase the ability of transport systems to remain functional and recover quickly at minimal cost. From the economic perspective, adaptation measures may limit future operational and rehabilitation costs incurred by incremental climatic changes and/or extreme weather events.

The Asian Development Bank has also estimated that Asia needs to invest $1.5 trillion a year in infrastructure from 2016 until 2030 to keep pace with economic growth. The estimated investment requirement rises by 16% to more than $1.7 trillion a year when taking into account climate adaptation and mitigation measures. Mitigation costs could amount to $200 billion annually, while adaptation costs are estimated at $41 billion a year, mostly for transport infrastructure. Specifically, the overall infrastructure investment requirements of India, including transport, rise to 8.8% of its GDP when adjusted for climate resilience. In South-East Asia, it rises to 5.7%, while in the Pacific the expected additional investment is highest, at 9.1% of GDP.[21]

Climate-adapted transport projects are already being promoted by multilateral development banks and other development actors, often with loans being contingent upon adaptation planning. These considerations, however, need to be integral to the national and regional transport planning processes currently underway in the region and still fall short of covering the resilience needs of critical links and nodes in the regional network. Various methodologies have been employed for several years to calculate vulnerabilities and the likelihood and nature of disruptive events across the region, including by ESCAP. By way of example (figures 1.2 and 1.3), the Asian Highway network is deemed increasingly exposed to high risks of disruptions because of earthquakes, floods, cyclones and landslides, thus creating multi-hazard risk prone areas and infrastructure assets.

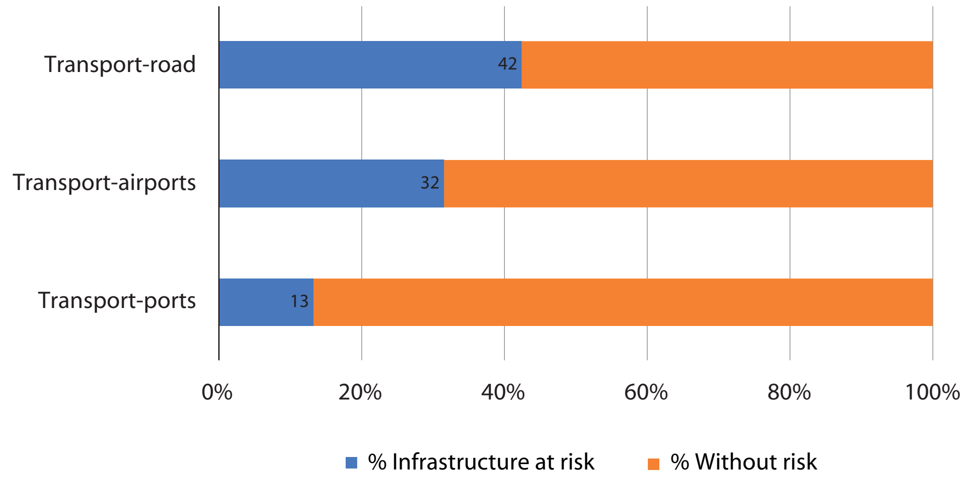
Figure 1.2. Segments of the Asian Highway network exposed to medium to high multi-hazard risk



Source: ESCAP, based on Global Risk Data Platform, 2013 and ESCAP Transportation Data, 2018.
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

[20] H. Gokcekus and G. Gelete, "The economic impact of climate change on transportation assets", *Journal of Environmental Pollution and Control*, vol. 1, No. 1, (2018).
[21] Asian Development Bank *"Meeting Asia's Infrastructure Needs", (*Manila, ADB, 2017).

Figure 1.3. Percentage of infrastructure at risk of all multi-hazards (earthquake, flood, cyclone and landslide)



Source: ESCAP secretariat

The World Meteorological Organization (WMO) released data – up to July 2019, as part of a high-level synthesis report entitled *United in Science* and published under the umbrella of the Science Advisory Group of the United Nations Climate Action Summit 2019.[22] According to the report, the period 2015-2019 is not only set to be the warmest five-year period in recorded history, but also the period during which CO_2 growth rates exceed those of the previous five years by a staggering rate of approximately 20%. Preliminary data from a subset of greenhouse gas observational sites for 2019 indicate that global concentrations of CO_2 are on track to reach or even exceed 410 parts per million by the end of 2019. On that basis, WMO warned that *climate change causes and impacts are increasing rather than slowing down* as evidenced by the frequency and intensity of climate disasters in this period. The key recommendation from the report was that greenhouse gas emissions, notably from energy production, industry and transport should be drastically reduced. Importantly, the WMO Secretary-General and co-chair of the Science Advisory Group stated at the Summit that *To stop a global temperature increase of more than 2 degrees Celsius above pre-industrial levels, the level of ambition needs to be tripled. And to limit the increase to 1.5 degrees, it needs to be multiplied by five.*

The key takeaway from these findings is that the transport sector is not only a major contributor to climate change but it is also set to be one of the hardest-hit sectors from climate change impacts. In this regard, a resilient transport sector in Asia and the Pacific will be one that equally addresses its role as part of the problem and as part of the solution by embracing its dual nature; transport is a necessary driver for sustainable development but should itself as a sector be sustainable. This would, among others, require incorporating effective mitigation strategies and adaptation measures.

1.2. Bringing in the context: advances in the Asia Pacific connectivity landscape

The institutional backbone behind the development of transport networks in the ESCAP region is the Intergovernmental Agreement on the Asian Highway Network and the Intergovernmental Agreement on the Trans-Asian Railway Network, which entered into force in July 2005 and June 2009, respectively. In addition, the identification of a set of dry ports of international importance under the Intergovernmental Agreement on Dry Ports has facilitated the implementation of the two networks and their integration with ports and other modes. This regional effort has gone a long way towards aggregating disparate infrastructure systems into a common regional infrastructure network that is best able to serve the region's economic integration, strengthen its future economic growth and facilitate the exchange of goods and services.

Despite progress made, the level and quality of infrastructure provision remain uneven across the region and relatively low in many Asian and Pacific countries, while operational challenges with commensurate effects on

[22] World Meteorological Organization, "High-level synthesis report on latest climate science information" (2019). Available at https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/United_in_Science_ReportFINAL_0.pdf?XqiG0yszsU_sx2vOehOWpCOkm9RdC_gN.

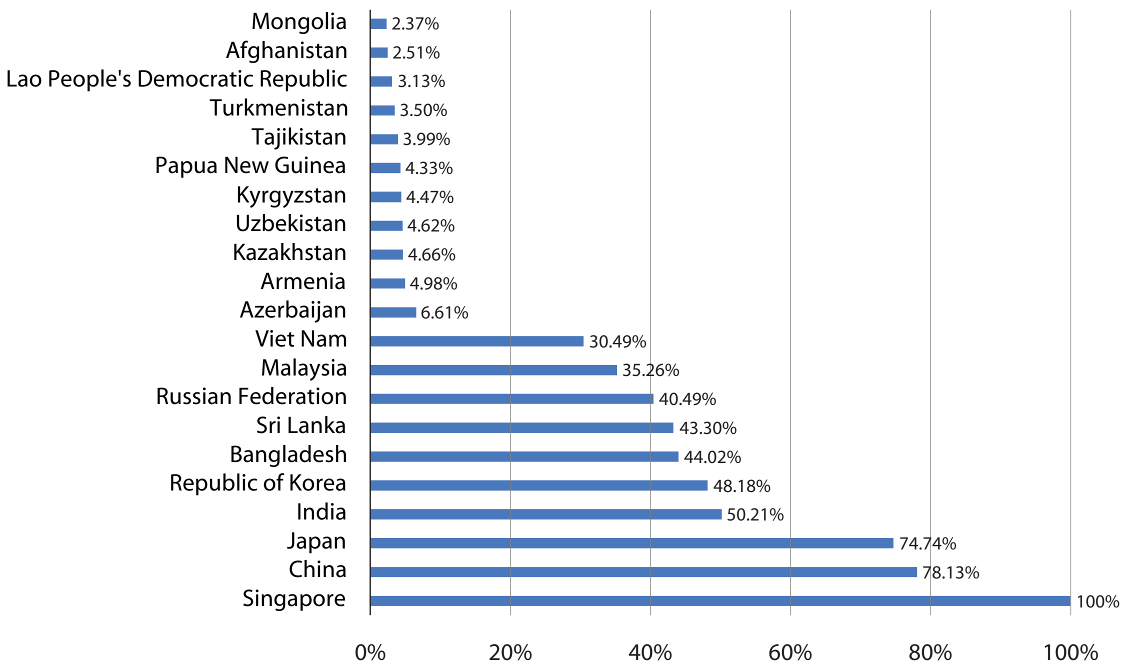
supply chain efficiency persist such as, most notably, restrictions on traffic rights, lack of harmonized standards on vehicle weights, dimensions and emissions, mismatched and varying border crossing procedures and other administrative requirements. Similarly, missing links and the lack of harmonized technical standards within the railway sector also adversely affect the efficiency and effectiveness of international railway operations among ESCAP member States.

To measure the progress in the Asia and Pacific region, ESCAP developed a transport connectivity index[23] which assigns a score that indicates how well each transport mode is connected in each country. The index is based on five components of the freight transport sector: air, roads, rail, maritime and logistics. For air and land transport dimensions, a country's value is based on a mathematical procedure that transforms a number of possibly correlated variables into a small, uncorrelated variable through the principal component analysis method. The input of the principal component analysis is normalized by subtracting the sample mean and dividing by the standard deviation so that all variables have mean zero and unit standard deviation. The summary indicator for land transport covers road and rail density measured as the length of each network relative to each country's land area. For other components, such as maritime and logistics performance, existing assessment indictors were used namely the Liner Shipping Connectivity Index of UNCTAD and the Logistics Performance Index of the World Bank, which are based on the same methods. Data for the ESCAP transport connectivity index were collected across all components for 33 countries in Asia and the Pacific.

Connectivity in the region and by subregion is then also analysed separately on the basis of several well-established and broadly used indices, such as the Logistics Performance Index of the World Bank; the Liner Shipping Connectivity Index of UNCTAD; and the Global Connectivity Index of the International Transport Forum. In the first instance, this comparison of findings shows that by all these accounts, the major connectivity gaps and restrictions in the region and strongest and weakest performers are, by and large, consistent across the various methodologies.

The ESCAP connectivity assessment reveals, as illustrated in figure 1.4, that Singapore is the best performer in the region, followed by China, Japan, and India while the Lao People's Democratic Republic, Afghanistan, and Mongolia are the furthest away from the top performing country.

Figure 1.4. ESCAP transport connectivity index, as a percentage of the highest performer's score, selected ESCAP countries

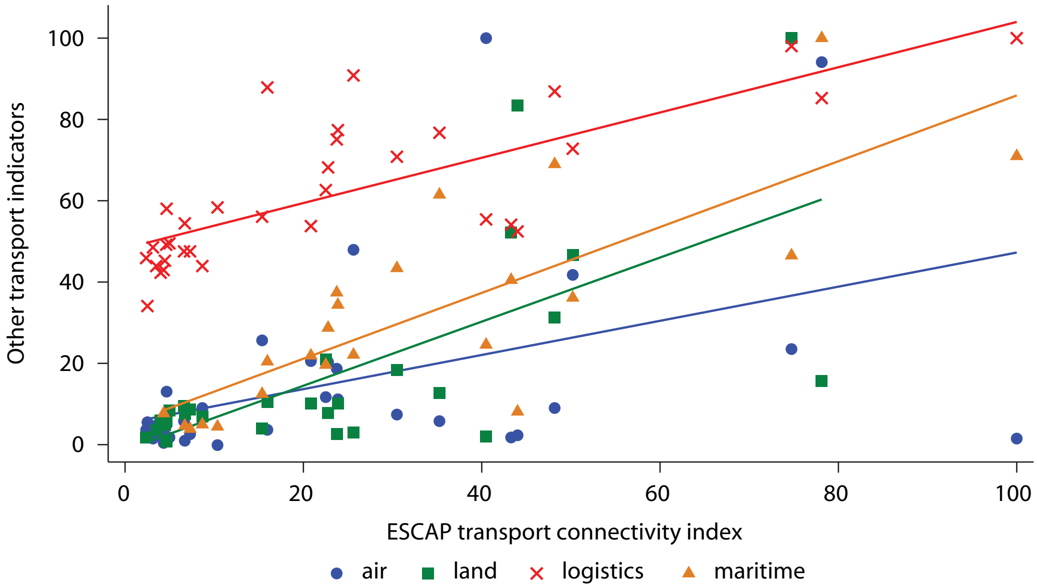


Source: ESCAP calculations.

[23] The index was constructed based on the methodology of the Asia-Pacific Economic Cooperation (APEC) multimodal transport indicator see: Asia-Pacific Economic Cooperation, "The economic impact of enhanced multimodal connectivity in the APEC region", APEC Policy Support Unit (2010). Available at https://www.apec.org/Publications/2010/06/The-Economic-Impact-of-Enhanced-Multimodal-Connectivity-in-the-APEC-Region.

As shown in figure 1.5, the index that incorporates all transport modes and logistics performance has a strong positive correlation with each modal indicator, which is shown by the linear upward slope of each line of best fit. The index clearly captures an important tendency of the full range of modal data and should be a useful indicator of overall transport connectivity.

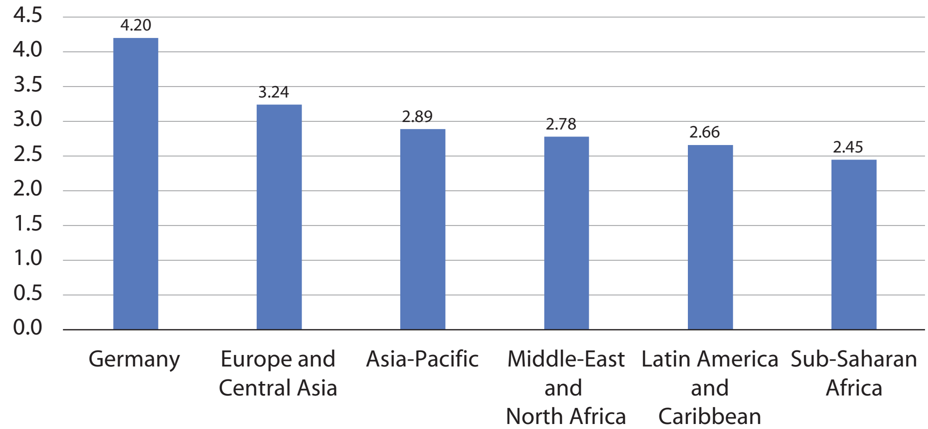
Figure 1.5. Correlation between the ESCAP transport connectivity index and its components (indicators for each mode plus logistics performance)



Source: ESCAP calculations.

In comparing Asia and the Pacific with other regions, most available global indicators of transport connectivity and the Logistics Performance Index of the World Bank converge on the finding that the Asia-Pacific region is solidly positioned in terms of transport connectivity and logistics performance (figure 1.6) and is home to frontrunners and cases of major qualitative leaps in connectivity.

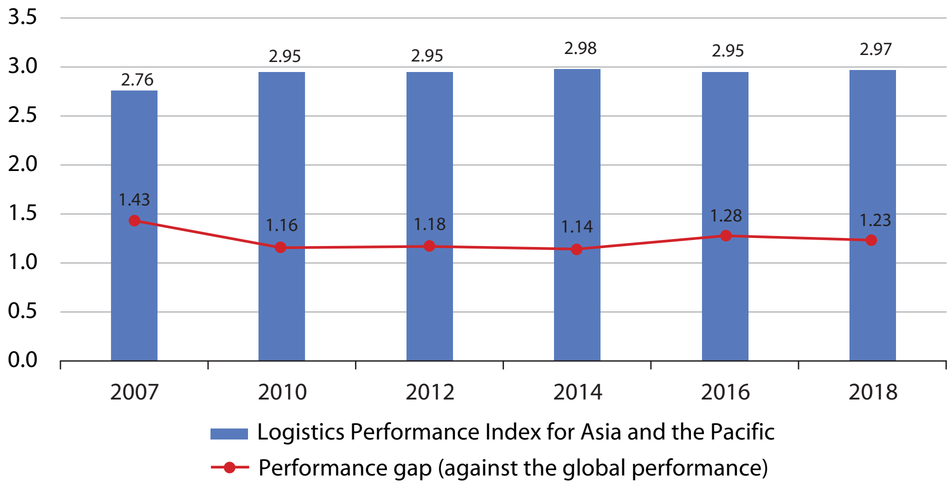
Figure 1.6. Logistics Performance Index, 2018



Source: ESCAP secretariat based on data from J-F. Arvis, and others, "Connecting to compete 2018: trade logistics in the global economy Washington, D.C, The International Bank for Reconstruction and Development/The World Bank, 2018).

The analysis of the Logistics Performance Index average for the region since 2007 suggests a steady performance, but alerts to the persistent, but declining gap between the leading logistics performance at the global level and the region's performance (figure 1.7).

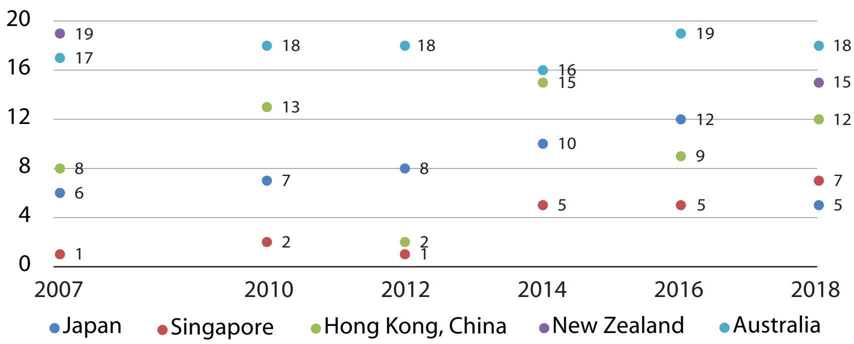
Figure 1.7. Logistics Performance Index, performance gap against the global performance Asia-Pacific 2007-2018



Source: ESCAP secretariat based on data from J-F. Arvis, and others, "Connecting to compete 2018: trade logistics in the global economy" (Washington, D.C, The International Bank for Reconstruction and Development/The World Bank, 2018).

The analysis of the Logistics Performance Index also shows the transition of the region from being home to frontrunners in logistics performance during the period 2007-2012, to the situation in most recent years, in which four or five economies from the region are consistently ranked in the top 20, but never as high as the position attained in 2007 (figure 1.8).

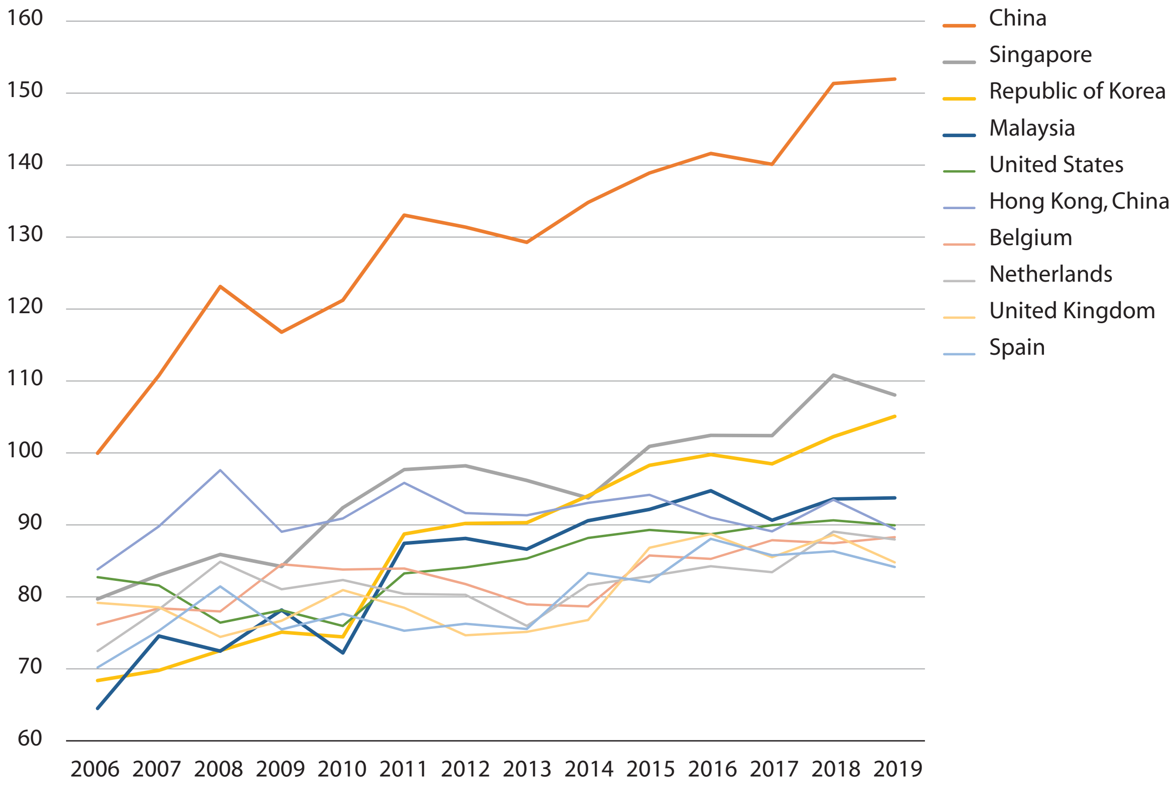
Figure 1.8. Asia-Pacific economies in the top 20 of the Logistics Performance Index: 2007-2018



Source: ESCAP secretariat based on data from J-F. Arvis, and others, "Connecting to compete 2018: trade logistics in the global economy", (Washington, D.C, The International Bank for Reconstruction and Development/The World Bank, 2018).

In terms of maritime connectivity, global indicators such as the UNCTAD Liner Shipping Connectivity Index (LSCI), which indicates a country's integration level into global liner shipping networks, show five economies from the region, China, Singapore, Republic of Korea, Malaysia and Hong Kong, China, have been consistently identified as top performers since 2006 (figure 1.9).

Figure 1.9. Top 10, 2006-2019 Liner Shipping Connectivity Index



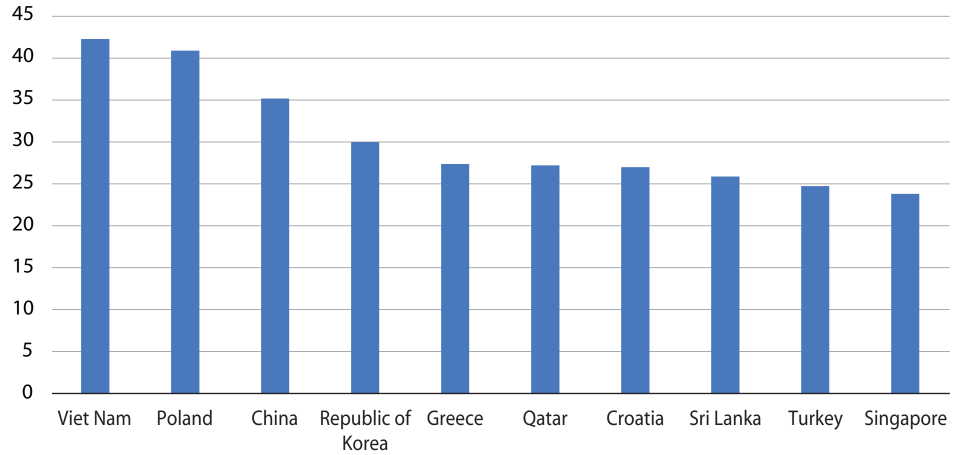
Source: ESCAP based on the Liner Shipping Connectivity Index.

The Liner Shipping Connectivity Index captures how well countries are integrated in global liner shipping networks. It is computed by the United Nations Conference on Trade and Development (UNCTAD) based on six components of the maritime transport sector: number of scheduled ship calls per week in the country; deployed annual capacity in TEUs: total deployed capacity offered at the country; number of regular liner shipping services from and to the country; number of liner shipping companies that provide services from and to the country; average size in TEUs of the ships deployed by the scheduled service with the largest average vessel size that deploy container ships in a country's ports; and number of other countries that are connected to the country through direct liner shipping services. The LSCI is generated for all countries that are serviced by regular containerized liner shipping services. For each component, the country's value is divided by the maximum value for the component in 2006; the average of the six components is then calculated for the country. The country average is then again divided by the maximum value for the average in 2006 and multiplied with 100. The result is a maximum LSCI of 100 in the year 2006. This means that the index for China in 2006 is 100 and all other indices are in relation to this value.

Source: UNCTAD, Division on Technology and Logistics, based on MDS Transmodal (https://www.mdst.co.uk/).

Furthermore, during the past decade, Asian countries comprised 50% of the top 10 countries recording the highest increases in the Liner Shipping Connectivity ranking, with Viet Nam increasing the most since 2009, worldwide (figure 1.10). In terms of port throughput, two thirds of the global volume is concentrated in Asian ports. In 2017, 63% of the global world container port volumes was handled in Asia, with Europe coming second at a mere 16%.[24]

Figure 1.10. Highest Liner Shipping Connectivity Index increases 2009-2019



Source: UNCTAD, based on data provided by MDS Transmodal.

While aviation carries only 0.5% of world trade by volume, air cargo represents 34.6% of trade by value, according to the International Civil Aviation Organization (ICAO). Such a large disparity between tonnage and value reflects air cargo's unique position in transporting goods that often require a high level of speed, reliability, and security. The demand for air freight is limited by cost, which is typically four to five times that of road transport and 12 to 16 times that of sea transport;[25] as such, the commodities shipped by air are those that have high value per unit density. Among those traded goods, computing equipment, machinery, and electrical equipment account for the highest share of airborne trade tonnage versus containership tonnage.

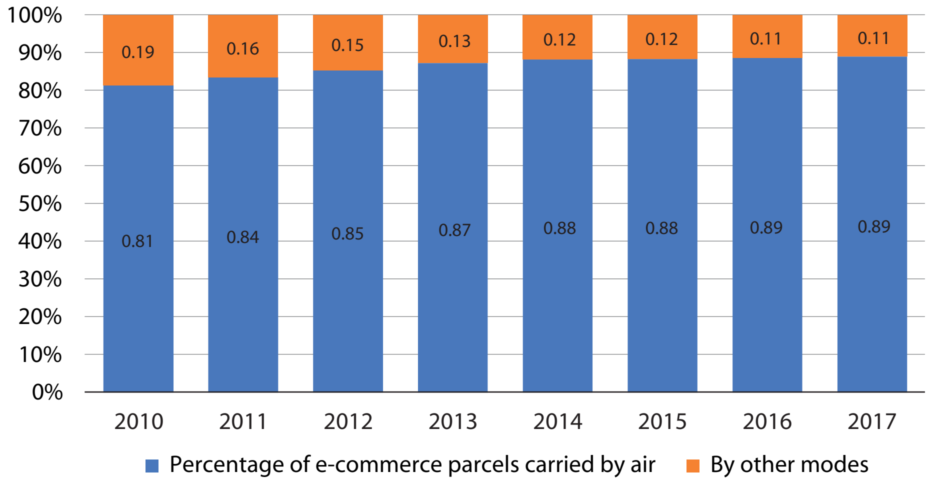
The Asia-Pacific region represents 38% of the world freight traffic measured in freight ton-kilometres (FTKs) and recorded an annual growth of 2.7% in 2018.[26] More than 88% of the air freight traffic handled by carriers based in Asia and the Pacific is international.[27] In 2018, Chinese carriers handled 29% of the total freight traffic of the region and registered growth of 8.3%.[28] Measured by total international freight (tons), four of the top five airports worldwide are in the Asia-Pacific region, namely Hong Kong International Airport, Shanghai Pudong Airport (China), Incheon International Airport (Republic of Korea), and Narita International Airport (Japan).

Importantly, in the last two decades, the evolution of Internet technology has led to the explosive growth of e-commerce. With easy access to the global marketplace, the rise of e-commerce has radically transformed business and consumer buying behaviour. The Asia-Pacific region is home to four of the ten largest and fastest growing e-commerce economies, including the largest, China. Furthermore, many countries in South-East Asia are emerging as fast-growing e-commerce markets. For example, the Indonesia market is projected to exceed $200 billion in e-commerce sales by 2025.[29] Combining the Chinese market together with those of Japan, the Republic of Korea, and the Russian Federation, $808 billion in e-commerce (or 57% of the total) is transacted in Asia, most of which is carried by air (figure 1.11).[30]

Asia is expected to continue to lead the world in average annual air cargo growth, with domestic China and intra-East Asia markets projected to expand by 6.3% and 5.8% per year, respectively.[31] Supported by faster-growing economies and rising middle classes, the East Asia-North America and Europe-East Asia markets will grow slightly faster than the world average growth rate.[32]

[24] Review of Maritime Transport, 2018 (United Nations publication, Sales No. E.18.II.D.5).
[25] According to information provided by the International Civil Aviation Organization.
[26] Ibid.
[27] Ibid.
[28] Ibid.
[29] Boeing, World Air Cargo Forecast, 2018-2037. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.
[30] Information provided by ICAO.
[31] Boeing, World Air Cargo Forecast, 2018-2037. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.
[32] Ibid.

Figure 1.11. Percentage of e-commerce carried by air

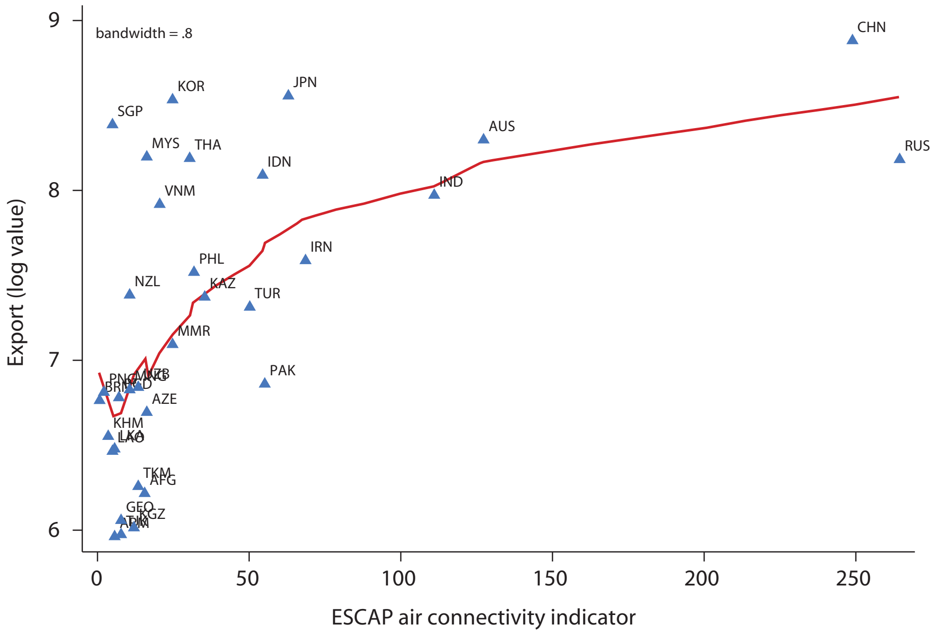


Source: Provided to ESCAP by ICAO

Despite its high cost and small share of world trade, aviation represents a critical connectivity link because it can enable countries, regardless of their geographical location, to connect to distant markets and global supply chains in a speedy and reliable manner. Direct benefits include employment and economic activity generated by the air transport industry, while indirect benefits are employment and economic activity of suppliers of the air transport industry. Air transport can also be relied on during emergencies and disease outbreaks to deliver medical personnel, vaccines and other supplies rapidly to the affected areas. As nodes, airports also complement other modes and provide connectivity locally and across oceans reliably and in a relatively short timespan.

Correlation analysis carried out by ESCAP illustrates that countries with increased air connectivity as expressed by the availability of airports with paved runways of 2,400 meters or more (capable of supporting medium-large jet operations), and airports with paved runways of 1,500 meters to 2,400 meters (capable of supporting smaller jets and turboprops) are better positioned to support export growth (figure 1.12).

Figure 1.12. Correlation between air connectivity and export volumes, selected Asia-Pacific countries

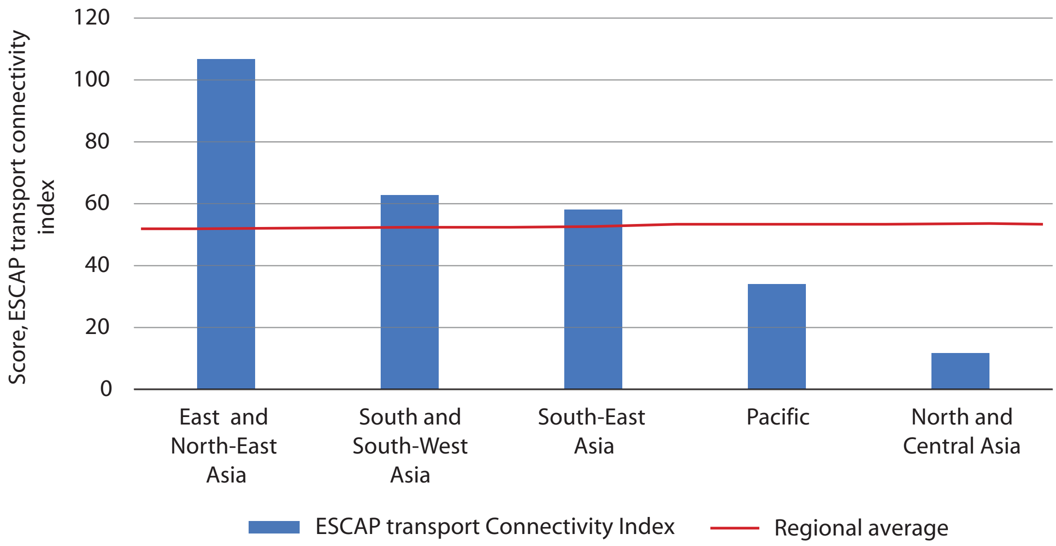


Source: ESCAP calculations.
Notes: AFG, Afghanistan; ARM, Armenia; AUS, Australia; AZE, Azerbaijan; BGD, Bangladesh; BRN, Brunei Darussalam; KHM, Cambodia; CHN, China; GEO, Georgia; IND, India; IDN, Indonesia; IRN, Islamic Republic of Iran; JPN, Japan; KAZ, Kazakhstan; KOR, Republic of Korea; KGZ, Kyrgyzstan; LAO, Lao People's Democratic Republic; MYS, Malaysia; MMR, Myanmar; NZL, New Zealand; PAK, Pakistan; PNG, Papua New Guinea; PHL, Philippines; RUS, Russian Federation: SGP, Singapore; LKA, Sri Lanka; TJK, Tajikistan; THA, Thailand; TUR, Turkey; TKM, Turkmenistan; VNM, Viet Nam.

1.3. Challenges in leaving no one behind: subregional connectivity variations in Asia and the Pacific

Transport connectivity and performance across the ESCAP subregions remain highly uneven, as the region's high overall transport connectivity performance hides the wide gaps among subregions. The ESCAP transport connectivity index places East and North-East Asia in the lead, with the performances of North and Central Asia, comprising a large number of the region's landlocked countries, and of the Pacific lagging behind the regional average (figure 1.13).

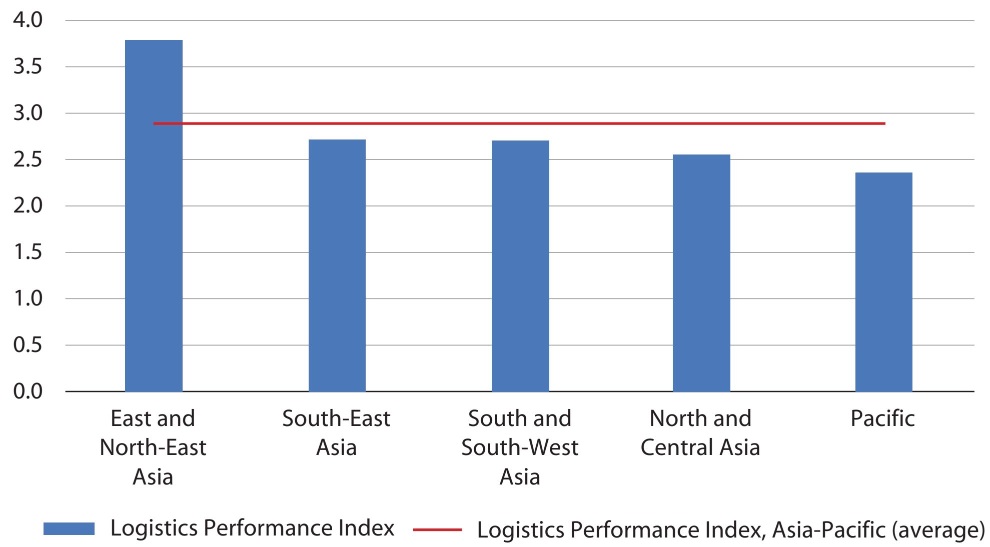
Figure 1.13. ESCAP transport connectivity index, by subregion



Source: ESCAP calculations.

In terms of logistics performance, the subregion of East and North-East Asia is again leading regional performance, with the rest of the subregions' scores behind the regional average (figure 1.14). North and Central Asia and the Pacific are the worst performers.

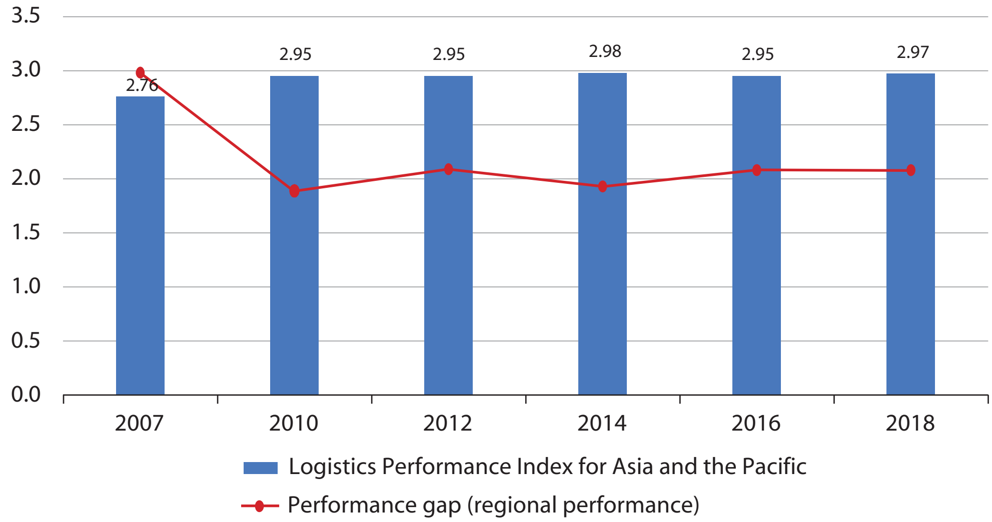
Figure 1.14. Logistics Performance Index, 2018, by subregion



Source: ESCAP secretariat based on data from Jean-Francois Arvis, and others, "Connecting to compete", World Bank (Washington, D.C, The International Bank for Reconstruction and Development/The World Bank, 2018).

Furthermore, similar to the gap with the region's performance and the best global performance, the gap between the region's best and worst performance is not narrowing (figure 1.15).

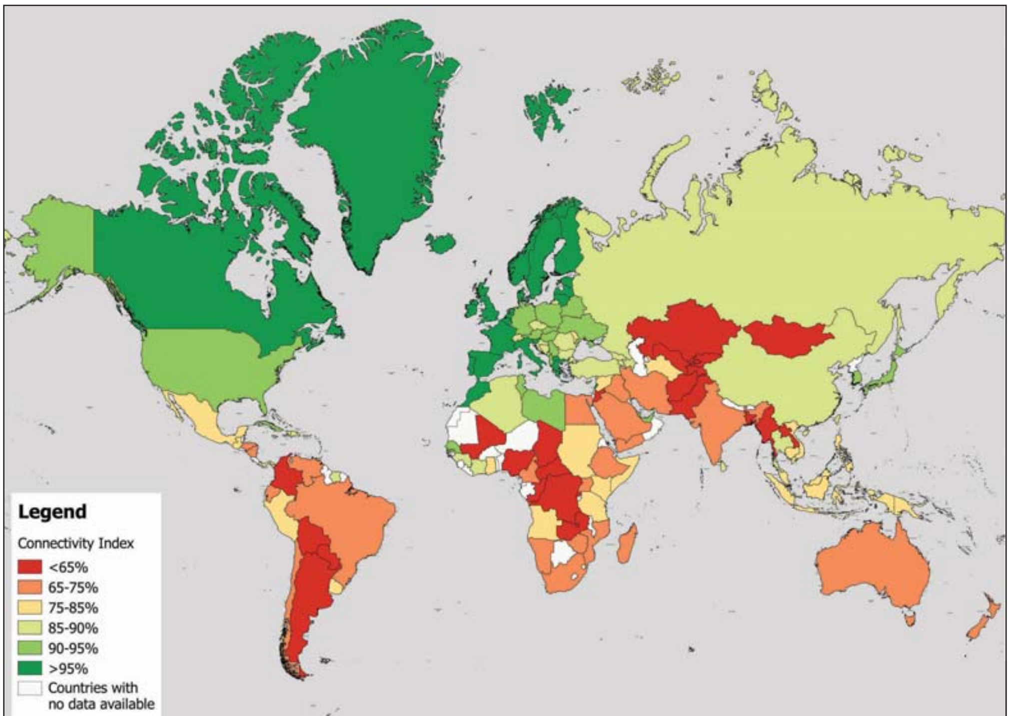
Figure 1.15. Logistics Performance Index, 2007-2018, performance gap (regional performance)



Source: ESCAP secretariat based on data from Jean-Francois Arvis, and others, "Connecting to compete", World Bank (Washington, D.C, The International Bank for Reconstruction and Development/The World Bank, 2018).

Other global indicators paint a similar picture. The Global Connectivity Index of the International Transport Forum, measures connectivity as the ease of access to global GDP, as compared to the best-connected country at the global level. The index identifies the pockets of high connectivity restrictions in major parts of Asia, which show the lowest levels of connectivity at the global level, as illustrated in figure 1.16. It is a gravity-based connectivity indicator, which measures the percentage of global GDP accessible from one country by going through or over another country. The explanatory components are calculated for road, rail and maritime transport modes and include distance, transport cost, including border crossing and handling cost, travel time and border crossing time.

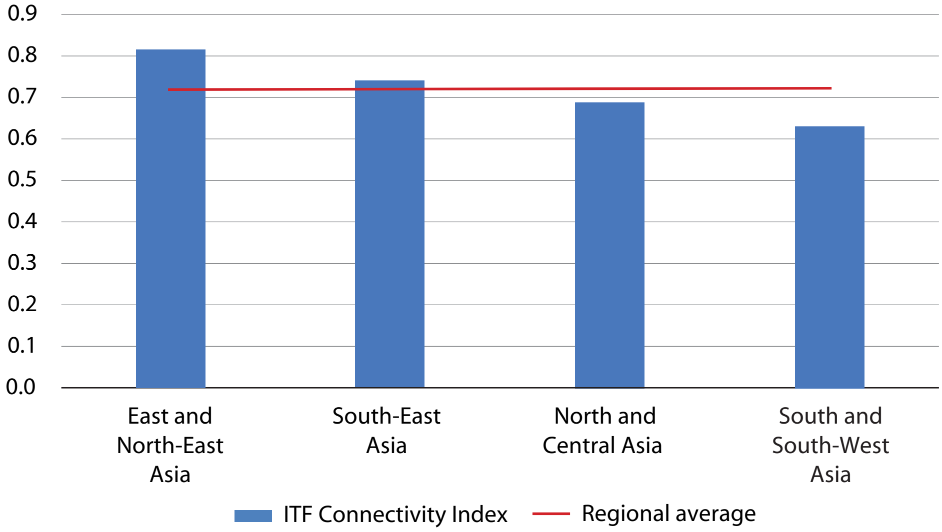
Figure 1.16. OECD/ITF global connectivity estimates, 2019 (access to global gross domestic product)



Source: OECD/ITF (2019). Provided to ESCAP and reproduced as intact.
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The regional average based on the International Transport Forum connectivity index also indicates that subregional variations are masked, as East and North-East Asia drive up the overall regional performance (figure 1.17).

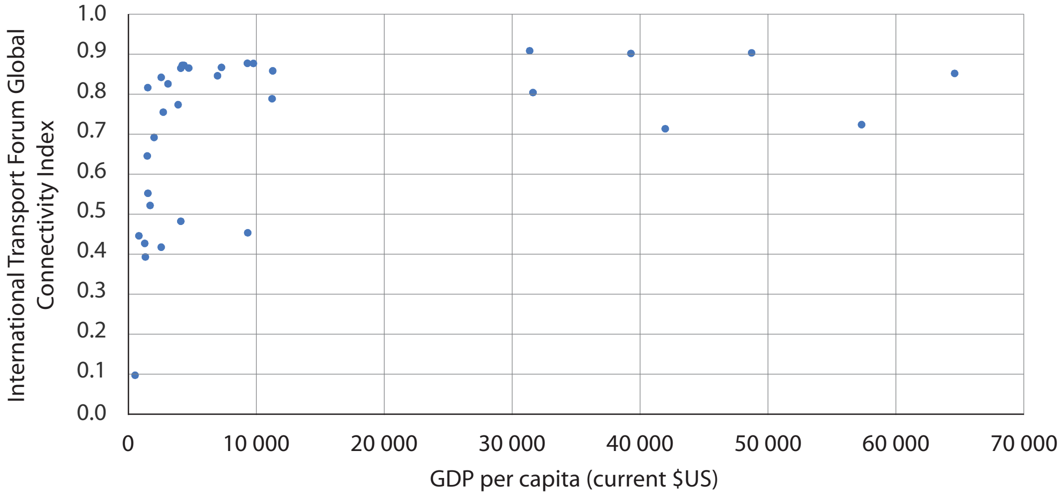
Figure 1.17. Global connectivity estimates in Asia and the Pacific, 2018, by subregion



Source: ESCAP secretariat based on International Transport Forum, 2019.

Economies in the region with relative high GDP per capita, including Australia, China, Japan, New Zealand, the Republic of Korea and Hong Kong, China, rank higher in the International Transport Forum connectivity index, (figure 1.18). The Republic of Korea is shown under this index to have the highest level of connectivity in the region.

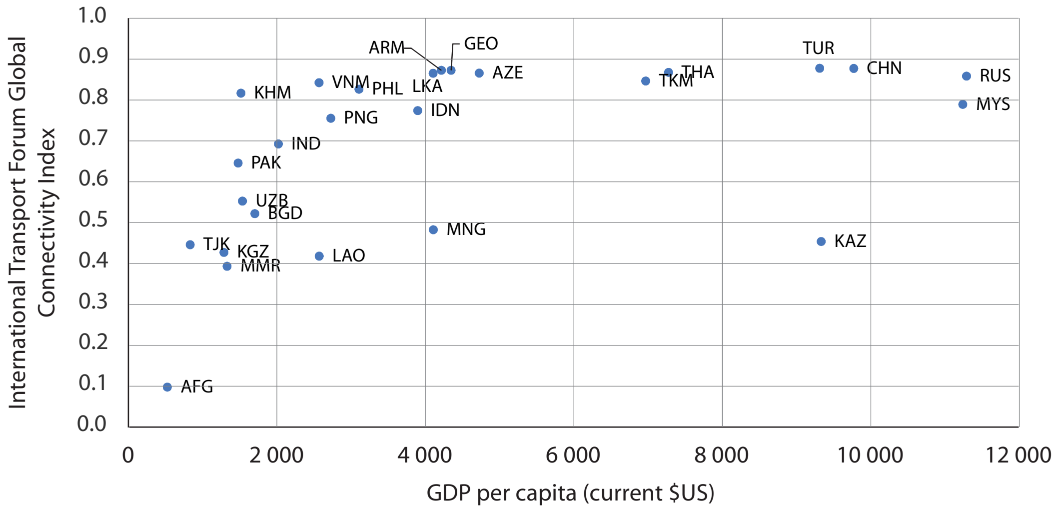
Figure 1.18. Global connectivity and GDP per capita in Asia, 2018



Source: ESCAP secretariat based on data from the International Transport Forum (2019) and the World Bank.

The connectivity estimates by the International Transport Forum also show a higher level of connectivity for many ESCAP developing countries with lower levels of GDP per capita, including some landlocked developing countries, such as Azerbaijan and Turkmenistan (figure 1.19).

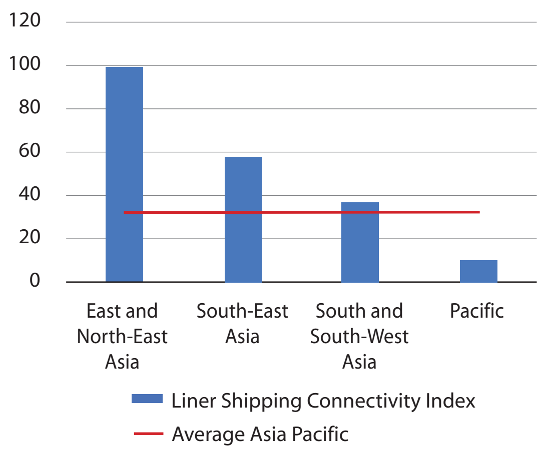
Figure 1.19. Global connectivity and GDP per capita (current $US): selected economies in Asia, 2018



Source: ESCAP secretariat based on data from the International Transport Forum (2019) and the World Bank.

The same sizeable gap can also be observed in maritime connectivity among some Asian countries that engage heavily in global trade and the least connected subregion, the Pacific, where some countries are ranked at the bottom of the global maritime connectivity range (figures 1.20 and 1.21).

Figure 1.20. Liner Shipping Connectivity Index, 2019: by subregion



Source: UNCTAD, Liner Shipping Connectivity Index, 2019.

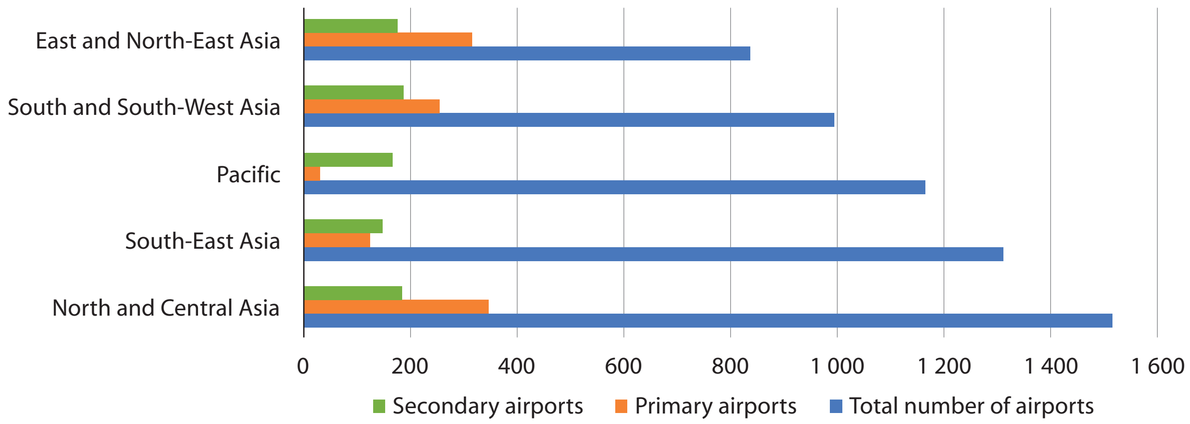
Figure 1.21. Least connected countries and/or territories in 2019

1. Norfolk Island
2. Christmas Island
3. Cayman Islands
4. Bermuda
5. Tuvalu
6. Wallis and Futuna Islands
7. Nauru
8. Cook Islands
9. Kiribati
10. Timor-Leste

Source: UNCTAD, Review of Maritime Transport, 2019.

In the aviation sector, according to the *World Factbook 2018*,[33] the number of airports in the Asia-Pacific region is estimated at 5,821[34] of which only 1,072 are classified as primary airports and 864 are classified as secondary airports.[35] From a subregional perspective, the data show that despite a very large number of airports, very few of them are equipped to handle large volumes of passengers and cargo, and that, by this metric, the Pacific has the largest air connectivity deficit in the region (figure 1.22).

Figure 1.22. Number of airports in Asia and the Pacific



Source: ESCAP calculation based on the United States, Central Intelligence Agency, *World Factbook 2018* (Washington, D.C., Central Intelligence Agency, 2019)

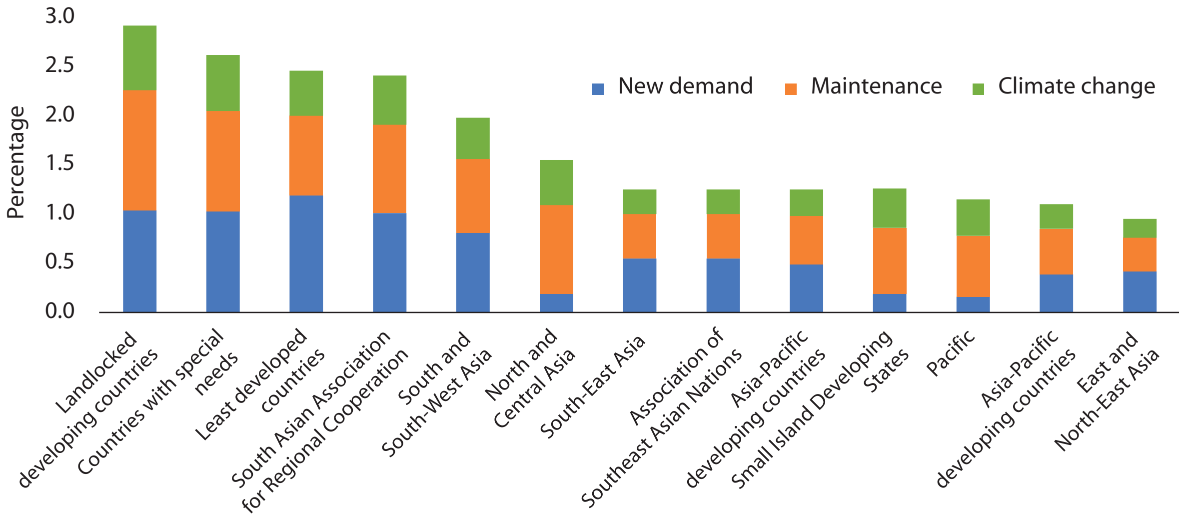
Beyond infrastructure, the Pacific aviation market is characterized by small and widely dispersed populations spread across many islands. The provision of air services is, consequently, fragmented, often involving long routes with thin traffic and freight levels. As a result, airlines face considerable constraints in profitably managing returns through a viable passenger and cargo mix, and in achieving sufficiently high levels of aircraft utilization and revenue load factors. While physical infrastructure is not generally considered to be a primary limiting factor for air connectivity, it may be that the available infrastructure is not being used efficiently, in terms of operations, processes, practices, as well as destinations served directly, indirectly or through a hub.

Unsurprisingly, the subregional groupings comprising countries with special needs, such as the landlocked developing countries or the small island developing States, face the greatest connectivity restrictions. The connectivity gaps among subregions and for the countries with special needs, in particular, translate into the high level of financial resources necessary to reach the performance levels required to support the attainment of the Sustainable Development Goals. According to recent ESCAP analysis, the developing countries of Asia and the Pacific will need to invest an additional $126 billion in transport infrastructure annually, accounting for 0.4% of the region's GDP. The bulk of the investment needs to be directed to countries with special needs and, specifically, landlocked developing countries (figure 1.23).

The specific challenges of these countries have already been reflected in the ESCAP Regional Action Programme on Sustainable Transport Connectivity, which identifies, as one of its seven components, transport connectivity for least developed countries, landlocked developing countries and small island developing States. These countries' needs are also part of United Nations global initiatives, such as the Vienna Programme of Action for Landlocked Developing Countries for the Decade 2014-2024 and the SIDS Accelerated Modalities of Action (S.A.M.O.A.) Pathway. Building on this work, efforts should be sustained and accelerated towards addressing the connectivity challenges of countries with special needs to ensure the full implementation of the 2030 Sustainable Development Agenda.

[33] United States, Central Intelligence Agency, *World Factbook 2018* (Washington, D.C., Central Intelligence Agency, 2019).
[34] Excluding American Samoa, Bhutan, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Maldives, Marshall Islands, Micronesia, Nauru, Nepal, New Caledonia, Niue, Northern Mariana Islands, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu.
[35] Primary airports are regarded as those with paved runways of 2,400 meters or more (capable of supporting medium-large jet operations), while secondary airports are those with paved runways of 1,500 meters to 2,400 meters (capable of supporting smaller jets and turboprops) (APEC TPT-WG 2007: 14). These definitions are commonly used international benchmarks, but alternative definitions can be applied which mayt result in different airport counts.

Figure 1.23. Transport investment needs, by component
(Annual average total investment need, 2016-2030, expressed in percentage of annual average GDP, 2016-2030)



Source: S. Banerjee, "Costing the transport infrastructure component of SDGs in Asia and the Pacific, MPFD Policy Brief No. 89, (April 2019). Available at https://www.unescap.org/resources/mpfd-policy-brief-no-89-costing-transport-infrastructure-component-sdgs-asia-and-pacific.

Despite these efforts, in reviewing the overall connectivity landscape in the region, it becomes increasingly clear that the regional connectivity agenda needs to put the persisting connectivity gaps within the region at the centre of regional transport cooperation. Referring to the questions surrounding resilience, it can be argued that the region's transport system is only as resilient as the most-weakly connected components of its overall network. Adding the qualitative and operational connectivity considerations, it would arguably not be too much of a stretch to contend that despite measurable improvements in connectivity over the past 20 years, the region still has a long way to go to ensure the sustainability of that connectivity.

Meeting the region's needs for sustainable transport connectivity requires significant financial efforts; accordingly, resource mobilization for infrastructure construction and maintenance remains a key priority in this area. At the same time, there is still ample scope for increasing the level of regional cooperation towards resource optimization. The costs of transport development vary significantly based not only on initial conditions and development objectives, but also on the means of delivery. In many cases, transport services could be supplied at lower costs with fewer externalities if implementation strategies were to capitalize on promoting a more balanced modal split between transport modes and other ways of optimizing the development and use of transport networks, such as addressing the issues of operational connectivity. Accordingly, in addition to resource optimization, the current and future configuration of transport connectivity needs to be viewed from a holistic sustainability standpoint in which the analysis is expanded beyond the traditional vehicle operating costs to a wider range of benefits but also takes into consideration possible negative impacts of increased transport connectivity.

Recent analyses of transport connectivity and the regional transport corridors are focused on the role of operational connectivity, especially the reduction of costs and times at the border crossings. According to the recent International Transport Forum study entitled *Enhancing connectivity and freight in Central Asia*, for the countries included in the study to meet their future freight demand, connectivity improvement resulting from improved border crossings is comparable to one resulting from new infrastructure.[36] The recent joint analysis of transport corridors in South Asia, by the World Bank, ADB and the Japan International Cooperation Agency, indicate, based on solid empirical evidence, that transport corridor initiatives create both winners and losers, and that, as a result, a holistic appraisal methodology is required to ensure that economic benefits of investments in transport corridors are amplified and more widely spread, and that possible negative impacts are minimized.[37]

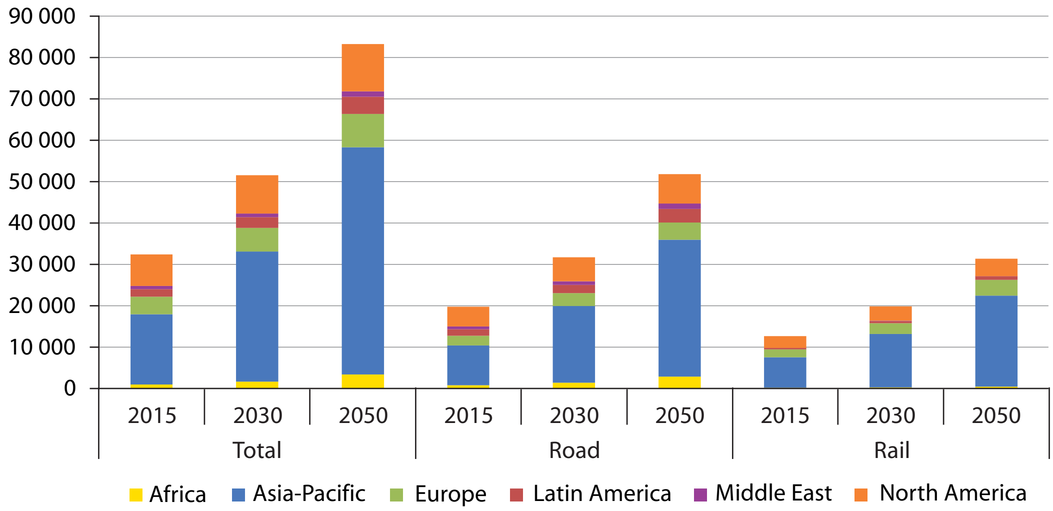
[36] International Transport Forum, "Enhancing Connectivity and Freight in Central Asia", International Transport Forum Policy Papers, No. 71, (Paris, OECD Publishing, 2019).
[37] Asian Development Bank, World Bank and Japan International Cooperation Agency, *The WEB of Transport Corridors in South Asia.*, (Washington, D.C., World Bank, 2018)

1.4. Sustainability implications for freight transport policies in Asia and the Pacific

The overall connectivity landscape supports the assertion that the region is constantly improving in terms of connectivity and that significant progress has been achieved in the past 20 years. The data, however, also strongly point towards the need to drastically reassess regional policies to address the needs of the least connected subregions and countries, in particular those that are landlocked and small island developing States. In turn, this implies the need for a new generation of freight transport policies for Asia and the Pacific, which would be tailored to equally consider all aspects of sustainable transport performance and capitalize on new and emerging technologies. Indeed, the transport sector today is being revolutionized by advances in technology, and the transformation of modern transport networks could change the way people and goods are moved from origins to destinations, marking a clear transition from "business as usual" policies, to policies that address the development priorities while mitigating adverse social and environmental impacts.

The main considerations in traditional freight transport policies continue to revolve around the traditional link between transport and economic growth, extrapolating future transport needs based on the changes in the volume, structure and directions of freight flows, and is driven by trends in population growth and economic development, such as sustained economic growth and changes in the geography of trade. Some demographic trends, in particular urbanization, have been incorporated into traditional transport planning. In Asia, specifically, there has been rapid population growth. The continent comprises 60% of the world population, but only covers 30% of the world's landmass[38]. The number of people in Asia is projected to continue to rise and reach an estimated 5.3 billion in 2050.[39] Accordingly, some estimates suggest that in Asia, ton-kilometres from surface freight alone will increase by 261% from 2015 to 2050 and account for more than two-thirds of surface freight globally (figure 1.24).[40]

Figure 1.24. Surface freight ton-kilometres by region, baseline scenario, billion ton-kilometres



Source: Organization for Economic Cooperation and Development, International Transport Forum, *ITF Transport Outlook*, 2017 (Paris, OECD Publishing, 2017).

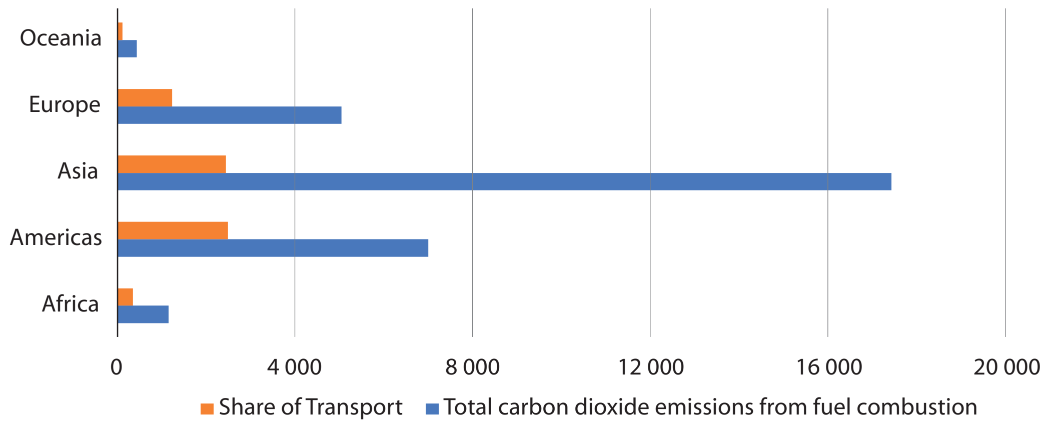
Accordingly, the demand for transport and mobility in the region, which is being compounded by the emergence and continued development of geographically dispersed supply chains, is continually on the brink of exceeding capacity. From an infrastructure perspective alone, $126 billion is required to upgrade the regional transport systems and construct missing links in the region's rail, road and intermodal network.[41] Estimates from a recent study covering 53 ports in the Asia-Pacific region indicated that the cost for adapting these ports to future climate realities could range from $31 billion to $49 billion.[42]

[38] See http://worldpopulationreview.com/continents/asia-population/.
[39] Population Reference Bureau "World population data sheet". Available at https://spark.adobe.com/page/73lXWbgFnO7Nz/.
[40] Organization for Economic Cooperation and Development, International Transport Forum, ITF Transport Outlook 2017 (Paris: OECD Publishing, 2017).
[41] ESCAP estimate, 2019.
[42] B. McCarron, A. Giunti and S. Tan, "Climate Costs for Asia-Pacific Ports" (2018). Available at https://static1.squarespace.com/static/5991a3f3d2b8570b1d58cc7e/t/5ab289c588251bd42703af29/1521675706594/APAC+ports+climate+costs.pdf.

In addition, increasing pressures resulting from the transport sector continuing to be a leading contributor to greenhouse gas emissions and a major consumer of fossil fuels, and emerging and potentially disruptive technologies, indicate that traditional thinking related to transport policies and actions may need to be reassessed. For example, there is limited understanding on how low-carbon transport and energy technologies will evolve, making it difficult to assess this gap for the transport sector.[43] Technological developments and innovation are assuming a prevalent position in policy discussions, as policymakers seek to understand and, if possible, anticipate their impact on the demand and supply of transport services.

In this context, freight transport and, especially, the sustainability of it is of paramount importance. In 2016, the transport sector was responsible for approximately 25% of global emissions at about eight gigatons of CO_2 (figure 1.25).[44] This figure represents a 71% increase over 1990 levels.[45] Historical data[46] show that growth in absolute CO_2 emissions was the highest globally in Asia, at 92%, followed by Africa (84%), and Latin America (49%). The growth can be attributed to increases in passenger and freight transport activity in these regions. Emissions from freight transport, more specifically, are growing much more rapidly than other emissions from other types of transport, and the share of freight transport-related emissions increased from 35% in 2000 to 41% in 2015.[47] In addition, in 2015, the highest share of freight demand was in India, at 53%, and China, at 43%, exceeding the global average of 40%, while in many Asian landlocked countries, such as Afghanistan, Kazakhstan and Uzbekistan, freight transport exceeded 50% of total surface transport demand.[48]

Figure 1.25. Carbon dioxide emissions from fuel combustion and share of transport by continent in 2016 (in million tons of carbon dioxide)



Source: ESCAP based on data from International Energy Agency, *CO_2 Emissions from Fuel Combustion 2018*, (Paris: OECD/IEA, 2018) (with 2016 data).

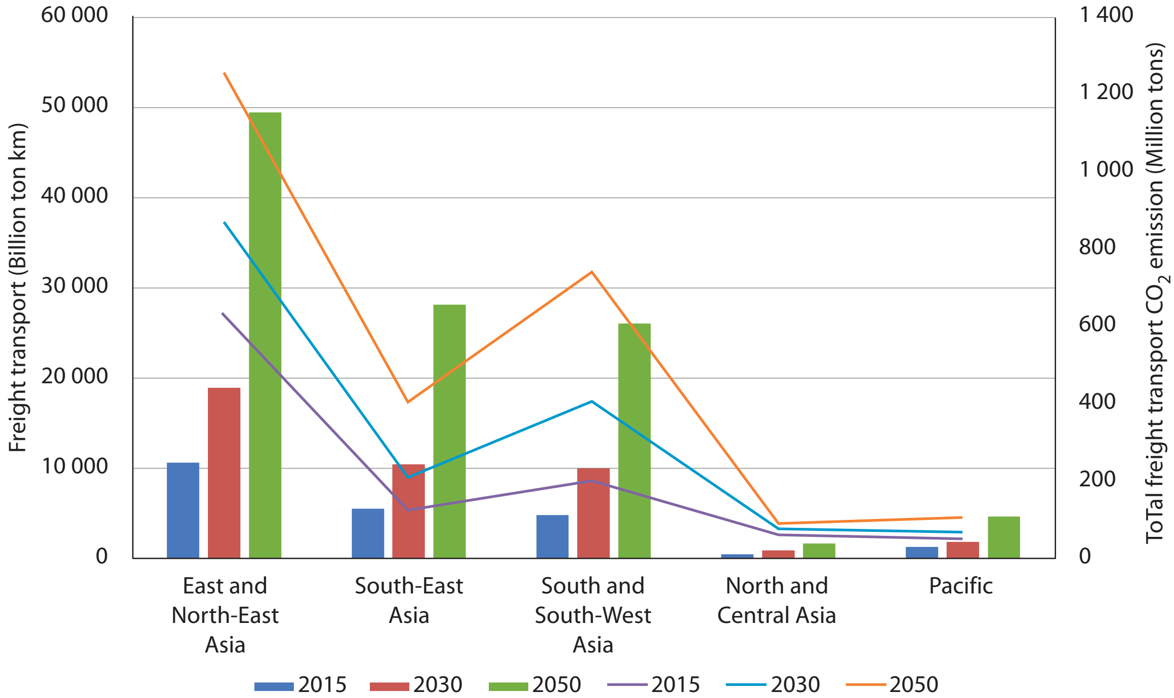
Road transport is the largest contributor to global CO_2 emissions from transport, accounting for 75% of transport emissions in 2015. In the freight transport sector, railways accounted for 3% of global transport CO_2 emissions. International aviation emissions increased by 47% from 2000 to 2016 to 523 million tons of CO_2 in 2016. International shipping emissions grew by 33% to reach 656 million tons of CO_2 in 2016. Together, international aviation and shipping produce more transport CO_2 emissions per year than any country in the world except the United States.[49.]

The literature suggests that the decarbonization of transport should indicatively be aiming at 2-4 gigatons of CO_2 emissions by 2050.[50] Global freight transport increased from approximately 64 trillion ton-kilometres in 2000, to about 108 trillion ton-kilometres in 2015.[51] Freight movements accounted for 39% of total world transport energy consumption in 2012, of which the road freight trucks made up the largest share, namely

[43] IPPC Fifth Assessment Report. Available at https://www.ipcc.ch/assessment-report/ar5/.
[44] International Energy Agency, "CO_2 Emissions from Fuel Combustion 2018 (with 2016 data)" ISBN 978-92-64-27818-9.
[45] International Energy Agency, *CO_2 Emissions from Fuel Combustion 2018*, (Paris: OECD/IEA, 2018) p. 15.
[46] Partnership on Sustainable, Low Carbon Transport, "Transport and climate change global status report" (2018) p.1. Available at http://slocat.net/tcc-gsr.
[47] Ibid. p. 1.
[48] Ibid, p. 1.
[49] Ibid, p.1
[50] R. Sims, and others, "Transport". In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, O. Edenhofer, and others, eds. (Cambridge University Press, Cambridge, United Kingdom and New York (2014).
[51] Organization for Economic Cooperation and Development, International Transport Forum, *ITF Transport Outlook 2017* (Paris: OECD Publishing, 2017).

23% of total transport energy use.[52] The International Transport Forum estimates that, on the basis of current CO_2 emissions rates and policies in effect today, emissions from global transport will rise by a further 60% between 2015 and 2050 (figure 1.26), effectively outweighing mitigation measures being currently deployed. The sharp expected rise in demand for freight transport in Asia and the Pacific in particular would, in this scenario, place the ESCAP region among the highest emitting regions in the world.

Figure 1.26. Freight transport in billion ton-kilometres (columns) and carbon dioxide emissions in million tons 2015-2050 (lines), by subregion[53]



Source: ESCAP secretariat based on data provided by the International Transport Forum.

While environmentally friendly mobility and public transport may be gaining ground with more affordable vehicle technologies and policies supporting shared mobility, walking, cycling and smart public transport, freight transport continues to rely heavily on oil for propulsion and is not yet in a position to be fully adapted to using other cleaner alternative energy sources. In addition to this making the contribution of transport in general to mitigating emissions much harder to effectively address, it also exacerbates traditional development challenges, such as the exposure of freight rates and transport costs to oil price volatility and surges in prices in particular, which in turn increases the vulnerability of developing economies that are already facing disproportionately high transport costs.[54] The Pacific small island developing States, for example, import 95% of their energy, as compared to the global average of 34%, while, 70% of their energy, comprising petroleum fuels, is consumed for shipping.[55]

According to the International Energy Agency (IEA), demand for mobility is likely to remain one of the main underlying drivers of energy demand growth.[56] The Agency also projects that energy demand in South-East Asia is set to grow by almost 66% by 2040, and account for 10% of the rise in global demand. In the light of this, the strong projected growth in low-carbon energy is not expected to offset rising consumption of all fuels. In particular based on the expected rate of motorization, 62 million vehicles are projected to be in South-East Asia alone by 2040. Policy efforts to diversify the energy mix are focusing on biofuels which could bring environmental benefits, provided that palm oil production is managed sustainably, an important policy issue for the main producers in the region.[57]

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[52] U.S. Energy Information Administration, *International Energy Outlook* (Washington, D.C., 2016), p.130.
[53] The estimates in this figure do not include: American Samoa, Bhutan, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Macao (it's part of China in the ITF model), Maldives, Marshall Islands, Micronesia, Nauru, Nepal, New Caledonia, Niue, Northern Mariana Islands, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu.
[54] UNCTAD, Trade and Development Commission, Multi-year Expert Meeting on Transport, Trade Logistics and Trade Facilitation, *"Sustainable freight transport systems: Opportunities for developing countries"*, note by the secretariat (D/B/C.I/MEM.7/11) (2015).
[55] Ibid.
[56] International Energy Agency, "*Southeast Asia Energy Outlook"* (Paris, OECD/IEA, 2017).
[57] Ibid.

The expansion of national and regional road networks, while increasing connectivity overall, has also strengthened the position of road transport as the main vehicle for domestic, intraregional and even interregional connectivity, bringing, with it negative externalities, such as emissions, road safety accidents, congestion and noise pollution. While comprehensive data on this are difficult to attain, assessing information from individual country reports across the region indicates that roads are the principal mode of transport for the movement of cargo, goods and merchandise, notably at the national level, but also for cross-border transport for short to medium distances.

In North-East Asia, road transport accounted for 78% of cargo transported in 2018 when measured in freight-tons[58] in China, and slightly more than 90% in Japan and in the Republic of Korea.[59] Rail transport was a distant second for cargo transport. A similar trend also occurred in South-East Asia, where, according to a study published in 2016, roads were the mode of transport for 89% of freight transported in Myanmar,[60] 83% in Thailand[61], 76% in Viet Nam[62] and a mere 58% in the Philippines[63], where coastal shipping plays an important role for inter-island connectivity in the archipelago. In Western Asia, 85% of freight is estimated to be transported by road in Turkey[64] and 94% in the Islamic Republic of Iran[65], according to data estimates for respective countries over the period 2012-2017.

In North and Central Asia, road transport accounted for 93.4% of freight movement in Kyrgyzstan[66] and 78% of cargo transported in the Russian Federation[67], according to 2017 estimates when measured in freight tons. It should be noted, however, that when the distance of cargo movements is taken into consideration, measured in ton-kilometres, rail is the dominant mode of freight transport in North and Central Asia. In Kazakhstan, 61.9% of freight turnover in 2018 was transported by rail, followed by 37.7% by road. Other modes of transport, namely air and inland waterways, accounted for only 0.04% of total freight turnover.[68] A similar modal split occurred in Uzbekistan for 2018, where rail accounted for 62% and road 37%.[69] In that country, road transport is mainly used for short distances while rail is used for long distance transport.

The road-centric domestic and intraregional connectivity, as manifested by the dominance of road transport in the national and regional freight operations, brings about the well-documented bottlenecks and operational restrictions, along with additional costs, which could be offset not only by higher usage of other modes of transport, such as rail and waterborne transport, but through greater synergy in combining different transport modes into a transport chain that is efficient, environmentally sound, safe and reliable. To support this idea, ESCAP analysis of the available data for the region, also show that increased intermodal connectivity can reduce transport-related CO_2 emissions. As illustrated by the negative linear correlation in figure 1.27, the countries ranking higher on the transport connectivity index of ESCAP (see figure 1.4) demonstrate the highest potential to reduce their CO_2 emissions from transport.

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58 National Bureau of Statistics of China, *China Statistical Yearbook 2018*, (Chinese Statistics Press (2018).

58 *Review of Development in Transport in Asia and the Pacific 2017*, (United Nations publication, Sales No. E.18.II.F.6).

60 Asian Development Bank, Myanmar *Transport Sector Policy Note; River Transport* (Manila: ADB, 2016) p. 15.

61 S. Ongkittiful, "Thailand country report", in *Financing ASEAN Connectivity*, F. Zen and M. Regan (eds.) (Economic Research Institute for ASEAN and East Asia, 2014) p. 356.

62 T. Long, "Vietnamese national standard of weights, dimensions for road freight vehicles and enforcement mechanisms", presentation at ESCAP expert group meeting on strengthening the capacity of ESCAP member States to harmonize standards on weights, dimensions and emissions of road vehicles for facilitation of transport along the Asian Highway network, Tbilisi, 23-24 January 2019.

63 Asian Development Bank, *Philippines: Transport Sector Assessment, Strategy and Road Map* (Manila: ADB, 2012) p.1.

64 ITE Transport and Logistics, "A guide to Turkey's transport and logistics industry", 26 August 2016.

65 A. Alireza, "I.R. Iran transportation report", presentation at ESCAP expert group meeting on strengthening the capacity of ESCAP member States to harmonize standards on weights, dimensions and emissions of road vehicles for facilitation of transport along the Asian Highway network, Tbilisi, 23-24 January 2019. Available at https://www.unescap.org/events/expert-group-meeting-strengthening-capacity-escap-member-states-harmonize-standards-weights.

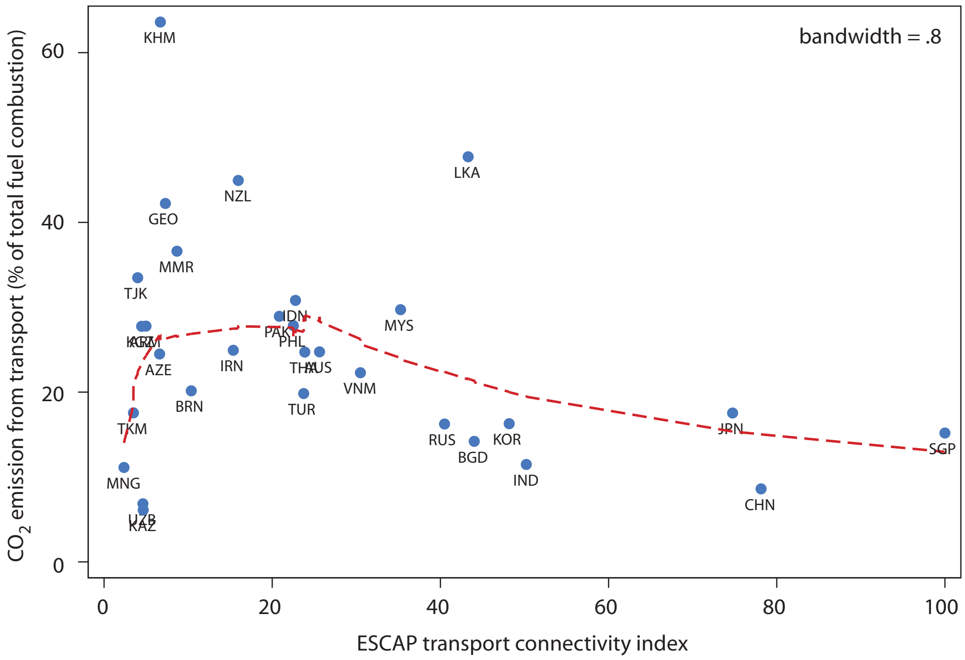
66 Ministry of Transport and Roads of the Kyrgyz Republic, presentation at ESCAP expert group meeting on strengthening the capacity of ESCAP member States to harmonize standards on weights, dimensions and emissions of road vehicles for facilitation of transport along the Asian Highway network, Tbilisi, 23-24 January 2019. Available at https://www.unescap.org/events/expert-group-meeting-strengthening-capacity-escap-member-states-harmonize-standards-weights.

67 http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/enterprise/transport/.

68 See http://stat.gov.kz/official/industry/18/statistic/7.

69 See https://stat.uz/uploads/doklad/2018/yanvar-dekabr/ru/doklad-yan-dekabr-ru.pdf.

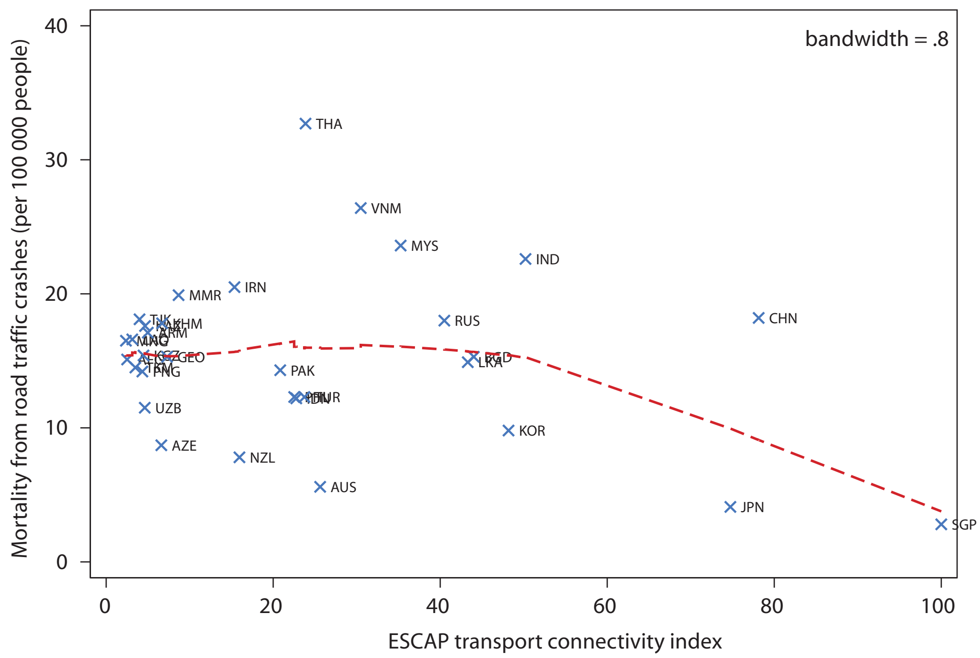
Figure 1.27. Correlation between carbon dioxide emissions and connectivity performance, selected Asia-Pacific countries



Source: ESCAP calculations based on data on fuel combustion from the International Energy Agency and ESCAP transport connectivity index
Notes: AFG, Afghanistan; ARM, Armenia; AUS, Australia; AZE, Azerbaijan; BGD, Bangladesh; BRN, Brunei Darussalam; KHM, Cambodia; CHN, China; GEO, Georgia; IND, India; IDN, Indonesia; IRN, Islamic Republic of Iran; JPN, Japan; KAZ, Kazakhstan; KOR, Republic of Korea; KGZ, Kyrgyzstan; LAO, Lao People's Democratic Republic; MYS, Malaysia; MMR, Myanmar; NZL, New Zealand; PAK, Pakistan; PNG, Papua New Guinea; PHL, Philippines; RUS, Russian Federation: SGP, Singapore; LKA, Sri Lanka; TJK, Tajikistan; THA, Thailand; TUR, Turkey; TKM, Turkmenistan; VNM, Viet Nam.

A similar trend is observed with regard to road traffic crashes (figure 1.28), in part, owing to expected changes in the modal split from reduced reliance on road transport.

Figure 1.28. Correlation between road traffic crashes and connectivity performance, selected Asia-Pacific countries



Source: ESCAP calculations based on road traffic fatality data from the World Health Organization and ESCAP transport connectivity index.
Notes: AFG, Afghanistan; ARM, Armenia; AUS, Australia; AZE, Azerbaijan; BGD, Bangladesh; BRN, Brunei Darussalam; KHM, Cambodia; CHN, China; GEO, Georgia; IND, India; IDN, Indonesia; IRN, Islamic Republic of Iran; JPN, Japan; KAZ, Kazakhstan; KOR, Republic of Korea; KGZ, Kyrgyzstan; LAO, Lao People's Democratic Republic; MYS, Malaysia; MMR, Myanmar; NZL, New Zealand; PAK, Pakistan; PNG, Papua New Guinea; PHL, Philippines; RUS, Russian Federation: SGP, Singapore; LKA, Sri Lanka; TJK, Tajikistan; THA, Thailand; TUR, Turkey; TKM, Turkmenistan; VNM, Viet Nam.

It is, by and large, undisputed that road transport has numerous advantages over other modes of transport because of its flexibility, routes and timings that can be adjusted to individual requirements without much inconvenience. While the increasing focus on sustainability has prompted many ESCAP member States to scale up their efforts to promote other modes of transport, such as rail or waterborne transport, the role of road transport is unlikely to decline in the foreseeable future. In fact, recent estimates of future freight transport demand suggest that road freight on the Asian continent will increase by 269% between 2015 and 2050.[70] This can be attributed to an array of factors, including, among them, the market conditions and private business practices. To some extent, however, the state of infrastructure connectivity and the institutional and regulatory conditions prescribed by governments, also have a role to play in the current picture of the modal split and of the sustainability of freight transport at large.

1.5. Takeaway from chapter 1

Connectivity is pivotal for sustained economic growth, supply chain efficiency and transport system resilience. While the Asia and Pacific region has made measurable progress in addressing connectivity gaps, the high overall regional performance is driven by few top performers, thus, hiding significant subregional variations. This is impeding the region from advancing further to reach the connectivity performance of the top regions worldwide and strongly points to the need to focus regional policies on leaving no one behind. From a broader perspective the data can also be interpreted to indicate that the needs of countries in special situations should not be dealt with in isolation or as a stand-alone development area, but in tandem with all transport development areas as a cross-cutting issue.

As consistently indicated across different indicators, each subregion is compensating for its individual connectivity restrictions by relying on available solutions. This, in most cases, has led to excessive growth of road transport. Notably, North and Central Asia have the strongest potential for expanding rail transport, while the Pacific continues to be primarily and almost exclusively reliant on maritime transport and remains among the least connected subregions in the world, as indicated by established maritime indicators.

The sharp increase in population, economic growth and trade in the region indicate that the freight transport sector is far from accomplishing long-term sustainability objectives. The environmental impact of the dominantly fossil fuel dependent freight transport sector under the above connectivity conditions has drastically increased the vulnerability of the regional transport system to climate and hazard-related disasters and is rapidly placing the region among the highest CO_2 emitting regions in the world, especially when taking into account projected growth through 2050.

These findings reinforce the view that sustainable transport connectivity warrants a holistic approach, most notably the systematic development of integrated intermodal transport with due emphasis on strengthening the modes of transport that are considered friendlier to the environment such as waterborne transport and rail. While the flexibility of road transport will continue to place it among the most utilized modes of transport, there is scope for policy instruments to make meaningful interventions in support of sustainability. The analysis shows that integrated intermodal transport can positively influence environmental performance, among others. Finally, the ESCAP transport connectivity index, constructed based on available data and indicators, yields results that are, by and large, consistent with other indices, in terms of the strongest and weakest performers and the subregional variations.

Against this background, the specific connectivity conditions for land, maritime and air transport are more closely reviewed in chapters 2 and 3, while chapter 4 is focused on emerging trends and drivers that would enable the development of a better balanced modal split, which, in turn, would support the achievement of a sustainable freight transport sector in Asia and the Pacific, including, importantly, in the areas of technology and innovation, governance and the role of the private sector.

[70] Organization for Economic Cooperation and Development, International Transport Forum, *ITF Transport Outlook 2017* (Paris: OECD Publishing, 2017).

CHAPTER

2

LAND TRANSPORT CONNECTIVITY IN ASIA AND THE PACIFIC

Among the many regional and subregional transport initiatives, the definition and formalization of the regional networks of Asian Highways, trans-Asian railway and dry ports, remain a milestone in the regional transport cooperation in Asia and the Pacific. Since their inception, the Asian Highway and trans-Asian railway networks have been included in the national plans of many member States. They are also being used as a reference for the development of subregional cooperation programmes in the Greater Mekong Subregion and by organizations such as the Association of Southeast Asian Nations (ASEAN), the Central Asia Regional Economic Cooperation (CAREC) Programme, the Shanghai Cooperation Organization, the Economic Cooperation Organization (ECO) and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). For example, the ASEAN Highway network was formulated on the basis of the Asian Highway network, with the same technical and design standards. Within the CAREC initiative of the Asian Development Bank (ADB) and BIMSTEC, road networks have been formulated with reference to the Asian Highway routes and design standards and ECO has also adopted the Asian Highway design standard for its road network.[71] The definition of a network of dry ports under the Intergovernmental Agreement on Dry Ports[72] has increased the operational efficiency of the Asian Highway and trans-Asian railway networks, extending their reach to wider areas and facilitating their integration with the region's main maritime ports and other transport modes.

[71] Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China, Georgia, India, Indonesia, the Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, the Lao People's Democratic Republic, Mongolia, Nepal, Pakistan, the Philippines, Sri Lanka, Tajikistan, Thailand, Uzbekistan and Viet Nam.

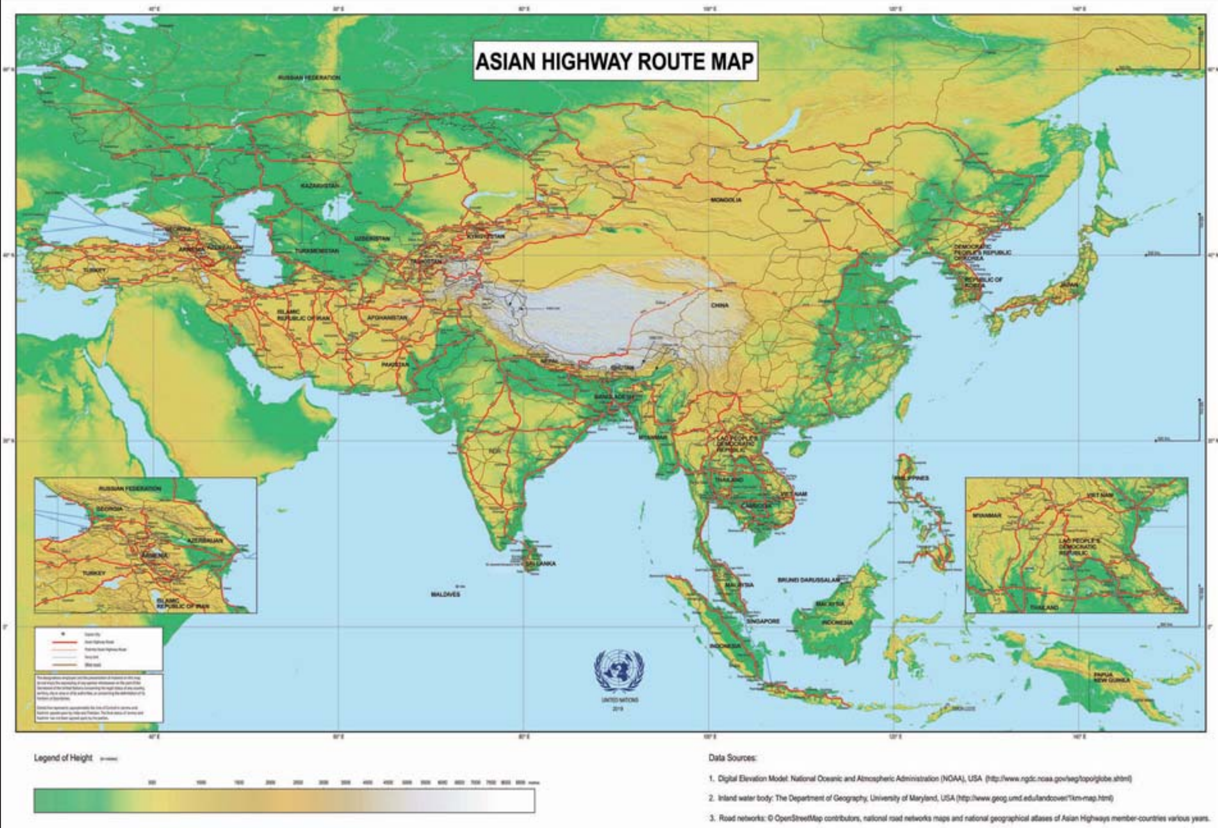
[72] Extensive information on the Intergovernmental Agreement on Dry Ports can be found in the document entitled "Development and operation of dry ports of international importance" (ESCAP/CTR/2018/4).

2.1. Road transport along the Asian Highway network

The formalization of the regional road network through the Intergovernmental Agreement on the Asian Highway Network mapped out the main existing and potential road transport corridors that support regional economic growth and intraregional and interregional trade. As of June 2019, the network spans more than 143,000 kilometres, covering the subregions of East and North-East Asia, North and Central Asia, South-East Asia and South and South-West Asia (figure 2.1). To date, 30 ESCAP member States are Parties to the Agreement.

In addition to defining the network itself, the Agreement sets out minimal technical design standards and classifications to ensure the quality of the road infrastructure along the Asian Highway routes. While initially focused primarily on the road design for accommodating increasing freight and traffic volumes, the technical standards have been expanded to other areas. Notably, the adoption of a new annex II bis to the Agreement, entitled "Asian Highway Design Standards for Road Safety", incorporates standards for road safety facilities into the Agreement.[73]

Figure 2.1. Map of the Asian Highway network



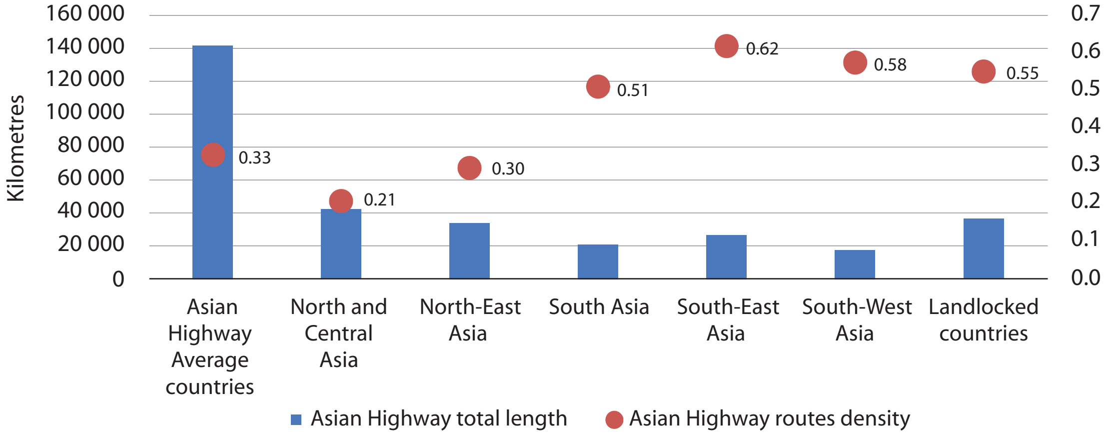
Source: ESCAP secretariat.
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

A. Infrastructure connectivity along the Asian Highway network

The coverage of the Asian Highway network is comprehensive. It has been consolidated over the past two decades with very few missing links, if any, along the network. While the overall extension of the network tends to remain stable, its exact configuration continues to evolve, with the Parties adding new itineraries or regrouping parts of existing subregional routes as a single Asian Highway route. Overall road density assigned to be part of Asian Highway network among parties to the Agreement is estimated at approximately 0.3 kilometre per 100 square kilometres. There is, however, wide divergence among subregions, as shown in figure 2.2.

[73] Further information on the status of annex II bis can be found in document ESCAP/AHWG/2019/1.

Figure 2.2. Asian Highway length and density by subregion



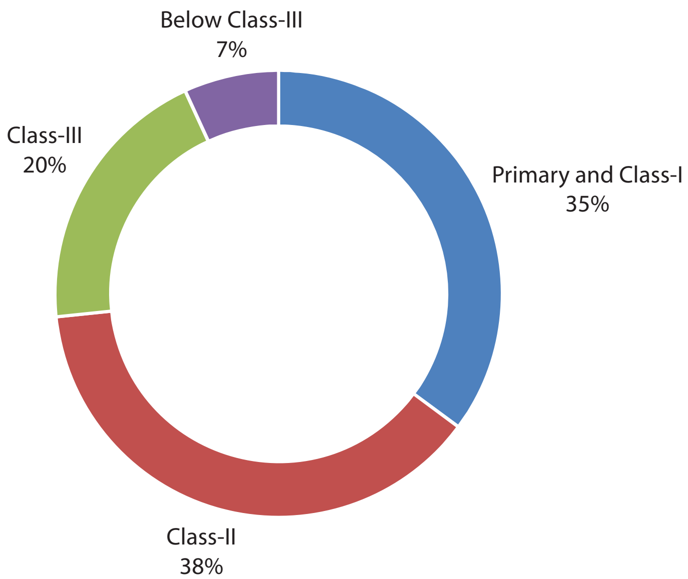
Source: Calculated based on ESCAP Asian Highway Database and the World Bank's *"World Development Indicators"* Database. Note: These calculations include the 15,400 kilometres in China.

South-East Asia, South-West Asia and South Asia have overall higher than average road density. These subregions comprise smaller-sized countries located at the crossroads of major economic and transport corridors and heavily rely on roads for domestic and international movement of cargoes. As such, landlocked countries have assigned more routes (0.55 kilometre per 100 square kilometres) to become major transport and economic corridors.

By contrast, North and Central Asia and East Asia, which are dominated by countries with large landmasses, have a density below the Asian Highway average. One of the contributing factors to this may be the low overall population density, for example, in Mongolia and the Russian Federation. Uneven distribution of population concentration may also be a contributing factor. For example, the east coast of China, has high population density with more roads assigned to be Asian Highway routes in comparison to the more sparsely populated western part of China, should also be taken into account when assessing the data.

The infrastructure quality is a greater concern than the geographical coverage of the Asian Highway network. According to the latest updates to the ESCAP Asian Highway Database, more than 70% of the Asian Highway network is comprised of Primary Class, Class-I and Class-II roads, with 35% of roads reported to be Primary and Class-I and 38% Class-II. 27% of the roads are categorized as Class-III or below (figure 2.3).

Figure 2.3. Asian Highways by road category



Source: ESCAP, Asian Highway Database, 2019.
(https://www.unescap.org/our-work/transport/asian-highway/database).

In 2019, 15,400 kilometres of previously potential Asian Highway routes in China were converted to actual Asian Highway routes and a new Asian Highway route was added to the network to support the Europe-West Asia corridor

The eighth meeting of the Working Group on the Asian Highway took place in Bangkok on 18-19 September 2019, resulting in the adoption of several major amendments to the list of the Asian Highway routes listed in Annex I to the Intergovernmental Agreement on the Asian Highway network.

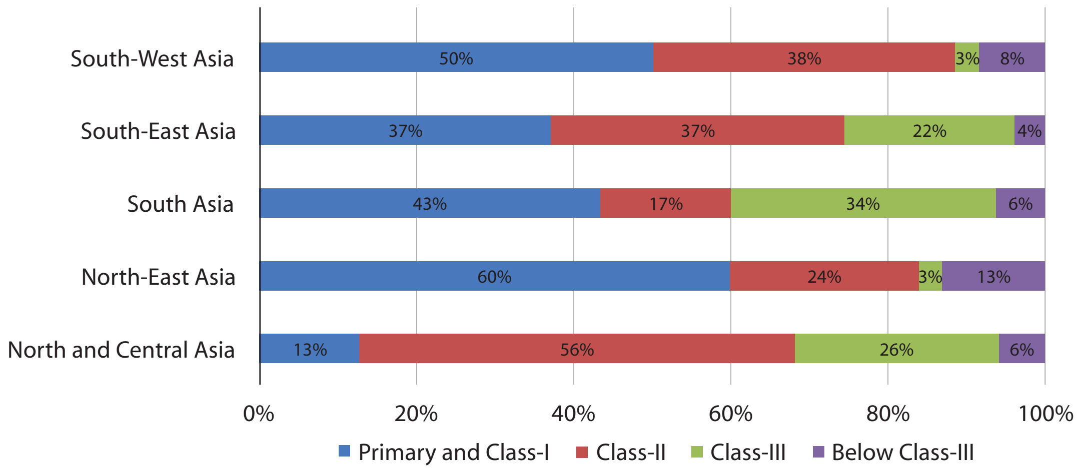
The Working Group adopted the proposal to introduce a new route AH 9, which follows the international transport route between Europe and Asia, going through the major trade points in China, Kazakhstan and the Russian Federation.

The Working Group also adopted the proposal by China to convert over 15,000 kilometres of the potential routes on the territory of China into actual Asian Highway routes, to be upgraded and maintained in accordance with the technical standards set out by the Agreement.

Finally, the Working Group introduced new potential and actual routes in Georgia and the Islamic Republic of Iran, enhancing the land connectivity with major ports and sea-routes and increasing the network density in Western and North Asia.

The quality of Asian Highway routes differs substantially across countries and subregions, while North-East Asia leads with higher quality routes and North and Central Asia lags behind significantly (figure 2.4).

Figure 2.4. Asian Highways by road classification by subregion



Source: ESCAP, Asian Highway Database, 2019. (https://www.unescap.org/our-work/transport/asian-highway/database).

Overall road conditions are good in North-East and South-West Asia. In North-East Asia, 60% of the network consists of Primary and Class-I roads; in South-West Asia, 50% of the network consists of Primary and Class-I roads. At the national level, the Asian Highway roads in Japan and the Republic of Korea are classified as Primary or Class-I. In China, 80% of the Asian Highway roads are classified as Primary or Class-I. Among countries in South-West Asia countries, 70% of the network in Turkey and 60% of the network in the Islamic Republic of Iran are Primary and Class-I roads.

In North and Central Asia, Primary and Class-I roads account for less than 20% of the entire Asian Highway network in the subregion while more than 50% of the network is classified as Class-II. Overall, road quality is good in Azerbaijan, Georgia and the Russian Federation; while in a number of other Central Asian countries, such as Kyrgyzstan and Turkmenistan, more than 80% of the Asian Highway network within their respective territories consist of Class-III and below Class-III roads.

Road infrastructure along the Asian Highway network in South-East Asia differs widely among member States. At the subregional level, 70% of the Asian Highway network roads are classified as Class-II and above. Malaysia, the Philippines, Thailand and Singapore have overall good road infrastructure, however, among least developed economies in South-East Asia, including Cambodia, the Lao People's Democratic Republic and Myanmar, Class-III and below Class-III roads account for 60% to more than 80% of the entire Asian Highway network within their national borders.

In South Asia, the majority of roads designated as Asian Highway routes in Bangladesh, India and Sri Lanka are classified Class-II and above, while in Pakistan and Nepal, more than 60% and 80% of the designated Asian Highway routes, respectively, consist of Class-III and below roads.

Insufficient but also heterogeneous levels of road infrastructure quality along the Asian Highway network directly affect the efficiency and effectiveness of international road transport connectivity within the region by creating, among other problems, bottlenecks along the Asian Highway network and adversely affecting the seamlessness of logistics connectivity and supply chain systems. ESCAP member States are continually implementing projects to expand road networks and improve road quality in their respective countries, notably on roads along the Asian Highway network, which are usually important transport or economic corridors.

For instance, in North-East Asia, Mongolia, a landlocked country with a road network of about 48,538 kilometres, of which only about 13.2% are paved,[74] has undertaken development projects to improve road infrastructure, including, more specifically, the roads along AH3 and AH4. The main transport and economic corridor in the country is AH3, connecting China to the Russian Federation through Ulaanbaatar. The entire route has been paved and upgraded to Class-II. Along AH4, most of the road has been paved. There is still, however, ongoing road improvement work between Bayan Ulgii and Khovd Aimags, funded jointly by the Government of Mongolia and ADB.[75] This infrastructure improvement, together with the implementation of the recently concluded Intergovernmental Agreement on International Road Transport along the Asian Highway network is expected to further enhance the seamlessness of cross-border road transport between China, Mongolia and the Russian Federation.

In South and South-East Asia, the Government of Viet Nam is implementing phase 1 of the North-South Expressway Project 2017-2020. The North-South transport corridor plays a very important role in the economic development of Viet Nam, passing through 32 provinces and cities, connecting Hanoi in the north to Ho Chi Minh City in the south and running along the routes of AH1. Over the period 2017-2020, the Government is prioritizing the development of approximately 654 kilometres of roads, through a project with 11 subprojects, based on the traffic demand forecast. The roads will have four lanes, with the exception of a section between Cam Lo and La Son on which there will be only two lanes.[76]

Similarly, Cambodia is implementing numerous projects to improve road quality in the country, including upgrading AH1 from the border with Viet Nam to Phnom Penh and AH11 from Phnom Penh to the port city of Sihanoukville from Class-II and III roads to expressways by 2025.[77] In India, the Government is upgrading some sections of the Golden Quadrilateral[78] to six lanes. The projects were 40% completed as of 2017.[79]

The road network in some countries in North and Central Asia require significant repairs. For example, 60% of the roads in Kyrgyzstan, 54% in Kazakhstan and 48% in Tajikistan do not have asphalt or concrete cover.[80] Accordingly, road development is a top priority to many countries in the subregion. In this context, Kazakhstan plans to expand its expressway network from the 210 kilometre toll road connecting Nur-Sultan with Buranbay

[74] Asian Development Bank, "ADB-supported road development to help spur growth in Mongolia", 2 July 2018. Available at https://www.adb.org/news/adb-supported-road-development-help-spur-growth-mongolia.

[75] S. Jigjee, and O. Ulziikhutag. "Intermodal transport corridors: challenges and opportunities for Mongolia", presentation delivered at the Expert Group Meeting on Enhancing Efficiency of Selected Intermodal Transport Corridors, Bangkok, 26-27 June 2019.Available at https://www.unescap.org/events/expert-group-meeting-enhancing-efficiency-selected-intermodal-transport-corridors-asia.

[76] B-G Thong Van Tai, "North-South Expressway Project Phase 1 (2017-2020)", Viet Nam, Ministry of Transport, presentation delivered at the Expert Group Meeting on Enhancing Efficiency of Selected Intermodal Transport Corridors, Bangkok, 26-27 June 2019.Available at https://www.unescap.org/events/expert-group-meeting-enhancing-efficiency-selected-intermodal-transport-corridors-asia.

[77] Cambodia, Ministry of Public Works, "Logistics master plan development in the Kingdom of Cambodia", presentation at the Workshop on Strengthening Transport Operational Connectivity among Cambodia, Lao People's Democratic Republic, Myanmar, Viet Nam and Thailand (CLMV-T), Hanoi, 30 November–1 December 2017.

[78] See https://www.mapsofindia.com/roads/golden-quadrilateral.htm.

[79] Presentation delivered by the Ministry of Transport of Turkey at ESCAP Expert Group Meeting on Comprehensive Planning of Eurasian Transport Corridors, Beijing, 5-6 July 2017.

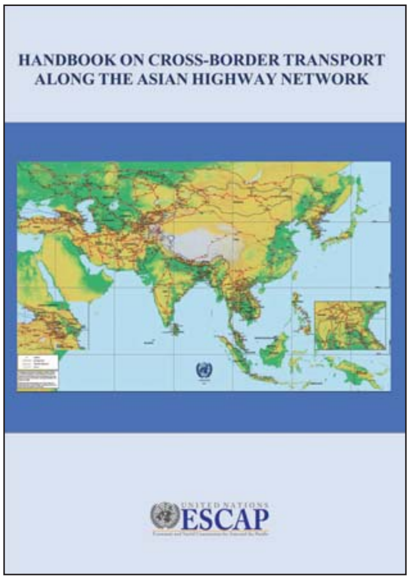
[80] M. Levina, "Central Asia improves ailing road infrastructure", *The Times of Central Asia*, 10 June 2018. Available at https://www.timesca.com/index.php/news/26-opinion-head/19855-central-asia-improves-ailing-road-infrastructure.

to a network of 10,000 kilometres of toll roads by the end of 2021.[81] In Kyrgyzstan, ADB is allocating $78 million to complete the rehabilitation of road sections, the Balychy-kilometre marker 43 and Kochkor-Epkin, which connect two major transport corridors linking the landlocked country to international markets.[82] In 2016, the Government of Tajikistan spent $96 million on rehabilitating the road that connects Dushanbe to Qurghonteppa, which runs mainly along AH7 and $54 million on road on the Khujand-Isfara section.[83] The Government of the Russian Federation has approved a new State programme to develop the federal high-speed roads to create a unified network in the country. The programme will run until 2030 with most construction slated to be completed over the period 2020-2030.[84]

There are numerous major road development projects in West Asia. For example, the Gebze-Orhangazi-Izmir Motorway project in Turkey, spanning 433 kilometres when completed, will reduce the average journey time between Izmir and Istanbul from 10 hours to approximately four hours. Another major undertaking being carried out in the country is the Northern Marmara Motorway project. The objective of the project is to reduce traffic congestion on bridges crossing the Istanbul Strait through the construction of a suspension bridge to be located on the north of Istanbul close to the Black Sea region. The project is comprised of three segments, including the Yavuz Sultan Selim Bridge and will cover 405 kilometres.[85]

B. Operational connectivity along the Asian Highway network

Cross-border and transit transport facilitation remains one of the major bottlenecks affecting the performance of road transport along the Asian Highway network. Consequently, ESCAP member States have placed the facilitation of international road transport at the centre of their cooperation. The Regional Strategic Framework for the Facilitation of International Road Transport,[86] adopted by ESCAP member countries in 2012, includes six fundamental issues: (a) road transport permits and traffic rights; (b) visas for professional drivers and crews of road vehicles; (c) temporary importation of road vehicles; (d) insurance of vehicles; (e) vehicle weights and dimensions; and (f) vehicle registration and inspection certificates. In addition, the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017-2021) includes a thematic area on operational connectivity to focus on, among others, the need to harmonize legal requirements and technical and operational standards using new technologies and transport facilitation tools.



ESCAP is continuing to support its member States in identifying and addressing the operational challenges along the Asian Highway network. The *Handbook on Cross-Border Transport along the Asian Highway network*[87] was published in 2017 and can be used as a "one-stop" source of practical information and a tool for policymakers, transport operators, logistics service providers and other stakeholders in relation to border crossing processes and formalities.

The secretariat has also recently conducted a comprehensive assessment of the operationalization status of international road transport connectivity on major transport corridors along the Asian Highway network. Three main Eurasian transport corridors were identified, the Eurasian Northern Transport Corridor; the Eurasian Central Transport Corridor and the Eurasian Southern Transport Corridor.

The routes of the Eurasian Northern Corridor connect North-East Asia (Russian Far East, China and the Korean Peninsula) to Europe through the Russian Federation, Mongolia and Kazakhstan. The Eurasian Central

[81] World Highways, "Kazakhstan's major road development programme", 2 July 2018. Available at https://www.worldhighways.com/categories/road-highway-structures/news/kazakhstans-major-road-development-programme/

[82] Asian Development Bank, "ADB provides $78 million to improve regional road transport links in Kyrgyz Republic", 2 November 2018, Available at https://www.adb.org/news/adb-provides-78-million-improve-regional-road-transport-links-kyrgyz-republic.Ky

[83] Presentation delivered by the Ministry of Transport of Tajikistan at the second Expert Group Meeting on Comprehensive Planning of Eurasian Transport Corridors: Eurasian Central Transport Corridor, Istanbul, Turkey, 20-21 September 2017.

[84] World Highways, "Russia new programme for developing high-speed roads, October 2018. Available at https://www.worldhighways.com/sections/emergent/features/russia-new-programme-for-developing-high-speed-roads/#targetText=Amongst%20the%20largest%20high%2Dspeed,Lena%2C%20Sortavala%20and%20Narva%20highways.

[85] Presentation delivered by the Ministry of Transport of Turkey at the second Expert Group Meeting on Comprehensive Planning of Eurasian Transport Corridors: Eurasian Central Transport Corridor, Istanbul, Turkey, 20-21 September 2017.

[86] ESCAP resolution 68/4, annex, appendix II.

[87] The handbook is available online at: https://www.unescap.org/resources/handbook-cross-border-transport-along-asian-highway-network.

Corridor consists of routes linking Europe with China, the Russian Federation and countries in Central Asia and West Asia. The Eurasian Southern Corridor connects China and India through countries in South-East Asia and Bangladesh. The study results indicate that the seamlessness in the operationalization of each of the corridor differs widely. It also indicates that there is divergence in the effectiveness and efficiency of operational connectivity within segments of the same corridors. This is mainly the result of different bilateral and multilateral initiatives undertaken by countries, which are often influenced by political and economic factors.

In general, cross-border road connectivity along the Asian Highway network can be divided into three categories:

(a) *No permission for cross-border transport by road*: traffic rights are not granted to foreign vehicles to cross borders for commercial transport and transloading of cargo takes place at the border areas.

(b) *Cross-border transport by road permitted subject to quota:* traffic rights are granted to foreign vehicles through the issuance of road permit system. Specific numbers of road permits are granted to road transport operators depending on bilateral or multilateral arrangements among countries. Road permits are usually issued with conditions. For example, foreign trucks are required to use certain border-crossing points and follow designated routes upon entering foreign countries. Cabotage is frequently not allowed.

(c) *Cross-border transport by road permitted and not subject to a quota:* there are no quota restrictions on foreign road freight vehicles. This is usually the case when a number of countries enter into a "customs union", such as the Eurasian Economic Union.

Within the Eurasian Northern Transport Corridor, all the countries along the corridor, except those in the Korean Peninsula, the Democratic People's Republic of Korea and the Republic of Korea, are fully covered by respective bilateral or multilateral road transport agreements. Traffic rights are exchanged at every border crossing with a "single round trip road permit" system as the standard practice along the corridor. Along the Kazakhstan – Russian Federation border, permit-free bilateral transport without restrictions on routes and border-crossing posts applies as both countries are members of the Eurasian Economic Union. On the Korean Peninsula, land borders between the Democratic People's Republic of Korea and the Republic of Korea are technically closed; transloading takes place at the border areas between China and the Democratic People's Republic of Korea.

The Eurasian Central Corridor is almost entirely covered by relevant agreements or arrangements. Among the 16 border crossing points along the Corridor, transshipment at the border is only required between Afghanistan and Pakistan. The most common permit system along this Corridor is the "single round trip permit". There are, however, cases of permit-free bilateral transport arrangements, for example between Turkmenistan – Islamic Republic of Iran, Kyrgyzstan – Tajikistan and Uzbekistan – Kazakhstan.[88] Some countries along the corridor, such as Armenia, Georgia and Turkey, are also parties to the Black Sea Economic Cooperation multilateral permit system which is modelled after the European Conference of Ministers of Transport international road haulage permit system.

In sharp contrast to the Northern and Central Corridors, several countries along the Eurasian Southern Corridor do not exchange traffic rights with neighbouring countries. For example, there is no exchange of traffic rights between India and Bangladesh and Myanmar, China – Myanmar and Thailand – Malaysia, though for the latter, there are some special arrangements allowing Thai trucks to transport perishable goods to Singapore through Malaysia.

Traffic rights are mutually granted among the countries of the Greater Mekong Subregion.[89] Bilateral arrangements on the exchange of traffic permits with a set quota are in place among all the countries of the Subregion. For example, Cambodia and Viet Nam grant 500 permits to operators in respective countries. There is also a trilateral arrangement under which Cambodia, the Lao People's Democratic Republic and Viet Nam grant 150 permits to operators for transport among the three countries. Under the initiative of the Greater Mekong Subregion Cross-Border Transport Facilitation Agreement, Greater Mekong Subregion member countries can issue up to 500 road transport permits to foreign operators.

[88] Economic and Social Commission for Asia and the Pacific, "Comprehensive planning of Eurasian transport corridors to strengthen the Intra- and inter-regional transport connectivity", study report, 2017. Available at https://www.unescap.org/resources/comprehensive-planning-eurasian-transport-corridors-strengthen-intra-and-inter-regional.

[89] Cambodia, China (Yunnan Province and Guangxi Zhuang Autonomous Region, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam

Against this backdrop, there are two more major subregional agreements whose objective is to open segments of the network to international road transport, the Intergovernmental Agreement on International Road Transport along the Asian Highway network and the Agreement of the Shanghai Cooperation Organization Member States on the Facilitation of International Road Transport.

The Governments of China, Mongolia and the Russian Federation signed the Intergovernmental Agreement on International Road Transport along the Asian Highway network in Moscow on 8 December 2016. In doing so, each country agreed to grant the other two countries traffic rights for international road transport on the sections of AH3 and AH4 that connect their respective territories. Through the Agreement, the three ESCAP member States have operationalized the following Asian Highway routes: AH3 from Ulan-Ude in the Russian Federation to Tianjin port in China, through Ulaanbaatar and Beijing, providing access to the sea for landlocked Mongolia; and AH4 from Novosibirsk in the Russian Federation to Honqiraf at the Chinese border with Pakistan, through Urumqi and Kashi in China. This constitutes the first intergovernmental agreement concluded within the framework of the China-Mongolia-Russian Federation economic corridor. At the first meeting of the Joint Committee under the agreement in 2019 it was agreed that each country will issue 200-permits. This exchange of permits under the Agreement is set to ease international road transport on these segments.

The Agreement of the Shanghai Cooperation Organization Member States on the Facilitation of International Road Transport, which entered into force in January 2017, is another example of a legal instrument that operationalizes road transport infrastructure in the region through the provision of traffic rights for international road transport. This Agreement promotes transport connectivity among member countries of the Shanghai Cooperation Organization. The number of parties to the Agreement is eight (China, India, Kazakhstan, Kyrgyzstan, Pakistan, the Russian Federation, Tajikistan and Uzbekistan). The first meeting of the Joint Committee in 2018 agreed that the initial quota of road transport permits for 2019 would be 200 permits per party and took other decisions pertinent to the implementation of the Agreement.

C. Further steps in the development of the Asian Highway network

Almost 15 years since entering into force, the Intergovernmental Agreement on the Asian Highway network remains a flexible and adaptable tool for promoting international road traffic and a mechanism to help countries to define their national transport policies with a broader regional perspective. The Agreement helps to guide discussions at high-level intergovernmental meetings on issues related to the technical, operational and institutional development of the Asian Highway network and on regional transport connectivity, in general. During the seventy-fourth session of the Commission, held in Bangkok from 11 to 16 May 2018, and the fifth session of the Committee on Transport, held in Bangkok from 19 to 21 November 2018, the continued key role of the network in promoting regional integration and acknowledged the progress made by member States in developing and operationalizing the network was highlighted.

While initially focused on infrastructure aspects, the development of the Asian Highway routes has always been inextricably linked to issues related to operational connectivity. The Asian Highway network has incorporated a wider set of concerns and objectives, as the region's connectivity agenda and development objectives have evolved. The adoption of the 2030 Agenda for Sustainable Development provided extra momentum to further the consideration of the network's role in supporting the region's sustainable growth.

The shift to improving the quality of the infrastructure urgently warrants the harmonization of technical requirements applicable to road infrastructure. Building on the considerations of infrastructure quality already included in the Agreement, there is scope for further upgrading the traditional and emerging aspects of road infrastructure, increasing the capacity and safety of the Asian Highway routes and enabling the transition towards safer, smarter and more resilient infrastructure. The notion of quality infrastructure needs to encompass all aspects of sustainable transport performance, including environmental concerns, time, safety and cost of travel.

Furthermore, in the development and management of the network, operational connectivity issues, such as those related to transport facilitation, should continue to be prioritized as an integral part of the network's development plans. In doing so, development along the network needs to take into account and build on the synergies and respective strengths of other modes of transport in order to realize an integrated intermodal transport and logistics system in Asia and the Pacific.

Finally, in the further expansion of the quality parameters of the Asian Highway network, one promising area is new infrastructure requirements that are conducive to a greater use of intelligent transport systems, which would support a move towards smart Asian highways. Currently, the level of deployment of intelligent transport systems varies throughout the Asian Highway network. Some countries have been making the transition towards the use of more automated technologies in transport systems, taking advantage of such advances as artificial intelligence, the Internet of Things and big data analytics. Even relatively less developed countries in the region are striving to leapfrog the technology gap by adopting these innovations.

Taking these circumstances into consideration and building on its previous work on the use of intelligent transport systems along the Asian Highway network, work has commenced towards the development of a common understanding on the use of highly or fully automated vehicles along the network. The project is aimed at strengthening regional cooperation by developing a set of guidelines, which will seek to address infrastructure and border-crossing requirements.

2.2. Rail transport along the trans-Asian railway network

Rail transport depends on the quality of the transport organization (which is commonly, albeit not exclusively, State-owned and State-run), on the technical reliability of the rolling stock (trains often break down on the tracks) and on the continuity of rail track (missing links). The latter is often affected by terrain. When moving from national rail systems or networks to cross-border rail connectivity, efficiency in international rail freight transport is also compromised by limited interoperability and break of gauge leading to transshipment costs and delays along with load capacity issues. Railways also tend to incur high operational and maintenance costs for the State, particularly in the ESCAP region and are bound by physical infrastructure with identified security, safety and climate vulnerabilities. Further to that, problems are encountered with axle load which is not dependent on gauge but, instead, on the strength of the tracks. For example, in South-East Asia only a few countries have a railway network designed to withstand an axle load of 20 tons, whereas the majority of South-East Asian railways can carry 10 to 15 tons per axle.

Turkey becomes twentieth Party to the Intergovernmental Agreement on the Trans-Asian Railway Network

Turkey deposited its instrument of ratification on 11 June 2019, becoming the twentieth party to the Intergovernmental Agreement on Trans-Asian Railway Network.

The country has been taking measures to expand the capacity of its railway network to serve the growing international railway transport and to leverage its strategic location at the crossroads of East and West. The opening of the Baku-Tbilisi-Kars railway line that became operational in October 2017 is of critical importance in linking Asia with Europe.

In response to these challenges, the trans-Asian railway network offers a regional blueprint for the development of international rail transport in the region. It is formalized by the Intergovernmental Agreement on Trans-Asian Railway Network, which entered into force in June 2009. Currently, the network includes more than 118,000 kilometres of railway lines in 28 countries (figure 2.5). From the time of its definition, the trans-Asian railway network rests on four major corridors:

Northern Corridor connecting the rail networks of China, Kazakhstan, Mongolia, the Korean Peninsula and the Russian Federation;

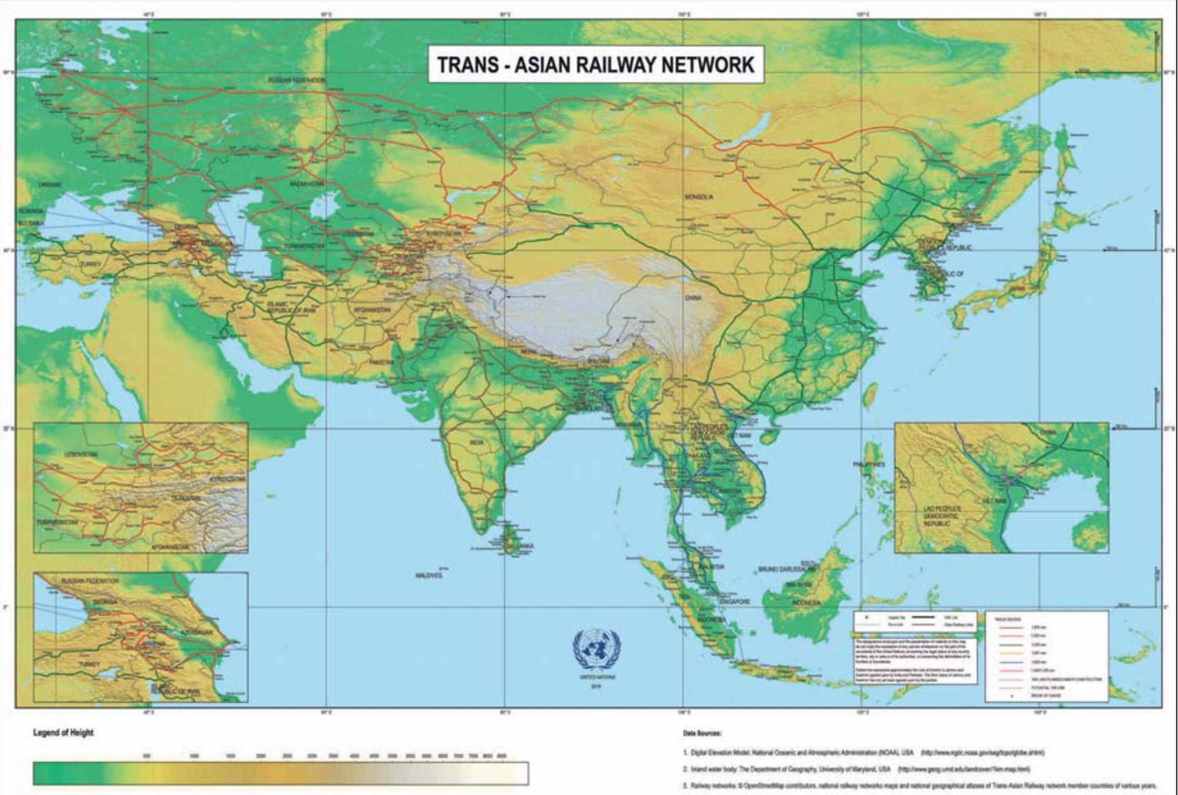
Indo-China and ASEAN subregion: Cambodia, China, Indonesia, Lao People's Democratic Republic, Malaysia, Singapore, Thailand and Viet Nam;

Southern Corridor of Asia-Europe Routes: Bangladesh, China, India, Islamic Republic of Iran, Myanmar, Pakistan, Sri Lanka, Thailand and Turkey;

North-South Corridor Northern Europe to the Persian Gulf; Armenia, Azerbaijan, Finland, Islamic Republic of Iran, Kazakhstan, Russian Federation and Turkmenistan.

From the time of the formalization of the trans-Asian railway network, each corridor has consistently presented different characteristics in the configuration and operational readiness. The Northern Corridor, with the exception of the missing link between the northern and southern parts of the Korean Peninsula, had a high level of operational readiness. In the Southern Corridor, a number of missing links hampered the development of international traffic and the priority assigned to their development varied among the countries. In the Indo-China and the ASEAN region, the need to develop subregional rail linkages was starting to receive renewed attention and related activities were being implemented by the ASEAN secretariat under the Singapore-Kunming Rail Link (SKRL) project. In the North-South Corridor linking Northern Europe to the Persian Gulf, activities were being carried out by the countries concerned to promote traffic along the corridor in an effort to capitalize on shorter transit times by rail as compared to maritime shipping. The divergence among the corridors persists to this day with some notable developments, owing, in particular, to the continued growth of regional and global trade.

Figure 2.5. Map of the trans-Asian railway network



Source: ESCAP secretariat.
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

A. Infrastructure connectivity along the trans-Asian railway network

Prompted by growing demand arising from intraregional and interregional trade, the trans-Asian railway network continues to expand. China-Europe freight trains have been growing exponentially over the past few years. Since 2011, China has sent more than 11,000 freight trains to Europe and back. A total of 6,300 freight trains in 2018, an increase of 72% over the previous year, transported goods from China to Europe; of these, 2,690 made the return trip to China.[90] Accordingly, railway freight volumes along the Northern Corridor of the trans-Asian railway network continue to grow. The container volumes transported by the United Transport and Logistics Company, a major operator of container trains, along the China-Europe corridor increased by 280% between 2016 and 2018. The company runs 15 trains daily, with an average transit time of 5.5 days between the European Union and the western border of China.[91]

[90] J. Suokas, "China sent a record 6,300 cargo trains to Europe in 2018, *gb Times*, 4 January 2019, Available at https://gbtimes.com/china-sends-a-record-6300-cargo-trains-to-europe-in-2018.
[91] See https://utlc.com/en//

A further increase in rail traffic along the Northern Corridor of the trans-Asian railway network critically hinges on tapping into the large volumes of trade between the Republic of Korea and Japan with Europe. In this regard, intermodal transport could play an important role. Already, Russian Railways have joined hands with transport companies to launch a transit route between the Republic of Korea and Europe. In June 2019, the first container from Busan, Republic of Korea was shipped to Vladivostok, Russian Federation by sea, then moved to Brest in Poland on the Tran-Siberian Railway from where it was transshipped to the European narrow gauge rolling stock and delivered to the railway station at Brzeg Dolny in Poland. Final delivery was made in Wroclaw in Poland in 21 days; notably it would have taken twice that time had it been shipped by sea.[92]

In addition, other routes through Central Asia are becoming increasingly prominent. All countries in Central Asia are actively striving to facilitate railway transit and strengthen their position as a Euro-Asian landbridge. The completion of Baku-Tbilisi-Kars railway line in October 2017 opened a new railway transit route to connect countries of Europe with Turkey, Azerbaijan, Georgia and Central Asia. It is estimated that the line will carry three million to five million tons of freight by its third operational year, six million to eight million tons by its fifth year, and then up to three million passengers and 17 million tons of cargo annually.[93] The Baku-Tbilisi-Kars route is the shortest link between the Caspian Sea and Europe, making it of geostrategic importance. Kazakhstan and Turkmenistan have plans to start regular ferry services across the Caspian Sea. This line would eventually make it possible for Turkey to transit 24 million tons of additional goods through its territory.[94] Uzbekistan has also been considering to join the route, however, that is contingent on completion of the railway line connecting Navoi in Uzbekistan to Turkmenbashi in Turkmenistan. Aiming to bring additional freight volumes to this line, the railways of Azerbaijan, the Russian Federation and Turkey signed a memorandum of understanding in May 2019.[95]

The opening of the Qazvin-Rasht railway line in March 2019, a previously missing link of the network in the Islamic Republic of Iran, is another noteworthy and recently completed project with wider implications for regional connectivity. The new railway line is part of the International North South Transport Corridor. The only remaining missing link is the one between Rasht and Astara. Once completed, South Asia will be connected to Europe through railway lines crossing Azerbaijan, the Islamic Republic of Iran and the Russian Federation.

Missing links on the territory of China are Dali – Baoshan – Ruili, a 330 kilometre-long line bordering Myanmar, which is scheduled to be completed in 2021 and Yuxi – Xishuangbanna – Mohan, a line of approximately 508 kilometres bordering the Lao People's Democratic Republic, which is expected to be completed by 2021.

In Viet Nam, the missing link, Ho Chi Minh City – Loc Ninh connecting Cambodia, is 129 kilometres long. For the missing link between the Lao People's Democratic Republic and Viet Nam along the Vientiane – Thakhaek – Mu Gia – Tan Ap – Vung Ang section, after completion of a feasibility study in 2017, the detailed design is being developed. A joint committee has been established to work on this railway project, and in February 2019, an agreement was signed between the two Governments on the construction and operation of the line. In a trial run of the India-Bangladesh container trains in April 2018, 60 twenty-foot equivalent units (TEUs) were transported from the Majherhat container terminal in India to Bangabandhu West station, 117 kilometres from Dhaka.[96] The rolling of regular container services between the two countries would significantly reduce transport time and cost.

Notwithstanding notable progress reflected in these developments, the trans-Asian railway network still faces several restrictions in infrastructure connectivity, resulting from persistent missing links along the network in most of the ESCAP subregions as shown in table 2.1.

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92 Russian Railways, "Russian Railways Holding and FESCO expand Trans-Siberian LandBridge geography and launch transit service from Korea to Europe via Trans-Sib, 26 July 2019, Available at http://eng.rzd.ru/newse/public/en?STRUCTURE_ID=15&layer_id=4839&refererLayerId=3920&id=107524.

93 I. Aliyev, President of Azerbaijan in the inaugural speech at the meeting of the Cabinet of Ministers dedicated to the outcomes of the socioeconomic development in 2017 and upcoming duties.

94 F. Shabazov, "Will the Baku-Tbilisi-Kars Railway become Uzbekistan's new connection to Europe", *Europe Daily Monito*r, vol. 14, No. 130 (16 October 2017).

95 Daily Sabah, "Trilateral deal on Baku-Tbilisi-Kars railway to augment freight transportation", 8 May 2019. Available at https://www.dailysabah.com/business/2019/05/08/trilateral-deal-on-baku-tbilisi-kars-railway-to-augment-freight-transportation.

96 The Hindu Business Line, "Trial fun of India-Bangladesh Container train services", 3 April 2018. Available at https://www.thehindubusinessline.com/economy/logistics/trial-run-of-india-bangladesh-container-train-service-begins/article23423509.ece.

Table 2.1. Trans-Asian railway network: missing links by subregion

Subregion	Distance (kilometres)	Percentage of total
ASEAN (including Yunnan Province of China)	4 763	38
Caucasus	346	3
Central Asia (including the Islamic Republic of Iran and Turkey)	1 405	12
North-East Asia	3 396	27
South Asia	3 495	20
Total	12 405	

Source: ESCAP secretariat.

Countries in the region are, therefore, continuing efforts to construct missing links along the trans-Asian railway network, however, the levels of required financial investment by far exceeds the capacity of national budgets. In addition, several countries lack a mature legal and institutional framework needed to effectively attract private investment either in whole or in part through public-private partnerships. In this context, the commercial operations for railways have increasingly become critical to meet the investment needs of railways for maintenance and further development of infrastructure at a time when demand for public funding outstrips the supply.

While policy discussions often focus on expanding infrastructure and building missing links, the issue of cost-effective and regular maintenance of the vast regional network is also a pressing matter of priority. Railway infrastructure requires regular structural monitoring, especially for critical assets, such as bridges and tunnels; environmental security monitoring to prevent fires and explosions along the tracks; physical security monitoring to detect, for example, intrusions, objects stolen or moved, graffiti and vandalism; safety monitoring (early detection of failures on track elements, devices or obstacles on the track); and situation assessment and emergency or crisis management. These aspects warrant proactive management to ensure reliability of service along the national and regional networks. These processes, however, require large numbers of specialized staff and equipment, in the absence of which several parts of the network are in disrepair or in a suboptimal condition. Various solutions are gradually being introduced to address this, most notable of which is the use of aerial drones. Currently piloted for infrastructure monitoring in several countries, including Australia, China, India, Singapore and Japan, the use of drones is steadily proving to offer significant benefits: Drones equipped with high-resolution cameras, sensors and scanners enable remote yet precise infrastructure inspections, while carrying out hazardous activities previously implemented by human staff directly. This includes working at heights, accessing dangerous locations, and monitoring and inspecting operational network assets from a safe location. For instance, it is estimated that a few hundred fixed-wing drones could monitor approximately 200,000 kilometres of railway tracks.[97]

Custom designed aerial drone for railway tunnel Inspection

Photo credit: Provided by the Institute on Railway Technology, Monash University, Australia.

[97] SESAR Joint Undertaking, “European drone outlook study: unlocking the value for Europe” (2016). Available at https://www.sesarju.eu/sites/default/files/documents/reports/European_Drones_Outlook_Study_2016.pdf.

Despite offering economic and safety benefits at a cost significantly lower than that of conventional methods, challenges in the deployment of aerial drones remain to be addressed, such as aviation risks, flight management, training and expertise, privacy and cyber-security concerns, all of which warrant further consideration and research. As the labour cost per drone flight in 2017 was already less than $300, aerial drones could potentially offer high-quality monitoring with significant savings. To this end, it could be beneficial to consider whether, and under what circumstances, a regional approach could be elaborated. Indeed, the current international legal framework effectively omits international commercial drone operations, leaving it to national jurisdictions to formulate the frameworks most appropriate for their purposes. Meanwhile, an increasing number of international instruments codify the use of various technologies and tools on the basis of technological neutrality and functional equivalence. The question then arises as to whether these elements can be combined to take a soft regional approach introducing these types of operations and whether that could conceivably, facilitate the alignment of the policy cycle with the speed of technological development.

In addition, the ever-present challenge of break-of-gauge remains one of the major infrastructure connectivity concerns along the trans-Asian railway network. Break-of-gauge operations must be organized at railway border crossings mostly between 1,435 millimeter and 1,520 millimeter gauges, although there are border crossings with other gauges as well, as shown in table 2.2.

Table 2.2. Break-of-gauge border crossings on the trans-Asian railway network

1 435-1 000	Hekou (China)-Lao Cai (Viet Nam) Pingxiang (China)-Dong Dang (Viet Nam)
1 435-1 520	Alashankou (China)-Dostyk (Kazakhstan) Erenhot (China)-Zamyn Uud (Mongolia) Manzhouli (China)-Zabaykalsk (Russian Federation) Suifenhe (China)-Grodekovo (Russian Federation) Astara (Islamic Republic of Iran)-Astara (Azerbaijan) Jolfa (Islamic Republic of Iran)-Djulfa (Azerbaijan) Sarakhs (Islamic Republic of Iran)-Saraks (Turkmenistan) Incheboroun (Islamic Republic of Iran)-Gudriolum (Turkmenistan) Dogukapi (Turkey)-Akhuryan (Armenia)
1 435-1 676	Mirjeveh (Islamic Republic of Iran)-(Koh-i-Taftan) Pakistan

Source: United Nations, *Treaty Series*, No. 46171.

The existence of different track gauges prevents continued movement of rolling stock across borders and require appropriate technical solutions to deal with it. Limited reloading capacities, lack of availability of wagons, lengthy transshipment operations and inefficient information exchange among the railways are factors that severely affect the efficiency of railway border-crossings and that are directly linked to the issue of break-of-gauge. Solutions used across the region include bogie changing for the wagons and transshipment for the containers. Efficient information exchange between the railways could further support early preparation for dealing with break of gauge and prevent related delays.

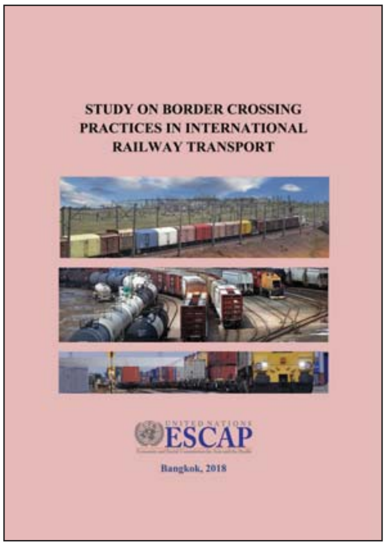
B. Operational connectivity along the trans-Asian railway network

Apart from constructing missing links, rehabilitating weaker sections and modernizing rolling stock all of which need considerable investment, the railways of the region need to focus on operational issues to harness the full potential of the network. Among the issues are strengthening port-hinterland connections through the use of new technologies; locating intermodal and logistics facilities appropriately for bundling cargo to capitalize on the competitive strength of railway transport; electronic information exchange between railways and other stakeholders for efficient completion of regulatory and operational requirements; and harmonization of border-crossing formalities for rail transport. Strides made in railway connectivity indicate that there is enormous potential for rail freight on various routes along the trans-Asian railway network. Recent estimates by the International Union of Railways suggest that on the Europe-Asia route alone, by 2030, the railway cargo could increase to 810,000 TEUs from 141,000 TEUs in 2016.[98] Goods carried by rail could be of high value and time

[98] R. Berger, “Eurasian rail corridors: What opportunities for freight stakeholder?” (Paris, International Union of Railways, 2017), p. 9.

sensitive, such as high-tech electronics, metal products, vehicles and automotive parts and spares, and chemicals. For the transport of such types of goods higher costs could be acceptable on the condition of predictability and reliability of delivery and reduced inventory requirements for firms.

An increase in container transport by railway critically depends on rail freight trains being economical, reliable and predictable. This calls for strengthened cooperation among border agencies and railways of the countries involved, as it can substantially increase the competitiveness of rail transport. For instance, the use of an electronic cargo tracking system on the containers transported by rail that carry third party imports to Nepal while transiting Indian territory has shown to result in more rapid customs clearance with simplification of procedures, including those related to transshipment.[99] Consequently, importers can turn around containers in 14 to 21 days, leading to reduction in demurrage payable to shipping lines.[100]



Border crossing processes play a vital role in facilitation of international railway transport. The delays related to border crossing formalities increase transit time and adversely affect the competitiveness of railway transport compared to other modes. A recent ESCAP survey of border crossing practices in international railway transport[101] the processes at 52 pairs of selected railway border crossings in the region are documented and ways to improve their efficiency are identified; the study also includes good practices and practical examples of rail border crossings within the region and beyond. Issues of technical, legal and operational interoperability are among the root causes of inefficiencies.[102] Lack of technical interoperability can be attributed to the lack of common technical parameters of railway infrastructure and rolling stock. Lack of legal interoperability stems from diverging contractual obligations vis-a-vis customers from origin to destination. The lack of operational interoperability results from absence or limited use of harmonized operational practices along a railway corridor.

To tackle issues related to railway border crossings, several developments are worth highlighting, including, among them, advances in the electronic exchange of information among railways, which can enormously enhance the efficiency of processes at border crossings. Currently, systems for electronic information exchange have different technical specifications. Operating under varying legal frameworks hinder the flow of information along international railway corridors. To date, many countries in Asia and the Pacific are harnessing the advantages of electronic interchange of data among railway undertakings. For example, the railways of the Russian Federation have introduced advanced solutions for electronic information exchange and concluded bilateral agreements with Belarus, China, Mongolia, Baltic countries, some Nordic countries and Commonwealth of Independent States member countries. The electronic information exchange has already been implemented with most of them. Harmonizing electronic information exchange platforms and processes for operating of freight trains regionally would contribute measurably towards the efficient flow of information among railways and control authorities for efficient completion of border crossing formalities. In this context, a recent ESCAP study was conducted to examine the existing systems for electronic exchange of information for international railway transport, namely:

Facilitation of Customs and other government agencies formalities: Completion of regulatory formalities is a major activity being carried out at the railway border crossings. In this regard, a lot of information and documents are exchanged among railways, customs and other government agencies that handle for example, border security guards, immigration, sanitary issues, food safety issues, veterinary issues, and phytosanitary issues. To support the increase in the volume of goods transported by railway, the benefits of new technologies must be exploited, including electronic exchange of information for enhancing efficiency of regulatory controls. An appropriate legal arrangement for harmonization of customs formalities for international railway transport using modern technologies could be considered in this regard. This instrument would draw from the good

[99] Government of India, Public Notice No. 33/2018. Available at http://www.kolkatacustoms.gov.in/admin/uploads/pdf/KC_Port_public-notice_941_15_04_2018_04_25_32.pdf.

[100] The Kathmandu Post, “Nepal seeks transhipment privileges at Kolkata port, 7 October 2019. Available at https://kathmandupost.com/money/2019/01/12/nepal-seeks-transshipment-privileges-at-kolkata-port.

[101] Economic and Social Commission for Asia and the Pacific, “Study on border crossing practices in international railway transport”, 2018. Available at https://www.unescap.org/sites/default/files/Study%20on%20Railway%20Border%20crossings%2046218.pdf.

[102] Economic and Social Commission for Asia and the Pacific, “Enhancing interoperability for facilitation of international railway transport, 2018. Available at https://www.unescap.org/resources/enhancing-interoperability-facilitation-international-railway-transport.

practices that are scattered across various other agreements and conventions. Moreover, taking into consideration the different state of development electronic systems of railways and control agencies in the countries, implementation of them could be staggered and in conjunction with the existing paper-based systems. An electronic single window for railway transport is another option that could be contemplated at the railway border crossings using modern technologies. The data collected from multiple sources, such as electronic systems of railways, customs, immigration, automatic control equipment and dynamic scanners, could be stored in a neutral platform or the single window for railway transport. It could then be accessed by control authorities at the railway border crossing for completion of regulatory formalities.

Commercialization of railway corridors: Commercialization of a rail corridor involves achieving its full market potential through improvement of the corridor infrastructure, the quality of transport services offered, and flexible tariffs that could lead to the gradual expansion of market serviced by the transport corridor. The main objectives of railway freight corridors are the following: (a) improving customer orientation; (b) providing high-quality railway freight services; (c) improving capacity and harmonized standards along the railway freight corridors; (d) strengthening cooperation among railway authorities and other stakeholders; and (e) marketing services of railway corridor. Several regional best practices could be studied to provide useful inputs to the improvement of corridor mechanism. To make the railway corridor covering Belarus, Kazakhstan and the Russian Federation commercially viable, the railways of three countries, namely Kazakhstan Railways, Russian Railways and Belarusian Railway have formed the Joint Stock Company United Transport and Logistics Company – Eurasian Railway Alliance, which provides full services for container transport by rail on the 1,520 mm gauge route from the Kazakhstan-China border up to Belarusian-Poland border in Eastern Europe. The company is involved in a range of activities, including coordination with the three railways on such issues as speed and length of freight trains, reliability and timeliness of train operations, processing of documentation required for regulatory formalities, provision of competitive transport costs. The success of the company in managing the railway transit transport corridor between Asia and Europe indicates that such a model could be considered for replication for other trans-national railway corridors being developed in the region to enhance commercial orientation for international railway operations.

To support member States in enhancing commercial viability of international railway transport corridors, ESCAP is implementing a project to commercialize the railway corridor for Kazakhstan, Turkmenistan and Islamic Republic of Iran. The objectives of the project are to develop (a) a corridor management mechanism to support efficient operations along the corridor, (b) an action plan for commercialization of the corridor and (c) a marketing plan for the railway services along the corridor.

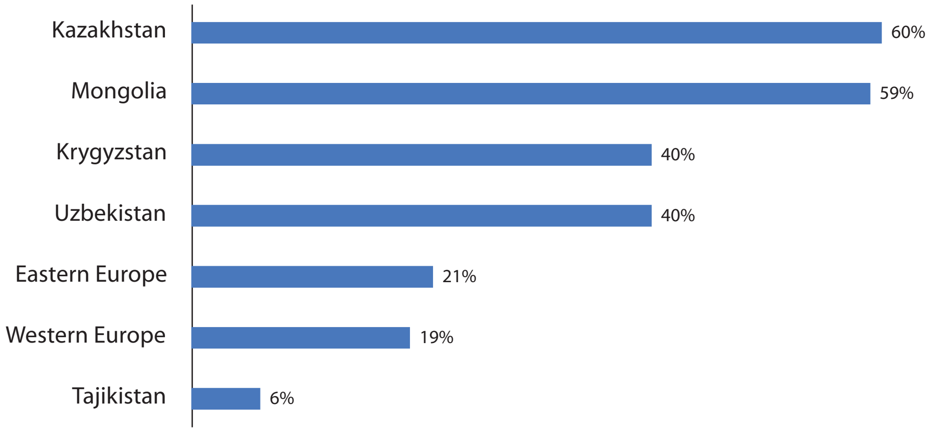
Evolving role of railway terminals to boost railway transport: Railway terminals have three types of structuring effects: adjacency, accessibility and network. Adjacency is a structuring effect in which nature and the level of terminal traffic influences the land use in close vicinity to the terminal. Storage of commodities, such as grains, chemicals and minerals is adjacent to railway terminals. Accessibility implies that the user of a railway terminal is affected by the distance decay function related to frequency of its use. Network is a structuring effect in which a set of interconnected railway terminals support specialization and interdependency of locations. Inland container terminals have been established in many countries as a result of concerted efforts of the port authorities, terminal operators and railways to effectively access hinterlands. For example, the Container Corporation of India has set up 51 rail-based terminals[103] throughout the country to consolidate loads and provide links with the seaports. Most of these railway terminals also serve as dry ports where customs clearances are also carried out.

C. Making railways part of the overall logistics solution

At the beginning of the twentieth century, the largest share of surface freight was transported by rail. By 1950, up to 90% of all freight in Africa, Latin America, and South Asia was carried by rail. There were then years of rapid decline of railways in favour of road transport. Asia represents one of the few regions of the world where the role of railway transport in freight operations remains significant and has a tremendous potential for further growth as shown in figure 2.6.

[103] See http://www.concorindia.com/map.asp.

Figure 2.6. Railways: modal share, selected economies (2015, in ton-kilometres)



Source: International Transport Forum, "Enhancing connectivity and freight in Central Asia", International Transport Forum Policy Papers, No. 71 (Paris, OECD Publishing, 2019).

The most important change required pertaining to rail freight, is to establish its role as part of the overall logistics solution.[104] The railways traditionally had captive markets in mining and movement of bulk products mainly owned by public sector. Assured captive markets led railways to focus more on building infrastructure than on understanding markets and changing customer requirements. Moreover, in many emerging and least developed countries railways had served multiple, including social and political, objectives. Accordingly, most railways started to lose commercial orientation and become more dependent on public funding, which set themselves up in a vicious cycle of underinvestment in railways.

Efforts to contain the declining share of railways have focused on improving internal processes and operations and underscoring the cost advantage of moving freight by railway. Improving operational efficiency is important, but this in itself cannot lead to a significant shift of freight to railways. The changing landscape of global logistics in which several modes of transport can be used in a supply chain based on the total logistics cost has encouraged shippers to use other modes, such as road and air transport, even though they have considerable negative externalities.

Some successful railway examples indicate that a focus on operational efficiency and a holistic view of the supply chain from the perspective of various stakeholders, such as shippers, freight forwarders and third-party logistics providers can lead to railway freight being perceived and used as a part of the total logistics solutions to minimize the transport cost from origin to destination. Studies and empirical evidence indicate that reliability, price, flexibility of service and security are critical considerations in choosing the mode of transport. For example, shippers operating in time-sensitive freight place reliability above cost as for many containerized goods, the inventory carrying cost is much higher than the transport cost.

Apart from making railways more reliable, it is also imperative to enhance the freight flows on long distance railway corridors. In many countries in the region, however, the modes of surface transport are not integrated to allow for synergies and complementarities. The fragmented networks are not able to sustainably support the rising demand for freight and changing production patterns. As such, this lack of integrated planning and investment in freight transport infrastructure has led to inefficiencies that have contributed to increased logistics costs.

Finally, railways would immensely benefit from building strategic partnerships with key shippers, freight forwarders and third-party logistics providers, either through affiliated companies or by forging other mutually acceptable arrangements. Partnerships with third party logistics providers could help attract more customers to railways, in particular shippers that may be reluctant to manage the complexity of intermodal chains and have reservations about the reliability of railway transport but are comfortable with using a third-party logistics provider.

[104] Adapted from B. Aritua, *The Railway Freight Challenge for Emerging Economies: How to Regain Modal Share* (Washington, D.C., World Bank Group, 2018).

Railways in North America have attracted many customers by partnering with third party logistics providers, such as United Parcel Service. In turn, these companies have benefited by providing lower costs to the customers. Analysis of the logistics chain and understanding of how railways could offer door-to-door solutions could open a wide range of opportunities for the railways in the region. For example, the operation of China-Europe trains offers enormous opportunities for railways to forge lucrative partnerships with various stakeholders and increase their modal share.

2.3. Dry ports and intermodal facilities in Asia and the Pacific

Growth in the global economy over the past two decades, increased manufacturing and agricultural production, and new marketing techniques creating more demand, have resulted in the need for more efficient transport infrastructure and services. These services are important because industries now operate globally and require frequent shipments, precise scheduling and efficient logistics to bring components together for assembly and to deliver finished products where they are wanted. In this context, inland intermodal facilities or dry ports have attracted much attention because of their potential to improve transport efficiency and meet supply chain requirements by grouping access to highways and railways together with customs processing, warehousing, consolidation and distribution, manufacturing and clustering of economic activities along domestic and transboundary economic corridors. The dry port concept initially emerged from the idea of a seaport directly connected by rail to inland intermodal terminals, where shippers can leave and/or collect standardized units as if they are at the seaport. This was a response to the problems posed by the growth of containerized transport and the corresponding lack of space at seaport terminals and growing congestion on the access routes serving their terminals.

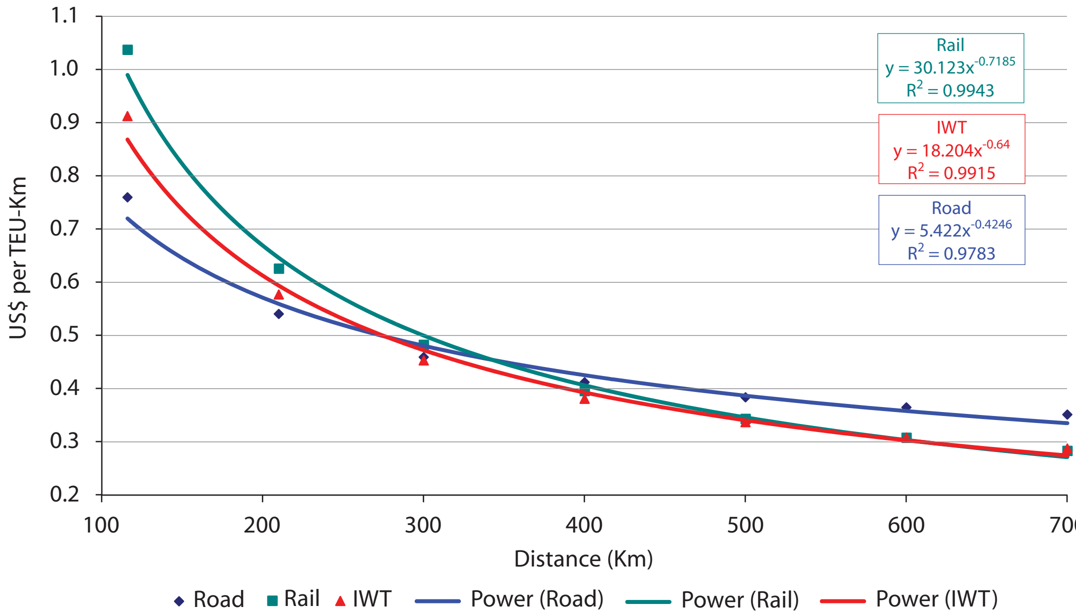
Seaports can generate economies of scale economies to operate cost effective intermodal transport with high frequency to different destinations beyond their traditional hinterland, namely to use rail to enlarge their hinterland and at the same time to stimulate intermodal transport. In addition, seaports are not only competing with seaports in their local area, but also with distant seaports attempting to serve the same hinterland. Accordingly, as seaports try to attract as much flow as is economically feasible, the size and shape of a seaport's hinterland is not statically or legally determined, but it varies dynamically because of developments in technology, economy, and society. However, in contrast to a seaport, which is an integral link between the maritime and land transport systems, a dry port is an optional transport node. A dry port as an element of hinterland transport is a part of many supply chains and, therefore, affect supply chain performance.

Dry ports can also play a significant role in inducing a modal shift, as they are designed to allow the diversion of cargo movement from inefficient to efficient combinations of transport, mainly from all road to rail plus road, but also from all road to inland water transport, where applicable, plus road. For example, dry ports close to the cargo sources (or trade-generating locations) and far from a seaport could optimize transport costs by employing small-medium trucks for transport of breakbulk cargo between the cargo source and the dry port and rail or inland water transport, if available for the transport of containers between the dry port and a seaport. In turn, this shift and the corresponding cost reduction would contribute towards an increase in trade volumes.

As part of its capacity-building programmes on dry ports, ESCAP has estimated the relative operating costs for rail, road and inland water container transport in Cambodia and Viet Nam (figure 2.7). The findings indicate that rail container haulage costs begin to fall below those of road at around 330-340 kilometres, while convergence of rail and inland water transport costs occurs at approximately 500 kilometres. The cost difference between road and rail becomes substantial at around 600 kilometres, namely twice the breakeven distance.

In India, a rail container haulage using electric traction and longer trains (45 wagons = 90 TEUs) at a distance exceeding 350 kilometres yielded a unit operating cost of approximately $0.022 per TEU-kilometre; in Viet Nam, haulage of containers in trainloads of 30 wagons (= 60 TEUs) more than 1,700 kilometres yielded a unit cost of $0.0275 per TEU-kilometre. The environmental benefits of rail, in particular, can be magnified by the application of electric rather than diesel traction, with the caveat being that emissions in this case may be transferred from trains to power-generating sources. CO_2 emissions may be calculated at the rate of 2.7 kilograms per litre of diesel fuel consumed.

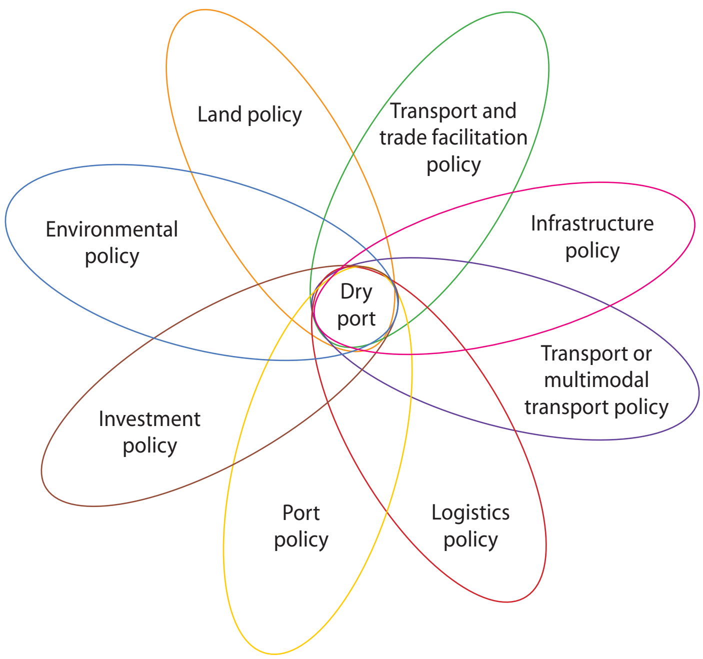
Figure 2.7. Relative operating costs for rail, road and inland water container transport in Cambodia and Viet Nam



Source: Presentation given at ESCAP capacity-building seminar on planning, design, development, and operation of intermodal freight interfaces, including dry ports, New Delhi, 1-2 August 2018, "Introduction to dry ports and the transport network". Available at https://www.unescap.org/events/regional-framework-development-dry-ports-international-importance-capacity-building-workshop.

It follows that dry ports, as points of convergence and interaction between transport modes, transport operators and logistics providers, public sector agencies and private sector entities, offer ideal settings for all public and private sector stakeholders to work out sustainable cooperative mechanisms among them and identify the needed logistics and connectivity-related interventions that have the highest potential to reduce the cost of trade and boost integration into global supply chains. This is important given that logistics- and connectivity-related issues are so intertwined that, as several experiences have demonstrated, success lies in addressing these issues in a holistic manner (figure 2.8). In other words, the development of dry ports should not be considered only for their merit in connecting infrastructure but also for their potential to implement such policies encompassing the regulation of services, sustainability and resilience.

Figure 2.8. Sectoral policies relevant for dry port development

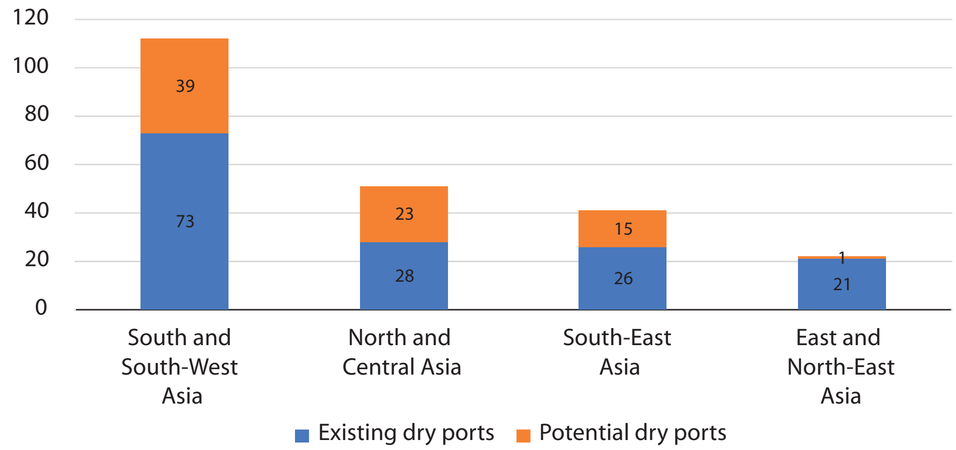


Source: S. Hanaoka and M.B. Regmi, "Promoting intermodal freight transport through the development of dry ports in Asia: an environmental perspective", IATSS Research, vol. 35, No. 1, (2011) pp. 16-23.

A. The intergovernmental Agreement on Dry Ports

The Intergovernmental Agreement on Dry Ports, which entered into force in April 2016 to provide a uniform definition of a dry port of international importance, identifies the network of existing and potential dry ports of importance for international transport operations and proposes guiding principles for their development and operation. The key principle underlying the development of the Agreement was that it would lead to consistency among them in terms of the services that they provide, their location in relation to trade-generating industries, and their transport connections. While the Agreement provides guidelines with respect to all these factors, it is clear that the facilities identified by countries as dry ports under the Agreement fall within a wide range of types, infrastructure links and service functions. Some do not have the authority or facilities for customs and other border-control functions. To date, the Agreement has 14 Parties and covers 226 dry ports in the ESCAP subregions, except for the Pacific; potential dry ports comprise up to 34% of the total (figure 2.9).

Figure 2.9. Dry ports coverage by subregion



Source: ESCAP secretariat based on the Intergovernmental Agreement on Dry Ports.

The Lao People's Democratic Republic becomes the fourteenth Party to the Intergovernmental Agreement on Dry Ports

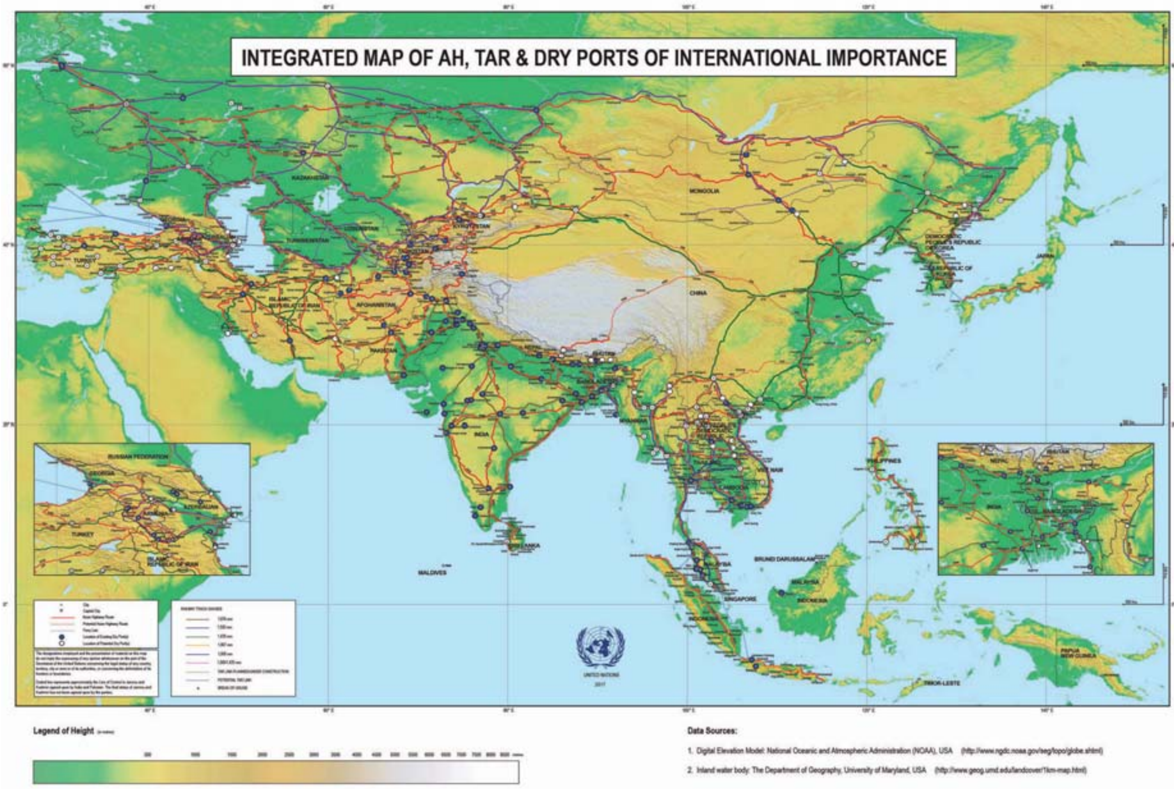
The Lao People's Democratic Republic deposited its instrument of ratification on 5 November 2019, becoming the fourteenth party to the Intergovernmental Agreement on Dry Ports.

The country has been taking measures to develop, revise and enact new national legislation on Dry Ports with the overall objective of becoming land-linked and ensuring seamless cargo flows with Thailand and Viet Nam. The Lao People's Democratic Republic is also viewing the development of dry ports as an avenue through which logistics services and capacities can be strengthened.

The Agreement specifies that dry ports should, ideally, be connected to the Asian Highway and/or the trans-Asian railway networks (figure 2.10) and operate under *"institutional, administrative and regulatory frameworks that are favourable to the development and smooth operation of dry ports, including procedures for regulatory inspection and the execution of applicable customs control and formalities in line with the national laws and regulations of the Party concerned"*, without however offering much detailed guidance in that respect. It further sets out guiding principles for the development and operation of dry ports in its annex II.[105]

[105] ESCAP resolution 69/70.

Figure 2.10. Integrated map of the Asian Highway network, the trans-Asian railway network and dry ports of international importance



Source: ESCAP secretariat.
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

As part of the activities to support the implementation of the Intergovernmental Agreement on Dry Ports upon its entry into force, the secretariat formulated a regional framework for the development, design, planning and operation of dry ports of international importance. The framework was developed with a view to facilitating the definition of a common approach to the development and operationalization of the dry ports designated in annex I to the Intergovernmental Agreement on Dry Ports as being of international importance. The key concept underlying the framework is the establishment of a network of interconnected dry ports in the ESCAP region. It is envisaged that such a network could be formed from the dry ports nominated for coverage by the Intergovernmental Agreement on Dry Ports. This framework provides a means by which their development may be planned so that they may follow the same standards and be interconnected in future. Accordingly, fundamental issues related to the hard and the soft infrastructure of dry ports of international importance are identified, and, along with the description of each issue, a related target is proposed for designing or operating dry ports of international importance, as well as recommended processes to follow to reach each target. The key elements are outlined below.

Location:

The selection of the optimal location for a dry port is deemed a key prerequisite for it to operate successfully. Dry ports in proximity to trade-generating centres and a considerable distance from seaports (more than 300 kilometres) could achieve economies of scale and consequently lead to lower logistics costs by consolidating cargoes at the dry port and transporting them using a combination of road and rail transport for short and long-distance transport, respectively. In contrast, dry ports near seaports (less than 300 kilometres) and away from trade generating-centres could face problems of insufficient cargo volumes needed to generate the economies of scale necessary to make rail haulage tenable. It is, therefore, essential to blend the economics of long-haul rail transport with that of short haul road transport and the location of dry ports to lower overall transport and consequently, logistics costs. Furthermore, in the case of a dry port network, dry ports located along intermodal transport corridors can act as consolidating and deconsolidating centres that enhance and optimize intermodal transport and consequently, generate economic, environmental and social benefits. Over time and through the clustering of economic activities along the corridors, intermodal transport corridors can eventually transform into economic corridors.

Strategically positioned dry ports can also help to decongest existing seaports that are functioning at maximum capacity. The increase in the number of very large container ships carrying more than 12,000 TEUs calling at major ports has required port operators to process increasing volumes of cargoes, all while ensuring quick vessel turnaround time. In the context of increased competition among ports and limited options to expand existing seaports, port operators are looking at setting up dry ports as a means to decongest seaports. On the other hand, dry ports can also extend the reach of seaports to the hinterland by increasing the catchment area of existing ports. In the case of seaports serving landlocked countries, the catchment areas extend even beyond national borders, while in other cases, the catchment areas of seaports may also overlap, as is the case with the Indian ports of Kolkata and Visakhapatnam, which offer connectivity to the Birgunj dry port in Nepal.

Services:

While the location of dry ports is a key factor in optimizing freight transport networks and lowering overall logistics costs, the viability of these facilities depends to a considerable extent on their ability to provide customers with time-bound and cost-effective services. Dry ports and seaports can only be effective and operate at their intended capacities if the connecting road, rail and waterway infrastructure can handle the cargo volumes being processed at these facilities. Bottlenecks in the transport infrastructure can result in inefficiencies and high logistics costs, which could render these facilities unviable. It follows that the development of dry ports of international importance does not require them to have identical design standards, however, they need to have comparable basic facilities and provide a minimum set of services in order to function efficiently as part of an integrated transport network. Those services are handling, consolidation, storage and modal transfer of containers and cargo; and customs and other border control inspection and clearance of international cargo.

Infrastructure:

The effective provision of these services will normally require the following infrastructure:

- A fenced customs secure area;
- A container yard for receiving, dispatching and storage of containers by road and rail;
- A container freight station for loading and discharging of containers;
- A customs inspection area;
- A bonded warehouse for underbond cargo;
- An administration building, which has at least two levels, for accommodating the offices of the various service providers on site.

Land area:

The physical area required to be occupied by dry ports depends on the volume and type of cargoes that these facilities are expected to process and the type of handling equipment to be deployed. For dry ports with intermodal transport linkages, provisions are needed for the smooth flow of heavy-duty vehicles in the facility and, in the case of rail served dry ports, the length and number of railway tracks to be accommodated within their boundaries when must be considered when designing their facilities. Adequate provisions should also be made for future expansion of these facilities to accommodate increasing trade flows. Ideally, rail-served dry ports should position their rail infrastructure to reduce the number of moves required before a container or other cargo is placed on a train wagon for dispatch to onward destinations. Rail infrastructure should have a sufficient length to enable the arrival and departure of full-length trains running between a single origin and single destination, without the need for being broken up or remarshalled. The railway infrastructure should comprise at least three tracks for loading and unloading of trains, with the third track enabling the release and repositioning of locomotives. The actual number of tracks must also be based on projected traffic volumes.

B. Selected developments related to dry ports

Many countries in the ESCAP region have scaled up efforts to expand their existing dry port facilities or build new ones. For instance, the policy of Thailand systematically considers land transport links to dry ports that are aligned with the Asian Highway and trans-Asian railway networks, which in turn, further strengthens the institutional stability of the national policy. Clear environmental priorities are also set for the sector, with an optimal share of rail-freight aimed at reaching 50% by 2025.

With regard to dry ports designated under the Intergovernmental Agreement on Dry Ports, Thailand has one operational inland container depot, Lard Krabang which is operated by the State Railway of Thailand, while the Chiang Khong Intermodal Facility in Chiang Rai, is now under phase 1 of construction and is expected to be operational in 2020. One more dry port is planned to be selected among four possible locations (table 2.3), that will be connected to Laem Chabang Port by rail. In addition, all locations are connected to the Asian Highway. Chachoengsao also offers the possibility of containers being moved to and from the dry port on the Bang Pakong River (inland waterway transport).

Table 2.3. Potential dry port locations in Thailand

Location	Direction from Bangkok	Rail distance from Bangkok (kilometres)	Rail distance from Laem Chabang Port (kilometres)
Chachoengsao	East	64	78
Khon Kaen	North-East	450	500
Nakhon Ratchasima	North-East	264	315
Nakhon Sawan	North	252	390

Source: Presentation delivered at the third meeting of the Working Group on Dry Ports on 13 November 2019. Available at: https://www.unescap.org/sites/default/files/2.%20Thailand%20.pdf.

The Lard Krabang Inland Container Depot was established to free up landside capacity and accelerate vessel turnarounds within the Port of Laem Chabang by transferring the customs clearance and the stuffing and unstuffing processes of containers outside of the port. Current capacity is for 800,000 TEUs per year, but the maximum annual volume to date has been 450,000 TEUs. The depot is comprised of six independent modules, each with its own container yard and warehouses and operates independently under an operating concession. Each operator has common access to centrally located rail loading and unloading sidings.

Laem Chabang is the largest of five ports under the administration of the Port Authority of Thailand. The others are Bangkok, Chiang Saen, Chiang Khong and Ranong ports. In 2016, Laem Chabang was ranked number 20 in the global container port throughput league; in 2017, the port handled a container volume of 7.6 million TEUs and in 2018, it was projected to handle a volume of 8 million TEUs. Previous planning phases (1 and 2) led to the development of two basins for the accommodation of bulk, container and Ro-Ro vessels (the latter transporting cars). Container handling has been contracted out to four major private sector operators. Phase 3 is being tendered as a build-operate-transfer project. This phase is designed to handle cellular container vessels. Berth width will be 920 metres and length 2,275 metres. Dredged depth will be 18.5 metres, sufficient to accommodate the largest container vessels currently afloat. Design capacity is for seven million TEUs per year.

Rail is connected to Container Terminals B and C at Laem Chabang Port, with services being operated to and from the Lard Krabang Inland Container Depot. The Single Rail Transfer Operator was established as a subsidiary of the Port Authority of Thailand to consolidate rail handling in a single railway terminal comprising two adjacent loading and unloading areas, located close to the port container berths. The Single Rail Transfer Operator terminals are being developed in two phases, the first of which is linked to Container Terminal B and was completed in October 2018. Completion of the second phase will allow rail capacity to increase from 800,000 TEUs to two million TEUs per year. In addition to Lard Krabang, rail services will extend to Map Thapud Port (Eastern Thailand), and in North and North-East Thailand.

The future Single Rail Transfer Operator capacity of two million TEUs per year is expected to comprise one million TEUs from Lard Krabang, 500,000 TEUs from Map Thapud Port and the balance of 500,000 TEUs from North and North-East Thailand. The State Railway of Thailand is working with the Port Authority of

Thailand to match Lard Krabang capacity expansion with the development of the Single Rail Transfer Operator. The State Railway of Thailand has an agreement with the Port Authority of Thailand to operate up to 22 trains a day between Lard Krabang and Laem Chabang. Initially, trains will comprise 32 container flat wagons, but train length will increase to 40 wagons when additional lifting equipment is added to the Single Rail Transfer Operator terminal. Each of the Single Real Transfer Operator development phases will provide six loading and unloading tracks and two roadways spanned by two rail mounted gantry cranes and four rubber-tyred gantry cranes. The first phase is now in operation.

The Government of the Lao People's Democratic Republic is expanding its dry port facilities at Savannakhet and developing new facilities at Thanaleng, south of Vientiane. The Thanaleng Container Yard is on the metre gauge railway line which crosses the river from Thailand. The alignment of the new standard gauge railway from China (now under construction) will pass nearby to the container yard, but the Government is considering to set up another dry port as part of a planned railway freight complex.

Viet Nam has also focused on dry port development. Under decision number 2223/QD-TTg of the Prime Minister, the Government intends to develop 13 inland container depots in the three main regions in the country. The depots are expected to have total annual capacity of six million TEUs in 2020 and 14 million TEUs in 2030. Lack of public funds and experience in dry port development has created strong incentives to facilitate public-private partnerships, which was made possible by a new regulation, decree number 15 of 10 April 2015. The regulation presents a single legal framework for public-private partnerships in Viet Nam, in line with international practice. It regulates the areas, conditions and procedures of public-private partnerships in the view of implementing such projects; the public investment and management mechanism of these projects; and public support and responsibilities in managing the partnerships. In addition, following decree number 163/ND-CP, foreign investors are allowed to set up logistics services companies. The establishment of new companies is subject to conditions on ownership and services. The services are divided into 16 areas, including among them, cargo handling, container warehousing and cargo agency.

C. Current issues in dry port development: overcoming the institutional barriers

One issue that could affect and seriously deter the continued development of Asia and the Pacific is institution-level failures in the areas of design, control and implementation of public policies that address infrastructure services. These are typically characterized by the lack of a common vision among those who make decisions on matters related to infrastructure, transport and logistics and by the absence of coordination and integration of policies and investments that target these sectors. In turn, these conditions create cost overruns and inefficiencies that hamper the region's economic and social development.

Voluminous literature documents a strong correlation between good institutions and economic performance, meaning that the introduction of new technologies or know-how, whether hardware or software, will only be as efficient as the institutional set-up in which they are operated or implemented allows them to be. This holds true across a broad spectrum of sectors, including transport and logistics. The idea that institutions matter for economic policy is not a novel one. The centrality of institutional determinants for economic performance has, however, steadily gained prominence in the economic policy debate. This is supported by, for example, several initiatives launched either by intergovernmental organizations or foundations focused on measuring the impact of institutional frameworks on growth or competitiveness. The "Doing business" series published annually by the World Bank is a prominent example in this respect. Recent debates over global financial crises have further renewed the role of institutional setting and legal standards as *"genetic"* features of well-performing markets.

The rising consensus about the inefficiency of many direct governmental interventions in the economy, as well as of many omissions, has led to the view that designing appropriate institutional frameworks and structural reforms should be at the core of policymaking. This could ostensibly be attributed to the established causal relationship between institutional frameworks and the dynamics of the economy.[106] The significant body of academic work that emphasizes the importance of institutions for driving growth provides, at the same time, little guidance on how to measure institutional strength on the ground.[107] This makes the institutional strength analysis a largely theoretical construct that requires translation into the real economy, and into the sector

[106] E. Brousseau and A. Nicita, "How to design institutional frameworks for markets", Revue d'économie industrielle (2010), pp. 129-130. Available at: https://journals.openedition.org/rei/4144.

[107] Ibid.

being analyzed. However, it is hard to find a proxy that would be able to accurately reflect the quality of the institutional environment in a specific sector, case in point being dry port development. Realistically, much depends on national objectives and on the national and local context, including overall governance; legal frameworks; relevant capacity; culture and social structures; and the economic situation.

Regarding the development of efficient intermodal transport at large, the complexity of modern supply chains, along with the multiplicity of actors with different interests, make the provision of effective, reliable and transparent institutional arrangements with the task of governing related issues across ministries, transport modes operators, logistics providers, and other stakeholders such as chambers of commerce, even more essential.

Against this backdrop, ESCAP has identified, through its technical and project work,[108] seven core elements that need to be present for a strong institutional basis on dry ports: (a) being Party to the Intergovernmental Agreement on Dry Ports; (b) developing a relevant national masterplan; (c) designating a lead decision-making entity; (d) establishing a multi-agency coordination mechanism at the policy level; (e) institutionalizing coordination across mode-specific authorities in defining infrastructure and/or investment plans; (f) defining a role and involvement of the private sector in the policy consultation process; and (g) providing a clear, stable and enforceable legal and regulatory framework on public-private partnerships that would enable or facilitate private-sector financing and investment in facilities.

Furthermore, facilities such as dry ports and their corresponding transport connections are systematically identified elements of the logistics policy in several countries. Accordingly, logistics development and dry ports development, from the policymaking perspective, can be considered inexorably linked, if not virtually indistinguishable. From that perspective, institutionally speaking, the purpose of a dry port should be ideally geared towards reducing transport costs and overall logistics costs and in that regard approaching dry port development as a business case could ensure that it becomes an attractive option offering added-value to the logistics industry.

One of the key issues for all the stakeholders within a country to agree on is not necessarily an all-encompassing definition of a dry port, but, instead, the type and level of services and functions these facilities should provide. This, in turn, would enable the identification of the institutions and jurisdictions that would apply to their development. In addition, the use of information and communications technology could be a helpful tool not only for efficiency gains, but also for managing environmental impacts and overall sustainability of the sector. Finally, good operational practices and operational standards for the private sector and ways for public policy to support the development of know-how and human resources development in dry port and logistics operations is an area that reportedly still warrants significant capacity development in several countries in the region.

On a more strategic level, national policy on dry ports should ideally be conceived in an integrated manner and not as the sum of sector development plans. Along the same lines, infrastructure planning should be designed to serve productive development to support existing and future productive centers. Regarding the institutional and organizational aspects, it is essential that there is clarity in the meaning of “strengthened institutions”. In the context of dry port development, this is understood to mean that forums should be created for dialogue and analysis, and that coordination and cohesion be achieved within the government and beyond. High-performing countries in the region tend to have a coordination mechanism in which all government ministries and institutions involved in the process are represented, but in which the private sector, namely the major generators and users of cargo, academia and non-governmental organizations, are also engaged in the process. A lead agency serving as the visible head under clearly defined jurisdictional relationships has shown to make a difference towards a achieving a common vision and the execution of related policies.

[108] See “Institutional determinants for dry port development in Cambodia, Lao People’s Democratic Republic, Thailand and Viet Nam” (ESCAP, Bangkok, August 2019). Available at: https://www.unescap.org/sites/default/files/Study%20Report_Institutional%20determinants%20for%20dry%20port%20development.pdf.

2.4. Takeaway from chapter 2

This review of the infrastructure and operational land transport connectivity in Asia sheds light on the extent of efforts and resource mobilization needed to address, in the first instance, the infrastructure needs in the region, with particular emphasis on integrating road, rail and dry ports. The subregions of North and Central Asia, South Asia and South-East Asia have the longest way to go to reach the regional average of the connectivity performance, with the largest leapfrog potential being found in the efficient development of dry ports as a vehicle for revitalizing railways as a prime option for freight and incentivizing an environmentally healthier freight transport system. This holds especially true for landlocked countries. At the same time, the operational connectivity assessment illuminates a number of other factors, such as congestion and border crossing delays, which are symptoms of bottlenecks and should not be treated exclusively as an infrastructure problem. Expansion of the infrastructure will not solve a problem that is regulatory in nature. An infrastructure bottleneck can be rectified, at least temporarily, if enough money and time is invested. As such, priority should be accorded to institutional, legal and regulatory interventions that can alleviate bottlenecks.

The intergovernmental agreements on the Asian Highway, trans-Asian railway networks and dry ports have marked a milestone in Asia-Pacific transport cooperation in support of regional economic growth and international trade. This regional institutional framework provides a backbone for regional transport collaboration, remains a flexible and adaptable tool for promoting international transport and guides discussions at high-level intergovernmental meetings on issues related to the technical, operational and institutional development of regional transport networks and regional transport connectivity in general. It also serves as a mechanism to help countries define their national transport policies with a broader regional perspective. Finally, the Agreements are meant to provide a comprehensive institutional framework that would increase the capacity of the networks to function as an integrated system and reduce the risks and negative externalities of disproportionate reliance on one transport mode (resilience). As such, accession to the Agreements by those countries that have not yet done so, and a coordinated approach to the designation of road and rail routes and dry ports would be a key enabler for achieving the objectives of sustainable connectivity in the region.

While initially focused on infrastructure aspects, the role and perspective for the development of the Asian Highways, the trans-Asian railways and dry ports have been transformed to incorporate a wider set of concerns and objectives. Notably, the evolving connectivity agenda and development objectives of Asia and the Pacific have repositioned the role of transport connectivity in supporting sustainable growth in the region. The sustainable development perspective focuses on improving the quality of the infrastructure, while expanding the very notion of quality infrastructure to encompass all aspects of sustainable performance. This includes environmental concerns, time and cost of transport operations and their safety. More than ever, it primes the discussion on the operational connectivity and intermodal connections, which are crucial to maximize the sustainability benefits from synergies and respective strengths of all modes of transport in order to realize an integrated intermodal transport and logistics system for Asia and the Pacific.

CHAPTER

3

CONNECTING GLOBALLY – SHIPPING AND AVIATION

Domestic and international aviation and shipping are key components of the Asia and the Pacific mobility system. They are economic sectors that directly offer many societal and economic benefits. The Asia-Pacific region represents 38% of the world air freight traffic measured in freight ton-kilometres (FTKs). More than 88% of the air freight traffic performed by carriers based in the region is international. Shipping accounts for 95% to 99% of trade by weight, albeit 70% to 75% in terms of value, because expensive goods, such as electronics, cell phones, semiconductors, and pharmaceuticals, are transported by air. From the broader environmental perspective, however, both sectors are also seen as challenging, because increasing demand within each of them is exerting increasing pressures on the environment and climate.

Competition and increased efficiency in maritime transport services, resulting in lower freight rates, contribute directly to a country's international competitiveness. Similarly, the development of air transport services is crucial for the sustainable development of trade and tourism. These sectors act as economic catalysts by opening up new market opportunities, moving products and services with speed and efficiency.

Historically, the shipping industry has proven to be a strong alternative to aviation, especially in terms of price compared to air. In recent years, however, decreasing oil prices have aided the profitability of passenger and freight airlines, but it is mostly the growth of express and e-commerce services that has gradually reduced the effects of this competition.[109] In this chapter, a closer look at shipping and aviation in Asia and the Pacific is taken, and sector-specific challenges in terms of connectivity and environmental performance are highlighted.

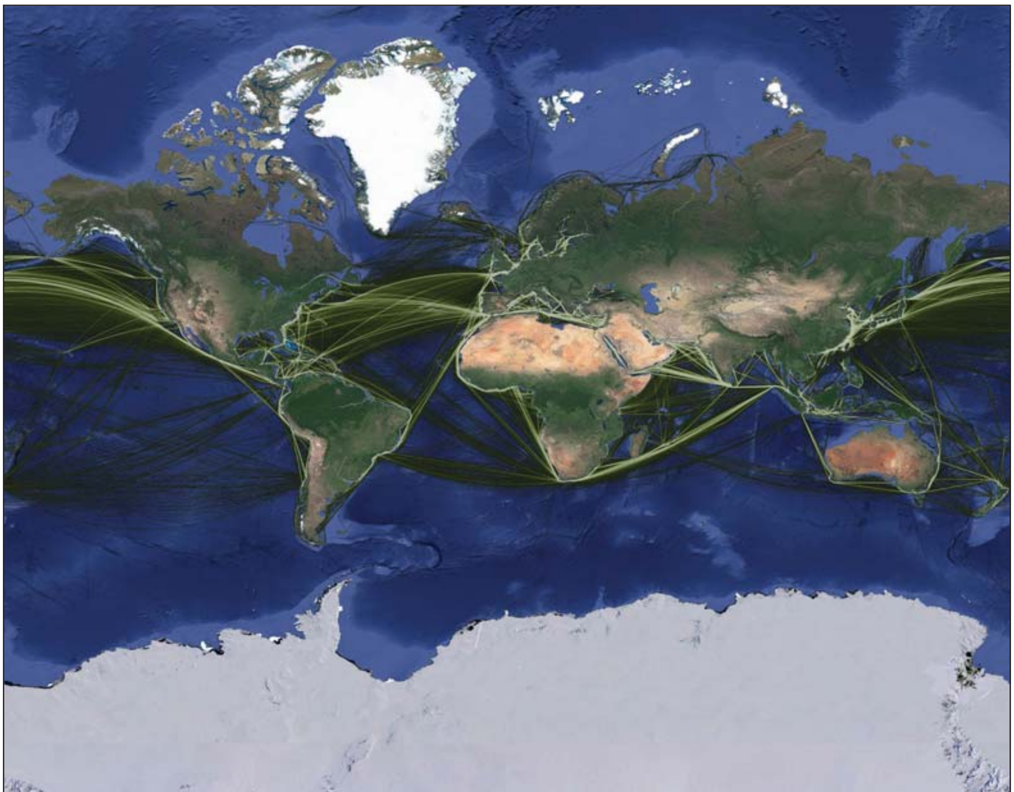
3.1. Maritime connectivity in Asia and the Pacific

In the Asia-Pacific region, the maritime transport axis is divided into Asia-America, Asia-Europe/Middle East and Asia-Oceanic routes,[110] while Intra-Asia is subdivided into subregions, such as East Asia, ASEAN, India sub-continent and the Pacific. These networks, which represent the underlying structure of the sea-going routes centred on hub ports and regional routes serving subregions and intra subregions, are connected together, similar to a net. In other words, the main trunk routes are a structure that collects cargo and transports it to Europe and America, while large vessels call at the gateway port of each country or regional hub port. Intraregional and feeder routes are used to build networks that connect secondary ports and small ports by using medium and small sized vessels.

The maritime transport connectivity in the Asia-Pacific region is ultimately dependent on the choice of the shipping lines, as it is determined by the carrier's port calling strategy and feeder network based on the geopolitical location of the port, the capacity of the port, and the volume of traffic. The choice of port of shipping lines is influenced by a number of factors, including, among them, port location, quality of service, unloading charges, terminal investment and operational strategies, and agreements between alliance member carriers, but ultimately, stable collection of cargo is essential.

Accordingly, as shown in figure 3.1, the maritime network connects the port to the port where cargoes are gathered; this naturally leads to more concentration of cargo on the major trunk routes and regional hub ports and gateway port of each country.

Figure 3.1. Density map of container ship movements in 2018



Source: UNCTAD. Provided to ESCAP and reproduced as intact.
Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

[109] Airbus' Global Market Forecast (GMF), "Global Networks, Global Citizens 2018-2037" (2018). Available at https://www.airbus.com/content/dam/corporate-topics/publications/media-day/GMF-2018-2037.pdf.
[110] As of September 2019, the weekly capacity is 148,700 TEUs transatlantic route, 479,200 TEUs transpacific route and 414,500 TEUs East-Europe respectively. source: https://alphaliner.axsmarine.com/PublicTop100/.

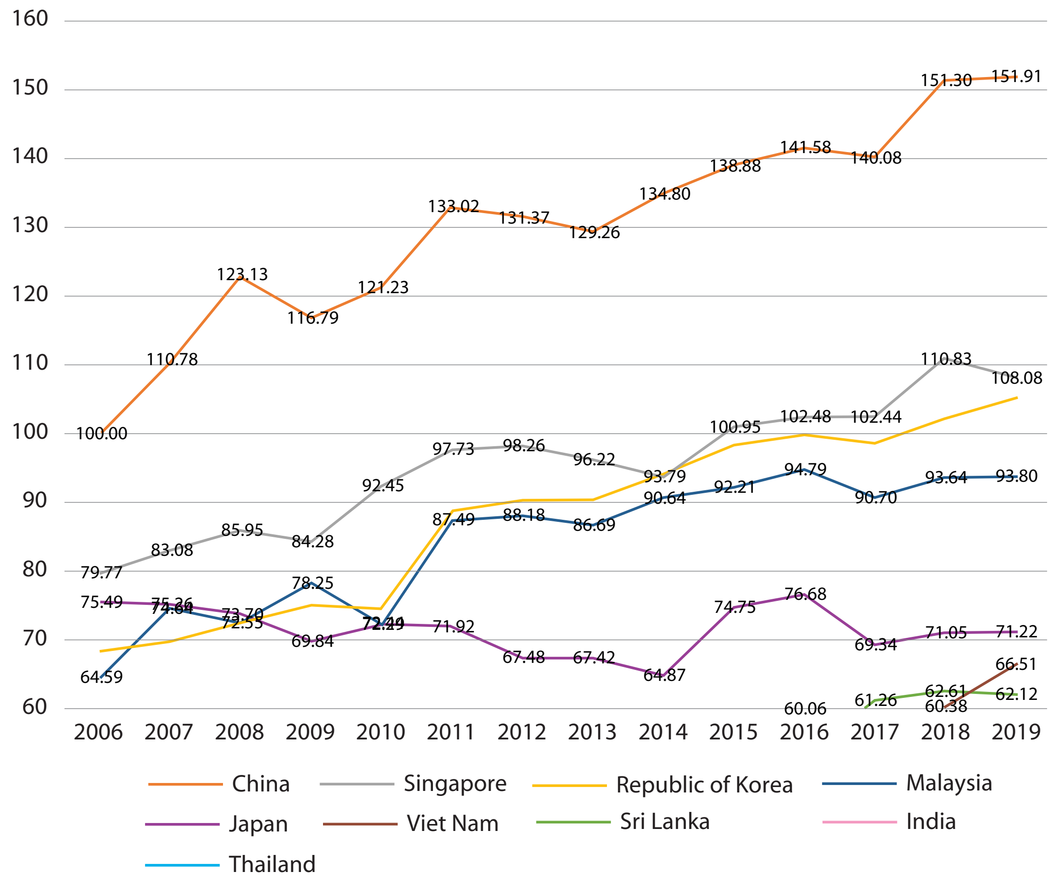
Consequently, countries with hub ports or regional gateway ports or shippers close to these ports can conveniently use competitive services provided by shipping companies at reasonable prices, while for regions or islands far from the main routes, the services are relatively unstable and users are forced to contract expensive services. In other words, as maritime networks are formed by services provided by private carriers, which are inevitably sensitive to cost and revenue, maritime connectivity becomes polarized. As a result, shipping companies and terminal operators want to scale up their businesses and service networks.

A. The current state of maritime connectivity in Asia and the Pacific

While the region enjoys a high degree of maritime connectivity overall, the small and remote islands of the archipelago and the small island developing States in the Pacific, which strongly rely on maritime transport, face the structural difficulties of paying high rates for inadequate services without accessing the advantages of the maritime transport available to the rest of the region. Most developing coastal countries encounter the following challenges: inadequate infrastructure; unstable services; inadequate development of integrated intermodal transport; risk of accidents associated with ageing vessel operations; lack of investment resources; and inconsistent policies. In addition, islands, especially the Pacific island countries far from the mainland often fail to provide reliable service because of the lack of commercial viability as many routes rely on subsidies.

The UNCTAD Liner Shipping Connectivity Index clearly shows the reality of the limited maritime connectivity and logistics performance. Figures 3.2 and 3.3 show a comparison of the Liner Shipping Connectivity Index among major coastal countries and among Pacific island countries. As indicated these figures, China is growing rapidly, which is well expected given the port traffic and number of ships that call at Chinese ports. In addition, the high index score of Singapore, the Republic of Korea and Malaysia is because these countries have transshipment ports that handle not only their own but also their neighbouring countries' cargoes.

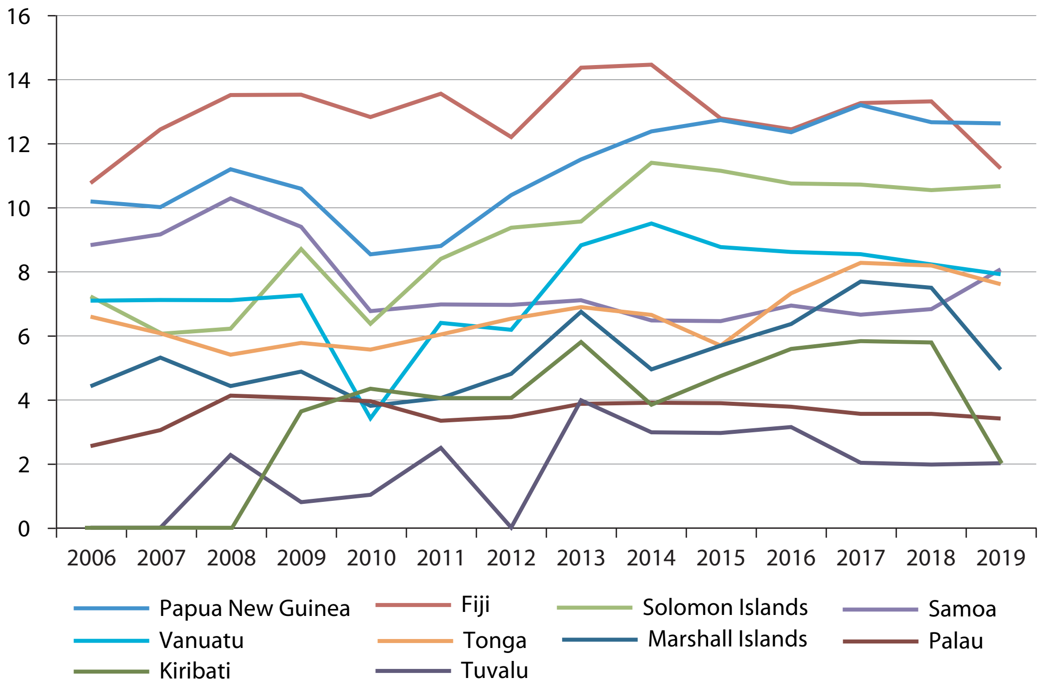
Figure 3.2. Comparison of Liner Shipping Connectivity Index scores among selected countries in Asia and the Pacific



Source: Liner Shipping Connectivity Index, UNCTAD, 2019.

The Pacific islands, on the other hand, are shown to have very low connectivity, well below the world median value, as the Index indicates the aggregated capacity of the liner shipping service to serve each country. The figures also indicate that their performance is irregular, while other countries are shown to experience steady growth. This means that liner services to Pacific island countries are not stable. On the positive side, in this regard, small island developing States have been trending slightly upwards since 2015.

Figure 3.3. Comparison of Liner Shipping Connectivity Index scores among selected Pacific Island countries



Source: Liner Shipping Connectivity Index, UNCTAD, 2019.

As compared to the Liner Shipping Connectivity Index, the Logistics Performance Index is a more comprehensive measure of logistics capacity rather than of physical connectivity, because it includes trade-related dimensions, such as customs procedures. The Logistics Performance Index is not a direct measure of maritime connectivity, but, nevertheless, the Index is meaningful because it measures the performance of supply chains, including shipping. Maritime connectivity is closely related to trade volume in general and the volume of goods carried by ships. This is because the more cargo handled, the higher the port call frequency and its transport capacity. Among the key components of the Logistics Performance Index, infrastructure and international shipments are closely related to the Liner Shipping Connectivity Index. This is because countries with high international shipments scores in the Logistics Performance Index generally show patterns that also present high scores in the Liner Shipping Connectivity Index.

Comparing the two indices, the country groupings with higher and lower ranking countries in both indices are similar. This means that for Pacific Island countries, improving maritime connectivity is not easy given their limited trade volume, population, industry structure and resources. Pacific countries, unlike other coastal countries, face challenges in providing commercially reliable transport services. Special measures are, therefore, needed, such as the subregional shipping commission or government support, as public obligations.[111] The subregional shipping commission system, introduced as a method for providing reliable transport services, has contributed to the improvement of the maritime transport service in the Pacific islands, so it is necessary to consider ways to use it efficiently.

In terms of port development, the growth of ports in the Asia-Pacific region has been in line with the economic development of most countries and cities, reflecting the recent rapid economic growth in the region. Because of various factors, such as international divisional production, global supply chains, production costs, and export-led growth policies of each country, Asia has grown to be called the world's factories, and the volume of Asian ports is being updated every year as shown in table 3.1.

[111] The shipping commission system is a quasi-cartel system that licenses certain shippers to service the region and is monitored by the participating parties.

Table 3.1. Asia container ports

Rank	Port	Volume 2018 (million TEUs)	Volume 2017 (million TEUs)	Volume 2016 (million TEUs)	Volume 2015 (million TEUs)	Volume 2014 (million TEUs)
1	Shanghai, China	42.01	40.23	37.13	36.54	35.29
2	Singapore	36.60	33.67	30.90	30.92	33.87
3	Shenzhen, China	27.74	25.21	23.97	24.20	24.03
4	Ningbo-Zhoushan, China	26.35	24.61	21.60	20.63	19.45
5	Guangzhou Harbor, China	21.87	20.37	18.85	17.22	16.16
6	Busan, Republic of Korea	21.66	20.49	19.85	19.45	18.65
7	Hong Kong, China	19.60	20.76	19.81	20.07	22.23
8	Qingdao, China	18.26	18.30	18.01	17.47	16.62
9	Tianjin, China	16.00	15.07	14.49	14.11	14.05
10	Jebel Ali, Dubai, United Arab Emirates	14.95	15.37	15.73	15.60	15.25

Source: World Shipping Council, "Top 50 world container ports". Available at www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports.

Asian economies in the development stage often adopt development strategies involving the import of raw and subsidiary materials to process and export. Accordingly, the high proportion of exports of goods produced is one of the reasons behind the increase in port traffic in the region. In this context, there is a surge in demand for port development, which is also related to the dynamics of Asian ports, and the demand for port construction in order to deal with the increasing cargo volume in most countries. Alternatives to dealing with increasing cargo volumes are mainly to strengthen the capacity of existing facilities and to build new ports, but usually they are applied simultaneously. The reinforcement of existing port facilities is mainly focused on enhancing productivity, including automation, informatization, improved work procedures, the introduction of new equipment and the training of employees.

Increasing the capacity of existing facilities still places limits on the handling of larger vessels and increasing cargo handling, so the demand for the construction of new terminals or ports is natural. In addition, some countries promote port development not only for their import and export freight but also in urban planning to enhance their urban functions and develop into hub ports by attracting transshipment cargo from neighbouring countries. In either case, however, it is clear that cargo demand should be the basis for port development. One of the recent changes in port development is the pursuit of harmonization between port functions and urban functions.

Another trend related to port development in recent years is that development proceeds under a long-term and comprehensive plan in terms of national logistics and infrastructure planning. Rather than developing the ports independently, the construction of logistics facilities such as roads, railroads, inland waterways, inland container depots, and cargo terminals, is being promoted simultaneously. In addition, by developing terminals sequentially in response to the increase in cargo demand, a method of preventing initial overinvestment and flexibly responding to cargo demand, which is referred to as trigger rule, is often used.

B. Current challenges for maritime transport and ways forward

While shipping is an important means of transport in foreign trade, in domestic freight transport, the proportion is relatively low compared to land transport. Maritime transport is characterized by relatively long transport time and long distances, but it has the advantage of transporting large amounts of cargo at a low cost. Because of these characteristics, maritime transport is totally dominant not only for the transport of raw materials such as oil, coal, iron ore and grain, but also for the transport of containers, which are unit cargoes. Accordingly, for archipelagic and Pacific island countries, sea transport accounts for 95 to 99% of foreign trade by weight, and most coastal countries handle 80 to 90% of foreign trade as sea transport.[112]

In most countries, domestic cargo transport depends heavily on roads, except for some island countries and countries with long coastlines where coastal shipping is more conducive.[113] This is because road transport is

[112] Shipping accounts for 95 to 99% by weight and 70 to 75% in terms of value, because expensive goods, such as electronics, cell phones, semiconductors, and pharmaceuticals, are transported by aircraft.
[113] Terms include short sea shipping and marine highways.

not only quick and convenient, but it is also suited to door-to-door transport. In addition, many countries have continued to set road-centric policies and invest in infrastructure to deal with the explosive growth in transport demand resulting from rapid economic development. Railroads and shipping have developed as supplementary modes, mainly for the transport of goods for long distances and bulk cargo. In addition, it is relatively easier to enter the road industry market, as the initial entry cost is lower than that of the shipping industry. For example in Japan, an island country, and in China, which has a long coastline, roads and sea transport are somewhat balanced; however most countries depend heavily on roads for cargo and passengers. In other countries, even in the islands of the Philippines and Indonesia, road transport accounts for 85 to 90% of domestic freight transport.

As sustainable development has become a global agenda, and countries and industries are required to establish strategies to cope with greenhouse gas emissions and climate change, shipping has recently emerged as the mode of transport most friendly to the environment. Transporting a metric ton of cargo for one kilometre by sea corresponds to about 5% of the cost incurred by road, and the amount of CO_2 emissions are about 17% of the emissions resulting from using roads.[114] In other words, many countries are aware that shipping can contribute to sustainable development in domestic cargo transport, but they are facing challenges in attracting active participation from the private sector, owing to road-oriented transport structures, lack of investment and lack of appropriate institutional set-ups. Some countries have introduced policies to facilitate coastal shipping through subsidies when converting land freight to sea transport, but their impact appears to be by-and-large inconsequential.

The transformation of road-oriented transport policies into more environmentally friendly policies incorporating and promoting shipping and railways requires long-term national planning, including consensus among stakeholders and various policy instruments, such as increased infrastructure investment, legal and institutional support systems, and the creation of an enabling business environment. There are, however, some common considerations for countries in the region when establishing maritime transport policies: global agendas, such as the Sustainable Development Goals, various conventions and agreements promulgated under the International Maritime Organization (IMO), a specialized United Nations agency, and technological developments and innovation in the private sector of the shipping and port industries.

Strengthening environmental performance

While maritime transport is considered the most environmentally friendly mode of transport, it still causes adverse effects to the environment. The maritime transport sector contributes up to 3% of total CO_2 emissions, 15% of the nitrogen oxide (NOx), and 5 to 8% of the sulphur oxides (SOx) and particulate matter, among others. It also pollutes oceans and seas by discharging ballast waters, wastes, accidental spills of oils and hazardous substances. To tackle this, the international community and countries have established and implemented various policies in connection with sustainable development. In the area of shipping and ports, efforts are focused on sustainable development and protection of the marine environment.

Various global regulations have been formulated and measures have been taken to regulate and protect the air and marine environment. The IMO Marine Environment Protection Committee adopted a strategy that envisages reducing total greenhouse gas emissions by at least 50% by 2050 based on emission levels of 2008. Consequently, more than 50,000 ships around the world are expected to stop using fossil fuels and switch to electric batteries, hydrogen regenerative fuels, liquefied natural gas and bioenergy. Under the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL), Annex VI, NOx and SOx and particulate matter, which are the most harmful of the various pollutants emitted from ships, are regulated. From 2020, air pollutants emitted from ships should be decreased at 0.5% from the current 3.5% through such measures as using low-sulfur fuel oil, installing scrubber and changing fuel to liquefied natural gas. To effectively manage ballast water, one of the major causes of marine ecosystem destruction, vessels are required to install special equipment on all ocean-going vessels from 2022 to 2024 under the Ballast Water Management Convention.[115]

Even with these regulations in place, the challenge of greening maritime transport remains formidable for Asia and the Pacific. IMO regulations raise growing concerns for shipping companies in the region because of installation costs, technical difficulties and performance issues, economic aspects (high low-sulfur oil prices

[114] Korea Shipping Association, "2012 International Symposium: The Future of Shipping Industry", (2012).
[115] A/RES/58/240.

and liquefied natural gas prices) and other factors. Furthermore, many public and private actors face serious constraints in their technical capacity to implement the global regulations.

Regarding the SOx regulations, which take effect in January 2020, all member States and shipping companies need to hurry to prepare for them. Regulations are generally a matter of time and cost for the implementer to respond to, and in most cases, a passive approach is taken to comply with minimum standards. However, while the regulations should be followed, they can create scope for the creation of new markets and lead a new way through technology development and innovation. It should be noted that some shipping companies have already strengthened their position in the market as leading responders in the shipping market.

Addressing the expanding market share of big players

One of the ongoing trends in the shipping and port sector is the growing share of large companies. In liner shipping, one of the leading sectors of economies of scale, shipping lines have increased their fleets and deployed larger ships to strengthen their competitiveness, as larger ships have lower transport costs per unit. Fleet enlargement is usually carried out through two approaches, one of which is to continue to order large vessels and the other is to increase the size of the company through mergers and acquisitions. Large shipping companies are currently using a mix of these two strategies; they have consistently ordered large ships from shipyards and strengthened their cooperation with other rival shipping lines to build a global service network. The infinite competition and market expansion strategy through the expansion of these shipping lines eventually led to the demise of the Hanjin Shipping of the Republic of Korea in 2016.

As of September 2019, the top ten container shipping companies had a market share of 83.9%, which is overwhelming compared to all other shipping companies. In particular, the share of the top four major shipping companies is 58.2%, resulting in a big gap between the top group and other medium- and small-sized shipping lines (table 3.2). This means that the market power of big shipping lines is getting stronger year-by-year.

Table 3.2. Market share of the top 10 container lines

Rank	Operator	TEUs	Share
1	APM-Maersk	4 195 447	18%
2	Mediterranean Shg Co	3 604 972	15.4%
3	COSCO Group	2 936 540	12.6%
4	CMA CGM Group	2 700 876	11.6%
5	Hapag-Lloyd	1 680 063	7.2%
6	ONE (Ocean Network Express)	1 576 642	6.8%
7	Evergreen Line	1 296 177	5.6%
8	Yang Ming Marin Transport Corp.	640 963	2.7%
9	Hyundai M.M.	408 285	1.7%
10	PIL (Pacific Int. Line)	386 892	1.7%

Source: Alphaliner top 100 (https://alphaliner.axsmarine.com/PublicTop100/).

Although the maritime market is not robust, shipbuilding orders are constantly being placed and the potential for mergers and acquisitions is often conveyed. Increasing market dominance of big shipping lines means that they are leading the industry in the service route, calling port, and freight rate decision-making, while small and medium carriers remain only as service providers in certain routes or subregions and partner in the feeder network. National anti-monopoly agencies have recently been more closely monitoring big shipping lines because of concerns about their dominant position in the market whenever there is an attempt by one of them to expand through a merger or acquisition.

In the container terminal industry, a few large companies dominate the market, similar to the shipping industry. Global terminal operators are also increasing their port investments in other countries and regions as well as in their own ports to build a global network. In the container terminal industry, the top-ranking companies have a large market share. This is because for port construction the yield return takes a long time, in addition to requiring a large amount of capital. Entering the liner market or container terminal industry requires a lot of capital and time, making it difficult for small- and medium-sized companies to enter the market. Because of the nature of the port industry, the government is often responsible for investment in infrastructure in most countries. In other words, the build-operate-transfer method is widely used to grant the operating rights to the private sector to recover the investment and then transfer it to the port authorities when the contract period is over. The construction and operation of a port can take many forms, depending on how it is owned and operated. The public-private partnership method is widely used to supplement government resources and drive private sector investment instead of government-led investment methods.

Accommodating specific regional challenges and issues

The rapid expansion of ports has resulted in new challenges and issues for countries in the region. Among them are the following:

- Lack of cooperation among central, provincial and regional governments for long-term development and developing a holistic strategy regarding the sustainable port development and improving port productivity;
- Lack of consistency and long-term government policy support for port development;
- Lack of government policy and law to support ecosystem conservation during port development;
- Need to upgrade safety standards;
- Lack of skilled or trained workers in the port industry;
- Inconsistent financial support;
- Lack of knowledge to deal with conflict between port automation and labour issues.

These challenges relate to infrastructure and operational connectivity. The infrastructure layer involves exploitation of basic structures for connectivity and nodes in the transport system. “This is where the intrinsic accessibility is valorized since a port site has little meaning unless capital investment is provided. The availability of adequate infrastructure in transport nodes (seaports and inland terminals) and on the links/corridors in the network is a prerequisite for the development of activities by transport operators and logistics players. Infrastructure should act as a strong enabler of port-related market dynamics that lead to efficient and sustainable co-modal freight transport services. Ports commonly face a range of freight mobility challenges at the infrastructural layer.”[116]

One of the key challenges at the infrastructure level is to secure investment. Even developed countries are struggling with finding funding needed for the development of ports and their hinterland. In many developing countries, the shortage of funds is coupled with the significant construction times, scarce incentives for the private sector to invest, public debt and dependence on external assistance. Another critical infrastructure issue in the region is the depth of ports and channels, as limited depth (draft) of channels prevent bigger ships from passing.[117] Other concerns include lack of efficient road and rail networks, limited maintenance of existing infrastructure, the geographical position to global shipping lanes and nautical accessibility, and lack of modern tools and use of information technology to optimize infrastructure use pertaining to traffic management.

The constraints at the operational level involve the operation of transport services at links and corridors between the port and other nodes within the multimodal transport system and the transshipment operations in the nodes of the system. Accordingly, problems arise from the institutional and human capacity factors, such as lack of clear transport policy goals and targets, lack of trained personnel to plan, implement, monitor and maintain transport projects, gaps in project management, safeguard monitoring, rehabilitation, maintenance planning, procurement and need for technology transfer both hardware and software. Finally, the diversity in governance models and management arrangements in port and supply chain business “poses a problem for the development of systematic responses to negative impacts. In order to deal with these impacts, higher level authorities need to be involved and appropriate incentive structures are required.”[118] For example, local effects, such as air contamination, affect local communities and not only the port area. Local authorities, therefore, must be in a strong position to discuss these topics with port authorities.

[116] O. Merk, and T. Notteboom, “Port hinterland connectivity”, International Transport Forum Discussion Papers, No. 2015/13 (Paris, OECD Publishing, 2015) p. 18.
[117] Ports constructed at river mouths and low waters have the problem of restricting the entry of large ships.
[118] Organization for Economic Cooperation and Development, International Transport Forum, “Port competition and hinterland connections”, OECD/ITF Round Table, No. 143 (Paris: OECD Publications, 2009).

Overall, major challenges in developing maritime transport and inland navigation in the Asia-Pacific region are to foster the development of appropriate and commercially viable models and enhance the business models of stakeholders involved and to meet the inflexible demand of time sensitivity in a just-in-time commercial environment.[119] With that in mind, it should be noted that the maritime transport business model, along with the use of inland waterways, may be, in many instances, the most suitable solution for the issue of freight mobility to satisfy the market place. One key decisive factor for efficiently adopting a maritime connectivity concept is making it an inexpensive seamless component of an integrated intermodal transport system so that it effectively facilitates cargo movements. This requires further changes and flexibility in current practices.

There are many reasons why the potential of maritime transport, including coastal shipping and inland waterways, cannot be fully exploited. Among them are the lack of long-term integrated transport plans and inadequate transport infrastructure and operations. Waterborne transport is not sufficiently connected to other land transport infrastructure; additional interconnection is required for first and last mileage transport. Despite the advantage of being able to transport bulk cargo at low cost, maritime transport is used mainly for long-haul transport of bulk cargoes because of the additional transport time and expense. To improve the efficiency of maritime transport, it is necessary to further strengthen the Ro-Ro network for rapid unloading and transport to the hinterland.

It follows that waterborne transport, including coastal shipping and inland waterways development, should advance beyond the discussion stage. The next step requires applied research and application work to develop coastal shipping and inland waterways and shipping services to Pacific island countries in a commercially viable manner. As an environmentally friendly means of transport, efforts should be made to improve the potential of maritime transport to mitigate the economic and social burden resulting from a road dominated transport system. As most ESCAP member countries are highly dependent on road transport for domestic traffic, a holistic and multisectoral approach is needed to develop waterborne transport.

A mid- and long-term national plan for developing maritime transport, including coastal shipping and inland waterways should be established and reflected in the integrated transport plan for the entire country. In doing so, it is critical that relevant departments, including the transport and budget departments, work together so that the reforms and operations can be supported. As noted above, maritime transport in particular, along with coastal shipping and inland waterways, should have higher policy priority because they can lead to a reduction in road congestion and accidents, mitigate air pollution and contribute towards achieving sustainable development. The concept of sustainable transport development in maritime and port sector necessitates the simultaneous pursuit of economic prosperity, environmental quality and social responsibility. In the shipping and ports industries, with broadened port functions as an economic catalyst for revenue and employment and a central position for industries related to international trade, economic stability (highlighted by the economic crisis in 2008) and corporate responsibility issues may shed new light on port operations.

As the countries under consideration share the same sea area and river basins, a regional cooperation programme is needed to prevent marine and fluvial accidents and to reduce pollution. Digitization is also required to accelerate and correct the work process, reduce logistics costs and improve service quality. With the world entering the age of hyperconnectivity, relying on paperwork and complex procedures is not only a deterrent to competitiveness, but it is also a constraint to development. Finally, it is equally important to continue to strengthen training and education to enhance expertise in cooperation with international organizations and donor countries, as the competence of waterborne transport stakeholders, including government officials and professionals, is essential for the development of the sector.

3.2. Air freight connectivity in Asia and the Pacific

The International Civil Aviation Organization has defined air connectivity as an indicator of a network's concentration and its ability to move passengers and goods from their origin to their destination seamlessly.[120] Assessing the level and impact of air freight connectivity has significant limitations; chief among them is that most air connectivity indices focus either exclusively or primarily on passenger traffic and services. The Logistics Performance Index of the World Bank contains survey data on the perception of logistics professionals on air transport infrastructure, and also air services. It does not deal specifically with cargo, even though the core expertise of survey respondents is typically in that area, so it could be assumed that their responses may

[119] G.A. Lombardo, "Short sea shipping: practices: opportunities and challenges". Available at www.insourceaudit.com/WhitePapers/Short_Sea_Shipping.asp.
[120] International Civil Aviation Organization (2013), Worldwide Air Transport Conference "Enhancement of air transport connectivity and facilitation", working paper (ATConf/6-WP/20).

relate more to cargo performance than to passenger traffic.[121] The World Economic Forum conducts a survey of global executives in a wide range of areas, including infrastructure. This indicator can again provide some information on the state of air transport infrastructure in a country, but it does not go into any detail about cargo performance.[122] Academic and practitioner thinking converge on the finding that air freight connectivity generates benefits through enabling foreign direct investment, business clusters, specialization and other spillover impacts on the economy's productivity, as well as that there is a strong association between stronger air connections to more countries and total trade value. The four most commonly used air connectivity metrics are infrastructure, direct air connections, indirect air connections and hub connectivity.

Direct air connectivity reflects the direct services available from a given country, city, or airport. It can be measured by the number of destinations served. Routes can be weighted by the relative importance of the destination, as well as by the frequency or capacity.[123] Indirect air connectivity incorporates the destinations that can only be reached with one or more stops. Connections can be weighted in terms of quality, with key factors being connecting time at the transit airport and the degree of diversion involved, compared with a hypothetical direct flight.[124] Hub connectivity is relevant for cities or airports that function as hubs and reflects the number of flight combinations that can be connected into credible itineraries, taking into account minimum and maximum connecting times. As with indirect connectivity, connections can be weighted in terms of quality, based on the diversion factor and connection times involved.[125] Invariably, these elements are critically influenced by any given policy environment and in particular, by the degree of liberalization of air services markets.

The International Air Transport Association (IATA) has developed an index of air service connectivity, which aims to measure the quality of the air transport network. The Index considers the number and size (in terms of passenger air traffic) of destinations served and the frequency of service to each destination and the number of onward connections available from these destinations. The World Bank published an air connectivity index in 2011 covering 211 countries and territories for the year 2007, which captured the full range of interactions among all network nodes, even when there is no direct flight connection between them.[126] Although this index does not seem to be broadly used at present, it does offer significant methodological insights on measuring air connectivity. Finally, the International Transport Forum published a report in 2018, in which a number of network connectivity metrics were developed to assess the aviation sector at a national, regional, and airport level.[127]

Air service agreements between States appear to be critical elements of air connectivity performance. Formulated to allow for the movement of passengers and goods between countries, these agreements have historically been bilateral and determine the number of airlines that may compete in any given market, the routes that airlines may operate, capacity (in terms of frequency, and often the number of seats offered) that airlines may provide, and airfares.[128] According to ICAO, the number of bilateral air service agreements exceeds 5,000 worldwide. In recent years, however, several countries have moved in the direction of either partially or fully liberalizing their air service agreements with other countries and concluding “open skies” agreements, which allow any airline of the countries party to these agreements to fly between any points in those countries. Many studies from around the world have found that air service liberalization led to increased competition in markets, providing greater choice and lower fares. As a result, connectivity increased, which, in turn, created further opportunities for air traffic volumes to increase. Despite these open access models, restrictions remain. Most notably, when it comes to ownership and control of airlines, most air service agreements allow governments to reject the designation of any airline that is not owned and controlled by the designating party.[129]

The Association of Southeast Asian Nations (ASEAN) has implemented a multilateral air service agreement that has benefited its members and served as a good practice example for States in other regions of the world. The ASEAN Single Aviation Market has been the mechanism through which policy changes have been instituted among the member countries, with full liberalization of air freight services in the region having taken effect on 1 January 2009.

[121] B. Shepherd, A. Shingal and A. Raj, “Value of air cargo: air transport and global value chains”, IATA (2016).
[122] Ibid.
[123] Caribbean Development Bank, “Air transport competitiveness and connectivity” (2018).
[124] Ibid.
[125] Ibid.
[126] J-F. Arvis, and B. Shepherd, “The air connectivity index: measuring integration in the global air transport network” Policy research working paper 5722, (Washington, D.C., World Bank, 2011).
[127] J. Egeland, “Defining, measuring and improving air connectivity”, OECD/ITF (2018). Available at: https://www.itf-oecd.org/sites/default/files/docs/defining-measuring-improving-air-connectivity.pdf.
[128] PwC, “Connectivity and growth: Directions of travel for airport investments” (2014).
[129] Ibid.

A. The current state of air freight transport in Asia and the Pacific

The carriage of goods by air operates broadly under two models: dedicated freighters and passenger aircraft lower holds, also referred to as “passenger belly capacity”. Freighters are particularly well suited for transporting high-value goods because they provide highly controlled transport, direct routing, reliability, and unique capacity considerations (volume, weight, hazardous materials, and dimensions).[130] These distinct advantages allow freighter operators to offer a higher value of service and currently generate more than 90% of the total air cargo industry revenue. Freighters comprise only 8% of the total commercial jet fleet, but they carry more than 50% of all air cargo traffic.[131]

Following the introduction of a new generation of widebody passenger airplanes with larger lower-hold capacity, more airlines are combining cargo transport with passenger operations to capitalize on additional revenue opportunities. Belly cargo space offers unique value on non-cargo routes by feeding dedicated freighter networks and providing new business opportunities for integrators.[132] However, while lower-hold capacity in widebody airplanes serving long-haul routes has increased by approximately 6% in the past five years, several parameters can limit the cargo operations in passenger aircraft. The reduced height of the lower deck can limit volumes. Different security standards and regulations may restrict commodities that can be shipped in passenger airplane lower holds. From a network standpoint, freighter routes are highly concentrated on relatively few trade lanes, especially in the world’s two largest trade routes, East Asia-North America and East Asia-Europe.[133] In contrast, passenger networks are much broader and often include destinations where cargo demand is minimal.

The long term forecast of ICAO projects that global freight traffic is expected to grow by 3.9% annually to 2035. The Asia and Pacific region is expected to grow by approximately 4.3% annually. Accordingly, some estimates suggest that the world freighter fleet is estimated to increase by more than 70% namely from the current 1,870 to 3,260 airplanes.[134]

Based on data collected by the industry, China represents the largest air cargo market in the East Asia-North America market; its market share rose from 14.1% in 1997 to 36.7% in 2007 and reached 50% in 2017. This led to a decline in the market share of Japan, from 30.9% in 1997 to 20.1% in 2007 and 14.1% in 2017.[135] The Republic of Korea holds the third-largest share, 7%, as of 2017.[136] Total air tonnage on the transpacific route is determined by the combined economic activities of North American and East Asian countries, international trade patterns and the different types of trade commodities. In principle, it is the economic growth in the importing region that primarily determines directionality of tonnage flow, but flow is also influenced by exchange rates, which affect the cost of imported goods in national currencies.[137]

The intra-East Asia and Oceania air cargo market continues to generate one of the largest global trade flows, accounting for approximately 16.5% of the world’s air cargo traffic in tonnage and about 8.4% in ton-kilometres. Intraregional air cargo traffic receives support from the manufacturing sector, in which critical parts and subassemblies move through the supply chain to various industrial locations across Asia before completion and export outside the continent. As a result of expansion in this sector, intraregional traffic now accounts for close to 50% of the total intra-East Asia and Oceania trade volume.

The Russian Federation and Central Asia market accounts for approximately 1.4% of the world’s total air cargo traffic in ton-kilometres and 2.4% in tonnage. Air trade originating in or destined to the Russian Federation and Central Asia was estimated at 1.3 million tons in 2017, based on the region’s airport statistics. Growth averaged 2.7% from 2007 to 2017, based on tonnage handled at airports.[138] Domestic air trade also plays a critical role this subregion, particularly in the Russian Federation. In 2017, airports reported that Russian domestic air cargo comprised more than 579,000 tons. The country’s vast distances often necessitate air transport to move goods and industrial materials, especially to remote areas in the Arctic, Siberia, and the Russian Far East. In addition to Moscow, leading air freight cities include Khabarovsk, Vladivostok, Novosibirsk,

[130] Boeing, “World Air Cargo Forecast, 2018-2037”. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.
[131] Ibid.
[132] Ibid.
[133] Ibid.
[134] Boeing, “World air cargo forecast, 2018-2037”. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.
[135] Ibid.
[136] Ibid.
[137] Ibid.
[138] Boeing, “World air cargo forecast, 2018-2037”. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.

Ekaterinburg, and St. Petersburg. Domestic air cargo traffic in China accounts for an estimated 8.9% of the world's total air cargo traffic by tonnage but only about 2.6% of the world market in ton-kilometres. At 4.6 million tons transported annually, the country's domestic air cargo market is second only to that of the United States. Scheduled freight accounts for 94.1% of its domestic air cargo traffic. Mail accounts for the remaining 5.9%.

B. Emerging trends, challenges and opportunities for air freight in Asia and the Pacific

Despite the high cost of air transport, the growing demand for temperature-sensitive products such as pharmaceuticals, perishables, chemicals and valuables, and the rising demand for just-in-time production of goods has boosted demand for air freight services. The rapidly expanding e-commerce sector has also put pressure on sales channels for faster delivery and an optimized supply chain. This is providing opportunities for the third-party logistics and warehousing services to integrate with the air e-commerce channel. Owing to the continued growth in online shopping, many third-party logistics (3PLs) are offering more multimodal services, which include air cargo service as a critical mode of transport.[139] In this context, digital processes are becoming increasingly attractive options for strengthening the value proposition of air freight services. The Air Waybill is an important air cargo document and its conversion to an electronic Air Waybill (e-AWB) is the first step towards digitization. Meanwhile, 34% of airports are reportedly planning blockchain research and development programmes by 2021.[140]

In addition, as autonomous vehicles are becoming increasingly popular, they are penetrating the logistics sector. For example, self-driving vehicles have made inroads in logistics, reaching a level of maturity for commercial use in warehouse operations, such as vision-guided autonomous forklifts. McKinsey Global Institute estimates that the transport-and-warehousing industry has the third-highest automation potential of any sector.[141] These developments are already prominent in the e-commerce industry and integrated with air transport services as they involve highly automatable tasks such as sorting and packing. Furthermore, the development of air cargo hubs is a critical factor that will further propel the growth prospects within the air cargo market over the next few years. With rising demand for air cargo services, many vendors have been compelled to develop dedicated cargo hubs which are capable of handling the largest freighter types, have robust flight navigation systems, outstanding infrastructure, dedicated cargo, and ground handling capabilities and lower landing, cargo handling, and warehousing costs.[142]

Perhaps the most pressing challenge and emerging priority for the air transport sector is its environmental performance. Between 2000 and 2016, aviation emissions increased by 47%. Already in 1999 the Intergovernmental Panel on Climate Change indicated that climate impacts of aviation emissions were especially problematic because of chemical interactions at high altitudes.[143] In fact, the radiative forcing impacts of aviation emissions are thought to be two to four times that of direct CO_2 emissions.[144] Per capita emissions from air travel is one of the highest in comparison to various other modes of transport.

While domestic aviation emissions are already covered by the Paris Agreement in national pledges, international flights, which account for approximately 65% of the aviation industry's CO_2 emissions, are covered by ICAO, which forecasts that improvements in aircraft fuel efficiency of 1-2% per year would not be enough to offset the expected air traffic growth. This means that CO_2 emissions could grow by between 2.4 and 3.6 times by 2050, depending on efficiency improvements. New technologies, such as supersonic and urban mobility aircrafts, risk increasing emissions even further. Significantly, these estimates do not account for the impacts of aircraft emissions other than CO_2, such as nitrogen oxides (NOx) and soot. These factors are believed to more than double the environmental impact of aviation. ICAO further predicts that biofuels will make up only 3% of the total aviation fuel being used by 2020.

Against this background, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was agreed by governments at the thirty-ninth Assembly of the International Civil Aviation Organization in 2016. It was concluded with a view towards achieving a carbon neutral aviation growth from 2020. Under this

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139 Mordor Intelligence LLP, "Air Freight Industry: growth, trends and forecast (2019-2024)", (2019).
140 SITA, Air Transport IT Insights, 2018.
141 M. Chui, J. Manyika, and M. Miremadi, "Where machines could replace humans—and where they can't (yet)", *McKinsey Quarterly*, July (2016). Available at https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet.
142 See https://www.technavio.com/research/air-cargo-market-analysis accessed on 31 October 2019.
143 Intergovernmental Panel on Climate Change, Special Report "Aviation and the global atmosphere", UNEP – WMO (1999). Available at https://archive.ipcc.ch/pdf/special-reports/spm/av-en.pdf.
144 Ibid.

scheme, 66 States (representing 86% of the aviation industry) have committed to cap carbon emissions at 2020 levels. From 2021, the scheme will be rolled out in phases in order to take into account the special circumstances and respective capabilities of States:

- From 2021 until 2026, only flights between States that volunteer to participate in the pilot and/or first phase will be subject to offsetting requirements.
- From 2027, all international flights will be subject to offsetting requirements, except flights to and from least developed countries, small island developing States, landlocked developing countries and States which represent less than 0.5% of international Revenue-Ton-Kilometres, unless they volunteer to participate.
- Since 1 January 2019, all operators have to report emissions for all international flights, including flights to/from exempted States.

Operators will be entitled to claim emissions reductions from the use of alternative fuels, provided the fuels in question meet defined sustainability criteria and are certified by an approved certification scheme. In order to be eligible for the Carbon Offsetting and Reduction Scheme for International Aviation, an alternative fuel must deliver at least 10% in greenhouse gas savings and must not be made from biomass obtained from land with high carbon stock.[145] Otherwise, airlines will have to buy emissions reduction offsets from other sectors to compensate for any increase in their own emissions. All airlines that operate routes between two volunteering states will be subject to the offsetting requirements. This is irrespective of whether the airline operator is itself based in a non-participating State.

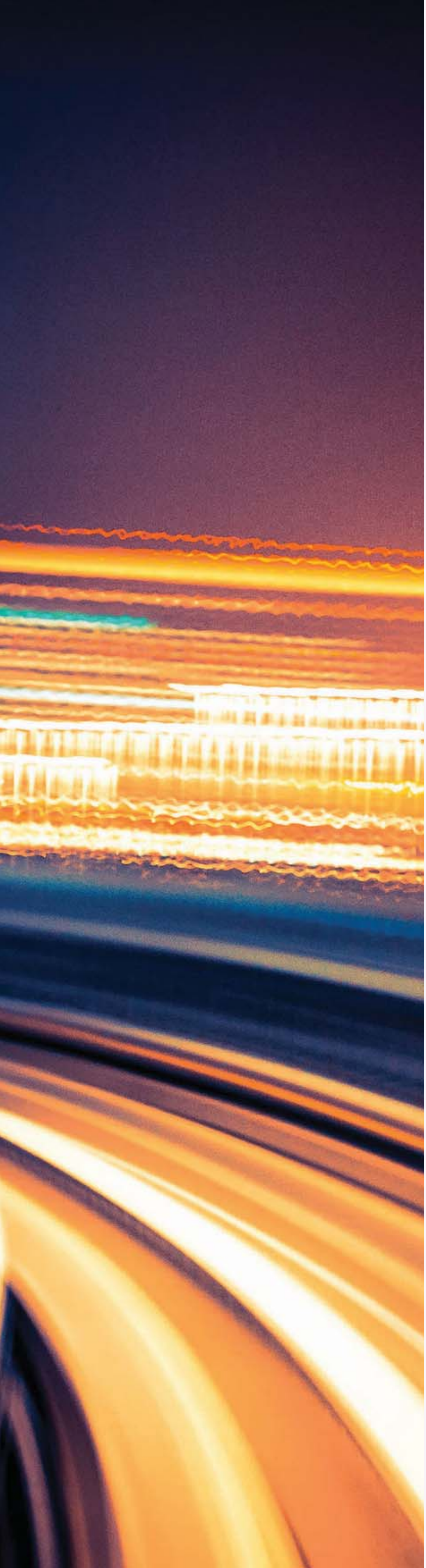
[145] International Air Transport Association, "Carbon offsetting for international aviation" (2019). Available at: https://www.iata.org/policy/environment/Documents/paper-offsetting-for-aviation.pdf.

3.3. Takeaway from chapter 3

While the region enjoys a high degree of maritime connectivity overall, the small and remote islands of the archipelago and the Pacific islands, which strongly rely on maritime transport, face the structural difficulties of paying high rates for inadequate services without accessing the advantages of maritime transport enjoyed by the rest of the region. Most developing coastal countries face challenges, such as inadequate infrastructure, unstable services, inadequate development of integrated intermodal transport, the risk of accidents associated with ageing vessel operations, lack of investment resources, and inconsistent policies. In addition, islands and especially the Pacific island countries far from the mainland often fail to provide reliable service because of a lack of commercial viability as many routes rely on subsidies. Similarly, the Pacific aviation market is characterized by small and widely dispersed populations spread across many islands. The provision of air services is consequently fragmented, often involving long routes with thin traffic and freight levels. As a result, airlines face considerable constraints in profitably managing returns through a viable passenger and cargo mix, and in achieving sufficiently high levels of aircraft utilization and revenue load factors.

The Asia-Pacific region represents 38% of the world air freight traffic measured in freight ton-kilometers (FTKs). More than 88% of the air freight traffic performed by carriers based in Asia and the Pacific is international. In 2018, Chinese carriers represented 29% of the total freight traffic of the region. Importantly, in the last two decades, the evolution of Internet technology has led to the explosive growth of e-commerce most of which is carried by air. This is rapidly and radically changing the logistics industry, bringing in integrated and automated logistics and air-transport services. Despite its high cost and small share of world trade, aviation represents a critical connectivity link because it enables countries, regardless of their geographical location, to connect to distant markets and global supply chains in a speedy and reliable manner. As nodes, airports also complement other modes and provide connectivity both locally and across oceans reliably and in a relatively short-time span.

As sustainable development has become a global agenda, shipping has recently emerged as the mode of transport considered most friendly to the environment. Nonetheless, its impact on the environment is not negligible. International shipping emissions grew by 33% between 2000 and 2016 and reached 656 million tons of CO_2 in 2016. Coastal shipping offers a viable alternative to road transport in many cases, however it is not yet prominent enough to offset the preference for road transport and policies to incentivize coastal shipping are lacking in the region. While the demand for air freight is limited by cost, which is typically four to five times that of road transport and 12 to 16 times that of sea transport, international aviation emissions increased by 47% from 2000 to 2016 and reached 523 million tons of CO_2 in 2016. Together, international aviation and shipping produce more transport CO_2 emissions per year than any country in the world except for the United States. The recently adopted Carbon Offsetting and Reduction Scheme for International Aviation is set to cap aviation emissions, but at 2020 levels. Against this background, more needs to be done to improve the carbon footprint of these transport modes not only in terms of fuel efficiency and alternative fuel use, but also in terms of operations and infrastructure.



CHAPTER 4

DRIVERS OF TRANSITION TO SUSTAINABLE FREIGHT TRANSPORT

Connectivity is inextricably linked to sustainable transport in that it encompasses dimensions of uninterrupted and seamless access, it contributes to increased supply chain efficiency and it boosts resilience. Accordingly, one cannot perceive sustainable freight transport in the absence of sustainable connectivity. However, in discussing the transition to sustainable freight transport, further considerations come into play that are different in nature to those pertaining to passenger transport, urban mobility and rural access to transport services, for example. While environmentally friendly mobility and public transport may be gaining ground with affordable vehicle technologies and policies supporting shared mobility, walking, cycling and smart public transport, freight transport continues to be oil dependent. As trade volumes are expected to continue to rise, so will the exposure of freight rates and transport costs to oil price volatility and surges in prices, which, in turn, will increase the vulnerability of developing economies that are already facing disproportionately high transport costs.[146] This has further spillover effects not only for the economy and the environment, but also for broader social development objectives.

When looking at freight transport, the pivotal role of industry and business, in terms of operational practices, business models, modal choices and so on, should not be overlooked.

[146] United Nations Conference on Trade and Development, Multi-year Expert Meeting on Transport, Trade Logistics and Trade Facilitation, “Sustainable freight transport systems: opportunities for developing countries”, note by the secretariat (D/B/C.I/MEM.7/11) (2015).

While several of these choices are directly influenced by the prevailing policy and regulatory environment, the availability of resources and technology and the overall connectivity conditions play a very important role. It would be remiss not to consider that the private sector, the generator and user of cargo, as well as the logistics and freight forwarding sectors also have a role to play in the sustainability of freight transport. On the other end of the debate is the argument that public policy also should provide at least relative incentives and policies conducive to a change in the prevailing business cultures, which are, by and large, not sustainable within the meaning of the Sustainable Development Goals.

Against this background, the present chapter begins with an overview of what is sustainable freight transport and the approaches and considerations beyond transport connectivity that affect its attainment. The chapter then contains a discussion on how technology and innovation can contribute to sustainable freight transport, taking into account disruptive effects. On that basis, the role and considerations of the private sector, and the factors that influence modal choice, and the conditions that could potentially induce a shift in favour of what are broadly considered more sustainable modes of transport is touched upon. Finally, the enabling role of governments and multilateral development actors is discussed, and selected examples are presented.

4.1. Select considerations on sustainable freight transport

The sustainability of transport is most commonly considered to be determined by socioeconomic, demographic and environmental megatrends. In this context, views coincide with the idea that sustainable transport should be safe, of high-quality and accessible to all. In addition, sustainable transport should be ecologically sound, economically viable, and a positive contributor to local, national and international sustainable development.[147] In a large portion of the bibliography reviewed for this report, the fundamental understanding of sustainable transport is derived from the definition given by the Organization for Economic Cooperation and Development (OECD) in 1999, notably as transport that does not endanger public health or ecosystems and meets the needs for access consistent with (a) use of renewable resources at below their rates of regeneration, and (b) use of non-renewable resources at below the rates of development of renewable substitutes.[148] It can generally be contended that sustainable transport has dominantly focused on reducing greenhouse gas emissions, which includes CO_2, SO_2, NOx, PM, Carbon Monoxide (CO), and Hydrocarbons (HC). Further to this, most studies on sustainable freight transport concentrate on the reduction of CO_2 emissions, as this is the dominant type of greenhouse gas and has the greatest environmental effects. In sum, often the term “sustainable transport” is equated or used interchangeably with the term “green transport”, on account of the dominant focus on mitigating the environmental impact of transport.

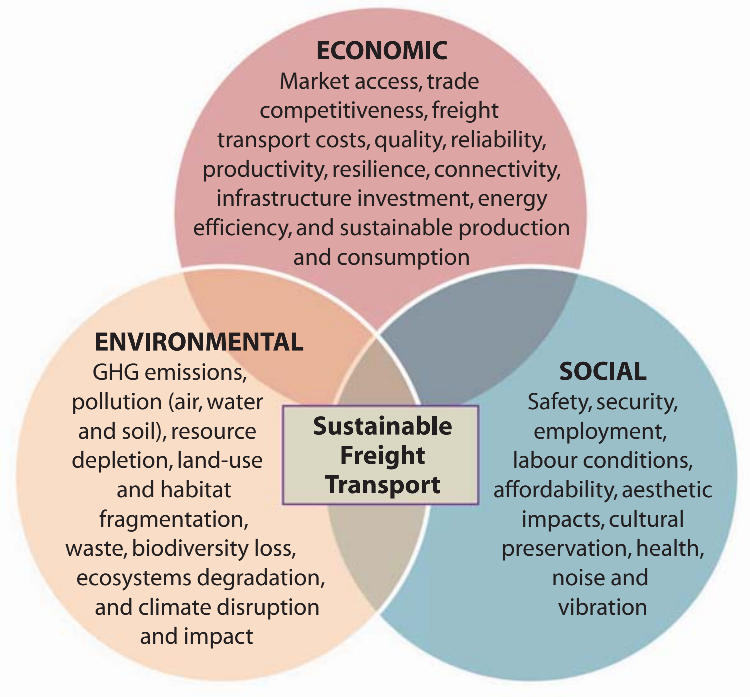
The United Nations Conference on Trade and Development (UNCTAD) has, quite extensively, looked into the various definitions for sustainable freight transport and has pertinently recalled that while they may vary and promote one particular dimension such as the environment (green transport), society (inclusive transport) or the economic dimension (efficient and competitive transport), sustainable freight transport should equally consider the economic, social and environmental dimensions of the sector in an integrated manner to ensure synergies, complementarities and coherence.[149] Aligned with this approach, ESCAP activities are intended to support the development of freight transport systems that are safe, socially inclusive, accessible, reliable, affordable, fuel-efficient, environmentally friendly, low-carbon, and resilient to shocks and disruptions, including those caused by climate change and natural disasters. Figure 4.1 illustrates the intersection between the economic, social and environmental dimensions of sustainable development as applicable to freight transport, the so-called triple bottom line.

[147] High-level Advisory Group on Sustainable Development, “Mobilizing sustainable transport for development: analysis and policy recommendations from the United Nations Secretary-General’s High-Level Advisory Group on Sustainable Transport, United Nations (2013). Available at https://sustainabledevelopment.un.org/content/documents/2375Mobilizing%20Sustainable%20Transport.pdf.

[148] C. Jeon, A. Amekudzi, and J. Vanegas, “Transportation system Sustainability Issues in High-, Middle-, and Low-Income Economies: case Studies from Georgia (US), South Korea, Colombia, and Ghana.”, *Journal of Urban Planning and Development*, vol. 132, No. 3, (2006) p. 173.

[149] United Nations Conference on Trade and Development, Multi-year Expert Meeting on Transport, Trade Logistics and Trade Facilitation, “Sustainable freight transport systems: opportunities for developing countries”, note by the secretariat (D/B/C.I/MEM.7/11) (2015).

Figure 4.1. Sustainable freight transport and the triple bottom line



Source: United Nations Conference on Trade and Development, UNCTAD Framework for Sustainable Freight Transport (2017). Available at https://www.sft-framework.org/.

Attainment of sustainable freight transport systems represents a significant challenge with multiple technical, operational, and policy aspects: the design, testing, and implementation of interventions require multidisciplinary, multi-country research. Promising interventions are not limited to introducing new transport technologies, but also include changes in framework conditions for transport, in terms of production and logistics processes.[150] Several constraints have evolved in recent years, despite the advancement in the applications of technology and efficient solutions to the freight transport sector. Lack of adequate infrastructure, high cost of freight transport, road congestion, traffic accidents and CO_2 emissions are some of the problems still militating against global sustainable freight transport, notably in landlocked developing countries where, by some estimates, transport costs are as much as 45% higher than in coastal States.[151] Moreover, increasing security concerns are largely believed to be boosting costs and increasing delays.

According to estimates by the International Transport Forum,[152] freight trucks are the fastest growing source of global oil demand, accounting for 40% of the oil demand growth by 2050 and 15% of the increase in global CO_2 emissions. The International Transport Forum further expects that freight trucks will even surpass passenger cars as the major oil consumer sector.[153] In Asia and the Pacific, more than 460 million tons of oil equivalent (Mtoe) of energy are consumed annually by the transport sector.[154] Road transport is responsible for most of the 1,451 million tons of CO_2 produced yearly. Regarding social externalities, approximately 813,000 road traffic fatalities occurred in the Asia-Pacific region in 2016, representing an 11% increase as compared to 2013.[155] While road traffic fatalities are attributable to an array of factors, high road safety risks are also associated with road freight transport, in particular the transport of dangerous goods such as chemicals and other flammable materials, protruding truck loads and ageing commercial fleets especially in developing countries.

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150 L. Tavasszy and M. Piecyk "Sustainable freight transport" *Sustainability*, vol 10, No. 10. pp. 1-4 (2018).

151 United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, "The development economics of landlockedness: understanding the development costs of being landlocked", (2013). Available at http://www.lldc2conference.org/custom-content/uploads/2014/04/Dev-Costs-of-landlockedness11.pdf.

152 International Transport Forum, "Towards road freight decarbonisation: trends, measures and policies", ITF Policy Papers, (OECD Publishing, Paris, 2018).

153 Ibid.

154 Economic and Social Commission for Asia and the Pacific, Report of the Working Group on the Asian Highway on its 8th meeting, Bangkok, 18-20 September 2019 (ESCAP/AHWG/2019/2).

155 Ibid.

Photo credit: Salvador Aznar / Shutterstock
shutterstock_704948617

Truck overloading is frequently practiced in situations in which there is a low frequency of truck trips, but where each truck trip could result in a high profit, such as at poorly managed land border crossings that do not efficiently process transit cargo. Truck overloading results in damage to vehicles and roads, and significantly increases the risk to the personal and public safety of freight movements. Furthermore, overloading is managed differently in different jurisdictions, leading to uneven management. Overloading is a difficult challenge to overcome without solving other traffic, inspection and border-crossing related issues. An opportunity to resolve overloading comes from developing consistent regional standards for roads, axle weights of trucks and the total dimensions of trucks among other technical standards that would lead to predictable enforcement across international borders.[156] Interestingly, the International Transport Forum has estimated quite conclusively that relaxing truck regulations by raising the limits for weight and size would result in quick direct emission cuts.[157]

ESCAP research and capacity building work has documented the existing differences in the standards on weights and dimensions and on emissions of pollutants by freight road vehicles and their impact on sustainable transport connectivity due to the needs to purchase additional fleet, increasing the number of trips, frequent rescheduling of operations, waiting times at the borders and other factors. While identifying the scope for possible harmonization of standards, this work has also demonstrated that to achieve a tangible impact of harmonization, a whole set of complimentary measures needs to be considered, including mutual recognition of the technical inspection certificates, a regional system of weighbridges and measuring stations with the certificates recognized by participating countries and many other policy and institutional measures.

Photo credit: Roman Korotkov / Shutterstock
shutterstock_631853333

Very long delays occur frequently at land borders, with trucks waiting for days or even weeks for their shipments to be cleared. Not only does this slow trade – in fact, it requires traders to have much more inventory on hand in order to ensure supply at the destination; it requires more trucks to be used in the transport system because they are stuck on the road at borders, and it requires truck freight services to charge higher fees because they cannot take as many trips while stopped at borders. If there is any disruption at all in the slow normal operation of land border crossings because of trade disputes, criminal activity, mechanical failures or other reasons, these problems only become exacerbated.[158] From a sustainable development perspective, lower productivity at border crossings reduces the potential for truck drivers or owners to make profits towards new, energy efficient or cleaner trucks or to properly maintain their trucks, leading to higher fuel consumption and air pollution from individual vehicles.[159]

[156] S. Nuruzzaman, "Improving transport connectivity, international trade and trade facilitation for LLDCs in Euro-Asia Region, draft report prepared by a consultant for the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, as a background document to support the Euro-Asia regional review meeting on the implementation of the Vienna Programme of Action for the Landlocked Developing Countries for the Decade 2014-2024. Available at https://www.unescap.org/sites/default/files/LLDCs_VPoA_%20EuroAsiaTransportConnectivityTradeFacilitation_5February2019.pdf.
[157] International Transport Forum, "Towards road freight decarbonisation: trends, measures and policies", ITF Policy Papers, (Paris, OECD Publishing, 2018).
[158] Ibid.
[159] Ibid.

Accordingly, there is significant scope for improving the sustainability of freight transport in the ESCAP region, provided that the adjustment is accompanied by the requisite connectivity leaps. Railways and inland navigation more specifically can play an important role in freight operations in some countries in the region. Both modes could be expanded to support the increasing demand for mobility at national, regional and interregional levels. Inland navigation can be a game changer for landlocked developing countries in the ESCAP region as several countries have considerable waterways. Apart from carrying passengers and providing livelihood opportunities to people living along these waterways, they are vitally important in transporting consumer and capital goods, in particular bulk items to hinterlands and remote areas. Several constraints and challenges have adversely affected the development and growth of inland navigation, including, among them, reduction of water level at low periods and gradual siltation of their major rivers and canals.[160] Inland waterways are generally owned and managed by public sector entities, while private operators carry out most of the transport activities. Constraints related to mobilizing sufficient financial resources to dredge the waterways and ensure proper operation, management and regulation have hampered the development of these waterways.[161]

Moreover, technological improvements in inland navigation and railways, if fostered and financed, are likely to significantly enhance economic performance and, thus, competitiveness. At the same time, while technology and innovation continuously enhance the sustainable performance of the road transport sector, current and projected demand for road freight transport underscore the need to consider and implement decarbonization strategies, many of which have been broadly discussed in the literature, such as reducing the demand for road freight; optimizing vehicle use and loading; increasing the efficiency of freight vehicles; reducing the carbon content of fuel used to transport freight; and shifting freight to low carbon-intensity modes.

Against this background, ESCAP is implementing a new project to promote a shift towards sustainable freight transport in the region. The project will recommend suitable national transport policies to promote more sustainable transport in selected ESCAP member States, considering, among others, the existing modal split of freight transport operations between air, maritime, rail, inland waterways and road transport.

4.2. Technology and innovation

Faced with the rising requirements for capacity and the overall performance of transport systems, greater consideration is given to new transport solutions or radically different technologies, which could profoundly transform the transport sector. Indeed, the transport sector today is being revolutionized by advances in technology, and the transformation of modern transport networks could change the way people and goods are moved from origins to destinations. Accordingly, container carriers, port authorities, customs agencies, logistics and freight service providers, among others, are gradually incorporating smart transport technologies to optimize their operations and to enable real time information and data sharing on freight movements.

Smart transport and intelligent transport systems

Smart transport systems are integrated applications that combine state-of-the-art technologies and innovative strategies applicable to different modes of transport. Smart transport incorporates intelligent transport systems tools, which have been used for more than a decade for addressing traffic issues in the region. Intelligent transport systems have been actively adopted by leading countries of the region and have proven their potential as a key enabler of cleaner, safer and more efficient transport systems. Although an array of definitions can be found across the relevant bibliography, ESCAP has recently put forward that *Intelligent transport systems are an agglomeration of diverse technologies that enhance the sustainability of transport systems in a safer, smarter and greener way.*[162] This definition was devised to take account of the varying levels of development of intelligent transport systems in the region, and the fact that they are not just hardware systems but rather overall systems encompassing technologies, policies, plans and regulations to make transport systems more sustainable.

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[160] S. Nuruzzaman, "Improving transport connectivity, international trade and trade facilitation for LLDCs in Euro-Asia Region, draft report prepared by a consultant for the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, as a background document to support the Euro-Asia regional review meeting on the implementation of the Vienna Programme of Action for the Landlocked Developing Countries for the Decade 2014-2024. Available at https://www.unescap.org/sites/default/files/LLDCs_VPoA_%20EuroAsiaTransportConnectivityTradeFacilitation_5February2019.pdf.

[161] Ibid.

[162] Economic and Social Commission for Asia and the Pacific, *Guidelines for the Regulatory Frameworks of Intelligent Transport Systems In Asia And The Pacific* (Bangkok, ESCAP, 2019).

There is a separate term specifically referring to intelligent transport system technologies when applied to freight transport, namely “commercial vehicle operations”. Commercial vehicle operations broadly refer to the operations and activities associated with moving goods and passengers by commercial vehicles. Related activities are electronic registration; permitting programmes; electronic exchange of data; electronic screening; and roadside operations.[163] Commercial vehicle operations are usually subdivided in ten common components: fleet administration; freight administration; electronic clearance; commercial vehicle administrative processes; Weigh-In-Motion; on-board safety monitoring; hazardous material planning and incident response; freight in-transit monitoring; and freight terminal management.[164] In the Asia-Pacific region, various related applications are emerging. Among them are the following:

Maritime transport applications

Through the deployment of smart transport applications such as automatic identification systems, shipping vessels can transmit information on their location to other ships and maritime authorities automatically. While these applications are intended primarily for vessel safety and traffic monitoring, the data generated from these systems can be used by freight service providers and logistics operators to monitor their fleet and track cargoes as they move from origin to destination

Photo credit: metamorworks / istockphoto
Photo no. iStock-1054579036 1

Road transport applications

A weigh-in-motion system is an application that improves efficiency of traditional weight stations by installing sensors along highways and at strategic locations along the transport network. Freight vehicles can be directed to move along the sensors where they are weighed while on the go, with information then being relayed to a monitoring system. Trucks carrying loads beyond the permissible limits can then be diverted to dedicated weigh stations for further inspection, thus eliminating the need to weigh every vehicle at a dedicated weighing station. This application minimizes delays and traffic jams caused by freight vehicle queues. The use of satellite navigation systems for monitoring the transport of dangerous goods has been in existence for several years. Recent advances in this technology has made it possible for vehicle location and monitoring applications to provide real-time information on the vehicle location together with information on the freight being transported which can then be transmitted to end users and other intermediaries in the transport process. These systems enable users to track their cargoes and estimate the arrival times, improving overall efficiency.

Port operations applications

Enhancing port capacity through digitalization is an increasingly used strategy, initially deployed to optimize operations and reduce costs, and gradually evolving to a stage where new services and business models are created. In this sense, digitalization combines the technological advances with the improvement of the processes to collect and distribute data and information to manage port operations. In many ways, the transition to digital or smart ports and to a smart transport and logistics systems becomes more a necessity rather than an option for Asia and the Pacific. For example, container terminals have started to rely on automated vehicles to improve the overall efficiency of terminal operations. Starting in 2015, Port Botany in Sydney, Australia, has automated some of its operations; it has automated straddle carriers that can load and unload the shipping containers into stacks and onto trucks, without any human involvement.[165]

[163] Florida Department of Transportation, “Commercial vehicle operations”. Available at https://www.fdot.gov/traffic/traf-incident/cvo.shtm.
[164] Economic and Social Commission for Asia and the Pacific, *Guidelines for the Regulatory Frameworks of Intelligent Transport Systems In Asia And The Pacific* (Bangkok, ESCAP, 2019).
[165] Transport for New South Wales, “Connected and Automated Vehicles Plan”. Available at https://future.transport.nsw.gov.au/plans/connected-and-automated-vehicles-plan.

Freight logistics applications (domestic and international)

Trucks carrying dangerous goods can be fitted with satellite positioning devices and other sensors which can collect data on the goods being transported and the location of the freight vehicle. These data are then relayed to a central monitoring system through a cellular network, where such cargoes are tracked. This information is of relevance to logistics operators, highway authorities, traffic management centres and emergency response management. Logistics companies are increasingly deploying smart transport applications that enable real time tracking of their fleet through the use of global satellite navigation systems to monitor cargoes and to update customers on the status and location of their cargoes.

Connected vehicles and autonomous vehicles

Within smart transport and intelligent transport systems, connected vehicles and autonomous vehicles hold a prominent position. Connected vehicles use wireless or telecommunications technology to link to transport infrastructure and other components of the transport network, such as other vehicles, motorcycles and pedestrians. Such technologies enable real-time communications between components of the transport network, and can, therefore, be used to improve traffic safety and emergency response services. They can also be used to analyze real-time traffic flow data across highways and consequently help smooth traffic flow. Autonomous vehicles can be defined as vehicles that incorporate varying degrees of automation and consequently require different levels of human involvement for operation. In principle, fully autonomous vehicles require no human intervention and their operation is to be fully automated through a combination of on-board sensors, computer programs, maps, satellite positioning systems and related technologies.

In line with this evolving technology, pilot runs are being carried out to deploy autonomous truck platooning. Truck platooning[166] involves linking multiple trucks in a convoy using connected vehicle technology. Once connected, the trucks maintain a predefined distance between each other for as long as they are connected. The truck in the front takes the lead with the connected trucks reacting automatically to changes in the movement of the lead truck, with minimal to no intervention from the drivers following the lead truck. Truck platooning reduces CO_2 emissions as trucks travelling in platoons consume less fuel as a result of reduced drag. Platooning also improves safety as connected vehicles respond instantaneously to any changes in speed by the lead vehicle.

Autonomous truck platooning system in Singapore

With the vehicle population in Singapore approaching one million, the initiative seeks to address the increasing travel demand and land constraints; 12% of the country's total land is used for road and land transport infrastructure. Additionally, Singapore is faced with a shortage of drivers. This situation has led the authorities to consider new vehicle concepts that will increase productivity, road safety, optimize road capacity and enable new mobility concepts. Singapore has tested autonomous cars, taxis, utility vehicles and buses, and is now adding trials of truck platooning concepts. Truck platoons have already shown the potential to achieve major fuel savings and contribute to increased road safety. Truck platooning involves a human-driven lead truck leading a convoy of driverless trucks.

The Ministry of Transport and the Port of Singapore Authority have partnered up with two automotive companies to design, develop and test an autonomous truck platooning system for use to transport containers from one port terminal to another. Truck platooning can also alleviate the shortage in manpower and allow more freight movements to be carried out at night to ease traffic congestion. The truck platooning trials have been taking place in two phases over a three-year period, from January 2017 to December 2019.

Source: Summarized from "Autonomous trucks on public roads in Singapore". Available at: https://www.scania.com/global/en/home/experience-scania/features/autonomous-truck-platoon-in-singapore.html

[166] See https://www.acea.be/uploads/publications/Platooning_roadmap.pdf.

The implications, however, of introducing autonomous vehicles should not be overlooked. Related discussions focus on the short- and medium-term safety risks linked to the parallel circulation of autonomous vehicles and traditional vehicles, as human error will continue to play a role until the global fleet has been completely replaced. Some of the topics of these discussions are the conditions under which these vehicles can share the road with traditional vehicles; insurance and liability considerations; the issues that may arise with regard to driver training and licensing; and corresponding traffic code revisions and special legislative and regulatory measures that may need to be introduced.

While information and communications technology will play a key role in the future development of the transport sector, transport policymakers and regulators also need to focus on new security risks and to the limitations of the technology's impact on the overall sustainability performance. Regarding security risks, connected vehicles are vulnerable to hacking and theft. The deployment of wireless technologies for connected vehicles requires the harmonization of standards across service providers, vehicle manufacturers and other stakeholders. Realistically, it should also be considered that technological innovation may not bring the expected sustainability gains. For instance, although various transport modelling studies use different methodologies, they seem to converge in suggesting that a future transport system that relies heavily on autonomous vehicles will most likely increase the number of overall vehicle-kilometres travelled, even if the vehicles are shared.[167]

As highlighted in recent research on the governance of "smart mobility", the overall performance of the transport sector is persistently suboptimal on measures of sustainability, despite constant technological progress, which shows that there is no guarantee that smart mobility will be conducive to sustainable development. Many different potential smart mobility systems may be implemented for any given package of technological innovations. Moreover, the driving role of the technology sector in marketing sensors, vehicles and software for smart mobility products maintains strongly vested interests in favour of more mobility, not less, in order to maximize returns on investments.[168] Taking this into account, policies that successfully leverage technology and innovation for attaining sustainable freight transport systems are contingent upon having a clear and unequivocal understanding of what these technologies are and how they work. Second, but equally important is that policy and regulation ought to be at pace with technological development.

Unmanned aerial vehicles (drones)

Photo credit: akiyoko / istockphoto
Photo no. iStock-959775700 1

Another element from which there are critical applications for transport is the use of unmanned aerial vehicles (drones). Business Insider's research service (BI Intelligence), defines drones as "aerial vehicles that can fly autonomously or be piloted by a remote individual". Based on this definition, BI Intelligence estimated that sales of drones are likely to exceed $12 billion in 2021. That is an increase by a compound annual growth rate of 7.6% from $8.5 billion in 2016.[169] Projections in a report published by Gartner in 2016[170] indicate that there will be ten times more commercial drones than manned aircraft by 2020, or approximately 230,480 commercially operated drones around the world in 2020. Furthermore, in the study it is estimated that the labour cost per drone flight in 2017 was already less than $300. PriceWaterhouseCoopers estimated, in 2017,[171] that the total global addressable market for drone technology for infrastructure maintenance in the road and railway sectors, is approximately $4 billion.

[167] T. Van Vuren, "Uncertain futures but consistent modelling messages", 3 January 2019. Available at https://www.linkedin.com/pulse/uncertain-futures-consistent-modelling-messages-tom-van-vuren-1c?trk=portfolio_article-card_title.
[168] I. Docherty, G. Marsden and J. Anable, "The governance of smart mobility", *Transportation Research Part A: Policy and Practice*, vol. 115 (2018), pp. 114-125.
[169] A. Meola, "Drone market shows positive outlook with strong industry growth and trends", *Business Insider*, 12 July 2017. Available at https://www.businessinsider.com/drone-industry-analysis-market-trends-growth-forecasts-2017-7.
[170] Gartner, "Gartner says almost 3 million personal and commercial drones will be shipped in 2017. 9 February 2017. Available at https://www.gartner.com/en/newsroom/press-releases/2017-02-09-gartner-says-almost-3-million-personal-and-commercial-drones-will-be-shipped-in-2017.
[171] PriceWaterhouseCoopers (PwC), *"Clarity from Above: Transport Infrastructure, the commercial applications of drone technology in the road and rail sectors"* (2017). Available at: https://eu-smartcities.eu/sites/default/files/2017-09/SUM_the-futures-of-mobility-how-cities-can-benefit%20%282%29.pdf.

The first applications of drones in infrastructure maintenance were for high-voltage electricity pylons, wind turbines, telecommunication masts and bridges – structures in which frequent and precise monitoring is essential to ensure safety and correct operation. Drones equipped with high-resolution cameras and scanners can collect precise data for infrastructure inspections, and advances in image processing can offer precision that is unattainable by the human eye. This is very important when access to infrastructure is difficult or dangerous.

Drones can be equipped with other sensors to provide road and railroad operators with easy access to detailed data that today are very costly, if not impossible, to collect.[172] However, having the ability to increase inspections of multiple assets starts to present a different problem. The more frequently a structure is inspected, the more data are captured. This data ultimately need to be analyzed, which may lead to an increase in the demand for specialists to review the data and, consequently, to a gradual transformation of the traditional transport workforce, with corresponding implications for the sector in terms of training and recruitment.

Drone-powered innovation is a significant development from several points of view. Using them is becoming increasingly commonplace in several countries. However, even though the cost of using drones is significantly lower than that of conventional methods, challenges remain to be addressed, such as aviation risks, flight management, training and expertise, privacy and cybersecurity concerns, all of which warrant further consideration and research. ESCAP is in the early stages of research on the applications of drones in transport in collaboration with research institutions and industry to better understand the regulatory and technical implications of this technology.

The Internet of Things, Artificial Intelligence and Blockchain

Many countries in the region are trying to shift their traditional technologies in transport systems towards more automated ones, and are actively adopting advanced techniques, such as artificial intelligence, the Internet of Things and big data analytics to catch up with their development gap pertaining to sustainable transport systems. Internet of Things represents a concept in which network devices can collect and sense data, and then share the data across the Internet, where that data can be utilized and processed for various purposes. The term goes beyond devices traditionally connected to the Internet, such as laptops and smartphones, by including all kinds of objects and sensors that permeate the public space, the workplace and homes, and that gather data and exchange the data with one another and with humans. According to Cisco, there will be 50 billion connected devices by 2020.The Internet of Things is closely related to big data analytics and cloud computing. It collects data and takes action based on specific rules, in contrast to cloud computing, which offers the capacity for the data to be stored, and big data analytics, which empowers data processing and decision-making. In combination, these technologies can empower intelligent systems and autonomous machines.[173]

An important trend that warrants attention is the emergence of blockchain, a shared digital ledger encompassing a list of connected blocks stored on a decentralized distributed network that is secured through cryptography. Each block contains encrypted information and hashed pointers to a previous block, making it difficult to retroactively alter without modifying the entire chain and the replicas within the peer network. New blocks are validated by peers on the network, providing credibility and preventing malicious activity and policy violations. Cryptography and membership functions provide easy data sharing between parties without privacy breach and tampering of records. All confirmed transactions are timestamped to provide full record provenance. The ability to more effectively track goods across the supply chain is one of the most appealing benefits of blockchain.

Several applications can benefit from the combination of the Internet of Things and Blockchain from a transport perspective. In terms of telematics, it enables manufacturers to add more sensors to help service centres securely capture and store engine diagnostics data and other vehicle performance information. This information can be used with machine-learning algorithms to determine when a vehicle requires maintenance. The role of blockchain in this example is to provide decentralized data storage, eliminate a single point of failure, provide a tamper-proof record and enable smart devices to autonomously communicate with one another. Similarly, the combination of the Internet of Things and Blockchain can be used to ensure safe delivery of perishable food products by controlling the temperature throughout the transport process. It also can be used to automate order fulfillment, invoicing and settlements using smart contracts. Each of these capabilities makes blockchain an ideal component of an Internet of Things solution.

[172] Ibid.

[173] Economic and Social Commission for Asia and the Pacific, "Frontier technologies for sustainable development in Asia and the Pacific, ESCAP (2017). Available at: https://www.unescap.org/sites/default/files/publications/Frontier%20tech%20for%20SDG.pdf.

Examples of blockchain applications

Toyota announced in May 2017 that it is exploring blockchain and distributed ledger technology for use in the development of a new mobility ecosystem that could accelerate development of autonomous driving technology. It is working in at least three areas of the new mobility ecosystem: driving/testing data sharing, car/ride share transactions and usage-based insurance.

Maersk, in collaboration with IBM, has recently completed a test of managing the company's cargos using blockchain.

Another pilot project began in 2016 in which Walmart was collaborating with IBM and Tsinghua University to use blockchain as a means of ensuring supply chain integrity. To give one example of their initial results, they found that tracing the origin of mangoes took just 2.2 seconds with the blockchain method – compared to 18 hours and 26 minutes using more traditional tracing methods.

Source: compiled by the ESCAP secretariat from various public sources.

Blockchain is widely publicized as being a disruptive innovation that has the potential to redefine finance, economics and even the macroscopic societal systems. It has recently attracted intensive attention from governments, financial institutions, high-tech enterprises and capital markets. Morgan Stanley, in a report, wrote that blockchain could potentially join autonomous trucks, drones, and the "uberization" of freight as a key disruptive technology that brings operating and cost efficiency to supply chains. It explained that blockchain offers numerous potential uses, in particular in areas related to security, automation, and supply-chain visibility, and that at a basic level, the secure, transparent and automated nature of blockchain technology can allow for smooth, speedy and secure execution of contracts across the supply chain, thereby eliminating physical documentation and manual involvement by automating contract execution and delivery from initiation through payment through smart contracts.[174]

Disruptive trends on the transport labour market

The transport sector has traditionally been a labour-intensive and employment generating sector. However, the outlook for transport development and the increasing rate of adoption and deployment of new technology and automation, may imply a disruptive trend and social costs associated with reduced employment opportunities or increasing demand for skilled employees. This may create new opportunities for highly specialized workers to support the planning and implementation of intelligent transport systems in the region. In a widely noted study published in 2013, the probability of computerization for 702 occupations was examined. The findings of the study indicate that most occupations in transport and logistics can be automated to some extent in the future, including taxi, freight and public transport drivers (figure 4.2).

Technological transformations in other sectors have shown that new roles tend to require higher skills and education, especially in science, technology, engineering and mathematics, and positions are generally higher paid.[175] The requirement of higher skills can create difficulties for retraining displaced employees for new roles.

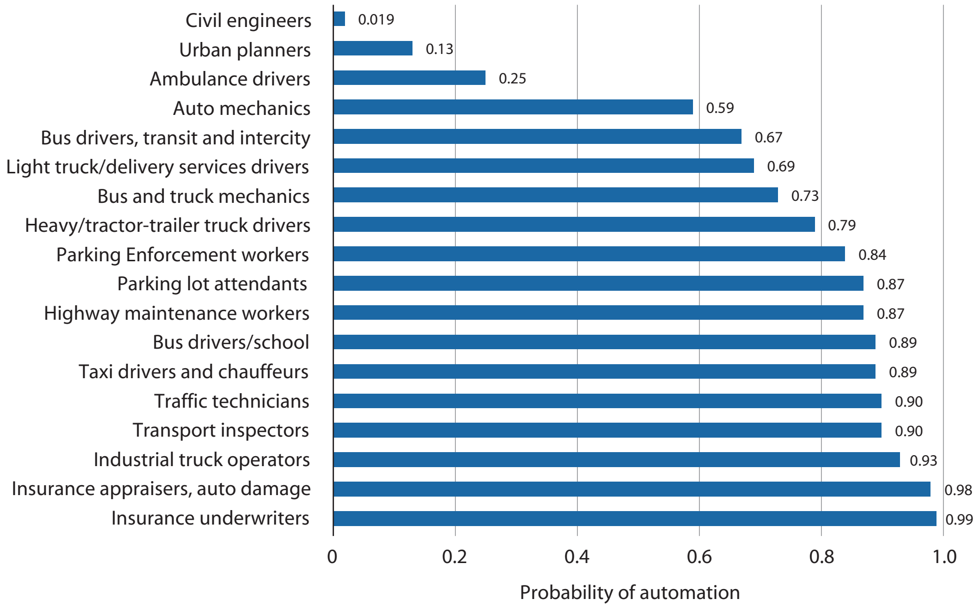
The World Maritime University noted in a recent report that the introduction of highly automated ships would lead to a decrease in the global demand for seafarers by 2040 vis-à-vis the baseline projection based on current technology. Furthermore, estimates for countries participating in the survey of the Programme for the International Assessment of Adult Competencies of the Organization for Economic Cooperation and Development (OECD) showed that 5.7% to 50% of low-skilled workers, such as dockers and baggage handlers, are exposed to high risks of automation. This is because their jobs will not exist in their current form by 2040, as more than 70% of their tasks are automatable.[176]

[174] Morgan Stanley, "Blockchain in freight transportation: early days yet but worth the hype" (2017).

[175] S. Hajkowicz and others, *Tomorrow's Digitally Enabled Workforce: Megatrends and Scenarios for Jobs and Employment in Australia Over the Next Twenty Years* (Brisbane, Australia, CSIRO, 2016). Available at www.acs.org.au/content/dam/acs/acs-documents/16-0026_DATA61_REPORT_TomorrowsDigiallyEnabledWorkforce_WEB_160128.pdf.

[176] World Maritime University, *Transport 2040: Automation, Technology, Employment – The Future of Work* (2019). "Available at www.wmu.se/docs/transport-2040-future-work.

Figure 4.2. Automation potential of select mobility-related occupations



Source: C. Frey and M. Osborne, "The future of employment: How susceptible are jobs to computerization?", Working Paper (Oxford, United Kingdom, University of Oxford, 2013).

In considering only 15 major developed and emerging economies, the World Economic Forum predicts that frontier technological trends will lead to a net loss of more than 5 million jobs by 2020.[177] Analysis by McKinsey Global Institute indicates that, technically, about 50% of jobs globally can be automated. In Asia-Pacific economies, jobs of 785 million workers or 51.5% of total employment in the region could be automated.[178]

Case study: APPLICATIONS IN CHINA

Mobile-based applications for freight transport

In response to the current needs of improving environmental performance and the sustainability of freight transport, mobile-based applications have penetrated the Chinese markets in recent years. More than 200 freight transport-related applications have been developed based on the success of taxi-hailing applications around the world. The objective of these mobile phone-based applications is to match freight transporters with customers and provide freight distribution, management and other services to freight stakeholders. Such applications help match the consignor's demand and the carrier's supply efficiently. Subsequently, trucks' empty trips are decreased with the improvement of average vehicle loaded which contribute to reduce relevant negative impacts to the environment. Optimized route planning and assignment of returning pick-up by applications reduce CO_2 emissions. It was reported that around 30% to 50% of empty kilometres were reduced by mobile-based applications.

Installation of satellite positioning systems for freight transport

According to the national guideline entitled "Demands on strengthening Road Traffic Safety", issued by the State Council in 2012, vehicles transporting dangerous goods are required to be equipped with satellite positioning systems to record the driving information.

Source: Summarized from Su Song, China Moves Toward Smart, Green and Inclusive Freight Transport, TheCityFix, 2017. Available at: https://thecityfix.com/blog/china-moves-toward-smart-green-and-inclusive-freight-transport-su-song/.

[177] World Economic Forum, "The Fourth Industrial Revolution: what it means, how to respond". Available at: www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-itmeans-and-how-to-respond/.

[178] J. Woetzel, and others, "China's digital economy a leading global force", McKinsey Global Institute discussion paper (2017). Available at: https://www.mckinsey.com/~/media/McKinsey/Global%20Themes/China/Chinas%20digital%20economy%20A%20leading%20global%20force/MGI-Chinas-digital-economy-A-leading-globalforce.ashx.

4.3. The role and considerations of the private sector

"Road freight is mostly a private and profit-driven sector. This is different than what occurs for passenger transport and urban mobility, where government and other public bodies play a more direct role, and which historically have deserved much more policy attention. Setting up policies requires recognizing that companies will play a key role since they are the ones that directly control their operations and set up their own supply chains. It will be extremely hard, if not outright impossible – to achieve decarbonization goals if the respective policies do not take into account the private interests of shippers, logistics suppliers, transport operators and other companies involved in the business".[179]

Source: International Transport Forum.

Factors influencing modal choice

Demand for transport is derived from the demand for other goods and services. The creation of transport infrastructure and facilities open-up new opportunities and strengthen markets for more goods and services.[180] Accordingly, in pursuing a sustainable freight transport system, it is necessary to fully grasp the whole logistics system and the reasons for the prevailing dominant role of road freight transport.

As a result of global competition many companies increasingly apply just-in-time practices in order to decrease inventory levels. Just-in-time practices necessitate punctual, reliable, and flexible transport, as with reduced inventory, any mismatch between supply and demand can result in significant disturbances to supply chain performance. The road transport sector offers fast and flexible door-to-door services as opposed to rail, coastal shipping and inland waterway transport that cannot satisfy these requirements as effectively. On the other hand, road transport is the least environmentally friendly mode of transport.[181]

More generally, a growing proportion of shippers tend to seek to optimize their comprehensive logistics costs, and not just to minimize their transport cost. Optimization means that the best solution is not necessarily the cheapest; it corresponds to the requirements of the customer and to their willingness to pay for it. Optimizing logistics, rather than just transport, means that a total cost, comprising transport, inventory and information systems, is also considered, especially in the context of today's "just-in-time" management practices. This means that a more expensive transport solution can result in a lower inventory volume and therefore an overall cheaper logistics solution.[182]

Freight forwarders, as crucial links in the logistics chain play a role in modal choice. As non-asset-based transport service providers, they dispatch shipments through asset-based carriers and book or otherwise arrange space for those shipments on behalf of an exporter, importer or another company or person, sometimes including dealing with packing and storage. Instead of only acting as an intermediary, many freight forwarders have become transport operators and have their own transport assets. The freight forwarding market is highly fragmented with low barriers to market entry and exit. This has historically allowed very small enterprises to enter the market and compete effectively with the major players, depressing margins. This situation, however, is changing as a small number of companies have achieved product differentiation through worldwide freight networks, underpinned by global technology. The forwarding sector has also been helped by a surge in international trade volumes, driven by the economies in the Asia-Pacific region, especially China. This has led to significant year-on-year growth in international trade volumes and the need to combine various modes of transport to get cargo from origin to destination.

To achieve competitive rates, most freight forwarders hold contracts or special arrangements with other transport operators which inevitably influences their decision-making. In the cases in which freight forwarders have agreements with special transport operators, they do not always consider possibilities that may be cheaper, safer or better for the environment than those offered by their partners.

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[179] International Transport Forum, "Towards road freight decarbonisation: trends, measures and policies", ITF Policy Papers, (Paris, OECD Publishing, 2018).
[180] B. Puri, "Sustainable Transport and the intermodal mix", Transport and Communications Bulletin for Asia and the Pacific No. 87, (Bangkok, ESCAP, 2017)
[181] A. Goel "A roadmap for sustainable freight transport" (2009). Available at: https://www.researchgate.net/publication/228725748_A_Roadmap_for_Sustainable_Freight_Transport.
[182] M. Savy, "Freight transport modes: Competition, cooperation or areas of advantage?" (Brussels, European Automobile Manufacturers' Association, 2009)

Another note-worthy element is that inland waterways, rail, coastal shipping and combinations of these various modes with final road haulage must all be able to consolidate significant quantities of goods in order to reach sufficient levels of productivity to compete with road prices. This is one of the reasons why road is also used for long distances, when the amount of goods transported is not sufficient to justify the use of other, heavier means. Finally, in many cases, road is selected for long distance freight transport just because it is the only solution available to shippers. In this case, it could be argued that where other choices are not available, competition between transport modes does not exist in reality.[183] This strengthens the case in favour of modal integration and sustainable connectivity discussed in previous chapters.

Further to this and recalling the earlier discussion on dry ports and intermodal facilities, many production, distribution and freight processing sites in the region are only accessible by road. Against this background, it could be contended that the choice of a freight transport mode is critically influenced by the selection of these locations, and consequently the modal split is biased long before shippers have to make any decision. In other words, actual competition between modes explains only a part of the modal split, given that this competition requires an adequate, pre-existing context, which is not the case in every country or along every route, especially with regard to infrastructure.[184]

It was argued already 20 years ago in Europe, that the general expansion of road freight transport at the expense of other modes reduces actual competition to a few corridors where heavy modes such as train or barge demonstrate their competitive advantage namely increased productivity for large shipments and long distances. In addition, the infrastructure must exist to enable an alternative solution. However, the provision of another transport mode, as an alternative to road, requires massive, indivisible and irreversible investments, which rarely reach private profitability rates and have to be provided, or at least guaranteed, by public authorities in many countries. In Europe, policies to change the modal split for freight have mostly failed. This does not mean that attempts to increase the use of alternatives to all-road haulage have no chance to succeed in Asia and the Pacific. Nonetheless it should be recognized that efforts to reduce greenhouse gases must entail using all available tools simultaneously: technology and standardization, organization and management, regulation and taxation, to name a few. In any case, the modal shift will only provide a limited part of the solution, and the main prospects for progress are largely expected to remain within road transport itself.

The case for engaging the private sector

The private sector is a key stakeholder and can play a major role in achieving sustainable development far beyond acting as a source of financing. This role as a driver of sustainable economic growth brings with it opportunities for value creation and important responsibilities for business. By way of example, the private sector plays a key role in the shipping sector, where the choice of the shipping routes is determined by the private carrier’s port calling strategy and feeder network based on the geopolitical location of the port, the capacity of the port, and the volume of traffic. In this sense, the maritime networks are formed by services provided by private carriers, which are inevitably sensitive to cost and revenue, and are the key decision makers, when it comes to adopting more sustainable shipping practices in order to reduce the impact of their operation on marine ecosystem.

Business, however, requires stable institutions and robust regulatory frameworks to be able to operate effectively. A national low-carbon green development strategy — developed in consultation with stakeholders, empowered by an inclusive and multi-sectoral institutional architecture, and supported at the highest level of government could provide a clear signal and long-term certainty to the private sector. This stability creates an enabling environment for the growth of sustainable enterprises and green business.

It follows that business is starting to accept sustainable freight transport as a business response to mitigate environmental and social risks to which they are exposed and embrace the business opportunities that come along with it. They see the benefits in increased reputation, trust from stakeholders, including from governments, improved risk management, being more attractive to high-quality employees and improved continuity of the business. The business model is changing gradually from a view based on short-term financial returns to a holistic view based on responsibility and value creation, taking into account the full value chain.

[183] Ibid

[184] M. Savy, “Freight transport modes: Competition, cooperation or areas of advantage?” (Brussels, European Automobile Manufacturers’ Association, 2009)

Case study: SUSTAINABLE FREIGHT AND LOGISTICS IN THE GREATER MEKONG SUBREGION

The logistics market in the Greater Mekong Subregion is very locally organized and highly fragmented. Trucking is the dominant form of freight transport in the subregion, accounting for 70% to 80% of all tonnage. Fuel costs are the major operating cost (40% to 60%) and contribute to high logistics costs, as compared to other parts of the world. The dominance of aged, fuel-inefficient truck fleets, inadequate logistics management capacity, low safety standards and insufficient driver training, and a lack of access to financial capital for technology and/truck upgrades perpetuate the problem. From the public policy side, the lack of freight data further inhibits sound road and fleet investment and policy planning. Some solutions exist that can reduce both fuel use and emissions, but they are not being adopted at scale because of lack of information, standards, investment, and policy incentives.

Against this background, the Mekong subregion has been the beneficiary of several multilateral development projects targeting the private sector as a key driver for change. From 2013 to 2016, the Asian Development Bank Green Freight Initiative, which focused on long-haul road freight, helped 60 small and medium-sized freight companies in the Lao People's Democratic Republic, Thailand, and Viet Nam to test ways to make their businesses more fuel efficient. The German Agency for International Cooperation supports an additional 500 small- and medium-sized companies under its European Union-funded technical assistance projects entitled "Sustainable Freight and Logistics in the Mekong Region (2016-2019)" in Cambodia, the Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam. The projects have focused on fuel efficiency, transport of dangerous goods, access to financing and on the creation of a database on green logistics. Beyond this, a green certification is in the works to certify logistics companies according to their level of performance based on uniformly defined green freight standards.

Source: Summarized from "Sustainable freight and logistics in the Mekong Region" (2018). Available at: https://eeas.europa.eu/headquarters/headquarters-homepage/41298/sustainable-freight-and-logistics-mekong-region_vi.

4.4. The enabling role of governments and multilateral development actors

Successful transition to sustainable freight transport raises important questions concerning how to organize strategic planning processes and how to apply knowledge tools to support the implementation of new policy goals and instruments for sustainability. Further questions arise on how the changing institutional frameworks in the transport sector influence the way new planning processes and tools for sustainability can connect to the existing national decision-making context. A sustainable transport policy, therefore, should be a deliberate, knowledge-based, and strategic endeavour towards integrating sustainability principles, criteria and goals in the development, management, regulation and assessment of nationally significant transport systems and services".[185]

In this context, countries in the region have increasingly recognized the importance of regional cooperation for the identification of a common vision, strategy and tools. For example, in the Kuala Lumpur Transport Strategic Plan (ASEAN Transport Strategic Plan) 2016-2025, sustainable transport is covered in a dedicated chapter for the first time and the scope of topics are far greater than in earlier plans. The newly covered topics are non-motorized transport, fuel economy, green freight and logistics, economic instruments, development of a monitoring framework and integration with land-use planning. In 2019, ASEAN published its Regional Strategy on Sustainable Land Transport, articulating the vision of a transport system that is equitable, efficient, safe and clean, and is in line with global sustainable development and climate change objectives, and provides access to opportunities and fosters regional inclusive growth and development.

[185] C. Sørensen, H., Gudmundsson, and S. Leleur, "National sustainable transport planning – concepts and practices". DTU Transport. (2013). Available at https://orbit.dtu.dk/en/publications/national-sustainable-transport-planning—concepts-and-practices(39ad989b-1c0d-4a0e-831d-8495d3ffff4c).html.

Perhaps more important are the national policies, which focus on national and local circumstances and context in designing measures aligned with the overarching vision for sustainable transport in the region. In that sense, it is worth looking at some examples of how policy can be a vital driver of the shift towards sustainable freight transport.

China and the push for balanced intermodal transport

China has one of the most freight-intensive economies in the world. In 2016, total freight volume in the country was 43 billion tons and 18 trillion ton-kilometres, approximately 2.5 times the total tonnage in the United States and double the ton-kilometres. In the past 20 years, China has built the world's largest high-speed rail network; it plans to expand its entire rail network to reach 150,000 kilometres. Since the mid-1980s, China has constructed a national trunk highway network of 142,500 kilometres, which surpassed the United States inter-state highway network in 2011 as the largest in the world. It also has the world's largest waterway network, with approximately 125,000 kilometres of navigable canals and rivers. Despite the investment in railways and waterways, 76% of freight in the country moves by road, which is much more carbon intensive than using rail or water. A major impediment to shifting freight from road to rail and water is the lack of efficient freight hubs to facilitate seamless intermodal transport between sea and rail, waterway and rail, and rail and road. In addition, operational rules and documentation are not standardized, while institutional barriers impede communication between the three modes, exacerbated by a lack of incentives to work across modes. Another problem is that information about intermodal transport is fragmented and not shared among various stakeholders, such as freight shippers, logistics services providers, freight forwarders, infrastructure managers and operators.

The country's 13th Five-Year Plan for Economic and Social Development (2016-2020)[186] called for an acceleration of intermodal transport development and the construction of intermodal freight hubs. Its 2014-2020 Mid-to-Long-Term Logistics Development Plan, published by the State Council, is also concentrated on intermodal transport as one of the most critical areas for logistics development. In response, local governments have accelerated investment in intermodal freight hubs and logistics parks. In 2015, the State Council and the Ministry of Transport jointly launched a national intermodal pilot demonstration project, which provided support and financial incentives to 16 selected intermodal transport schemes across the country.

A recently launched World Bank programme[187] focuses on developing policies, strategies and standards in China to improve the efficiency and environmental sustainability of the freight transport sector, with pilot projects in five cities and provinces. The programme is comprised of several key elements:

- Development of a low-carbon intermodal freight transport system to encourage modal shift of road freight to rail and inland waterways and reduce deadhead freight mileages;
- A new national strategy for low-carbon intermodal freight development with a focus on harmonizing freight standards for equipment, documentation and information systems across the modes, strengthen national institutions and stakeholder participation in freight transport and logistics, and creating a new national forum to change decision-making and policies that effect different modes;
- The Yangtze River Economic Belt Intermodal Freight Strategy, which entails constructing commodity flow surveys, assessing existing capacity and operation of intermodal infrastructure and hubs, developing a freight transport strategy for each mode, identifying bottlenecks, and recommending policy, investment strategy and information technology improvements;
- A green freight corridor improvement action plan to review bottlenecks, recommend ways to improve the capacity and efficiency of freight corridors, and improve service levels and integration at intermodal freight hubs – the major corridors are linked to freight corridors being developed under the Belt and Road Initiative.

India and the dedicated rail freight corridor programme

As at 2017, 65% of freight in India was transported by road. Furthermore, almost 90% of rail freight in the country is dominated by bulk commodities, such as coal, steel, iron, cement, food grains and fertilizers. To resolve the increasing need for road decongestion, accident reduction and energy efficiency, India launched

[186] See http://www.sustainabletransport.org/wp-content/uploads/2017/12/20171201_GIZ-Chinas-Five-Year-Plans-in-the-Transport.pdf.
[187] See "China: GEF efficient and green freight transport project", the Workld Bank. Available at: http://documents.worldbank.org/curated/en/821791534504301360/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-China-GEF-Efficient-and-Green-Freight-Transport-Project-P159883.pdf.

the “Dedicated Freight Corridor Programme”[188] to aid the growth of rail transport. Dedicated freight-only lines are being built along the four key transport routes, which connect Delhi, Mumbai, Chennai and Kolkata. These corridors carry the country’s heaviest rail traffic and are highly congested.

With the increase in capacity from the dedicated freight corridors, and more rapid and reliable transit, Indian Railways will expectedly attract new markets to rail in higher value freight sectors. The new electrified freight-only railway lines will allow trains to haul higher loads faster, cheaper, and more reliably than before, enabling the railways to make a quantum leap in their operational performance. The corridors are also expected to catalyse economic development of industrial corridors and logistics parks along the routes.

The dedicated freight corridor lines are being built for maximum speeds of up to 100 kilometres per hour compared to the current average commercial freight speed of about 25 kilometres per hour. The lines will also have a carrying capacity of 6,000 to 12,000 gross tons of freight trains at a 25-ton axle load at opening but will be designed to enable migration to a 32.5-ton axle load later on. Apart from a reliable service, which is critical for freight customers, the dedicated freight corridors will allow much shorter transit times from freight source to destination and, in some cases, reduce the delivery time by more than 50%.

The Philippines and the measures to decarbonize road freight transport

In May 2019, the Bureau of Philippine Standards officially approved the Philippine National Standard on Road Freight Transport.[189] The related document provides guidance on enhancing road freight transport based on four principles: reliability; safety; cost efficiency; and environmental sustainability. It includes recommendations derived from good practices on vehicle fleet management, transport operation activities, and organizational and personnel management. The Standard was originally developed in 2018 by the Technical Committee on Logistics, composed of government agencies, truckers’ associations, freight forwarding companies, and other private sector representatives, civil society organizations and development partners. Key recommendations from the document include the following:

- **Optimizing payload:** about 16% of trucks in the Philippines are overloaded. This not only causes safety issues because of the early deterioration of roads and bridges, but also adversely affects energy efficiency of the trucks, as they consume more fuel beyond their optimum loading limit.
- **Reducing empty trips**: About 79.4% of trailer trucks and 62.4% of three-axle trucks entering Metro Manila are empty. These empty trips not only cause high freight transport costs (shippers are usually charged for two-way trips), but they also consume large amounts of fuel for nothing. The guidelines encourage use of platforms for load sharing and freight matching to reduce empty backhauls.
- **Improving vehicle fleet management:** This pertains to the introduction of periodic vehicle maintenance and replacement to ensure safety and optimum energy efficiency, and route planning to reduce the number of trips.
- **Collaboration and consolidation:** Implementing the plan is beyond the capabilities of individual companies, but the government or other third-party entities could facilitate it to achieve less freight traffic, less environmental damage and reduced greenhouse gas emissions, better utilization of vehicle fleet and less space occupancy. This would involve setting up centralized logistics hubs with appropriate transport plans (inbound and outbound).

The Russian Federation and the focus on technology and clean fuels

In 2016, 7.1 billion tons of freight were transported throughout the Russian Federation, a figure that includes both international and domestic cargo loads according to data from the country’s Federal State Statistics Service. Road transport the dominant mode of choice, accounted for roughly 70% of total freight turnover, with rail coming in second place. The objective of the transport strategy of Russian Federation up to 2030[190] is to balance development of integrated transport infrastructure of all modes of transport. This entails the development of major transport hubs, logistics centres, dry ports and terminals on the main directions of traffic and at the joints between modes and ensuring their interoperability. The strategy is also focused on the broad and

[188] See “Green signal for faster development: India’s new freight corridor”, 7 February 2017. Available at: https://www.worldbank.org/en/news/feature/2017/02/07/green-signal-faster-development-indias-new-freight-corridor.
[189] See “Enhancing road freight transport in the Philippines through national standards”, Transport and Climate Change, 6 November 2019. Available at https://www.transportandclimatechange.org/2019/06/11/enhancing-road-freight-transport-in-the-philippines-through-national-standards/.
[190] See http://government.ru/en/dep_news/13191/

optimized use of information and communication technologies, information standards and unified transport documents, and the further development of inland waterway transport. Importantly, the strategy is envisaged to renew priority on increasing the share of clean fuels, hybrid and electric vehicle engines, materials and technologies and improving the energy efficiency of transport.

Viet Nam and the prioritization of inland water transport for freight

Overcoming financing constraints, Viet Nam has made enormous strides in developing its inland waterways transport by efficiently exploiting the natural conditions of its rivers and canals. This growth is highlighted by the 47% increase in the volume of traffic carried on the waterways between 2010 and 2016. Inland waterways directly connect with the country's major seaports. Consequently, inland water transport and coastal shipping taken together carry three-quarters of the total domestic freight traffic.[191] As indicated in table 4.1, while road transport carries the largest volume by tons loaded, it is mainly for short distances of 59 kilometres on average. In general terms, Viet Nam carries a higher share of goods by inland waterways than in any other country except the Netherlands.

Table 4.1. Percentage of domestic freight transport in Viet Nam by mode of transport (2016)

Mode	Tons loaded (%)	Ton-kilometres performed (%)	Average distance (kilometres)
Road	77.2%	23.7%	59
Rail	0.4%	1.3%	615
Inland waterways	17.1%	18.9%	212
Coastal shipping	5.2%	55.7%	2 046
Aviation	0.0%	0.3%	2 333

Source: Adapted from D. Hoan, and others "Sustainable development of inland waterways transport in Viet Nam: strengthening the regulatory, institutional and funding frameworks", World Bank working paper (Washington, D.C., World Bank Group, 2019).

There are more than 170,000 vessels in the inland water transport fleet, most of them very small. Just over 7,000 kilometres of national waterways, administered by the central government, carry the great majority of the traffic. But less than 30% of this network length can handle barges larger than 300 tons capacity, a very low proportion compared to most successful commercial waterways in the world. Vessel sizes in Viet Nam are limited by shallow channel depth, restrictive fairway geometry, and low bridge clearances. Many ports have outdated handling facilities and low levels of mechanization, are poorly maintained, or have poor hinterland access. Virtually all the main waterways of China, the European Union, and the United States can handle vessels of more than 1,000 tons, and usually ones with much bigger loads.

Despite these limitations, the country's success in utilizing inland waterways to such a large extent is attributable to well defined and robustly implemented policy directions over the period 2014 to present:

- Modernization and development of a sustainable inland waterway transport system accompanied by promotion of its advantages to transport users and the community;
- Development of inland waterway transport infrastructure in a more systematic way, specifying physical targets, improved management requirements, capacity upgrades, and cooperation with local governments;
- Development of the inland waterway transport fleet in conformity with national standards but encouraging specialized vessels for specific route capabilities and cargoes, and more container ships, as well as multipurpose vessels;
- Management of the development of inland waterway transport infrastructure more rigorously, modernizing assets, and achieving a national database, with more effective compliance and safety measures;
- Use of resources to maintain inland waterways in an advanced, scientific, effective, and safe way;
- Improvement of inland navigation safety through effective regulation, compliance of vessels and crews, and traffic management.

[191] D. Hoan, and others, "Sustainable development of inland waterways transport in Viet Nam: strengthening the regulatory, institutional and funding frameworks", World Bank working paper (Washington, D.C., World Bank Group, 2019).

4.5. Takeaway from chapter 4

The discussion in this chapter builds on the previous discussion by contending that sustainable freight transport cannot be attained in the absence of sustainable transport connectivity. It has gone on to posit that the key drivers of the shift to sustainable freight transport are technology and innovation, private sector engagement and the enabling role of public policy as formulated at the national and regional levels.

Insofar as perceptions of sustainable freight transport are concerned, most studies concentrate on the reduction of CO_2 emissions and often the term “sustainable transport” is equated or used interchangeably with the term “green transport”, on account of the dominant focus on mitigating the environmental impact of transport. However, sustainable freight transport should equally consider the economic, social and environmental dimensions of the sector in an integrated manner to ensure synergies, complementarities and coherence. The attainment of sustainable freight transport systems represents a significant challenge with multiple technical, operational, and policy aspects: the design, testing, and implementation of interventions require multi-disciplinary, multi-country research. Promising interventions are not limited to introducing new transport technologies, but also include changes in framework conditions for transport, in terms of production and logistics processes.

The advent of new transport solutions or radically different technologies come with the promise of sustainability and therefore container carriers, port authorities, customs agencies, logistics and freight service providers, among others, are gradually incorporating smart transport technologies to optimize their operations and to enable real time information and data sharing on freight movements. While information and communications technology will play a key role in the future development of the transport sector, transport policymakers and regulators also need to focus on new security risks and to the limitations of the technology’s impact on the overall sustainability performance. Consequently, policies that can successfully leverage technology and innovation for attaining sustainable freight transport systems are contingent upon having a clear and unequivocal understanding of what these technologies are and how they work. Second, but equally important is that policy and regulation need to be at pace with technological development and incentivize its introduction, adoption and widespread use by the industry.

Operational practices, business models and modal choices are directly influenced by the prevailing policy and regulatory environment, the availability of resources and technology and the overall connectivity conditions. It would be remiss, however, not to consider that the private sector, the generator and user of cargo, and the logistics and freight forwarding sectors also have a role to play in the sustainability of freight transport. On the other hand, more conducive public policies are necessary to make transport connectivity and freight transport operations sustainable and to incentivize a change in the prevailing business practices and cultures towards the attainment of the Sustainable Development Goals.

CHAPTER

5

CONCLUSIONS AND RECOMMENDATIONS

The Review of sustainable Transport Connectivity in Asia and the Pacific (2019) was produced at the three-year mark of the five-year Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific (2017-2021). It is focused on assessing the state of transport connectivity in the region and posits that, ultimately, sustainable freight transport cannot be attained in the absence of sustainable transport connectivity.

Reinforce the focus of regional transport policies on a cross-cutting approach to leaving no one behind.

In that context, conceptual and practical considerations with regard to what sustainable connectivity really is and why it matters in the broader context of sustainable development and sustainable transport are also touched upon. Transport connectivity is pivotal for sustained economic growth, supply chain efficiency and transport system resilience. While the Asia and Pacific region has made measurable progress in addressing transport connectivity gaps, the high overall regional performance is driven by a few top performers, thus, hiding significant subregional variations. This is impeding the region from advancing further to reach the transport connectivity performance of the top regions worldwide and strongly points to the need to reinforce the focus of regional policies on leaving no one behind. In that regard, activities to address the needs of countries in special situations should be reinforced in tandem with all transport development areas as a cross-cutting issue.

Sustainable freight transport policies ought to equally consider the economic, social and environmental dimensions of the sector in an integrated manner to ensure synergies, complementarities and coherence at the local, national and regional levels.

Insofar as perceptions of sustainable freight transport are concerned, most studies concentrate on the reduction of CO_2 emissions and often the term “sustainable transport” is equated or used interchangeably with the term “green transport”, on account of the dominant focus on mitigating the environmental impact of transport. Sustainable freight transport, however, should equally consider the economic, social and environmental dimensions of the sector in an integrated manner to ensure synergies, complementarities and coherence at the local, national and regional levels. The attainment of sustainable freight transport systems represents a significant challenge with multiple technical, operational, and policy aspects: the design, testing, and implementation of interventions require multidisciplinary, multi-country research. Promising interventions are not limited to introducing new technologies, but they also include changes in framework conditions for transport, in terms of production and logistics processes. ESCAP can support its member States in this regard by scaling up its capacity development programme to include better targeted national technical assistance.

Modal shift through integrated intermodal freight transport and greater use of coastal shipping, inland water transport and railways is only part of the solution. Equal policy attention is needed for improving the environmental performance of road transport as its modal share will continue to dominate freight transport in the region.

The sharp increase in population, economic growth and trade in the region indicate that the freight transport sector is far from accomplishing long-term sustainability objectives. The environmental impact of the dominantly road-centric and fossil fuel dependent freight transport sector under suboptimal connectivity conditions is systematically exacerbating the contribution of the sector to climate change, making the regional transport system more vulnerable to climate and hazard-related disasters and is rapidly placing the region among the highest CO_2 emitting regions in the world, especially when taking into account projected growth through 2050. While the flexibility of road transport will continue to place it among the most utilized modes of transport, there is scope for policy instruments to make meaningful interventions in support of greater use of coastal shipping, inland water transport and railways and in support of accelerated decarbonization of road freight transport.

Direct resource optimization efforts toward integrating road, rail, inland waterways, seaports and dry ports rather than on sub-sectoral development and expansion of infrastructure.

The detailed review of the infrastructure and operational land transport connectivity in Asia sheds light on the extent of efforts and resource mobilization and optimization needed to address, in the first instance, the infrastructure needs in the region, with particular emphasis on integrating road, rail, inland waterways, seaports and dry ports. While the region enjoys a high degree of maritime connectivity overall, the small and remote islands of the archipelago and the Pacific islands, which strongly rely on maritime transport, face the structural difficulties of paying high rates for inadequate services without accessing the advantages of maritime transport enjoyed by the rest of the region. Most developing coastal countries face challenges, such as inadequate infrastructure, unstable services, inadequate development of integrated intermodal transport, the risk of accidents associated with aging vessel operations, lack of investment resources, and inconsistent policies. In terms of strengthening environmental performance, coastal shipping offers a viable alternative to road transport in many cases, however it is not yet prominent enough to offset the preference for road transport and policies to incentivize coastal shipping are lacking in the region.

Prioritize institutional, legal and regulatory interventions to alleviate bottlenecks.

At the same time, the operational connectivity assessment illuminates a number of other factors, such as congestion and border crossing delays, which are symptoms of bottlenecks and should not be treated exclusively as an infrastructure problem. Expansion of the infrastructure will not solve a problem that is regulatory in nature. An infrastructure bottleneck can be rectified, at least temporarily, if enough money and time is invested. As such, priority should be accorded to institutional, legal and regulatory interventions that can alleviate bottlenecks, especially in landlocked developing countries.

Policies that can successfully leverage technology and innovation for attaining sustainable freight transport systems are contingent upon having a clear and unequivocal understanding of what these technologies are, how they work, the sustainability gains they can offer and the risks they entail.

The key drivers of the shift to sustainable freight transport are technology and innovation, private sector engagement and the enabling role of public policy as formulated at the national and regional levels. While technology and innovation will play a key role in the future development of the transport sector, transport policymakers and regulators will also need to focus on new security risks and to the limitations of the impact of technology on the overall sustainability performance. Consequently, policies that can successfully leverage technology and innovation for attaining sustainable freight transport systems are contingent upon having a clear and unequivocal understanding of what these technologies are and how they work. Second, but equally important is that policy and regulation should ideally be at pace with technological development and incentivize its introduction, adoption and wide-spread use by the industry. To this end, ESCAP member States can further leverage the ESCAP platform to further research and eventually address these emerging issues.

Prioritize private sector buy-in and engagement in national policy development

While operational practices, business models and modal choices are directly influenced by the prevailing policy and regulatory environment, the availability of resources and technology and the overall connectivity conditions, the private sector, the generator and user of cargo, and the logistics and freight forwarding sectors also have a role to play in the sustainability of freight transport. On the other hand, more conducive public policies are necessary to make transport connectivity and freight transport operations sustainable and to incentivize a change in the prevailing business practices and cultures towards the attainment of the Sustainable Development Goals. In that regard, greater engagement of the private sector, civil society and academia in the policy discussions can make a difference in the impact of policies. ESCAP could scale up its role as a platform through which all stakeholders can reach a common understanding of objectives and means for implementation.

Take full advantage of the regional institutional framework and cooperation mechanisms.

The intergovernmental agreements on the Asian Highway, trans-Asian railway networks and dry ports are meant to provide a comprehensive institutional framework that raises the capacity of the networks to function as an integrated system and reduce the risks and negative externalities of disproportionate reliance on one transport mode (resilience). While initially focused on infrastructure aspects, the role and perspective for the development of the Asian Highways, the trans-Asian railways and dry ports has been transformed to incorporate a wider set of concerns and objectives. The sustainable development perspective focuses on improving the quality of the infrastructure, while expanding the very notion of quality infrastructure to encompass all aspects of sustainable performance. This includes environmental concerns, time and cost of transport operations and their safety. More than ever, it primes the discussion on operational connectivity and intermodal connections, which are crucial to maximize the sustainability benefits from synergies and respective strengths of all modes of transport in order to realize an integrated intermodal transport and logistics system for Asia and the Pacific. Accordingly, accession to the agreements by the countries that have not yet done so, and a coordinated approach to the designation of road and rail routes and dry ports emerges as a key recommendation for achieving the objectives of sustainable connectivity in the region.

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