Review of Sustainable Transport Connectivity in Asia and the Pacific 2019

Addressing the Challenges for Freight Transport

[redacted]

The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional hub promoting cooperation among countries to achieve inclusive and sustainable development. The largest regional intergovernmental platform with 53 Member States and 9 Associate Members, ESCAP has emerged as a strong regional think-tank offering countries sound analytical products that shed insight into the evolving economic, social and environmental dynamics of the region. The Commission's strategic focus is to deliver on the 2030 Agenda for Sustainable Development, which it does by reinforcing and deepening regional cooperation and integration to advance connectivity, financial cooperation and market integration. ESCAP's research and analysis coupled with its policy advisory services, capacity building and technical assistance to governments aims to support countries' sustainable and inclusive development ambitions.

[redacted]

[redacted]

REVIEW OF SUSTAINABLE TRANSPORT CONNECTIVITY IN ASIA AND THE PACIFIC 2019

Addressing the Challenges for Freight Transport

[redacted]

EXPLANATORY NOTES

The term “ESCAP region” in this publication refers to the group of countries and territories/areas comprising: Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People’s Republic of Korea; Fiji; French Polynesia; Georgia; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People’s Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.

The term “East and North-East Asia” in this publication refers collectively to: China; Hong Kong, China; Democratic People’s Republic of Korea; Japan; Macao, China; Mongolia; and Republic of Korea.

The term “North and Central Asia” in this publication refers collectively to Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan.

The term “Pacific” in this publication refers collectively to American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The term “South and South-West Asia” in this publication refers collectively to Afghanistan, Bangladesh, Bhutan, India, the Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Turkey.

The term “South-East Asia” in this publication refers collectively to Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

Values are in United States dollars unless specified otherwise.

The term “billion” signifies a thousand million.

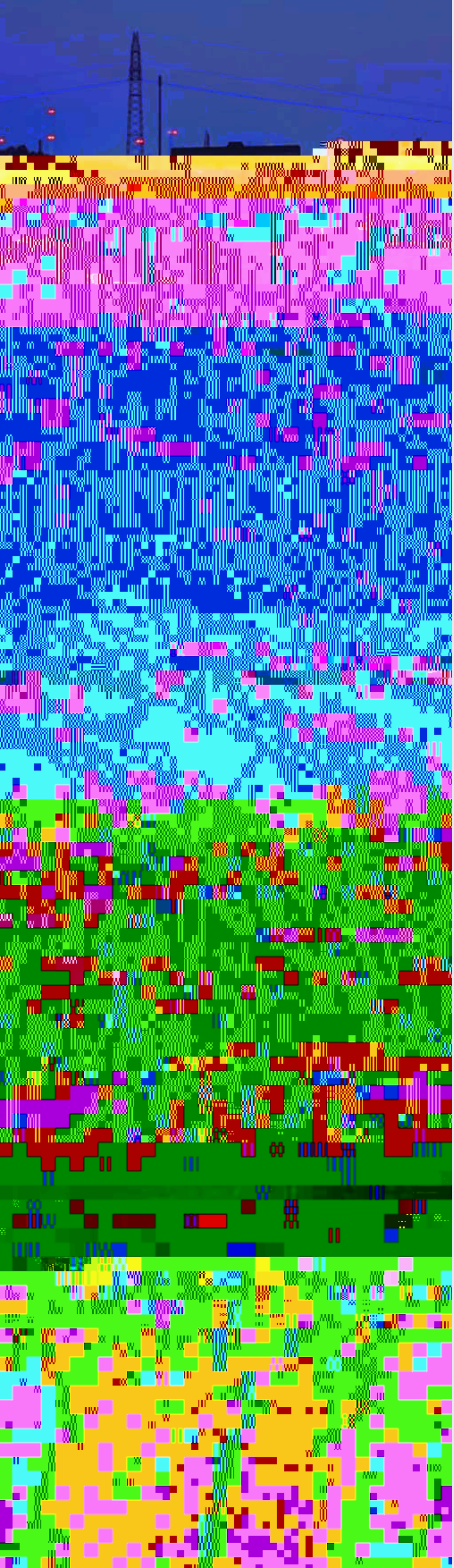
[redacted]

ACKNOWLEDGEMENTS

The A : A , was prepared under the guidance of Weimin Ren, Director, Transport Division of the

[redacted]

CONTENTS



CHAPTER

1

REFRAMING THE DISCUSSION ON SUSTAINABLE TRANSPORT CONNECTIVITY

he role of transport for sustainable development and, 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, [illegible].[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.

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.

.[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.

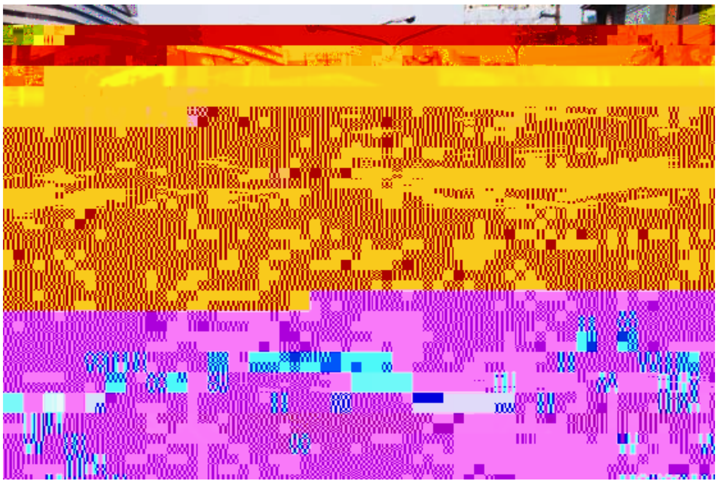


Photo credit: lovingyou2911 / istockphoto

[12] C.S. Holling, "Resilience and stability of ecological systems" *A*

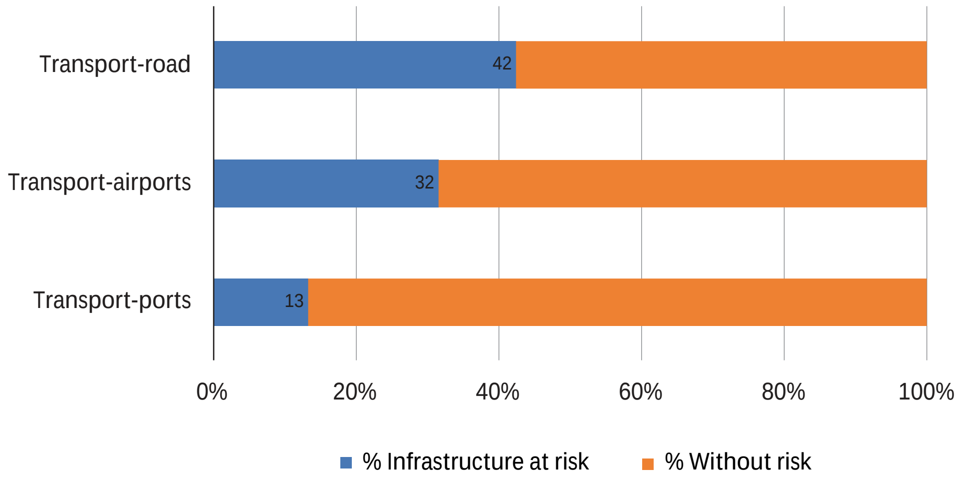
The surge in economic development in Asia and the Pacific over the past 20 years has also led to a sharp increase in infrastructure spending and construction, which is projected to continue in order to respond to growing demand in line with the region's prioritized economic growth. As a result, a large 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

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



: ESCAP secretariat

The World Meteorological Organization (WMO) released data – up to July 2019, as part of a high-level synthesis report entitled 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 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 *2 . A 1.5*

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

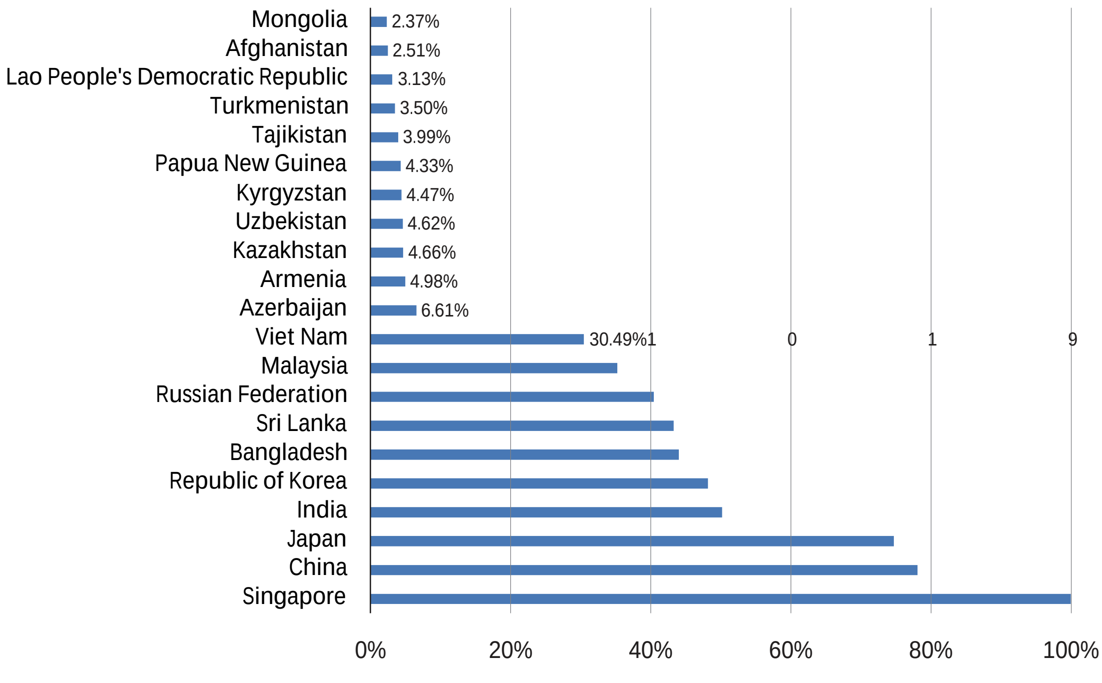
[22] World Meteorological Organization, "High-level synthesis report on latest climate science information" (2019). Available at https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/United_in_Science_ReportFINAL_0.pdf?XqiG0yszsU_sx2vOehOWpCOkm9RdC_gN.

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.

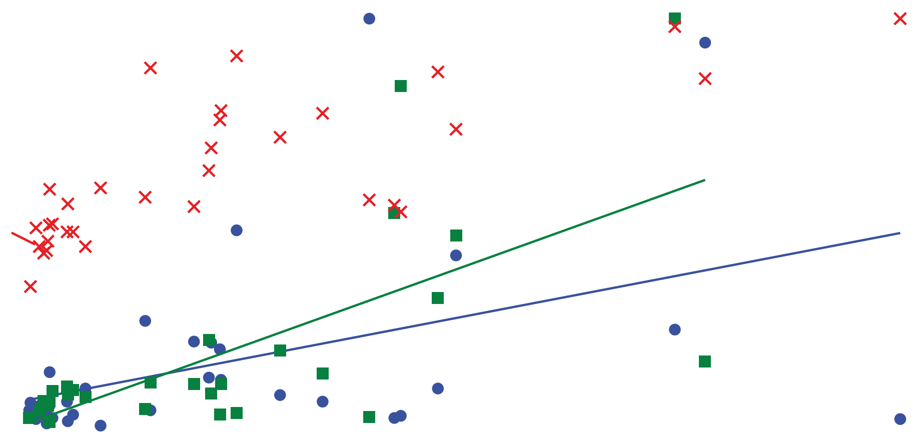
Connectivity in the region and by subregion is then also analysed separately on the basis of several well-established and broadly used indices, such as the Logistics Performance Index of the World Bank; the Liner Shipping Connectivity Index of UNCTAD; and the Global Connectivity Index of the International 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.



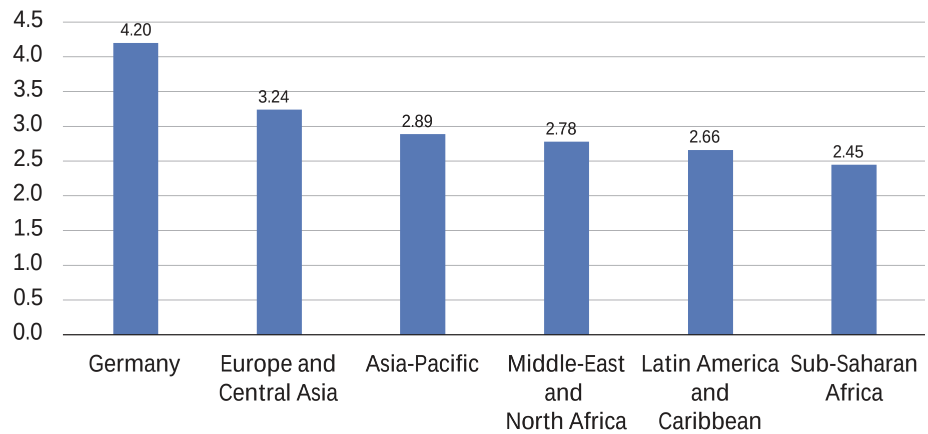
As shown in figure 1.5, the index that incorporates all transport modes and logistics performance has a strong positive correlation with each modal indicator, which is shown by the linear upward slope of each line of best fit. The index clearly captures an important tendency of the full range of modal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



: ESCAP calculations.

Figure 1.6. Logistics Performance Index, 2018



: 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).

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

: 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

: 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).

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

: 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]

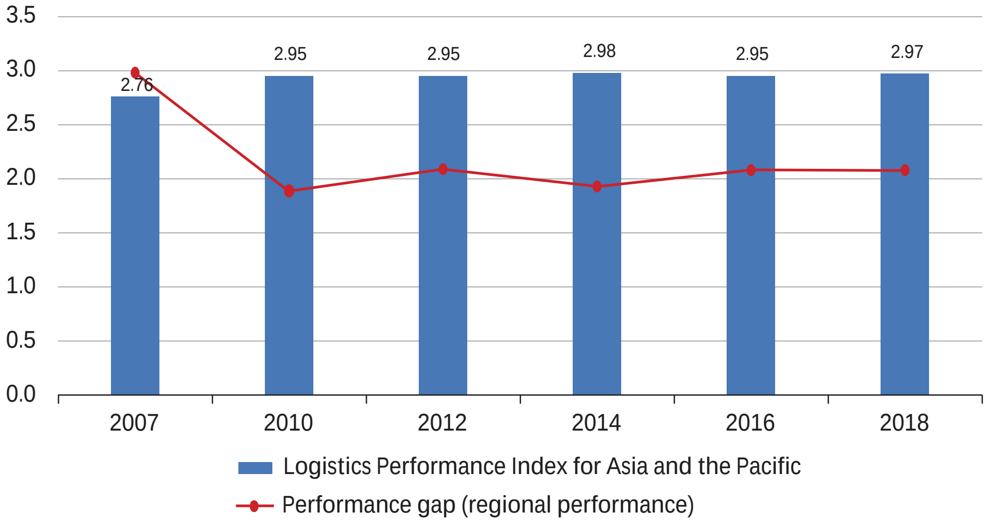
Asia is expected to continue to lead the world in average annual air cargo growth, with domestic China and intra-East Asia markets projected to expand by 6.3% and 5.8% per year, respectively.[31] Supported by faster-growing economies and rising middle classes, the East Asia-North America and Europe-East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

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

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).

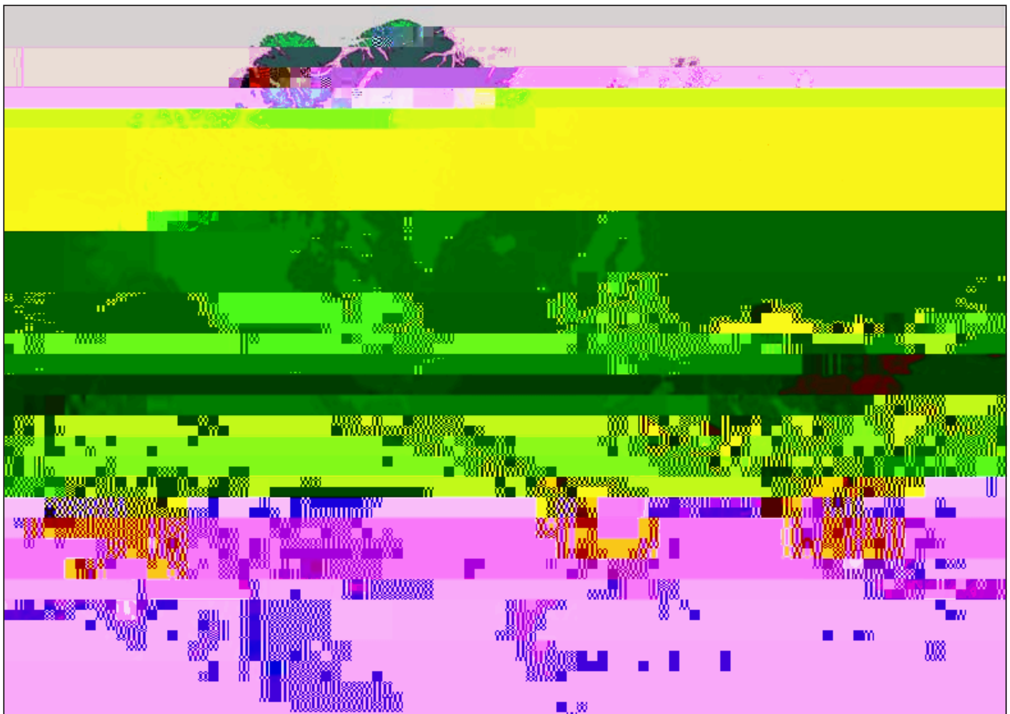
Figure 1.15. Logistics Performance Index, 2007-2018, performance gap (regional performance)



: 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)



: OECD/ITF (2019). Provided to ESCAP and reproduced as intact.

: 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.

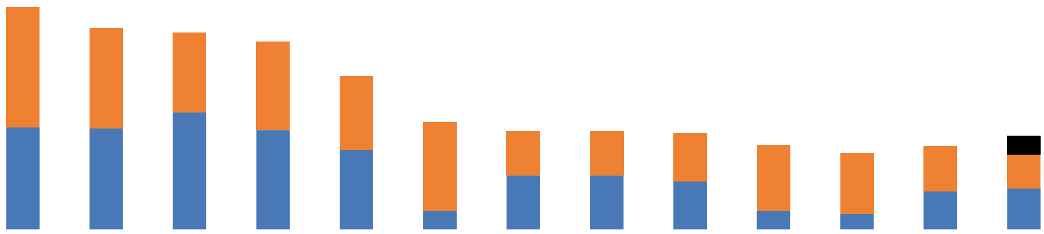
The regional average based on the International Transport Forum connectivity index also indicates that subregional variations are masked, as East and North-East Asia drive up the overall regional performance (figure 1.17).

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.

In the aviation sector, according to the *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).

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

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



: 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 , 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]

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

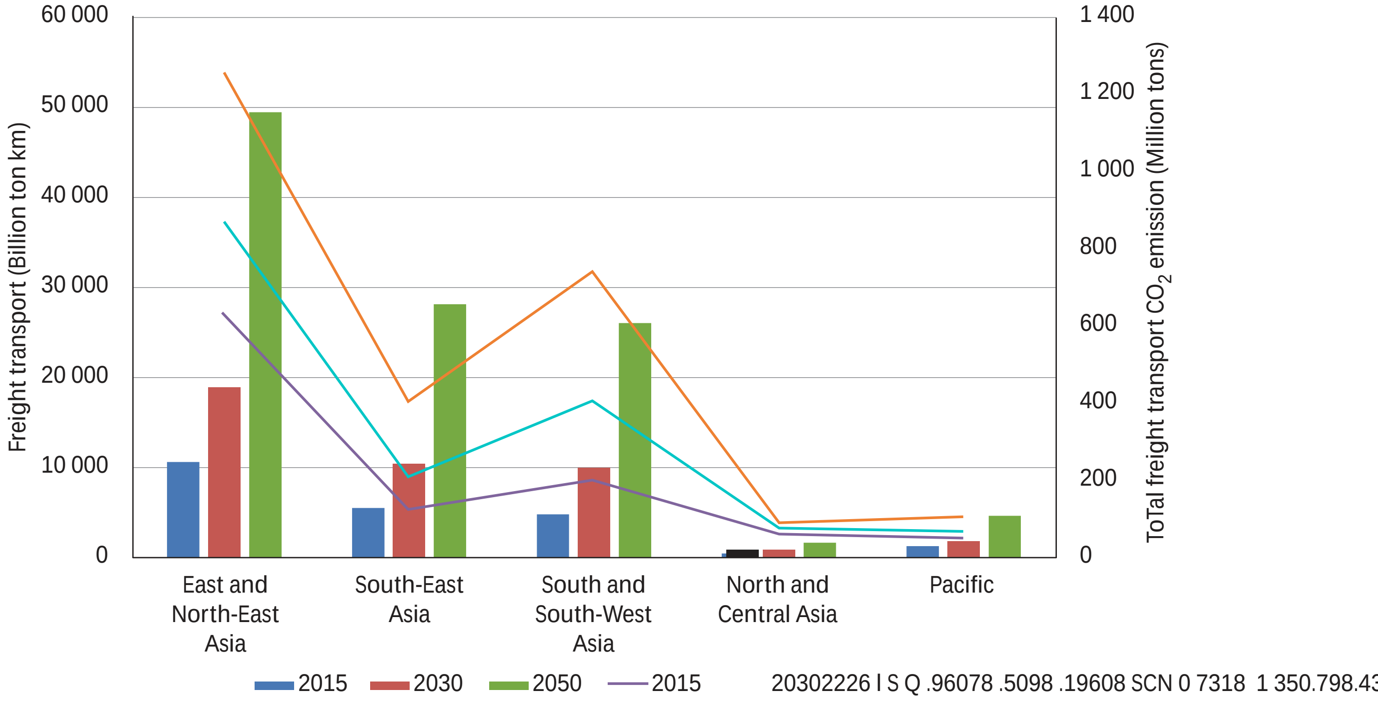
The overall connectivity landscape supports the assertion that the region is constantly improving in terms of connectivity and that significant progress has been achieved in the past 20 years. The data, however, also strongly point towards the need to drastically reassess regional policies to address 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]

[38] See 38

In addition, increasing pressures resulting from the transport sector continuing to be a leading contributor to

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



: 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]

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.

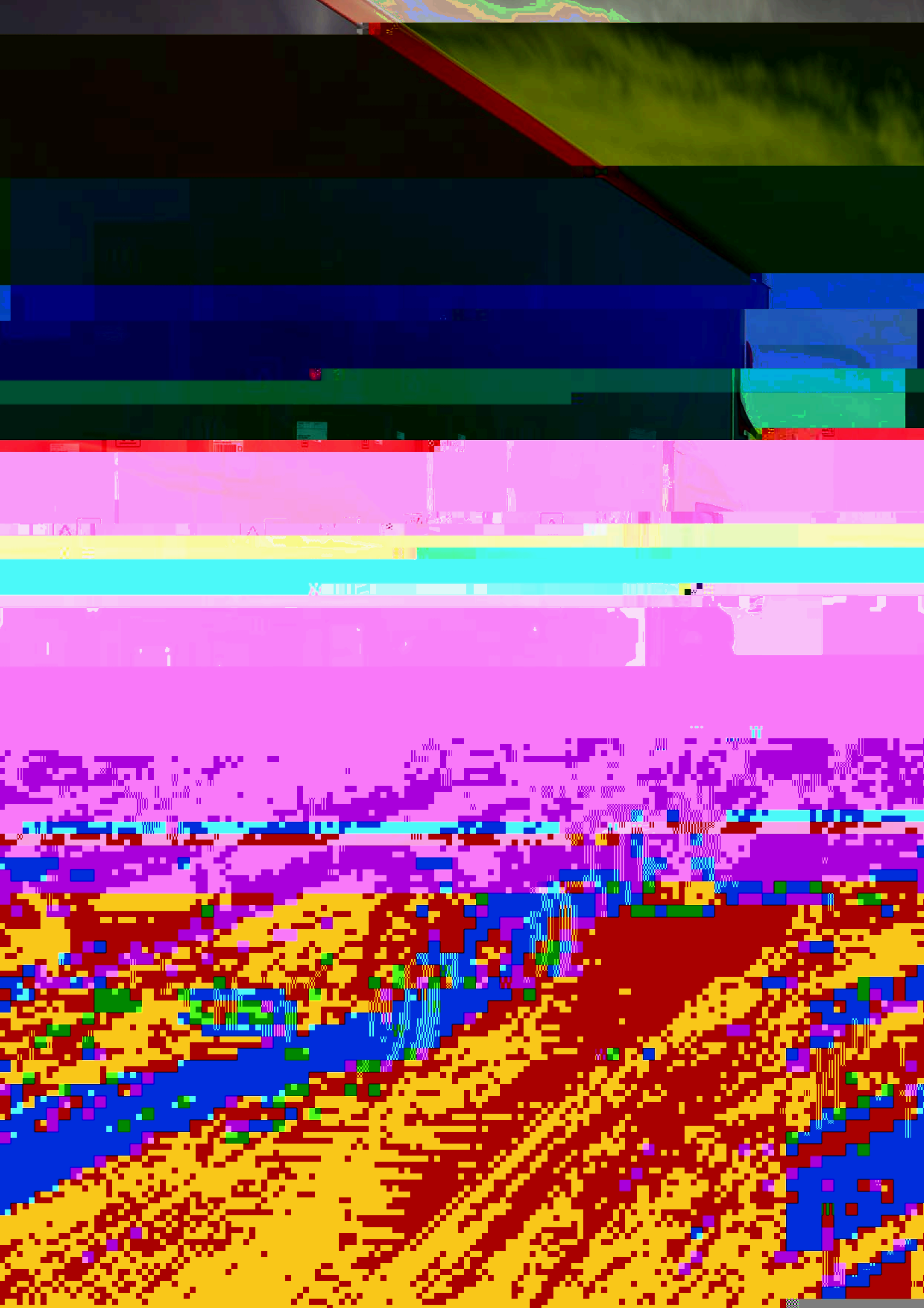
It is, by and large, undisputed that road transport has numerous advantages over other modes of transport because of its flexibility, routes and timings that can be adjusted to individual requirements without much inconvenience. While the increasing focus on sustainability has prompted many ESCAP member 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



CHAPTER

2

LAND TRANSPORT CONNECTIVITY IN ASIA AND THE PACIFIC

mong 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

Figure 2.2. Asian Highway length and density by subregion

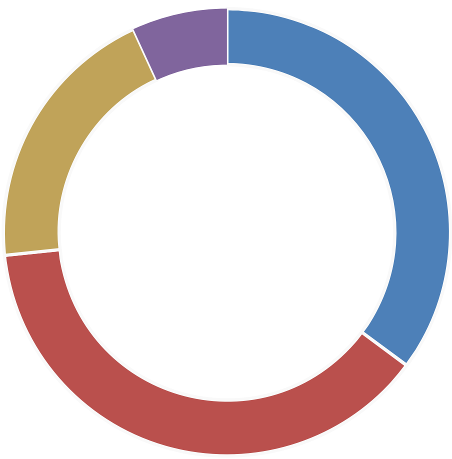
: Calculated based on ESCAP Asian Highway Database and the World Bank's Database. Note: These calculations include the 15,400 kilometres in China.

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



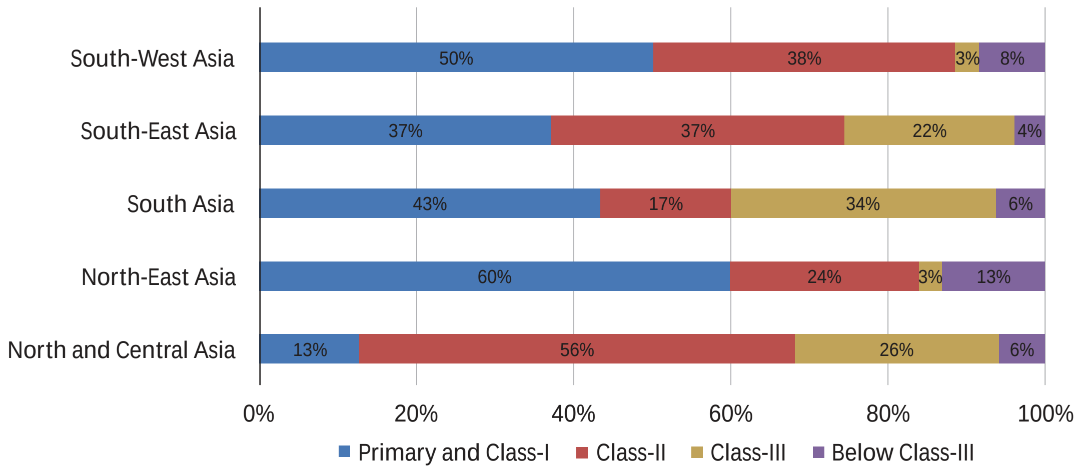
: ESCAP, Asian Highway Database, 2019.
(https://www.unescap.org/our-work/transport/asian-highway/database).

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

[illegible]

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



: 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.

to a network of 10,000 kilometres of toll roads by the end of 2021.[81] In Kyrgyzstan, ADB is allocating $78 million to comp0 0 of 2021.

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) - : 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) - *:* 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) - *:* 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

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

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

[illegible]

[illegible]

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

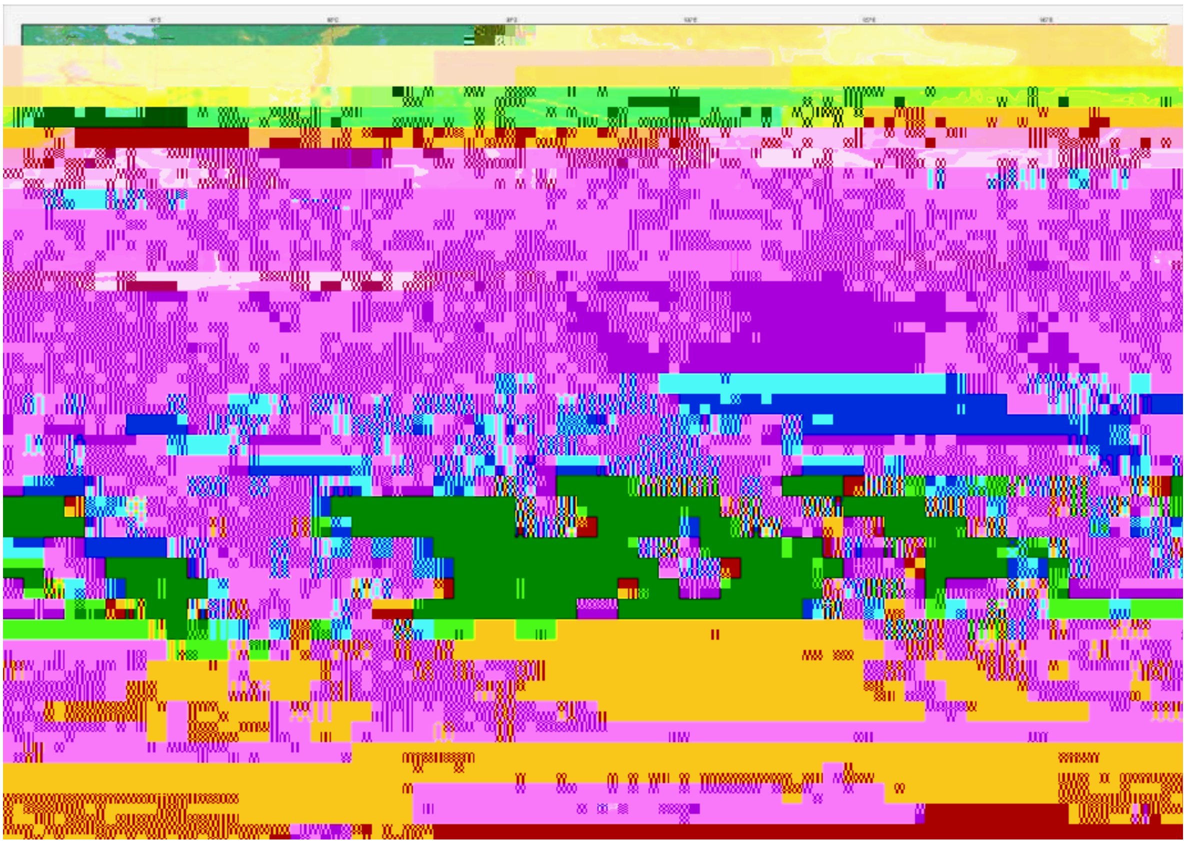


Table 2.1. Trans-Asian railway network: missing links by subregion

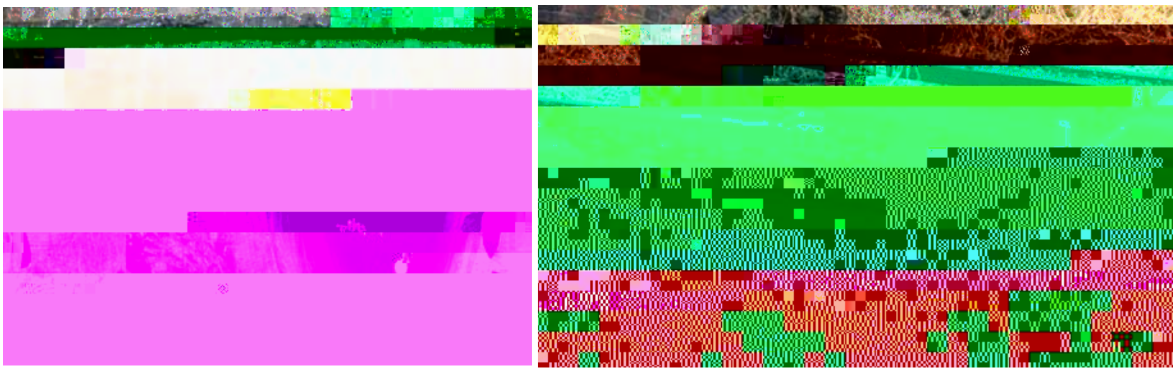
[illegible]	[illegible]	[illegible]
[illegible]	4 763	38
[illegible]	346	3
[illegible]	1 405	12
[illegible]	3 396	27
[illegible]	3 495	20
[illegible]	12 405	

: 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



: 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.

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:

F ˀ C ˀ : 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 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.

C z ĩ : 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.

E ĩ : 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.

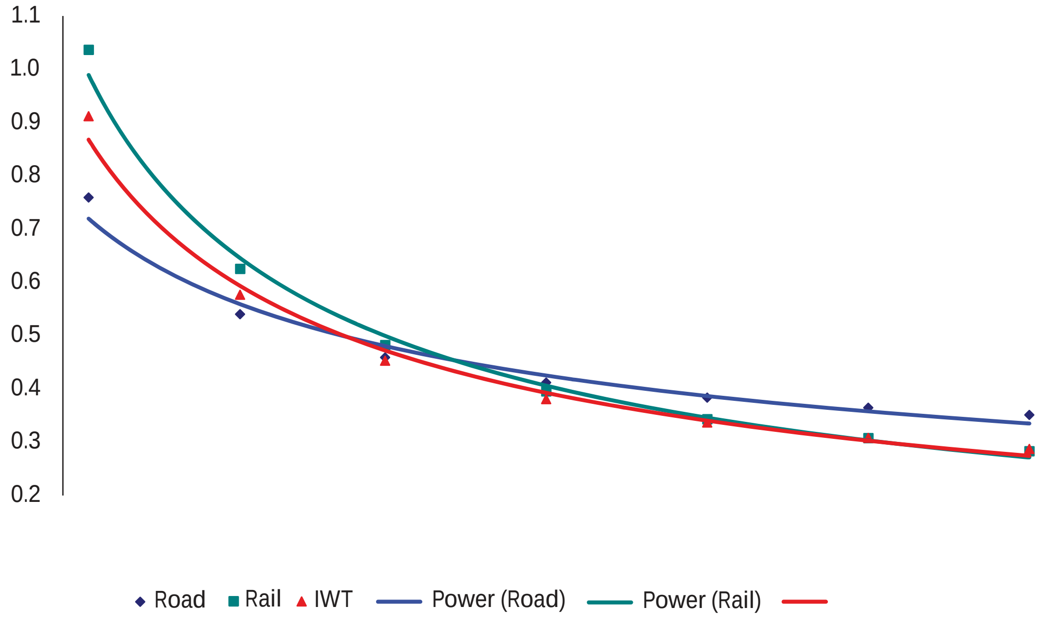
The most important change required pertaining to rail freight, is to establish its role as part of the overall logistics solution.[104] The railways traditionally had captive markets in mining and movement of bulk products mainly owned by public sector. Assured captive markets led railways to focus more 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

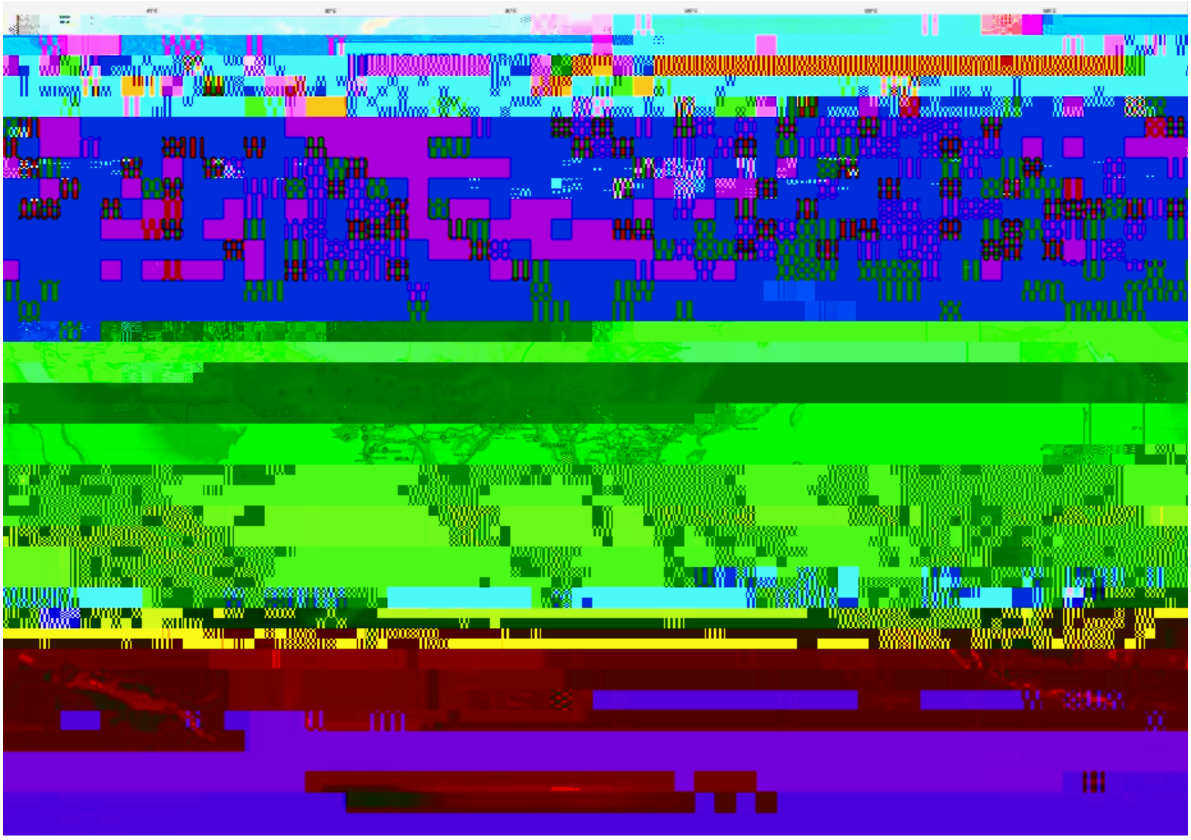
Railways in North America have attracted many customers by partnering with third party logistics providers, such as United Parcel Service. In turn, these companies have benefited by providing lower costs to the customers. Analysis of the logistics chain and understanding of how railways could offer door-to-door 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

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



*: 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.



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.

L :

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

Table 2.3. Potential dry port locations in Thailand

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	East	64	78
[illegible]	North-East	450	500
[illegible]	North-East	264	315
[illegible]	North	252	390

: 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

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.

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.

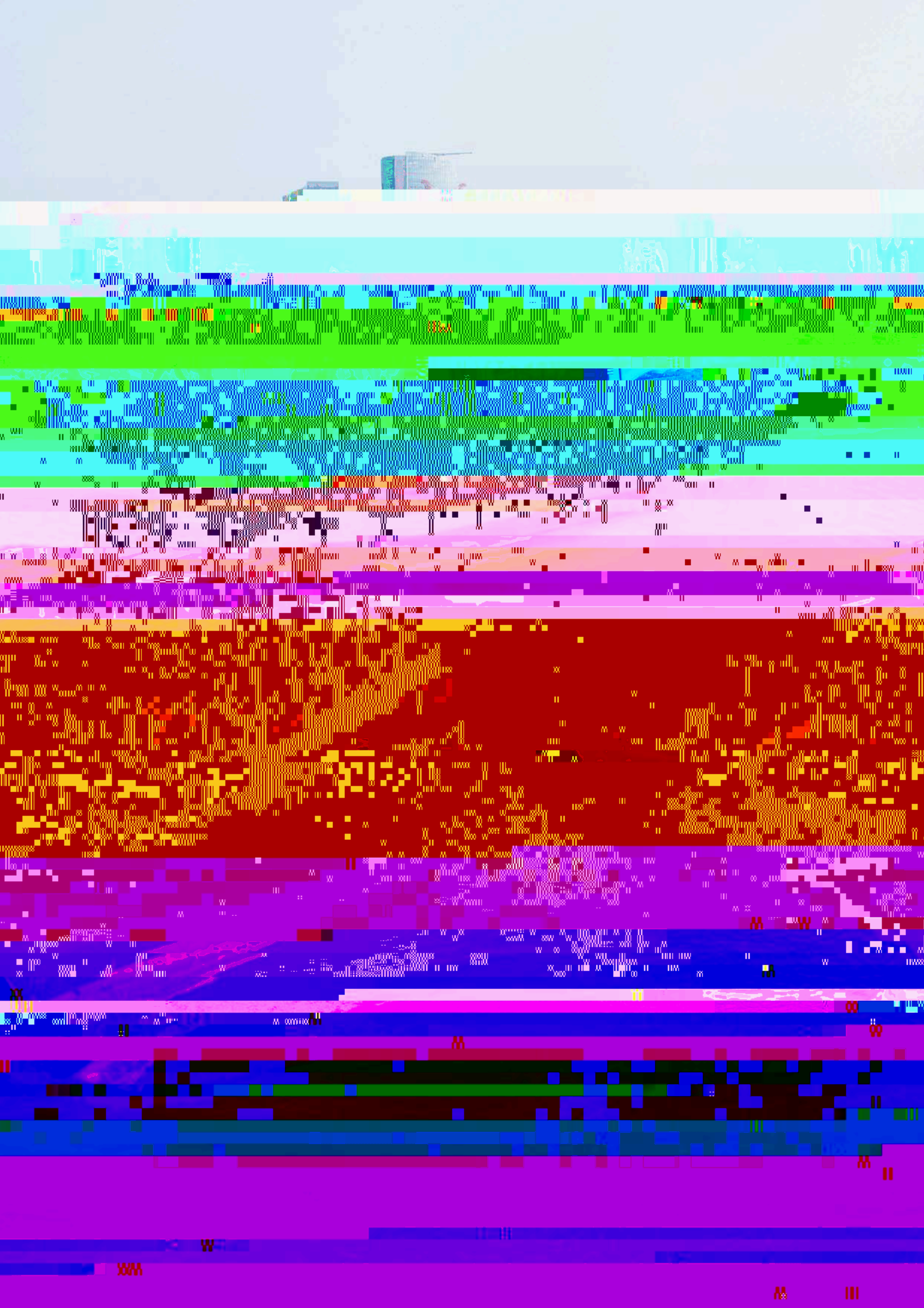
Regarding the development of efficient intermodal transport at large, the complexity of modern supply chains, along with the multiplicity of actors with different interests, make the provision of effective, reliable and transparent institutional arrangements with the task of governing related issues across ministries, transport

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.



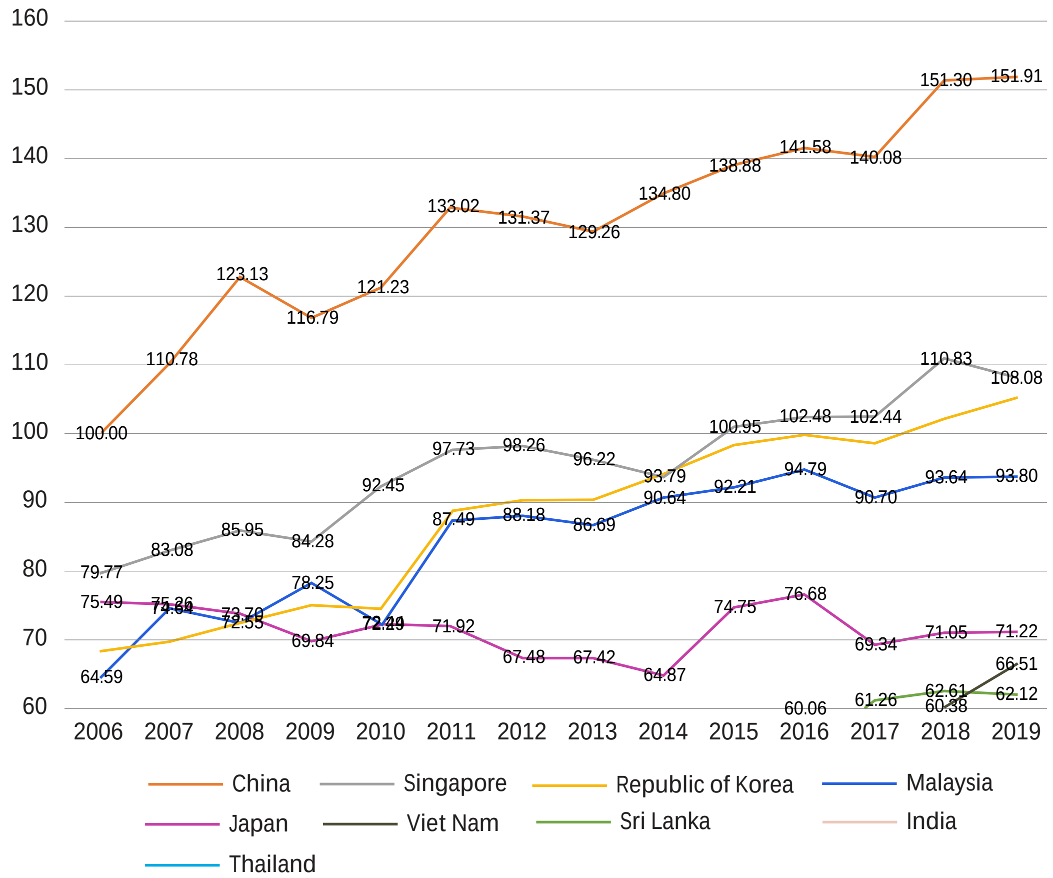
Consequently, countries with hub ports or regional gateway ports or shippers close to these ports can conveniently use competitive services provided by shipping companies at reasonable prices, while for regions or islands far from the main routes, the services are relatively unstable and users are forced 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



: Liner Shipping Connectivity Index, UNCTAD, 2019.

Asian economies in the development stage often adopt development strategies involving the import of raw

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.

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]

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 capacity10 0 0fnq750

Ammedicns
fInymprnciplr,
t, butfllonins alsoinfalu
frect the csht of ms

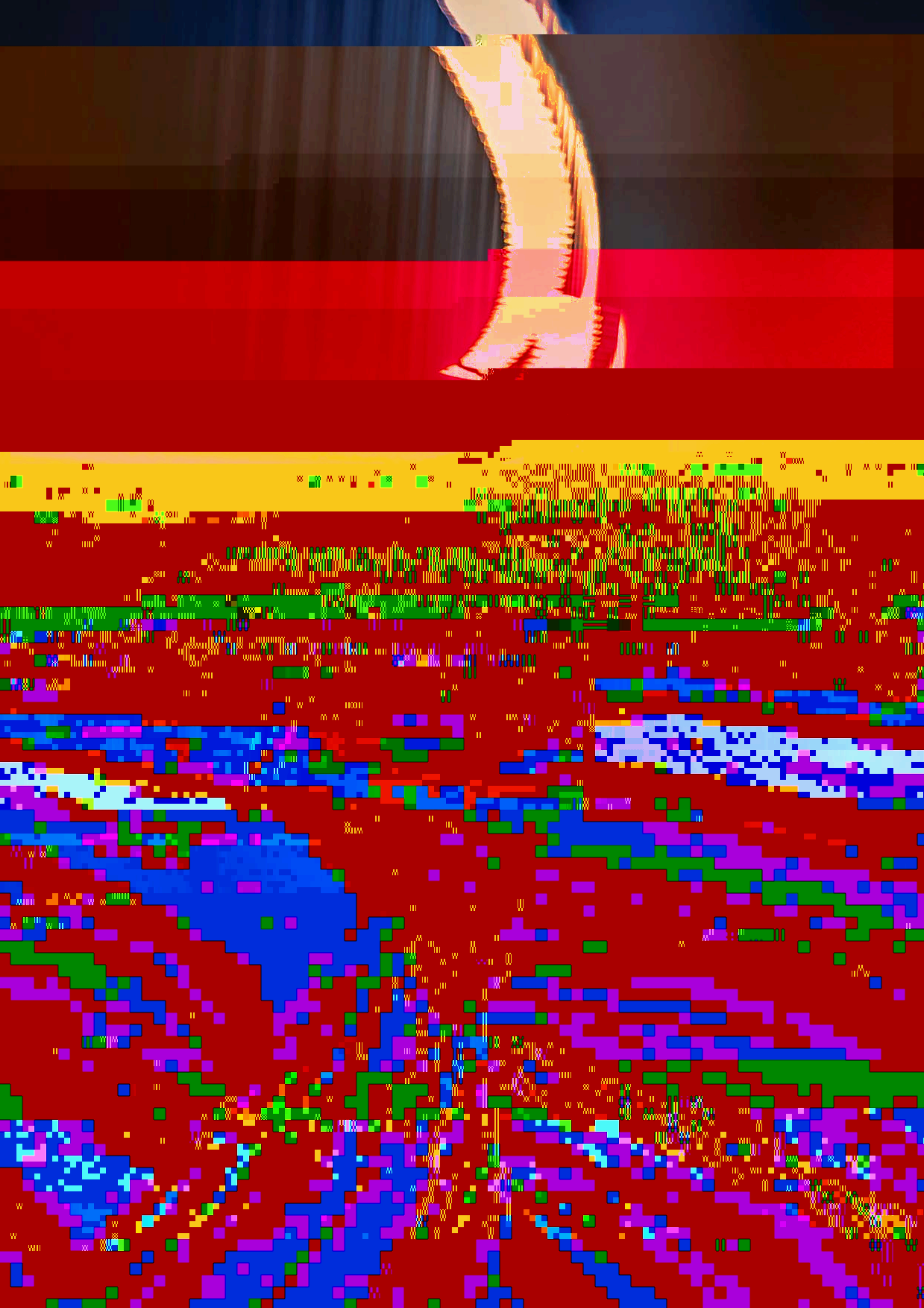
Ekaterinburg, and St. Petersburg. Domestic air cargo traffic in China accounts for an estimated 8.9% of the world's total air cargo traffic by tonnage but only about 2.6% of the world market in ton-kilometres. At 4.6 million tons transported annually, the country's domestic air cargo market is second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

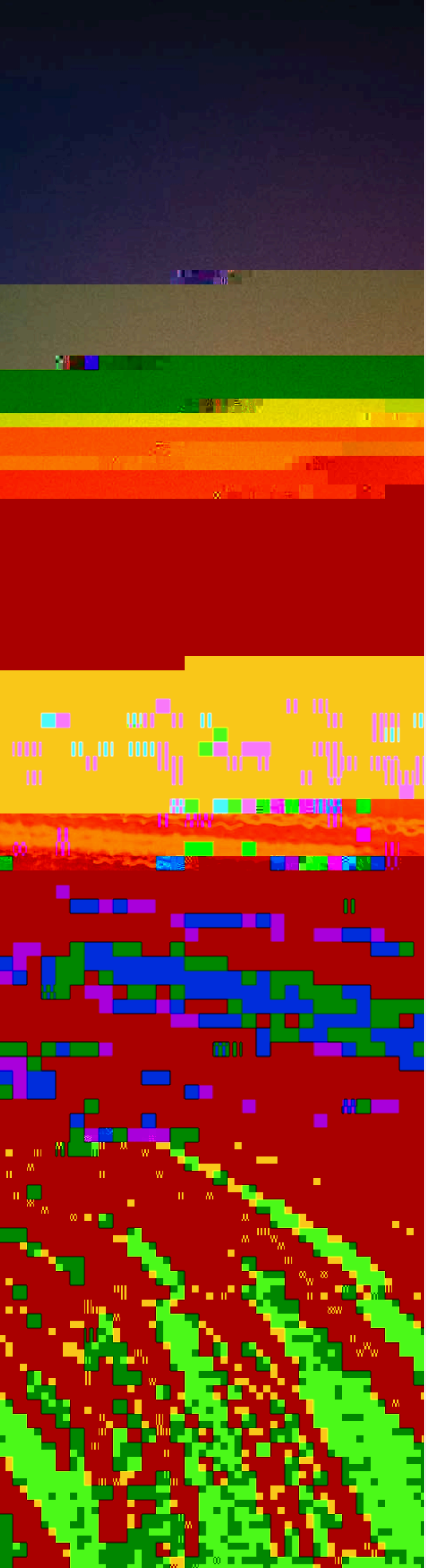
B. Emerging trends, challenges and opportunities for air freight in Asia and the Pacific

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 scheme, 66 States (representing 86% of the aviation industry) have committed to cap carbon emissions at

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





CHAPTER

4

DRIVERS OF TRANSITION TO SUSTAINABLE FREIGHT TRANSPORT

onnectivity 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.

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.

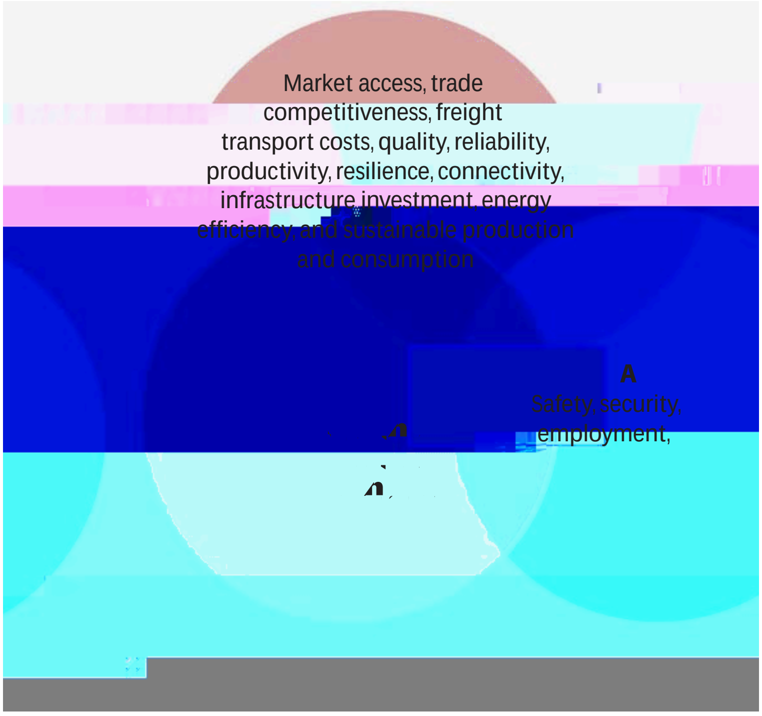
Against this background, the present chapter begins with an overview of what is sustainable freight transport and the approaches and considerations beyond transport connectivity that affect its attainment. The chapter then contains a discussion on how technology and innovation can contribute to sustainable 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.

Figure 4.1. Sustainable freight transport and the triple bottom line



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.

[150] L. Tavasszy and M. Piecyk "Sustainable freight transport" , 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.

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.

O [ic, . [t/ifyiR7nting dier2 ed tacue.aweighping

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 .[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.

[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, (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:

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

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.

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]

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)

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.

Figure 4.2. Automation potential of select mobility-related occupations

: 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

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.

: 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/.

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, 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

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:

- [illegible] 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.
- [illegible]: 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.
- [illegible] 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.
- [illegible] 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

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]

4.5. Takeaway from chapter 4

The discussion in this chapter builds on the previous discussion by contending that sustainable freight

> **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.**

he 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.

he 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

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.

REFERENCES AND RESOURCES

1. “Autonomous trucks on public roads in Singapore”. Available at:

[redacted]

20. 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.

21. B. Aritua, (Washington, D.C., World Bank Group, 2018).

22. 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.

23. B. Puri, “Sustainable Transport and the intermodal mix”, Transport and Communications Bulletin for Asia and the Pacific No. 87, (Bangkok, ESCAP, 2017).

24. B. Shepherd, A. Shingal and A. Raj, “Value of air cargo: air transport and global value chains”, IATA (2016).

25. 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.

26. Boeing, “World Air Cargo Forecast, 2018-2037”. Available at https://file.veryzhun.com/buckets/carnoc/keys/3fa55da709101d0d937e78732a88cd9d.pdf.

27. 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.

28. 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.”, , vol. 132, No. 3, (2006).

29. 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.

30. Cambodia, Ministry of Public Works and Transport, “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.

31. Caribbean Development Bank, “Air transport competitiveness and connectivity” (2018).

32. Container Corporation of India Ltd. Available at: http://www.concorindia.com/map.asp.

33. Daily Sabah, “Trilateral deal on Baku-Tbilisi-Kars railway to augment freight transportation”, 8 May 2019.ectivity” (201

41. European Automobile Manufacturers' Association (ACEA), Platooning, roadmap. Available at: https://www.acea.be/uploads/publications/Platooning_roadmap.pdf

42. Federal State Statistic Service. Available at: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/enterprise/transport/

43. Florida Department of Transportation, "Commercial vehicle operations". Available at https://www.fdot.gov/traffic/traf-incident/cvo.shtm.

44. 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.

45. Golden Quadrilateral Highway Network Map. Available at: https://www.mapsofindia.com/roads/golden-quadrilateral.htm.

46. 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.

47. H. Gokcekus and G. Gelete, "The economic impact of climate change on transportation assets", , vol. 1, No. 1, (2018).

48. 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.

49. 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).

50. 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.

51. I. Docherty, G. Marsden and J. Anable, "The governance of smart mobility", *A:* , vol. 115 (2018), pp. 1Association (ACEA), PlatoonintErsden , Advisory

64. 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).

65. Korea Shipping Association, “2012 International Symposium: The Future of Shipping Industry”, (2012).

66. L. Tavasszy and M. Piecyk “Sustainable freight transport” , vol 10, No. 10. pp. 1-4 (2018).

67. Levina, “Central Asia improves ailing road infrastructure”, *A* , 10 June 2018. Available at https://www.timesca.com/index.php/news/26-opinion-head/19855-central-asia-improves-ailing-road-infrastructure.

68. Liner Shipping Connectivity Index. Available at: https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92

69. M. Chui, J. Manyika, and M. Miremadi, “Where machines could replace humans—and where they can’t (yet)”, , July (2016). Available at https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet.

70. M. 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).

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

72. Ministry of National Economy of the Republic of Kazakhstan, Statistics committee. Available at: http://stat.gov.kz/official/industry/18/statistic/7.

73. 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.

74. Ministry of Transport of the Russian Federation, “On approving a new version of the Transport Strategy of the Russian Federation up to 2030”. Available at: http://government.ru/en/dep_news/13191/

75. Mordor Intelligence LLP, “Air Freight Industry: growth, trends and forecast (2019-2024)”, (2019).

76. Morgan Stanley, “Blockchain in freight transportation: early days yet but worth the hype” (2017).

77. National Bureau of Statistics of China, *2018*, (Chinese Statistics Press (2018).

78. O. Merk, and T. Notteboom, “Port hinterland connectivity”, International Transport Forum Discussion Papers, No. 2015/13 (Paris, OECD Publishing, 2015).

79. Organization for Economic Cooperation and Development, International Transport Forum, “Enhancing connectivity and freight in Central Asia”, International Transport Forum Policy Papers, No. 71 (Paris, OECD Publishing,2019).

80. Organization for Economic Cooperation and Development, International Transport Forum, “Towards road freight decarbonisation: trends, measures and policies”, ITF Policy Papers, (OECD Publishing, Paris, 2018).

81. Organization for Economic Cooperation and Development, International Transport Forum,” ITF Transport

130. 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/

131. 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.

132. World Maritime University, *2040: A* , , (2019). “Available at www.wmu.se/docs/transport-2040-future-work.

133. 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.

134. World Population Review, Asia Population 2019. Available at: http://worldpopulationreview.com/continents/asia-population/.

135. World Shipping Council, “Top 50 world container ports”. Available at www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports

136. 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.

137. 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.

Review of

Sustainable Transport Connectivity

Asia and the Pacific