Regional Road Map

to Support Regional Cooperation for the Wider Deployment of Sustainable Smart Transport Systems in Asia and the Pacific

ESCAP
Economic and Social Commission for Asia and the Pacific

*The shaded areas of the map indicate ESCAP members and associate members.**

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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. As the largest regional intergovernmental platform with 53 Member States and nine 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.

The ESCAP office is located in Bangkok, Thailand. Please visit the ESCAP website at www.unescap.org for further information.

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Executive Summary

Transport is essential for global economic and social development, especially in the Asia-Pacific region. However, its rapid expansion in the region has posed challenges, due to continued urbanization and motorization which increase negative externalities such as congestion, pollution, greenhouse gas emissions and road accidents. In response to transport challenges and other wider global issues, the 2030 Agenda for Sustainable Development, comprising 17 Sustainable Development Goals (SDGs), was adopted by the United Nations in 2015 focusing on achieving global sustainable development. Although transport issues are not directly allocated to a specific SDG, it plays a vital role in sustainable development by contributing to other SDGs such as improved health, energy efficiency, infrastructure development, economic growth, and liveable communities.

In furthering this agenda, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) prioritized the creation of a regional road map to support regional cooperation for the wider deployment of sustainable and resilient smart transport systems in Asia and the Pacific. The project was initiated through the Regional Action Programme for Sustainable Transport connectivity in Asia and the Pacific, phase I (2017–2021) which emphasizes the role of smart transport systems to achieve transport-related SDGs and align with the net-zero targets of the Paris Agreement.

Smart transport systems have been recognized as an essential enabler for sustainable transport goals, in that they digitize the transport ecosystem and enhancing transport efficiency, safety, and connectivity by reducing congestion and environmental impacts in accordance with the requirements of SDGs 7, 9, 11 and 13 amongst others. However, their wider deployment remains challenging as it requires robust policies, strategies and region-wide planning and architectures. Implementing these measures is crucial to support the region's progress towards sustainable and resilient smart transport systems and sustainable development.

Smart transport systems are an advanced integration of diverse technologies that enhance transport sustainability and are bolstered by expanding mobile services and internet connectivity across the region. ESCAP have categorised them specifically as Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Advanced Public Transport Systems (APTS), Commercial Vehicle Operations (CVO) and they include new emerging technologies such as autonomous vehicles, cooperative-ITS, connected vehicles, smart mobility, and Mobility-as-a-Service (MaaS). These technologies have promoted a paradigm shift from "transport" to "mobility" which focusses on individual travel needs while concurrently minimizing environmental impacts. This shift has been driven by interconnected digital technologies that offer seamless and user-oriented mobility services which are supported by significant improvements in automation and AI, the continued expansion of Big Data, and 5G and IoT wireless networks. In supporting this shift, ESCAP Transport Division is well positioned as an intergovernmental platform in the Asia-Pacific region. It works towards achieving regional cooperation and collaboration with various stakeholders for smart transport systems, and has many past achievements and on-going activities relating to regional policy frameworks, intergovernmental agreements, resolutions, and initiatives.

Well-directed policies and regional cooperation are crucial to achieve regional and global agendas on transport issues. ESCAP Transport Division's regional road map aims to promote wider deployment of smart transport systems, ensure sustainable transport in Asia and the Pacific, and contribute to the region's resilience and response to climate change. The regional roadmap has evolved over a period of time and valuable points from previous smart transport-related projects have also been used in its development.

Despite the ambitious vision for wider smart transport deployment, several roadblocks impede their development. Following research into the smart transport status, needs and priorities of Member States, fourteen issues were identified including current environmental and safety threats, a lack of awareness and understanding, the preparedness for a new mobility paradigm, technical expertise and institutional capacity, political will and regulatory foundations, harmonised policies, stakeholder cooperation and collaboration, fundamental transport infrastructure, digital technology constraints, connectivity and integration for intermodal and multimodal transport systems, data protection and use of Big Data, funding hurdles and the impact of the COVID-19 pandemic.

In addressing these issues and needs, ESCAP Transport Division has offered to facilitate the implementation of five critically relevant strategies. Under each strategy, several priority policy plans aligned with achieving the SDGs and the Paris Agreement are identified. They serve as a unified pathway for the wider adoption of smart transport while supporting the development of national policies and strategies. The strategies and corresponding policy plans include:

STRATEGY 1 **Connectivity – Reaching anywhere**	**POLICY PLAN 1-1:** Establish a dedicated cooperation mechanism for smart transport systems
	POLICY PLAN 1-2: Foster a dialogue with all stakeholders to forge international cooperation
STRATEGY 2 **Integration – Moving as one**	**POLICY PLAN 2-1:** Facilitate the integration of technical compatibility and interoperability with special attention to emerging technologies
	POLICY PLAN 2-2: Integrate road, maritime and rail transport
STRATEGY 3 **Inclusiveness – Access for all**	**POLICY PLAN 3-1:** Strengthen capacity building, training and raising awareness
	POLICY PLAN 3-2: Deepen institutional and regulatory foundations
	POLICY PLAN 3-3: Increased support for tailored policies for vulnerable groups and areas
STRATEGY 4 **Affordability – Withstanding burdens together**	**POLICY PLAN 4-1:** Facilitate a creative funding initiative
	POLICY PLAN 4-2: Upscale analytical work with particular development of assessment tools
STRATEGY 5 **Resiliency – Prepared for what may come**	**POLICY PLAN 5-1:** Make more environmentally friendly and safer mobility services
	POLICY PLAN 5-2: Ensure data security and the use of Big Data in transport
	POLICY PLAN 5-3: Be ready for unexpected disruption

In furthering these strategies, ESCAP Transport Division can play a vital role in supporting sustainable smart transport systems through enhancing technical expertise and capacity, fostering intergovernmental cooperation and collaboration, providing localize smart transport systems, and keeping current with evolving technical trends in smart transport systems and producing related knowledge products.

As a way forward, proactive actions are presented using previously determined goals, strategies, and implementable policy plans applicable for the short and long-term. Short term goals focus on connectivity, integration, inclusiveness, and affordability strategies, with plans to establish dedicated cooperation mechanisms, foster international dialogues, facilitate technical compatibility, and promote capacity building, funding initiatives and upscaling analytical work. Long term goals have a shift towards integration, inclusiveness and resilience strategies, with greater integration of different transport modes, deeper institutional and regulatory foundations, increase tailored policy supports for vulnerable groups and areas, resilient and environmentally friendly mobility services, data security and utilization of Big Data, and preparedness for unexpected disruptions.

It is expected that this regional road map optimizes the use of digital technologies, with a focus on harmonizing policies and strategies, promoting regional cooperation, addressing challenges for wider deployment, while remaining flexibility to the status, needs and challenges of Member States. It also aims to foster connectivity, integration, inclusiveness, affordability, and resiliency in the transport sector, guided by good governance and institutional effectiveness, to ultimately contribute to the region's sustainable development goals.

Contents

Figures and tables

Acronyms and abbreviations

5G	Fifth Generation of Wireless Cellular Technology
AI	Artificial Intelligence
APTS	Advanced Public Transport Systems
ASEAN	Association of Southeast Asian Nations
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
CO_2	Carbon Dioxide
COP 27	27th Conference of the Parties
CVO	Commercial Vehicle Operations
ESCAP	Economic and Social Commission for Asia and the Pacific
GHG	Greenhouse Gas Emissions
IoT	Internet of Things
ISO/TC 204	International Organization for Standardization Technical Committee 204
ITS	Intelligent Transport Systems
MaaS	Mobility-as-a-Service
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything

Chapter 1

What brings us here?

1.1 Background

The 17 Sustainable Development Goals (SDGs) and 169 targets of the 2030 Agenda for Sustainable Development were adopted by the 193 Member States of the United Nations in September 2015.[1] The SDGs are people-centred, universal, transformative and integrated, and are a call for action by all Member States to end poverty, progress economic development, and resolve social issues while curbing climate change.[2]

FIGURE 1 Sustainable Development Goals

Source: United Nations [Undated]. Communications Materials.)

Initially recognized at the United Nations Earth Summit in 1992, the role of transport in sustainable development was further acknowledged by the UN General Assembly's special session in 1997.[3]

Although no SDGs are directly dedicated to transport, sustainable transport is integral to those addressing improved health, reduced energy consumption, improvements to infrastructure, environment, economic growth, and liveable cities and communities. Goals 7, 8, 9, 11 and 13 are just a few examples of SDGs that are linked to transport.

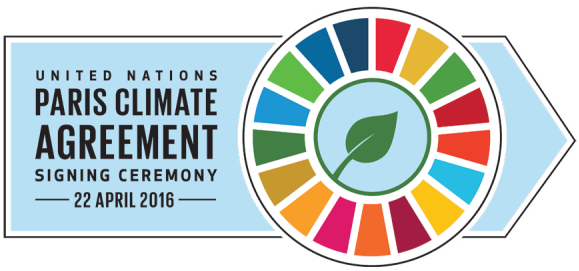
In November 2022, government representatives from around the world gathered again for the 27th Conference of the Parties (COP 27) to the United Nations Framework Convention on Climate Change (UNFCCC) to discuss climate change issues. The Paris Agreement is a legally binding international treaty which was created in 2015 in the 21st session of UNFCCC to tackle climate change and its negative impacts. At present, 194 Parties (193 States and the European Union) have joined this Agreement to significantly reduce greenhouse gas emissions and maintain a global temperature increase below 2°C and even closer to 1.5°C.[4] Given that the Agreement targets a net-zero carbon emissions world, the implementation of the

1 United Nations Sustainable Development Goals,. "The Sustainable Development Agenda". Available at https://www.un.org/sustainabledevelopment/development-agenda-retired/ (Accessed on February 7, 2023)
2 Ibid
3 United Nations Department of Economic and Social Affairs, "Sustainable Transport". Available at https://sdgs.un.org/topics/sustainable-transport (Accessed on February 7, 2023)
4 United Nations Climate Action, "The Paris Agreement". Available at https://www.un.org/en/climatechange/paris-agreement (Accessed on February 7, 2023)

Agreement interweaves throughout the SDGs. While Goal 13 directly calls for climate actions, Goal 7 on affordable and clean energy and Goal 12 on responsible consumption and production are also essentially related to the Agreement. Furthermore, climate solutions can also influence the attainment of other Goals.

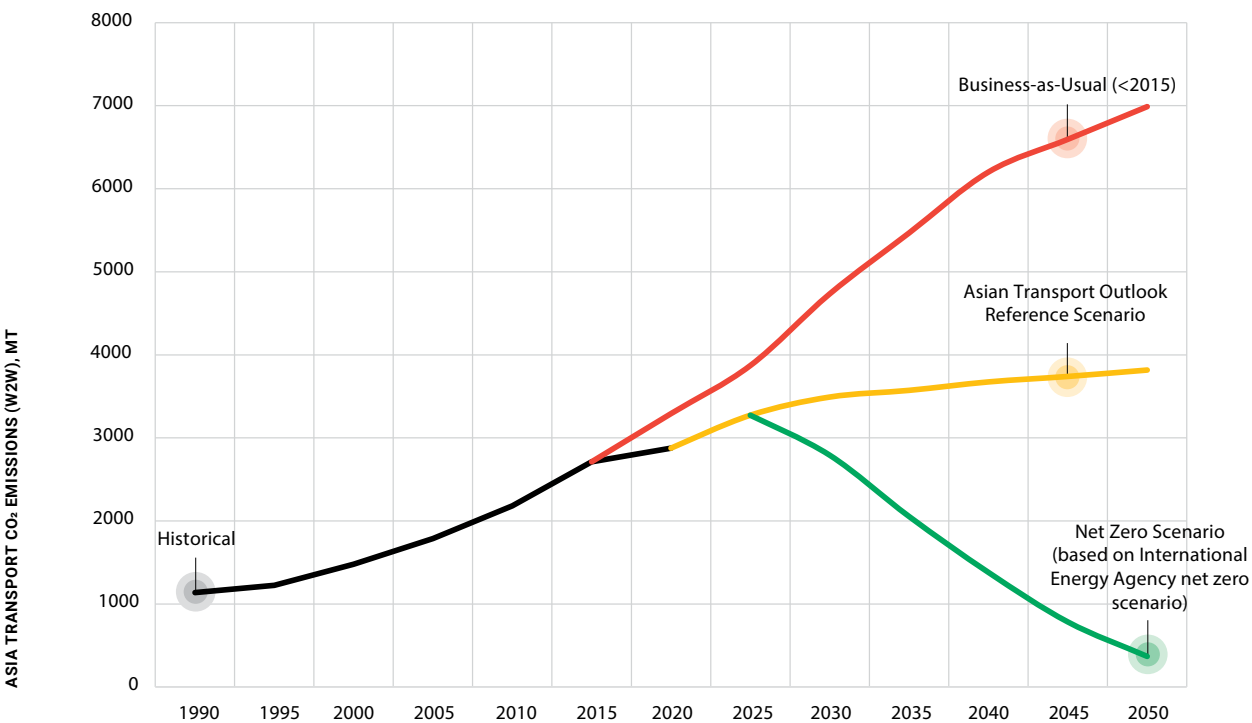
Within the context of the Asia-Pacific region, which has faced a daunting assortment of issues that block the achievement of the SDGs, it is evident that transport is one of the biggest threats for sustainable development. The growing population in urban areas is a main contributor to this threat. By 2050, forward population projections in Asia show that 66.2 per cent of the total population will live in urban areas, compared with 51.1 per cent in 2020.[5] More inhabitants demand more transport services, and the increasing rate of motorization provides a clear indication that the overall travel demand is also rising. In 2030, vehicle ownership will become as high as 1.6 billion in Asia and the Pacific.[6]

FIGURE 2 The Paris Agreement and SDGs



Source: United Nations. [2016]. Climate Action. https://www.un.org/sustainabledevelopment/parisagreement22april/.)

FIGURE 3 Trend of Transport CO_2 Emissions in Asia



Source: Asian Transport Outlook. [2021]. A New Perspective on Transport and Climate Change, as cited in Asian Transport Outlook. [2022]. Tracking Transport and Climate Change Indicators in Asia and the Pacific 2000-2020.)

5 United Nations Human Settlements Programme, *World Cities Report 2022: Envisaging the Future of Cities*. (Nairobi, 2022). Available at https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf (Accessed on February 7, 2023)

6 Asian Transport Outlook, *Asian Transport 2030 Outlook*.(Manila, 2022) Available at https://asiantransportoutlook.com/analytical-outputs/asian-transport-2030-outlook/ (Accessed on February 7, 2023)

Given that climate change remains a top priority in the Asia-Pacific region, transport is considered a major producer of CO_2 emissions, as a result of increased vehicle ownership and urbanization. The overwhelming evidence on this issue predicts CO_2 emissions from the transport sector in Asia to grow at a 1.5 per cent annual rate producing 3.5 Gt in 2030, compared with 2.9 Gt in 2018.[7] The demands on transport dropped due to global COVID-19 restrictions in 2020 but rebounded in 2021, resulting in an 8 per cent rise in transport CO_2 emissions compared with the previous year.[8] Without remedial actions, the increasing demands of transport could hinder the goal of sustainable development in Asia and the Pacific.

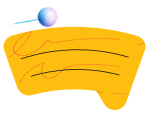
Noting this trend, "transport" was selected in the Regional Road Map by the Economic and Social Commission for Asia and the Pacific (ESCAP) in 2017 as a significant thematic focus area to implement the SDGs over Asia and the Pacific. More importantly, ESCAP Transport Division has conducted the Ministerial Conference on Transport since 2006. In addition, the fourth session of the Ministerial Conference on Transport in December 2021 recently adopted the Ministerial Declaration on Sustainable Transport Development in Asia and the Pacific and a new Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022-2026). Following this, ESCAP adopted Resolution 78/3 on the Implementation of the Ministerial Declaration on Sustainable Transport Development in Asia and the Pacific at its seventy-eighth session in 2022.[9]

Smart transport systems, previously known as intelligent transport systems, were first recognized as an important entity in the third session of the Ministerial Conference on Transport to increase the efficiency, safety and effectiveness of transport systems.[10] In response to this mandate, the first regional meeting of intelligent transport systems was held in April, 2019. The lack of adequate overarching strategies and plans for developing region-wide and interconnected services was recognized at the meeting as a key factor hindering the wider deployment of smart transport systems in Asia and the Pacific.

FIGURE 4 Ministerial Conference on Transport, Fourth Session

Source: ESCAP [2021]. Ministerial Conference on Transport, Fourth Session.

As smart transport systems play an important role in the move towards sustainable transport, their roles to achieve transport-related SDGs and net-zero targets from the Paris Agreement were significantly expanded in the Declaration at the fourth session of the Ministerial Conference on Transport.



"Noting that continued progress in the area of automotive and smart transport systems could improve transport connectivity, traffic efficiency, users' convenience and road safety, including through the progressive development of highly and fully automated vehicles, smart mobility and other technologies." [11]

7 Ibid
8 IEA, "Energy System: Transport". Available at https://www.iea.org/reports/transport (Accessed on February 7, 2023)
9 ESCAP, *Ministerial Declaration and Regional Action Programme for Sustainable Transport Development in Asia and the Pacific 2022-2026*. (Bangkok, 2022) Available at https://www.unescap.org/kp/2022/ministerial-declaration-and-regional-action-programme-sustainable-transport-development (Accessed on February 7, 2023)
10 Ministerial Declaration on Sustainable Transport Connectivity in Asia and the Pacific, document E/ESCAP/MCT(3)/11
11 Report of the Fourth Ministerial Conference on Transport, document ESCAP/MCT/2021/5/Add.1

Other forms of technology that are related to smart transport systems are also underscored in the Declaration according to the increasing needs from Member States.

"Recognizing that the new developments in digitalization, such as Big Data, artificial intelligence, machine learning, the Internet of things, blockchain and automation, are of increasing relevance to improving mobility and the operationalization of the regional transport network." [12]

More details are described in the Regional Action Programme. Among seven thematic areas of work, smart transport systems fall under "Digitalization of transport". Developing a regional road map for smart transport systems in Asia and the Pacific is one of the major activities to support wider deployment of sustainable and resilient smart transport systems.

1.2 Why smart transport systems?

Based on the concept of intelligent transport systems, defined by ESCAP[13], smart transport systems[14] can be an advanced form of transport that is an agglomeration of diverse technologies to enhance the sustainability of transport in a city and society. In other words, smart transport systems are an umbrella term that embrace a wide range of technologies aiming to integrate drivers, vehicles and transport infrastructure in a way that improves overall transport efficiency. Many emerging technologies, including smart mobility, are based on the concept of smart transport systems which can improve traditional transport with various technologies, services, and modes.

Smart transport systems allow for full integration into the overall transport ecosystem as part of vehicle systems, road infrastructure, and management and operational strategies. These systems directly and indirectly affect efforts to reduce traffic congestion, optimize transport routes, deliver timely information of road conditions and incidents, and reduce adverse environmental impacts. For example, in-vehicle systems enable drivers to optimize their travel routes and avoid incidents along their trip through satellite navigation systems. This application improves the general efficiency of the transport ecosystem. Smart transport systems can also be installed in road infrastructure along highways, arterial or feeder roads and major intersections to provide real-time traffic information to travellers and operators. Variable message signs, the Internet and mobile applications are representative tools used to broadcast traffic information gathered from detecting equipment. Other examples include electronic toll collection systems that automatically collect tolls without the need for vehicles to halt, and weigh-in-motion systems that calculate vehicle loads on the go without the need for queuing at dedicated weigh stations.[15] In terms of management and operational strategies, congestion pricing is increasingly relying on smart transport systems to enforce congestion policies for individual travel demands and encourage a modal shift to public transport. Vehicles entering predefined areas at certain hours can be automatically charged a congestion tax by deploying sensors in vehicles that track their movements. New technologies, such as autonomous vehicles, connected vehicles, cooperative-ITS, smart mobility and Mobility-as-a-Service (MaaS), could provide customized and user-oriented services to satisfy the needs of travellers and encourage commuters to reduce the use of private vehicles through increased convenience. Electrification or the use of renewable energy combined with such technologies can also further reduce dependence on conventional fuels.

12 Ibid

13 ESCAP, *Guidelines for the regulatory frameworks of intelligent transport systems in Asia and the Pacific. Manuals And Training Materials*. (Bangkok, 2019) Available at https://www.unescap.org/resources/guidelines-regulatory-frameworks-intelligent-transport-systems-asia-and-pacific (Accessed on February 17, 2023)

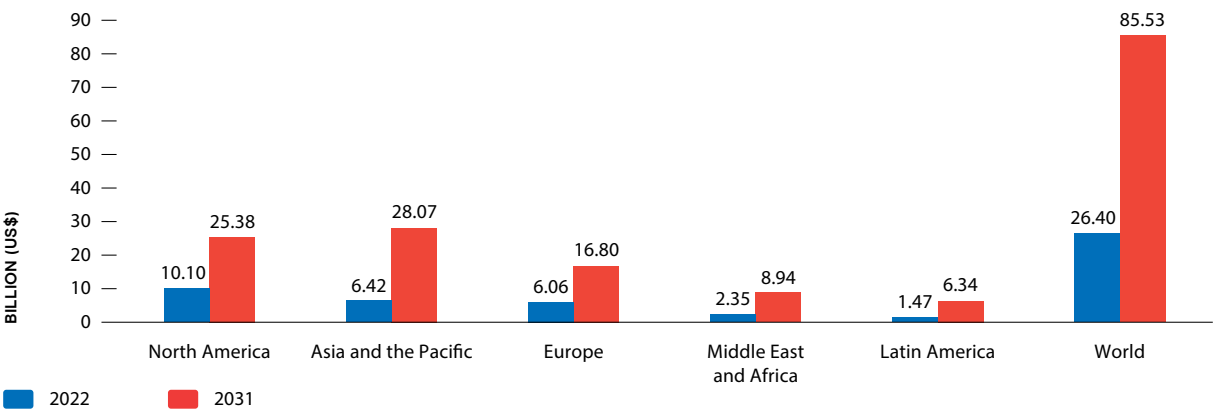
14 Smart transport systems was known as intelligent transport systems previously, but ESCAP defined ITS as a subset of smart transport systems.

15 ESCAP, *Using Smart Transport Technologies to Mitigate Greenhouse Gas Emissions from the Transport Sector in Asia and the Pacific*. (Bangkok, 2019) Available at https://www.unescap.org/sites/default/d8files/knowledge-products/Chapter01%20-%20Smart%20Transport%20Technologies.pdf (Accessed on February 17, 2023)

Smart transport systems are broad in nature and deliver tools applicable to the transport system in its entirety. For example, they offer many interfaces for linkages such as in intermodal transport with maritime transport, rail transport, or interregional corridors. Smart ports aim to streamline and reorganize port activities, and to improve environmental sustainability by using smart transport systems. The smooth linking of road and maritime transport offers the advantage of potentially valuable synergistic effects. This is helped by holistic integration and harmonization with smart transport systems of the hinterland network in terms of building an intermodal transport network and global supply chains. These provide significant reductions of carbon emissions, improvements in air quality and sustainable waste management in line with the SDGs.[16] Similar advantages are also detected in rail networks, including at rail border crossings, where the introduction of smart transport systems (e.g., electronic information exchange) can provide a smoother, more efficient and environmentally friendly process. Smart rail operations also envisage fully automated terminals in the future, with a range of specific solutions for automatic loading and unloading, intelligent gate systems, fully automated train formation and shunting with automatic wagon coupling.[17] Smart transport systems for border crossing enable a convenient handling of international corridor transport on roads through the management of interregional traffic coordination. Such technologies, in parallel with facilitating otherwise time-consuming and costly controls, evenly reduce the frequency of human contact and can thus reduce the international spread of disease in times of crisis, such as during the COVID-19 pandemic.

Despite the proven advantages of smart transport systems, their capabilities have been underestimated with the misconception that they are only associated with road transport and that their implementation is limited to developed countries.[18] This assessment hinders the wider adoption and utilization of smart transport systems in the region, despite numerous cases that prove the cost-effectiveness of smart transport systems as a feasible solution to address transport issues.[19] Considering a recent tendency to minimize the provision of new infrastructure which requires huge capital and produces negative environmental impacts, smart transport systems can utilize existing resources and infrastructure sustainably at a modest cost. In this regard, the deployment of smart transport systems is beneficial for many Member States in the Asia-Pacific region where fundamental infrastructure and funding resources are limited.

FIGURE 5 Smart transport systems market sizes, by region, 2022–2031



Source: ESCAP calculation and illustration based on data from Transparency Market Research, 2021.)

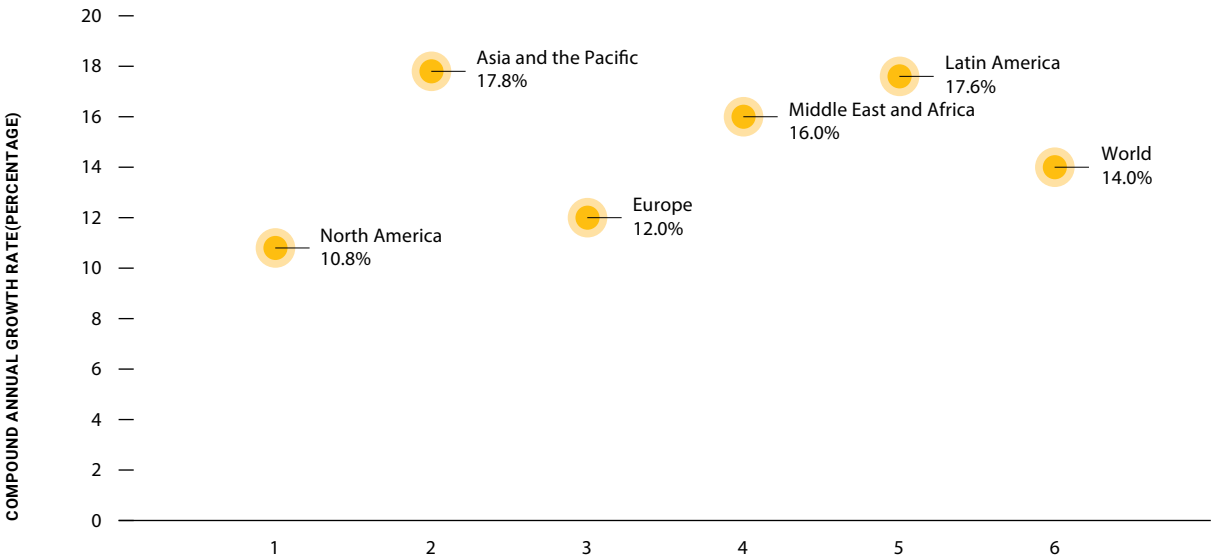
16 ESCAP, *Study Report on Smart Ports Development policies in Asia and the Pacific*. (Bangkok, 2021). Available at https://www.unescap.org/sites/default/d8files/event-documents/SmartPortDevelopment_Feb2021.pdf (Accessed on March 13, 2023).

17 ESCAP, *Smart Railway Solutions for Trans-Asian Railway Network in the Times of COVID-19 Pandemic*. (Bangkok, 2021). Available at https://www.unescap.org/kp/2021/smart-railway-solutions-trans-asian-railway-network-times-covid-19-pandemic (Accessed on March 13, 2023).

18 S. Y. Tan & A Taeihagh, 2020. Smart City Governance in Developing Countries: A Systematic Literature Review. *Sustainability* vol 12, pp. 899. Available at https://doi.org/10.3390/su12030899

19 ESCAP, *Using Smart Transport Technologies to Mitigate Greenhouse Gas Emissions from the Transport Sector in Asia and the Pacific*. (Bangkok, 2019) Available at https://www.unescap.org/sites/default/d8files/knowledge-products/Chapter01%20-%20Smart%20Transport%20Technologies.pdf (Accessed on February 17, 2023)

FIGURE 6 Compound Annual Growth Rate, by Region, 2022–2031



Source: ESCAP calculation and illustration based on data from Transparency Market Research, 2021.)

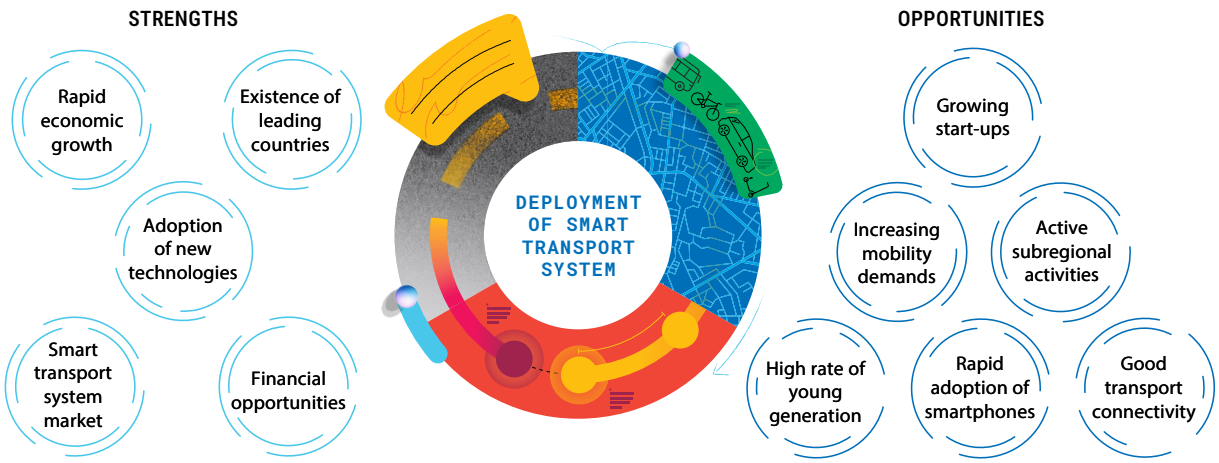
Moreover, the Asia-Pacific region has strengths and opportunities to implement smart transport systems for SDGs. One of the main strengths of the region is its growing population. With approximately two thirds of the world's population currently living in the region, which is expected to increase, huge mobility challenges are continually arising with the region's corresponding severe traffic congestion. However, it can be an opportunity for smart transport systems as the demand for new mobility services arises. The market size for smart transport systems was already as large as the estimated US$ 6.42 billion by 2022. It is expected to grow at its fastest rate by 17.8 until 2031 which will make this region the first largest market in the world at US$ 28.07 billion.[20] Furthermore, there are several promising factors for the successful deployment of smart transport systems. The comparatively large segment of the younger generation can become active users for smart transport systems. It is estimated that more than 1.1 billion young people (between 15 to 29) live in Asia and the Pacific, comprising more than 25% of the regional population and 60% of young people in the world.[21] Mobile services and internet connectivity are experiencing a rapid widespread expansion in Asia and the Pacific. By 2025, nearly 1.8 billion people (62% of the region's population) will subscribe to mobile services and around 52% of the population will be able to use mobile internet in this region. This is compared to 1.6 billion people with mobile services and about a 42% penetration rate of mobile internet in 2020.[22] Certain Member States and cities are already regarded as world-leaders in developing, testing and deploying cutting-edge smart transport systems, such as connected and autonomous vehicles and MaaS. Other Member States lagging behind can learn from these States about best practices, policies and technical standards which will allow them to leapfrog the development gap for sustainable smart transport systems. Lastly, existing efforts to improve transport connectivity such as the Asian Highway Network, the Trans-Asian Railway Network, the ASEAN Highway Network, and the Belt and Road Initiative, are also strengths and opportunities to promote smart transport systems and incorporate them in response to growing demands for new transport services in the region.

20 Transparency Market Research, "Intelligent Transportation Systems Market". Available at: https://www.transparencymarketresearch.com/intelligent-transportation-system-market.html (Accessed on February 7, 2023)

21 Asian Development Blog, "In Asia, Young People are Key to Achieving National Development Goals". Available at https://blogs.adb.org/blog/asia-young-people-are-key-achieving-national-development-goals (Accessed on February 17, 2023)

22 GSMA, "The Mobile Economy". Available at https://www.gsma.com/mobileeconomy/wp-content/uploads/2021/08/GSMA_ME_APAC_2021_Web_Singles.pdf (Accessed on February 17, 2023)

FIGURE 7 Strengths and Opportunities of Smart Transport Systems



Source: ESCAP [2019]). Guidelines for the regulatory frameworks of intelligent transport systems in Asia and the Pacific.)

While there are no SDGs specifically dedicated to smart transport systems, they have been mainstreamed in several of the Goals as affordable and accessible measures for clean, safe and resilient transport. Smart transport systems create a natural link with technologies, transport, and energy because of their applicability to the whole field of transport. Accordingly, Goals 7 (affordable and clean energy), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), and 13 (climate action) are closely related. The potential of smart transport systems can be revisited from social and economic perspectives, considering their merits to increase accessibility and mobility in vulnerable areas and groups, as well as connectivity and integration with other transport modes. In this sense, Goals 5 (gender equality), 8 (decent work and economic growth), and 10 (reduced inequalities) are indirectly linked. Goals 3 (good health and well-being) and 15 (life on land) are also relevant when ripple effects are expected from smart transport systems in a society.

1.3 Leading technologies and new trends

The invention of motor vehicles has induced the most significant impacts on the physical movability of people and goods. Transport has become an everyday, necessary utility for economic and social activities collectively as well as individually. Without a doubt, the growth of transport has inevitably created an enormous number of externalities, while responding to varied social needs. In this vein, recent trends in smart transport systems include multiple technical solutions that are expanding the frontiers of the transport environment, revolutionizing the ways in which people utilize new technologies, and redefining existing interactions. A wide range of technologies has been utilized in smart transport systems which are being developed dynamically. According to ESCAP[23], smart transport systems can be divided into five major categories in conventional applications and new trends of technologies. They are Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Advanced Public Transport Systems (APTS), Commercial Vehicle Operations (CVO) and emerging technologies.

23 Assessment of Urban Transport Systems and Services, document ESCAP/CTR/2018/6

While ATMS, ATIS, APTS and CVO have already been introduced in many Member States over the past few decades, the region is experiencing a new change. Emerging technologies have arisen which include all types of new applications and services that can be used to address increasing transport-related issues in a society. There is a primary focus on emerging technologies, which were once thought of as far-fetched notions bringing innovative approaches that can revolutionize the transport environment. All forms of newly developed applications and services are under this category including autonomous vehicles, connected vehicles, cooperative-ITS, smart mobility, and MaaS. Cooperative-ITS and connected vehicles are the most popular concepts discussed as emerging technologies in the field of smart transport systems. They utilize vehicular wireless communications, satellite positioning systems and a diverse range of sensors to collect and share information.[24] It may still be some time before autonomous vehicles, also called "self-driving" or "driverless vehicles", take to the roads. However, vehicles are already "talking" to each other by using Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I) and Vehicle-to-Everything (V2X) technologies to improve safety and efficiency.

"Paradigm change from transport to mobility"

Behind the advent of such technologies, the recent paradigm change from "transport" to "mobility" exists in response to socially, economically and environmentally changed needs. Transport is conceptually based on a modal approach which is now required to evolve into a service-based approach. For many people, vehicle ownership is no longer a primary objective for travelling, especially in urban areas. Thus, "mobility" generally refers to the ability to move freely and easily, whereas "transport" means the movement of people and goods with a vehicle.[25] Shifting to mobility is to flexibly accommodate the desire of individual's trips while minimizing damage to the environment. The concept of mobility causes disruption on the transport sector by breaking down barriers among traditional transport modes. This paradigm change is leading to a completely new generation of predictive seamless mobility that takes the transport experience of today to the next level. Naturally, this needs a wide range of service options and business types, and the creative use of technologies that should be considered in policy development.

"Acceleration of technological advancement and data processing with Big Data"

The development of digital technologies occurring at an unprecedented pace is another reason to bolster emerging technologies in the transport sector. Automation and Artificial Intelligence (AI) are two major keywords of innovation to support emerging technologies, together with the availability of massive quantities of real-time data, known as Big Data, from various sources on all aspects of transport. The advantage is that the producers and holders of such information and data can also be the sources of reprocessing and redistribution for better transport services. This offers solutions that were not previously available in all areas of transport through efficient processing techniques. It is noted that 90 per cent of global data has been created in the last two years and is projected to increase by 40 per cent every year.[26] Technological innovation with this tremendous volume of data is already upsetting the paradigm shift to mobility and will offer many opportunities to transport planners, operators and travellers to accelerate user-oriented mobility services with connected and autonomous transport systems. The technological vitality of increasingly connected systems and the potential offered by Big Data will also create many business opportunities. It is anticipated that legislation and regulations will have to be adjusted to take into account these changing conditions. The roles and responsibilities of various stakeholders will also undoubtedly change.

24 ESCAP, *Study Report on Smart Ports Development policies in Asia and the Pacific*. (Bangkok, 2021). https://www.unescap.org/sites/default/d8files/event-documents/SmartPortDevelopment_Feb2021.pdf (Accessed on February 17, 2023)

25 ESCAP, *Increasing the Use of Smart Mobility Approaches to Improve Traffic Conditions in Urban Areas of South-East Asia Policy Guidelines*. (Bangkok, 2022). Available at https://www.unescap.org/kp/2022/increasing-use-smart-mobility-approaches-improve-traffic-conditions-urban-areas-south-east (Accessed on February 17, 2023)

26 United Nations Peace, Dignity and Equality on a Healthy Planet, "Big Data for Sustainable Development". Available at https://www.un.org/en/global-issues/big-data-for-sustainable-development. (Accessed on February 17, 2023)

"Widespread mobile communications and wireless connectivity"

Advances in wireless communications have led to innumerable intertwined connectivity options that can be supported for the most part by mobile phones. Ironically, the COVID-19 pandemic has reinforced the importance of wireless communications that have helped people and businesses to stay connected while curbing the spread of the virus. Mobile phones have been particularly instrumental during the pandemic to provide alerts about vaccination programmes and address cases, and they will permeate our lives even more after the pandemic. Increased wireless connectivity in the transport sector that permits users, vehicles, and infrastructure to be linked generates dreams of new solutions to address specific traffic issues. In particular, 5G and the related Internet of Things (IoT) will play key roles in realizing the full potential of emerging technologies in transport across different industries, cities and States. A wave of 5G network rollouts has begun in the Asia-Pacific region and will replace slow wireless networks in the intervening period. Based on better wireless connectivity, mobile phone applications significantly influence the trend of mobility services (particularly, shared mobility, personal mobility, and demand-responsive transport) and will create a shift to greener transport systems. This creative utilization of mobile phones has reduced facilities and investments required for transport services and has additionally brought more seamlessness and convenience to travellers.

"Increased integration of technologies for smart transport systems"

The varying needs of users together with other transport issues require multifaceted actions. Technological advancement and ancillary structures that are also interconnected require the sharing of data and information, multi-coordination, and cohesive operations. In the same vein, technologies used for smart transport systems become integrated and interactive to provide more efficient, economical, and user-centred services. This technological tendency enables the connection of travellers from different origins to final destinations by using all available means through integrated barrier-free service design and technological solutions. High levels of increased integration of technologies permit travellers to use more than one mode of transport by switching from one to another to suit their travel needs. This will create a seamless travel experience for door-to-door journeys by a personalized mobility service, and each individual's specific needs will be flexibly met at the end.

1.4 ESCAP Transport Division's support for smart transport systems

For several decades, ESCAP Transport Division has provided a unique intergovernmental platform in the Asia-Pacific region to promote the unhindered and safe movement of vehicles, goods and people across borders and through countries. Concurrently, ESCAP Transport Division works to move towards more sustainable and inclusive transport with a focus on road safety, urban mobility, connectivity, low-carbon transport and smart transport systems for all including poor and vulnerable communities. The major outcomes of the work have been reflected in various intergovernmental agreements, resolutions, initiatives, and declarations. The Ministerial Conference on Transport which has been held since 2006, and the Committee on Transport inaugurated in 2008 are two major legislative initiatives advocating cooperation and collaboration among Member States for transport developments. They have mainly facilitated transport policy options and programmes including new transport technologies, road safety, low carbon transport, inclusive transport and maritime transport, as well as international transport agreements.

FIGURE 8 2019 Expert Group and Regional Meeting on Intelligent Transport Systems (ITS) Development and Operation for Sustainable Transport Systems in Asia and the Pacific

Formerly, ESCAP Transport Division considered smart transport systems as a key enabler to achieve sustainable transport and as an alternative solution for future transport systems. However, the discussion of smart transport systems has been relatively late. In the third session of the Ministerial Conference on Transport in December 2016, smart transport systems[27] were first assessed as one of the major issues for discussion. The establishment of regional policy frameworks and tools on the deployment of intelligent transport systems were prioritized as an indicator of achievement for the Regional Action Programme for sustainable transport connectivity in Asia and the Pacific, phase I (2017-2021). Acknowledging this barrier for the wider uptake of smart transport systems led to the organization of the first regional meeting as part of a series of activities under the Programme. The first regional meeting was finally held with 35 delegates from 26 Member States in 2019 to discuss further actions on policy recommendations. This meeting represented the first step in the development of ESCAP's Transport Division strategy on practical and legislative aspects of smart transport systems. The meeting contributed to the new Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022-2026) adopted at the fourth session of the Ministerial Conference on Transport in December 2021 which identified digitalization of transport as a key thematic area among the seven themes.

ESCAP Transport Division has collaborated closely with stakeholders on smart transport systems including ITS associations, research institutions, non-governmental organizations, multilateral development banks, and private entities in addition to the governments of Member States. A brief summary [28] is presented to highlight past achievements and on-going activities for smart transport systems.

- Development of technical standards on road infrastructure safety facilities and model Intelligent Transport Systems (ITS) deployments for the Asian Highway (AH) Network
- Promoting the use of digital solutions in building and operating international dry ports, in support of sustainable intermodal transport connectivity in Asia and the Pacific
- Facilitating the deployment of highly and fully automated vehicles in road traffic along the Asian Highway Network
- Strengthening capacity for operationalizing sustainable transport connectivity along the China-Central Asia-West Asia Economic Corridor to achieve the 2030 Agenda

27 The term of intelligent transport systems was used at the third session of the Ministerial Conference on Transport in December 2016.
28 These are the original titles of relevant projects.

- Policy framework for the use and deployment of Intelligent Transport Systems (ITS) in Asia and the Pacific
- Innovative and integrated Intelligent Transport Systems (ITS) for the development and operation of sustainable transport systems in urban areas
- Developing a regional roadmap to support regional cooperation for the wider development of sustainable smart transport systems
- Increasing the use of smart mobility approaches to improve traffic conditions in urban areas of the Southeast Asia Subregion
- Building technical capacity for utilizing smart transport technologies to mitigate greenhouse gas (GHG) emissions from the transport sector in Asia and the Pacific
- Promoting the utilization of transport Big Data from smart transport systems in the Asia-Pacific region for the achievement of sustainable transport
- Building capacity for integration and application of digital technology in urban public transport systems in Asia-Pacific cities
- Enhancing social inclusion and innovations in urban transport systems in Asia-Pacific cities

1.5 Visions and objectives

The convergence of cutting-edge technologies and the utilization of Big Data have become significant trends during the past few years. Concurrently, sustainable development and climate change are urgently in need of worldwide action. The behaviour of travellers varies according to their dynamic social and economic needs in modern cities. In the past all of the needs of travellers could not be satisfied because of limited technological advancement and a supply-driven approach. The advent of the fourth industrial revolution has begun to deliver user-oriented and mobility-based services that have started to materialize. Smart transport systems are at the centre of this revolution that can help existing resources and infrastructure to operate sustainably at a modest cost while meeting the various demands of travellers.

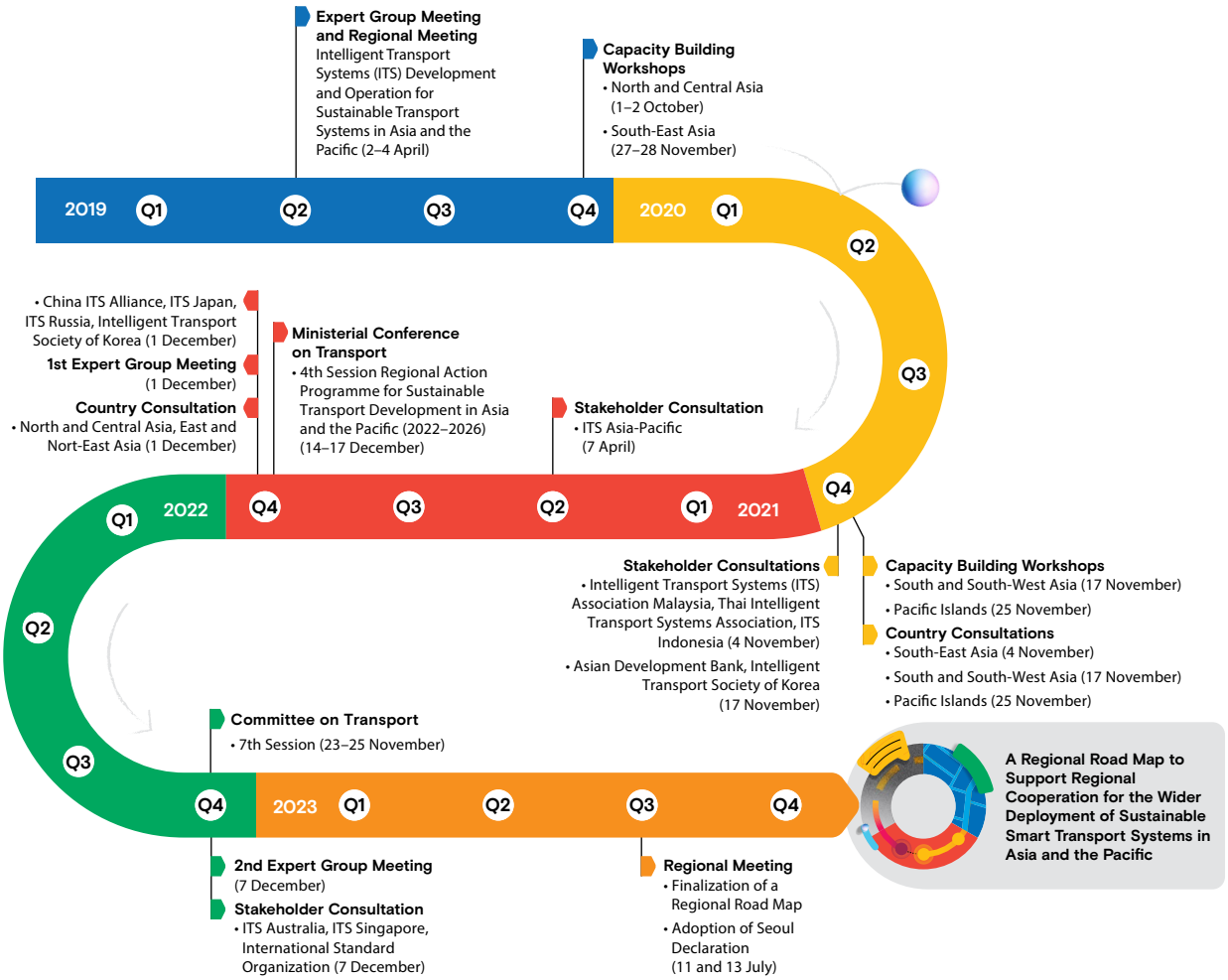
However, future transport systems need to be shaped by both technology and well-directed policy to successfully achieve regional and global agendas. Although many activities related to smart transport systems have been designed and pursued in Asia and the Pacific, they have been done locally in silos. This approach eventually creates fragmented and geographically limited services among Member States. The absence of future policy direction at a regional level will result in the benefits of smart transport systems being underutilized and ineffective in addressing transport-related issues. Smart transport systems are still evolving, and the levels of understanding and stages of utilization vary within the Member States. Strong regional collaboration and cooperation are necessary to advance the adoption and utilization of smart transport systems under an inclusive future policy direction in Asia and the Pacific. As the only intergovernmental body in Asia and the Pacific, ESCAP has, at the request of Member States, set in motion the goal of furthering the wider deployment of smart transport systems by actively facilitating regional collaboration and cooperation. The provision of a regional road map by ESCAP Transport Division is committed to bring smart transport systems to the regional agenda for policy makers in Member States; to establish a policy guidance to provide a clear policy direction for future development of smart transport systems; and to strengthen capacity for regional cooperation by bridging the imbalance and eliminating barriers to a broader deployment of sustainable smart transport systems in Asia and the Pacific.

Promoting sustainable transport in Asia and the Pacific is the most universal and enduring solution to help societies address their transport issues which hinder the stability and resiliency of the region. This regional road map recognizes that smart transport systems should be underpinned by inclusive and resilient societies. It also places an ambitious contribution to the regional response to climate change as a central issue for sustainable transport in the regional policy agenda.

1.6 A pathway to develop a regional road map on smart transport systems

The development of a regional road map for smart transport systems is not one simple journey, but rather a series of processes to understand the trend of technologies and the needs of Member States, and to seek necessary actions for the future form of transport. Most activities have been conducted under a direct initiative named as "Developing a regional road map to support regional cooperation for the wider deployment of sustainable smart transport systems". However, other outputs from previous smart transport-related projects have also been engaged to extract valuable points that can be referred to for developing the regional road map. The timeline of the chain of key activities that have contributed to the development of the regional road map is presented as follows:

FIGURE 9 The timeline of meetings to develop a Regional Road Map on smart transport systems



A snapshot of the data collected and information regarding the status, needs, priorities and challenges of Member States to develop a regional road map is outlined in Table 1. Note that only Member States located in the Asia-Pacific region have been targeted to collect relevant data and information. Significant efforts have been made from various angles to have at least one type of source for Member States.

TABLE 1 Status of data and information collection from Member States

Country	Open literatures	Country report	Survey response	Country presentation	Consultation participation
Afghanistan	●			●	●
Australia	●			●	●
Azerbaijan	●	●		●	●
Bangladesh	●	●		●	●
Bhutan	●			●	●
Brunei Darussalam	●				●
Cambodia	●		●	●	●
China	●	●	●	●	●
Fiji	●				●
Georgia				●	●
India	●			●	●
Indonesia	●		●	●	●
Iran (Islamic Republic of)	●		●	●	●
Japan	●				●
Kazakhstan	●			●	●
Kiribati					●
Kyrgyzstan			●	●	●
Lao People's Democratic Republic		●	●	●	●
Malaysia	●	●	●	●	●
Marshall Islands (the)					●
Micronesia (Federated States of)					●
Mongolia	●	●		●	
Myanmar	●		●	●	●
Nauru				●	●
Nepal	●	●		●	
New Zealand	●				
Pakistan				●	●
Palau				●	
Papua New Guinea					●
Philippines (the)	●		●	●	●
Republic of Korea (the)	●	●		●	●
Russian Federation (the)	●	●		●	●
Samoa					●
Singapore	●		●	●	
Sri Lanka				●	●
Tajikistan		●	●	●	●
Thailand	●	●	●	●	●
Tonga					●
Turkmenistan				●	
Türkiye	●	●	●	●	●
Tuvalu					●
Uzbekistan	●		●	●	●
Vanuatu					●
Viet Nam		●	●	●	●

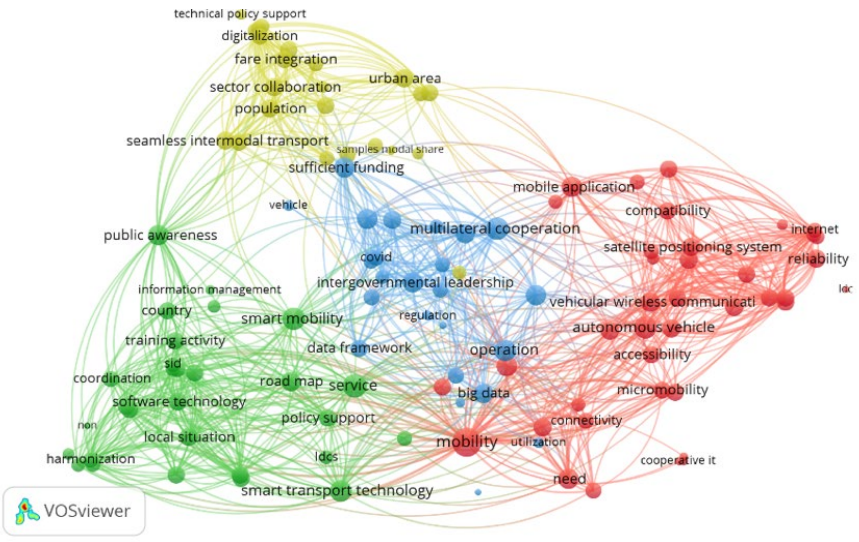
Note: Despite various efforts, data and information collection was not available in seven Member States (Armenia, Democratic People's Republic of Korea, Maldives, Solomon Islands, and Timor-Leste).

Chapter 2

Roadblocks in deploying smart transport systems in Asia and the Pacific

Despite many cases of the successful integration of smart transport systems into the transport landscape to address transport problems, several challenges still impede their wider development. Based on a combination of literature reviews, country reports, expert surveys, country presentations and country consultations, major challenges and issues can be identified. These serve as inputs to formulate regional strategies and policy plans, which consider the status, needs and priorities of Member States. To logically identify challenges and issues, noteworthy keywords are graphically evaluated through a scientific slide visualization approach according to the quantity and qualitative linkages of keywords. All keywords come from all of the related activities mentioned above. Based on the central feature of smart solutions in mobility and transport, main data knots emerge that include various technological, social and economic features as well as the countless interconnections between them. The network displays accurately how many features of smart transport systems in the Asia-Pacific region are intertwined and reinforced. Consequently, it considers how wholesome and all-encompassing policy approaches, such as action plans, should be designed to target smart transport systems. Considering the highlighted issues in their respective contexts, fourteen key issues are summarized and explained in more detail.

FIGURE 10 Graphical representation of keywords for challenges and issues



ISSUE 1 Environmental and safety threats from the transport sector

Among various sustainability issues, the management of greenhouse gases and road safety from the transport sector is quite challenging. The evidence is overwhelming that the Asia-Pacific region faces increasing urbanization and motorization, which is directly linked to environmental and safety risks. This situation is particularly applicable where road transport growth has outstripped the capacity of existing road transport infrastructure. Most of all, although transport decarbonization is a global trend, slow progress has been made to transition from fossil fuels toward renewable sources across the region. Oil still remains as the region's predominant energy source in the transport sector. This trend is expected to increase from 30.8 mb/d to 38.5 mb/d by 2030 in this region.[29] More than half of the region's total oil consumption in 2019 was attributable to the movement of freight and people, and it accounted for nearly 14 per cent of total CO_2 emissions.[30] The progression towards green energy and implementing net-zero carbon emission

29 IEA, "Oil demand by region and scenario, 2017-2040". Available at https://www.iea.org/data-and-statistics/charts/oil-demand-by-region-and-scenario-2017-2040 (Accessed on February 17, 2023)

30 ESCAP, "UN forum to focus on green and inclusive transport development in Asia and the Pacific". Available at https://www.unescap.org/news/un-forum-focus-green-and-inclusive-transport-development-asia-and-pacific (Accessed on February 17, 2023)

policies and strategies is critical to address climate change and to adhere to international commitments. Smart transport systems can offer various environmental sustainability and safety benefits in overcrowded urban areas where air pollution, traffic congestion, large numbers of road incidents and inefficient logistical processes from the transport sector are present. However, in combating these issues, smart transport systems are still underutilized and fragmented in the region because of entangled obstacles. Considering the unpredictable benefits from emerging technologies, policy management reforms related to smart transport systems can eventually lead to reductions in greenhouse gases and improvements in safety in cost-effective ways.

ISSUE 2 Awareness and understanding of smart transport systems

Despite longstanding attempts to utilize smart transport systems, the general awareness and understanding of their benefits is still not widespread, particularly in less developed countries and small island developing States in Asia and the Pacific. According to the survey conducted by ESCAP Transport Division[31], even some experts in the transport sector were not certain about the concept of smart transport systems. Missing a common internationally shared definition and/or limited exposure of the concept might be primary reasons. For all stakeholders to fully grasp the magnitude of merits from smart transport systems, the awareness of policymakers and professionals who address transport problems needs to be increased. Having an awareness of emerging mobility trends is the first stage of the transition process towards incorporating smart transport systems.[32] More importantly, a once in a lifetime chance is coming to fully absorb the advantages of smart transport systems according to the recent paradigm change from transport to mobility and the advent of emerging technologies. However, such drastic changes could bring a decreased awareness and understanding of smart transport systems as there will be countless new debut technologies and applications together with connected and automated technologies and Big Data. Supplementing this issue beyond the realm of technical experts to include all stakeholders, particularly the public sector and the general public, even at a fundamental level, is essential for furthering the deployment of smart transport systems in Asia and the Pacific.

ISSUE 3 Preparedness of new mobility paradigm

The new mobility trend is transitional, concurrent, and ubiquitous which is fuelled by the combined development of new technologies (e.g., Big Data, block chain, and AI) and the changing behaviour of travellers in recent years. This trend is expected to accelerate and expand in the coming decade as these technologies will become more mature and advanced, and the pressure of achieving global and local goals such as SDGs, carbon neutrality, accommodating an aging society and traffic safety within the transport sector will increase. Smart mobility is the representative concept centred in this paradigm change which can include shared mobility, personal mobility and demand-responsive transport together with the electrification of vehicles. The new mobility trend is disruptive to the transport industry and the legacy of supply-driven practice that still exists in smart transport systems, while also creating a user-centred environment that contributes significantly to higher levels of congestion and emissions mitigation. The issue is that the significance of this new mobility trend has not been well understood in this region. The extent of the potential of the new mobility approach can depend on design, implementation and management by the public sector with packages of actions such as legislation, funding, and public-private

31 ESCAP, *Increasing the Use of Smart Mobility Approaches to Improve Traffic Conditions in Urban Areas of South-East Asia Policy Guidelines*. (Bangkok, 2022). Available at https://www.unescap.org/kp/2022/increasing-use-smart-mobility-approaches-improve-traffic-conditions-urban-areas-south-east (Accessed on February 17, 2023)

32 Deloitte, "Harnessing the future of mobility". Available at https://www2.deloitte.com/uk/en/insights/focus/future-of-mobility/government-and-the-future-of-mobility.html/#endnote-5 (Accessed on February 17, 2023)

cooperation. Without good management, new mobility services and applications will be isolated, operated in standalone, and lacking synergy as integrated systems. Also, the deployment of new mobility services and applications requires a good orchestration of hardware and software infrastructure. Although each service and application has its own challenges, some general challenges that hamper the preparedness of new mobility trends with emerging technologies need to be identified. Most Member States are in the early stages of a paradigm change, but given the pace of technological innovation, it is argued that the time frame in which policymakers have broad control over the direction of smart mobility deployment and what impact it creates is very short.[33] Thus, transport organizations should dedicate resources to remain current with this change in trends and have mechanisms to adopt them smoothly as the roles and responsibilities of various stakeholders will undoubtedly change.

ISSUE 4 Technical expertise and institutional capacity

Smart transport systems are technology-intensive and require a certain level of expertise to efficiently implement them. Indeed, as numerous types of applications exist, their implementation might be incorrectly guided by policymakers without fully understanding the nuances of each application. This issue is also associated with a poor awareness and understanding of smart transport systems. Several requests to increase their technical capacity from Member States prove this importance.[34] Fortunately, new mobility concepts move swiftly and penetrate our community quickly. If related knowledge is not accumulated in a timely manner which is directly related to technical expertise and institutional capacity, sluggish policy responses are the result. This will disparage the benefits of smart transport systems as one of the most effective measures to address recent transport issues. Increased technical expertise and capacity is evidently a pre-requisite to further the goal of wider deployment of smart transport systems across the Asia-Pacific region.

ISSUE 5 Political will and regulatory foundations

The leadership of policymakers with a solid regulatory basis is critical to fully adopt new technologies. Smart transport systems are not an exception. Inadequate political will and the corresponding absence of any enabling smart transport-related regulations presented in some Member States[35] are linked to their transport status, needs and investment priorities. In these States, there is a perception that smart transport systems are not within the political sphere but rather reserved for technical expertise. In reality, the emerging mobility trend puts governments in a unique position in the transport sector as they are the ones who can determine how the private sector provides mobility services and how users consume them. They also have a direct influence on the operation of public transport services and transport infrastructure and can decide which smart transport systems are developed.[36] Limited political enthusiasm naturally results in an absence of regulatory fundamentals which can guide the correct direction of technology development. This lack of political attention might come from the misconception that smart transport systems require substantial investment which is reserved for only developed countries. An initial amount of investment is obviously required, but associated applications are generally cost-effective when compared with the

33 I. Docherty, G. Marsden, & J. Anable, 2018. The governance of smart mobility, *Transportation Research Part A: Policy and Practice*, vol. 115, pp. 114-125. Available at https://doi.org/10.1016/j.tra.2017.09.012

34 ESCAP, "2019 Expert Group Meeting and Regional Meeting on Intelligent Transport Systems (ITS) Development and Operations for Sustainable Transport Systems in Asia and the Pacific". Available at https://www.unescap.org/events/2019-expert-group-meeting-and-regional-meeting-intelligent-transport-systems-its-development (Accessed on February 17, 2023)

35 ESCAP, *Guidelines for the regulatory frameworks of intelligent transport systems in Asia and the Pacific. Manuals And Training Materials*. (Bangkok, 2019). Available at https://www.unescap.org/resources/guidelines-regulatory-frameworks-intelligent-transport-systems-asia-and-pacific (Accessed on February 17, 2023)

36 World Economic Forum, *Designing a Seamless Integrated Mobility System (SIMSystem)*. (Geneva, 2018). Available at https://www3.weforum.org/docs/Designing_SIMSystem_Manifesto_Transforming_Passenger_Goods_Mobility.pdf (Accessed on March 10, 2023)

financial burden given to major transport infrastructure projects. Smart transport systems commonly offer varied cost-effective options with greater benefits than traditional infrastructure options which Member States can choose depending on their needs and priorities. Overcoming any misguided perceptions, political support needs to be strengthened to play a part in the eventual creation of regulatory foundations for the full utilization of smart transport systems.

ISSUE 6 Harmonized and balanced policies

In a broader context, consistent policies for smart transport systems are critical to enhance ties among Member States for the attainment of sustainable development and net-zero carbon emissions in Asia and the Pacific. The Asia-Pacific region has a vast geographical area and different socio-political environments, and the level of technological development also varies by Member States. This has led to differences in policy approaches and incongruous results regarding the issue of how to best address smart transport systems within all Member States. The uncoordinated consensus on a regional policy among Member States will essentially undermine the efficiency of existing and future systems, and this will generate issues of compatibility, interoperability, and unnecessary costs. The divergence of development direction by each State will be widened by pursuing related projects locally in silos without any harmonized point of direction. As proven by the case of the COVID-19 pandemic, a balanced multilateral approach is required to address global issues. With shared regional policy, Member States can guide their national entities along a common path, and can easily receive peer support from other Member States when formulating their own policies. Particularly, when moving forward towards an environment of connected and autonomous vehicles, harmonized and balanced policies in smart transport systems are a pre-requisite for more streamlined cross-border transport movements.

ISSUE 7 Cooperation and collaboration with stakeholders and the public sector

Where policies for smart transport systems have been created, there can be a lag effect from their implementation when compared with the faster pace of technological innovation. Smart transport systems are technology-intensive, and their advancement is mostly driven by the private sector. However, policy support from the public sector has varying degrees of acknowledging these technologies and developing related policies. This differing pace of development results from ineffective governance and insufficient cooperation and collaboration, which produces various incompatibility issues between systems. Smart mobility has garnered recent attention for investment where most applications have been developed and deployed by the private sector. A lag effect is also noticed in new services between its operations by the private sector and its legislative management by the public sector. Policy reaction to incorporate a new service into transport assets managed by the public sector is slow. This delay in reaction occurs as the public sector has a critical role to play in ensuring that the new technologies are tested, complemented and redesigned to work well in existing transport systems and successfully meet higher level policy targets.[37] Moreover, as smart transport systems are often shaped concurrently by different technologies, the responsibilities are spread across multiple government agencies at various levels, making it a great challenge for creating virtuous policy alignment for its deployment.[38] This situation becomes more evident in low-income Member States adopting emerging technologies. Fostering a spirit of cooperation and collaboration between stakeholders (with the clarification of their roles) and Member States is viewed as an appropriate

37 M. Hodson, F. W. Geels, & A. McMeekin, 2017. Reconfiguring urban sustainability transitions, analysing multiplicity. *Sustainability*, vol. 9(2), pp. 299. Available at https://doi.org/10.3390/su9020299

38 I. Moscholidou, G. Marsden, & K. Pangbourne 2023. Steering Smart Mobility Services: Lessons from Seattle, Greater Manchester and Stockholm, *Sustainability*, vol. 15(5), pp. 4566. Available at https://doi.org/10.3390/su15054566

response to resolve this discrepancy. However, in the field of smart transport systems, cooperation and collaboration with stakeholders is still not enough because of the lack of a formally formulated space where all stakeholders can actively participate together with Member States.

ISSUE 8 Fundamental transport infrastructure

Supporting transport infrastructure is required to operate smart transport systems properly, although they are considered as very cost-effective solutions. Required infrastructure can be part of traditional road elements and new facilities that plug into emerging technologies. This includes the greater capabilities for charging stations and networks for electric vehicles, hydrogen refuelling stations, and communications technologies (e.g., V2I, V2V and V2X). Well-prepared basic infrastructure can result in uninterrupted transport services and a seamless transition to smart transport systems with emerging technologies. Furthermore, the upfront investment in smart technologies has already been proven in developed cities to produce high economic benefits by enabling cost-effective management for existing infrastructure. The problem is that transport infrastructure needs to be expanded in many Member States to incorporate smart transport systems. Moreover, the readiness to adopt emerging technologies is still being prepared from the viewpoint of fundamental infrastructure. Consideration should be made for infrastructure support for all modes of transport, including emerging technologies, within smart transport systems.

ISSUE 9 Digital technology constraints

In addition to transport infrastructure, several technical blockages restrict the wider deployment of smart transport systems which are mostly associated with digital technologies. The Asia-Pacific region is also facing a large digital divide among Member States. As digital technologies lay the foundation for smart transport systems, the maturity of these digital technologies is critical. More seriously, emerging technologies like cooperative-ITS and connected and autonomous vehicles require the most advanced digital technologies to provide streamlined conduits through which to use the latest facilities to collect and share data in real-time. However, while digital infrastructure has undergone great development in the past few decades, many Member States still have a variety of challenges in further developing digital technologies. Domestically, several Member States still experience a domestic digital divide particularly within rural areas, populations of low income, and populations of low educational levels. At the regional level, irrespective of domestic issues, the roll-out of commonly accepted universal digital technologies is needed to accommodate smart transport systems across the region. In particular, Member States with special needs should be treated in a customized way as they remain under-developed in providing fundamental digital technologies. With such digital constraints, streamlined services between applications within a country and internationally when crossing borders continues to be a significant issue due to a wide array of imbalanced digital foundations for smart transport systems.

ISSUE 10 Common technical standards

Further to the notion of transport infrastructure issues and digital technology constraints, discussions for unified technical standards have not been active in Asia and the Pacific. Technical standards are useful to integrate different processes, applications and services, and without them, efficient compatibility among systems cannot be facilitated. To benefit fully from smart transport systems, technical standards are needed which can establish the foundation of creating effective, high-performance transport systems for both users and operators. For example, the provision of traffic information to users can reduce congestion, but if different technical interfaces exist, seamless information services might be limited. Besides, with

the availability of standardized data, supply and demand of mobility can be easily optimized in real time, and the information becomes accessible to both mobility users and suppliers. This situation can become challenging as vehicles travel across international and regional borders. Once different technologies are inconsistent and out of step before one dominantly occupies the market, the positive effect of smart transport systems might not fully materialize. This is the reason that some organizations (e.g., the International Organization for Standardization, and the European Committee for Standardization) foster the harmonization of technical standards globally. In turning to the next page of a new mobility paradigm, the fragmentation of standards is detrimental to absorb emerging technologies into existing systems and circumvents the possibility of overlapped developments and investments. Thus, technical standards can assist in keeping up with the pace of new innovations in smart transport systems. However, in Asia and the Pacific, notable work on this philosophy for smart transport systems has not begun in earnest because of the limited opportunities to set up platforms for further discussions.

ISSUE 11 Connectivity and integration for intermodal and multimodal transport systems

Improving connectivity by integrating various modes of transport and technologies facilitates the complementarity of transport services, and the intermodality of freight transport. Further to the multitude of benefits attained by smart transport systems, they have the function of digitally integrating modes of transport together for the efficient transfer of passengers and freight. However, given the fast pace of diversifying transport modes and technologies, both technical and political issues related to integration with smart transport systems have arisen for intermodal and multimodal transport systems. It has been demonstrated that various transport modes have developed their own respective applications which are embedded in different technological bases. These applications may be specifically encompassed within the mode of transport they support, such as bus information systems and rail traffic management systems. Developed in silos, these technologies lack connectivity to larger systems in a holistic transport network which limits their intermodality and multimodality. For example, the information used in maritime logistics, which is an intrinsic part of global freight movements, is rarely integrated with air, land and railway modes of transport. Information sharing and interconnections between maritime transport systems and the systems of other modes is essential.[39] It is critical for transport operators to be able to provide seamless passenger and freight transport services. Exchanging and sharing information from various sources is the core element to ensure seamless operations. As can be seen in the new concept of MaaS, the integration of different modes, services and systems through smart transport systems is now a major transition which has not been well prepared for in this region. Moreover, the movement of passengers and freight across borders has not been streamlined with well-integrated modes, systems and services among operators through smart transport systems.

ISSUE 12 Data protection and use of Big Data

According to the increased use of information and data for smart transport systems, one particular technical concern has arisen which relates to security and privacy challenges. A range of sources are incorporated into smart transport systems including smart cards, satellite positioning systems, sensors, detectors, social media, and mobile phones, which contain lots of private data. Further, the expansion of smart transport systems with emerging technologies has resulted in exponential increases in the amount of data generated which falls into the realm of Big Data. The vitality of increasingly connected technologies and the potential

39 ESCAP, *Study Report on Smart Ports Development policies in Asia and the Pacific*. (Bangkok, 2021). Available at https://www.unescap.org/sites/default/d8files/event-documents/SmartPortDevelopment_Feb2021.pdf (Accessed on March 10, 2023)

offered by Big Data creates many opportunities, but also challenges. With this vast amount of new data being generated, scepticism may ensue among users about whether their data is secure and safe from corruption. The threat of identity theft from the loss of personal data may restrict confidence in using such systems and therefore their further deployment. Users will be increasingly dependent on smart transport systems because of the benefits they offer, but they must remain alert to their related threats, particularly those related to security and the right to privacy. It is anticipated that further work in creating robust cyber security systems, protective legislations, institutions and proper mechanisms to ensure the authenticity and integrity of transport information and data can bolster user confidence. Moreover, with Big Data, typical data processing approaches are inefficient and incapable of addressing the complexity of necessary analyses, which can result in further problems that limit the potential of Big Data utilization with smart transport systems. Proper data frameworks and governance are necessary for gathering and sharing for smart transport systems to limit their development in isolation of incompatible smart transport systems in Asia and the Pacific.

ISSUE 13 Funding

Funding issues are indicated as one of the greatest hurdles for the development of smart transport systems, as ranked in recent studies[40]. Smart transport systems by their nature are regarded as being very cost effective when compared with the higher costs of building traditional transport infrastructure. However, initial implementation costs are obviously required regardless of the magnitude of the amount. The problem is that because of the misconception or low understanding of this by policymakers, securing funding for smart transport systems is still arduous in some Member States. This situation becomes particularly evident in Member States with special needs where there is an even greater need for innovative approaches to funding. Also, smart transport systems are not always profitable. As traditional notions of transport modes that are financially unviable may require greater insight from an economic perspective for their funding, smart transport systems are also equally worthy of further attention from innovative funding sources. As this issue remains unresolved, the wider deployment and development of smart transport systems still has a long way to go as an effective tool for the achievement of SDGs.

ISSUE 14 COVID-19 pandemic impacts

The impact of the COVID-19 pandemic on the global transport sector and society in general has been dramatic since early 2020. It has played a part in rolling back the transport sector's achievements of the SDGs and the wider deployment of smart transport systems. However, the pandemic's impact has highlighted the positive results of what can be achieved from reductions in greenhouse gases and increased active travel such as walking, cycling and electro-personal mobility to increase social distancing. Member States have also demonstrated that they can move rapidly towards automation and innovation to maintain functionality and resilience, and support access to social inclusion.[41] Smart transport systems obviously present an opportunity to mitigate the spread of the virus through seamless and continuous international cross-border transport connectivity in the pursuit of disseminating vaccines and medical supplies.[42] Future proofing the transport sector against similar events through greater smart transport deployment is imperative to overcome future challenges of this nature.

40 ESCAP, *Increasing the use of smart mobility approached to improve traffic conditions on urban areas of South East Asia: policy guidelines*. (Bangkok, 2018). Available at https://www.unescap.org/kp/2022/increasing-use-smart-mobility-approaches-improve-traffic-conditions-urban-areas-south-east(Accessed on March 10, 2023)

41 Asia & the Pacific Policy Society, "A new transport agenda to carry Asia and the Pacific towards sustainable development". Available at https://www.policyforum.net/a-new-transport-agenda-to-carry-asia-and-the-pacific-towards-sustainable-development/ (Accessed on March 10, 2023)

42 ESCAP, *Seamless and smart connectivity along the Asian highway network in the time of COVID-19*. (Bangkok, 2020). Available at https://www.unescap.org/resources/seamless-and-smart-connectivity-along-asian-highway-network-time-covid-19 (Accessed on March 10, 2023)

Chapter 3

Taking the next step: Strategies and policy plans

To achieve sustainable transport and further SDGs and the Paris Agreement, regional cooperative efforts are required to fully utilize smart transport systems. The aim of strategies and policy plans is to facilitate regional cooperation as a blueprint in Asia and the Pacific by offering a guide for future policy direction which can be considered by Member States and supported by ESCAP Transport Division. The strategies and policy plans encompass primary challenges and issues that have been identified through activities by ESCAP Transport Division. They are designed to be reactive to, while remaining consistent with, addressing recent technology trends. Also, concurrent with the Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022-2026), the strategies and policy plans pursue the balanced implementation of the priority areas of work through regional cooperation for the effective pursuit of sustainable transport by Member States.

Five critical strategies which consider the issues and needs of Member States and the potential role of ESCAP Transport Division to facilitate are proposed:

STRATEGY 1

Connectivity – Reaching anywhere

STRATEGY 2

Integration – Moving as one

STRATEGY 3

Inclusiveness – Access for all

STRATEGY 4

Affordability – Withstanding burdens together

STRATEGY 5

Resiliency – Prepared for what may come

A set of priority policy plans which are aligned with the key aspects of achieving SDGs and the Paris Agreement is identified under each strategy. These strategies and policy plans can also assist and support the effective development of national policies and strategies. As a common unified pathway from the status quo to future transport systems, a series of policy plans for the five strategies is expected to promote a wider uptake of smart transport systems and an associated transformation towards more sustainable transport.

FIGURE 11 Issues, strategies and policy plans for the wider deployment and development of smart transport systems

ISSUES

- ISSUE 1 Environmental and safety threats from the transport sector
- ISSUE 2 Awareness and understanding of smart transport systems
- ISSUE 3 Preparedness of new mobility paradigm
- ISSUE 4 Technical expertise and institutional capacity and safety threats from the transport sector
- ISSUE 5 Political will and regulatory foundations
- ISSUE 6 Harmonized and balanced policies
- ISSUE 7 Cooperation and collaboration with stakeholders and the public sector
- ISSUE 8 Fundamental transport infrastructure
- ISSUE 9 Digital technology constraints
- ISSUE 10 Common technical standards
- ISSUE 11 Connectivity and integration for intermodal and multimodal transport systems
- ISSUE 12 Data protection and use of Big Data
- ISSUE 13 Funding
- ISSUE 14 COVID-19 pandemic impacts

STRATEGIES

STRATEGY 1
Connectivity – Reaching anywhere

STRATEGY 2
Integration – Moving as one

STRATEGY 3
Inclusiveness – Access for all

STRATEGY 4
Affordability – Withstanding burdens together

STRATEGY 5
Resiliency – Prepared for what may come

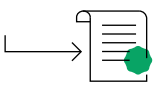
POLICY PLANS

- 1-1 Establish a dedicated cooperation mechanism for smart transport systems
- 1-2 Foster a dialogue with all stakeholders to forge international cooperation
- 2-1 Facilitate the integration for technical compatibility and interoperability with special attention to emerging technologies
- 2-2 Integrate road, maritime and rail transport
- 3-1 Strengthen capacity building, training and awareness raising
- 3-2 Deepen institutional and regulatory foundations
- 3-3 Increase tailored policy supports for vulnerable groups and areas
- 4-1 Facilitate a creative funding initiative through public-private partnerships
- 4-2 Upscale analytical work with particular development of assessment tools
- 5-1 Make more environmentally friendly and safer mobility services
- 5-2 Ensure data security and the use of Big Data in transport
- 5-2 Be ready for unexpected disruption

STRATEGY 1

Connectivity – Reaching anywhere

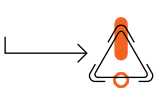
Connectivity is at the heart of transport. It is more than just a link to connect origins with destinations. The barriers crossed, the travel time required, and the accessibility of travel determines the success of a transport system. Achieving an effective means for travellers to reach their destinations can facilitate interactions between people, boost social and economic activities, and shape the future of individuals and societies. As the society becomes more connected in various ways, the importance of transport connectivity increases due to the ease of reaching destinations, and it is vital that transport policies are aligned to support it. Opportunities arise when transport connectivity is strengthened and interactions between people take place which can be stressed by cooperation and collaboration. Smart transport systems can coordinate all different areas of transport systems and facilitate faster and more efficient transport connections. This is particularly the case where geography, political borders, budgets, or social factors typically limit transport connections. As technology in the transport sector rapidly evolves, governments and stakeholders at all levels need to coordinate policies, strategies, and their roles and responsibilities together to increase transport connectivity that can be better facilitated through cooperation and collaboration with ESCAP.



POLICY PLAN 1-1

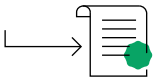
Establish a dedicated cooperation mechanism for smart transport systems

The wider uptake of smart transport systems across the Asia-Pacific region requires a multilateral and multidisciplinary approach to address disharmonized, imbalanced, and isolated situations. Thus, fostering a spirit of cooperation and collaboration between Member States is viewed as an appropriate response to these upfront issues. Greater cooperation and collaboration should lead Member States and their respective experts towards top-down and overarching policies, plans and strategies on smart transport systems. There are many ways to shape cross-sectoral and border cooperation and collaboration. This cannot be done in the short term but requires a stepwise process over a period of time. To upscale the spirit of cooperation and collaboration, a cooperative mechanism for smart transport systems in Asia and the Pacific can be established. Its establishment can be facilitated by capitalizing on the convening power of ESCAP. Through a dedicated platform for smart transport systems, this initiative will be a catalyst to encompass making specific strategies, masterplans and/or a steering committee to develop harmonized and balanced policies and strengthen cooperation and collaboration among Member States and all stakeholders to foster connectivity. Member States with special needs such as least developed countries, landlocked developing countries, and small island developing States can benefit from this initiative with particular consideration and emphasis. This platform would also facilitate leapfrogging of stages to reach a mature level of smart transport systems, limit unnecessary infrastructure development, and address the causes of roadblocks for the wider deployment of smart transport systems. It is envisaged that this dedicated cooperative platform for smart transport systems will eventually maximize the benefits of smart transport systems and realize the achievement of sustainable transport across the region consistent with the aspirations of the SDGs.



DIRECTLY RELATED ISSUES

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14



POLICY PLAN 1-2

Foster a dialogue with all stakeholders to forge international cooperation

The onus to achieve sustainable development and fully utilize the benefits of smart transport systems lies with various stakeholders. The public sector first needs to take a lead role in closing the gap in timing between the industrial development cycle of emerging technologies of the private sector and the development cycle for policy by the public sector. As there is a movement towards the mobility paradigm, each smart transport system is at a different stage of development, which requires a targeted set of policy actions. Furthermore, as technologies mature, the boundaries between each application become more obscure, requiring more complex interactions in implementation and development. When considering this situation, actions at different levels are needed and complexities can be mitigated when policy makers develop supporting policies which anticipate the future direction and range of smart transport systems. Given that smart transport systems are technology-intensive and driven by the private sector, there is a requirement that policy makers and a range of stakeholders all need to be involved in the policy making processes. Clarity in the roles of the various public and private sector stakeholders, including academia and others, is essential as part of an innovative institutional and governance model. This can foster coherent policy development-related endeavours for smart transport systems and related emerging technologies. These actions should be aligned and coordinated, requiring more intensified cooperation from all stakeholders. Supporting policies should be developed using inputs from stakeholders including the private sector, academia, governments, non-government organizations and international organizations to incorporate any future trends of technology development into the status, priorities and needs of local policies. Assistance can be provided by ESCAP Transport Division, and dialogue with all relevant stakeholders for enhanced cooperation can be strengthened. This can also benefit from the creation of a dedicated cooperative platform to bring all stakeholders to the discussion table. It is expected that this effort will promote safer, more efficient, and seamless cross-border transport movements. Together with all forms of infrastructure support from Member States, smart transport systems across the region can plug into emerging technologies such as cooperative-ITS, connected and autonomous vehicles, smart mobility, and MaaS.

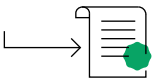
DIRECTLY RELATED ISSUES

1, 6, 7, 11, 13, 14

STRATEGY 2

Integration – Moving as one

Successful transport systems occur when the various modes and technologies are integrated and harmonious. The integration of different systems into a harmonized one across connected areas (whether it be cities, countries, or regions) is critical to deliver cohesive and competitive transport services. Further integrating common practices across transport modes will more deeply and comprehensively connect larger transport systems. From sea ports to railways to vehicles, all modes must communicate with each other and be systemically integrated so that the entire transport ecosystem can be optimally managed and operated. Smart transport systems with sound policy guidance can assist in technically integrating all modes and relevant technologies. This facilitates more efficient transport services and lower operating costs while offering a user-friendly and convenient experience. Regarding emerging technologies, their smooth integration into existing systems is expected to address some current confronting issues and maximize their advantages in the transport sector through greater synergy and compatibility. The everyday lives of people can eventually benefit from society's integrated transport services through smart transport systems in terms of improvements in efficiency, reliability, accessibility, and convenience.



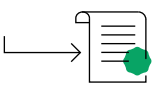
POLICY PLAN 2-1

Facilitate the integration for technical compatibility and interoperability with special attention to emerging technologies

In addition to governance and institutional requirements, the technical harmonization of smart transport systems within and between Member States is another critical barrier to be resolved in order to promote consistent regional wide services. Technical fragmentation and its corresponding compatibility and interoperability issues stem from both slow policy support at the national level and the lack of intergovernmental leadership at the Asia-Pacific level. In some Member States, technical compatibility and interoperability issues have been addressed through the adoption of technical standards and architecture with effective governance and institutional support. However, these States are at a more mature level of smart transport system development which many Member States have yet to reach. Furthermore, with the necessity for emerging technologies in smart transport systems to be incorporated into current systems, compatibility and interoperability issues will become more urgent. One of the main driving forces to resolve this issue is a nationally coordinated approach matched sub-regionally and regionally through ESCAP Transport Division. This approach will enhance technical ties among adjacent States and offer overarching guidance. Flexible technical tools that accommodate the pace of dynamic new innovations in smart transport systems are important. For example, notable work on this philosophy of consistent and harmonized standardization is demonstrated by international entities such as the International Organization for Standardization Technical Committee 204 (ISO/TC 204). On this basis, ESCAP Transport Division has a valuable role to assist with the elimination of technical constraints among Member States. This can be done by providing integrated approaches, models, and tools, and by collaborating with international standard organizations and industries. This facilitates an all of government approach for technical compatibility and interoperability of smart transport systems within and between States which can lead to better planning and coordination of smart transport systems. Another advantage of having an integrator is that the private sector can also be involved in the relevant intergovernmental process which can generate more efficient operations through data, service and information sharing among each component of separate systems.

DIRECTLY RELATED ISSUES

9, 10, 11



POLICY PLAN 2-2

Integrate road, maritime and rail transport

Although the names and functions of systems are different by applicable modes of transport, smart transport systems obviously penetrate all modes of transport and services for road, maritime and rail transport. Digital integration of all modes of transport and services is beneficial in that it can facilitate efficient transfers of passengers and freight through further optimized and advanced transport networks and enhance accessibility. Therefore, operationalizing transport integration through smart transport systems can yield maximum modal harmonization with more optimal and efficient passenger and freight movements, and less environmental pollution. This will also help Member States in special situations including least developed countries, landlocked developed countries and small island developing States. Further, research into setting up universal strategies by experts in the field will be beneficial. This can then be followed by greater knowledge sharing between Member States wishing to operationalize such strategies with guidance from ESCAP Transport Division. These strategies should be comprehensive to ensure the optimal use of existing transport infrastructure and a smooth transition to emerging technologies. As such, the potential possibility of interoperable systems can be enhanced with seamless intermodal and multimodal transport services from smart transport systems.

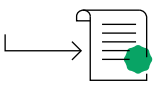
DIRECTLY RELATED ISSUES

8, 9, 10, 11

STRATEGY 3

Inclusiveness – Access for all

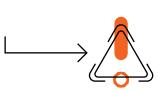
Transport must be inclusive, accessible, and safe for all. Societies only succeed when all people succeed. As transport provision creates opportunities, it is important that transport is inclusively available to and safe for all people regardless of background, race, religion, or economic status. Different areas and different people may have different transport needs, but all needs must be met to connect people effectively and safely. This particularly applies to vulnerable groups and areas for transport services. Smart transport systems can close the gap in inclusiveness by providing creative solutions to a variety of transport needs. Strengthening inclusiveness to neighbours and opportunities is a crucial first step in establishing successful transport systems. Ensuring equitable access for all is the best way to reap the full benefits of current and future transport systems. However, barriers to initiate the utilization of smart transport systems remain daunting. Education, training, research and collaboration on smart transport systems and their future in the region is critical to provide growing economies with the foundational knowledge and institutional and regulatory fundamentals to initiate inclusive transport.



POLICY PLAN 3-1

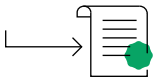
Strengthen capacity building, training and awareness raising

Bringing the concept of smart transport systems into the psyche of the general public and policy makers who have not been exposed to its benefits is a challenging endeavour. Although widely recognized among experts and policy makers in some Member States, the concept of smart transport systems may be virtually unknown in many Member States, particularly those with special needs, thereby generating limited technical and institutional capacity. Bridging this gap inclusively beyond the realm of experts to strengthen capacity, training, and awareness, even at a fundamental level, is essential for furthering the uptake of smart transport systems. This becomes more important in consideration of recent technical trends of smart transport systems. New software, hardware and communications technologies have given rise to a variety of options for smart transport systems. AI, Big Data, social media, V2V, V2I, V2X, autonomous vehicles and cellular/Bluetooth/satellite communications are only some of these examples. These technologies are at the forefront of the latest science, technology and innovation for smart transport systems. Their continued development represents a vision of what can be achieved and aspired to for many Member States. Educational establishment to increase capacity, training and awareness can decrease the gaps in developing all-encompassing programmes across the breadth of smart transport systems. Disseminating and sharing best practices and knowledge through capacity building activities, research works, educational programmes, consultations, and training and promotional activities provides a very useful inclusive knowledge base for all stakeholders in the field of smart transport systems while raising public awareness. Capacity building to mainstream financing for development issues including resource mobilization can also be part of such programmes. The result of such endeavours at a country-wide and international level can lead to greater capacity building, community engagement, and policy and institutional development to further the goal of wider deployment of smart transport systems across the region.



DIRECTLY RELATED ISSUES

2, 3, 4, 7



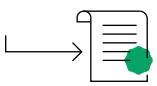
POLICY PLAN 3-2

Deepen institutional and regulatory foundations

Given the large disparity in the utilization of smart transport systems across the region, expanding the scope of relevant governance and regulations needs to be included in policy plans for Member States. There is an incorrect assumption that smart transport systems require huge investments only possible in developed Member States. This sometimes hinders the political will for providing structured institutional and regulatory foundations. An initial amount of investment is required, but smart transport systems commonly offer various cost-effective options with greater benefits than traditional infrastructure options which might be the usual focus of political attention. By correcting this misconception, the political will and leadership at the country level can be swayed to tighten up institutional and regulatory foundations, which can nurture an inclusive environment for smart transport systems. It has been demonstrated in some Member States with mature levels of smart transport systems that well established institutional and regulatory frameworks have many benefits in furthering their utilization. These include greater amalgamation between present and future technologies, the coordination of technological development and transfer, the provision of formal governance structure and long-standing plans/strategies, and the definition of the roles and responsibilities of stakeholders. These will create greater confidence for ongoing and future investment, policies, strategies, research, development, and operation of smart transport systems.

DIRECTLY RELATED ISSUES

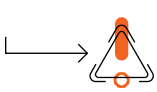
2, 4, 5



POLICY PLAN 3-3

Increase tailored policy supports for vulnerable groups and areas

It is noted that certain groups and areas are disconnected or experience disadvantages in transport systems and services. Although these inclusive issues prevail in several dimensions, geographical location, and social and economic backgrounds are major reasons for their existence. In terms of vulnerable groups, there are arguably many small and major segments of society whose inclusion in transport is not assured such as women, the elderly, and people with handicaps. Marginalized areas are generally where transport services are not properly accessible when necessary, which include suburban and rural areas and even transport-discriminated urban areas. Despite these differences, all of these vulnerabilities can be combined as social, economic, and geographical barriers which can exist at the same time. To achieve sustainable development, many grievances that exist for marginalized groups and areas need to be adequately addressed, which can be assisted by smart transport systems. Smart transport systems can provide customized mobility services for women, the elderly, and handicapped persons using real-time information and mobile applications. Demand-responsive transport and shared mobility can also address demands in suburban and rural areas in a cost-effective way where public transport services are not properly operated. Thus, tailored policy support for smart transport systems in response to specific vulnerable issues can be of great help. Considering the features of vulnerabilities in the region and smart transport systems, greater coherence of policy measures through trans-national and regional coordination on the ground to avoid unilateral solutions and periphery formations makes sense.



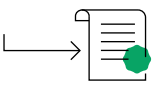
DIRECTLY RELATED ISSUES

2, 3, 4, 5, 6, 7

STRATEGY 4

Affordability – Withstanding burdens together

Cost is a primary barrier to quality transport services for both governments and individuals. For governments, constructing new transport infrastructure is capital intensive, and securing funds to build, operate and maintain it can be constrained. Allocating limited resources for transport infrastructure therefore requires careful decisions with a consideration of the expected economic and social benefits. In cases wherein these benefits are not clear, or governments cannot afford them, transport infrastructure investment can be impaired. Concurrently, the private sector is willing to commit capital for some transport infrastructure, with many countries requiring a taxation base to provide fundamental transport services. For individuals, offering reasonable prices for transport services is important, particularly for vulnerable groups and areas, to give equal opportunities for social and economic activities. Thus, maintaining their affordability is a key to achieve inclusive, equitable and sustainable transport systems. Smart transport systems can offer cost-effective alternatives to traditional transport infrastructure investments to address present issues. Even small technological applications can save large sums of money which can be passed down to the consumer. Integrating technology into transport systems can also initiate conversation between the public and private sectors and open opportunities for collaboration, potentially offloading some costs from the government onto the private sector. The more affordable transport systems become, the more empowered people and States are to take opportunities to better their lives and their society.



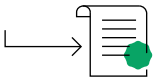
POLICY PLAN 4-1

Facilitate a creative funding initiative through public-private partnerships

The steady development of smart transport systems requires stable, progressive, and enduring funding. Considering the traditional funding mechanism for transport systems, potential financial sources can be listed including official development assistance agencies, multilateral development banks, United Nations agencies and local governments. However, the technological development of smart transport systems is led by the private sector because of the nature of technology-intensive systems and the financial viability of smart transport systems that might be more undefined compared with traditional notions of transport systems. For example, most smart mobility services such as e-scooter sharing and ride-hailing/sharing, which have significantly impacted the entire world, have been initiated and operated by private entities. Recent innovative technologies such as connected and autonomous vehicles have also been developed and tested by big technology companies. Unlike traditional transport systems which might run at a loss without financial subsidies from the public sector, smart transport systems do not necessarily require vast amounts of initial investment and operational costs. The advantage of smart transport systems is their modularization whereby units of application can be deployed to remedy immediate transport issues. With such features, a creative insight from an economic perspective is required to guarantee the financial viability and wider deployment of smart transport systems. Public-private partnerships, which can provide effective solutions for resource mobilization, have unfortunately not yet been widely discussed in Asia and the Pacific. This is because there are a limited number of initiatives and facilitators with a firm understanding of funding mechanisms from both the private and public sides as well as good technical insights of the nature of smart transport systems. However, as can be observed in emerging technologies, the role of the private sector is expected to grow further, and the financial needs of Member States will be increased accordingly. A creative funding initiative, supported by ESCAP Transport Division as a facilitator, is needed that can fully utilize the benefits of public-private cooperation.

DIRECTLY RELATED ISSUES

2, 3, 4, 7, 13



POLICY PLAN 4-2

Upscale analytical work with particular development of assessment tools

Smart transport systems can address many transport-related issues with considerable benefits while avoiding the requirement for further significant investment in transport infrastructure. This reemphasizes that there is a misconception in terms of financial requirements for the deployment of smart transport systems. This twists the notion of affordability in smart transport systems, but it can be mitigated through strengthened analytical work including the development of assessment tools. A lack of harmonized and proven methodologies to assess the process can hinder the implementation of systems which provide the greatest advantage over costly and less beneficial systems. Specifically, the further development of assessment tools customized for Member States in Asia and the Pacific can offer guidance on evaluating the various angles of the effectiveness of current smart transport systems, thereby providing for the planning of future smart transport systems affordably. These tools can specifically assess the feasibility of smart transport systems including their estimated costs and benefits, potential risks, and the valuation and quantification of their co-impacts. Some smart transport systems may require financial investment over a specified minimum level when compared with other transport strategies. This can be identified through analytical work with assessment tools. To a broader extent, related research and analysis can be conducted targeting specific States or subregions to enhance regional knowledge of financing for smart transport systems. The products of analytical work can be used to educate and train all stakeholders through activities for capacity building, training and awareness raising. Although there are obvious disparities and gaps in the level of development of smart transport systems between States, it is possible for lesser developed States to leapfrog to more advanced levels of smart transport systems. This can occur without the need for such States to invest heavily in intermediary infrastructure to reach a level of maturity. Specific assessments by analytical work can assist to prioritize policy support and financial investment, which will also help stakeholders in the early stages of development by offering a decision standard to move forward on.

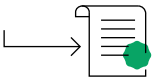
DIRECTLY RELATED ISSUES

4, 5, 8, 9

STRATEGY 5

Resiliency – Prepared for what may come

For transport systems, resiliency is the capability to recover from a disruption to an almost similar level of previous normal operation in a timely manner. The threats to resiliency in transport vary from anthropocentric to natural threats, and even to obscure events. Transport must be resilient on a daily basis to be a reliable connection to varying opportunities. Resiliency can be applied to individual short-term events, such as the operational barriers of transport systems in severe weather conditions, as well as life-altering, long-term events such as pandemics, climate change, or social and political societal shifts. Representatively, while the transport sector contributes to social and economic activities, it is also one of the main contributors to greenhouse gas emissions. However, smart transport systems can be implemented to reduce the sector's impact on climate change while operating the core function of transport systems. Smart transport systems can also be implemented to detect incidents, quicken response times, manage evacuation routes, and support neighbours in times of crisis. Resilient transport is the backbone of a sense of normalcy provided in tumultuous times. Maintaining access to jobs, neighbours, services, education, and other opportunities is upheld by transport and in turn strengthens a society's overall resilience. While it is unknown what the future holds, the increased resilience offered by smart transportation systems can maintain vital connections to withstand the test of time.



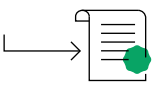
POLICY PLAN 5-1

Make more environmentally friendly and safer mobility services

Against the paradigm change in transport, political emphasis should be placed on new mobility services from which various environmental sustainability and safety benefits can be accrued. For example, shared mobility, demand-responsive transport, and MaaS will lead to reductions in air pollution and the need to build large transport infrastructure which can produce negative externalities. Cooperative-ITS and connected and autonomous vehicles will help to prevent collisions among vehicles, pedestrians, and facilities. Additionally, a shift towards low carbon transport with hybrid and electric vehicles and renewable energy sources is required to compliment new mobility services. To fully utilize the advantages of new mobility services and renewable energy sources, current governance, supporting policies and regulations need to be reformed to offer more environmentally friendly and safer services which also adhere to international commitments for green energy and net-zero carbon emissions goals. Thus, the priority area of cooperation emphasizes the promotion of low-carbon mobility, clean energy technologies, more efficient and optimised logistical movements, and the prioritization of safety elements. This is facilitated by assistance from ESCAP Transport Division with regional and multi-stakeholder cooperation, research and analysis, and technical assistance tools.

DIRECTLY RELATED ISSUES

1, 3, 6, 7, 10

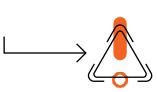


POLICY PLAN 5-2

Ensure data security and the use of Big Data in transport

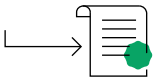
The significant technical barrier of ensuring and enhancing data security and privacy for the users of smart transport systems is critical for wider deployment. To maintain the performance and benefits of these systems, the threats of data losses and identity theft must be combated by improved techniques which are enforced by protective legislation, regulations and institutions that monitor compliance. Appropriate instruments are necessary to ensure the authenticity and integrity of data including the registration and revocation of vehicles together with robust cryptographic procedures to mask the identity of honest users. Proper provision of capacity building support for enhanced data security will also be helpful for Member States.

The data revolution has already been initiated, and a drastic change will come from the advent of the Big Data concept. Although this wave has not seriously affected the transport sector, it can be well expected through the development of various emerging technologies in smart transport systems. More importantly, advances in data processing and analysis now make it possible to utilize Big Data with smart transport systems for more reliable, efficient, and inclusive transport services. Smart mobility is a good example which collects substantial amounts of data from all cutting-edge devices and processes it to provide customized services to users. Connected and autonomous vehicles will also produce countless volumes of data which will offer the opportunity to experience a new level of transport services. To be prepared for this drastic change, Member States require the knowledge and capacity to utilize Big Data with smart transport systems in order to align their policies and strategies with social, economic, and environmental issues. At the regional level, the gap among Member States for Big Data utilization has already widened and needs intergovernmental action including the provision of policy guidelines to instigate data-driven policy and strategy making. It is eventually anticipated that further work in data security and transport Big Data will bolster user confidence and data-driven transport services.



DIRECTLY RELATED ISSUES

3, 4, 9, 10, 12



POLICY PLAN 5-3

Be ready for unexpected disruption

Among the numerous threats to the transport sector, the COVID-19 pandemic has recently exposed the extent to which the transport sector is vulnerable and how flexible it must be to unexpected external factors. For instance, there has been a trend towards individual vehicles with less demand for public transport because of the concern of viral infections. Some positive opportunities for what can be achieved in travel behaviour have emerged from the pandemic such as reductions in unnecessary trips, increases in active travel (e.g., walking and cycling) and mobility services to maintain social distancing. The valuable role of digital technologies has been reinforced in maintaining resilience during the pandemic, and the transport sector is no exception. Member States in this region have also demonstrated that they can move rapidly towards automation and innovation to maintain the functionality and resilience of transport services. Smart transport systems have particularly presented opportunities to provide customized mobility services and continuous paperless international cross-border road transport while maintaining social distancing.

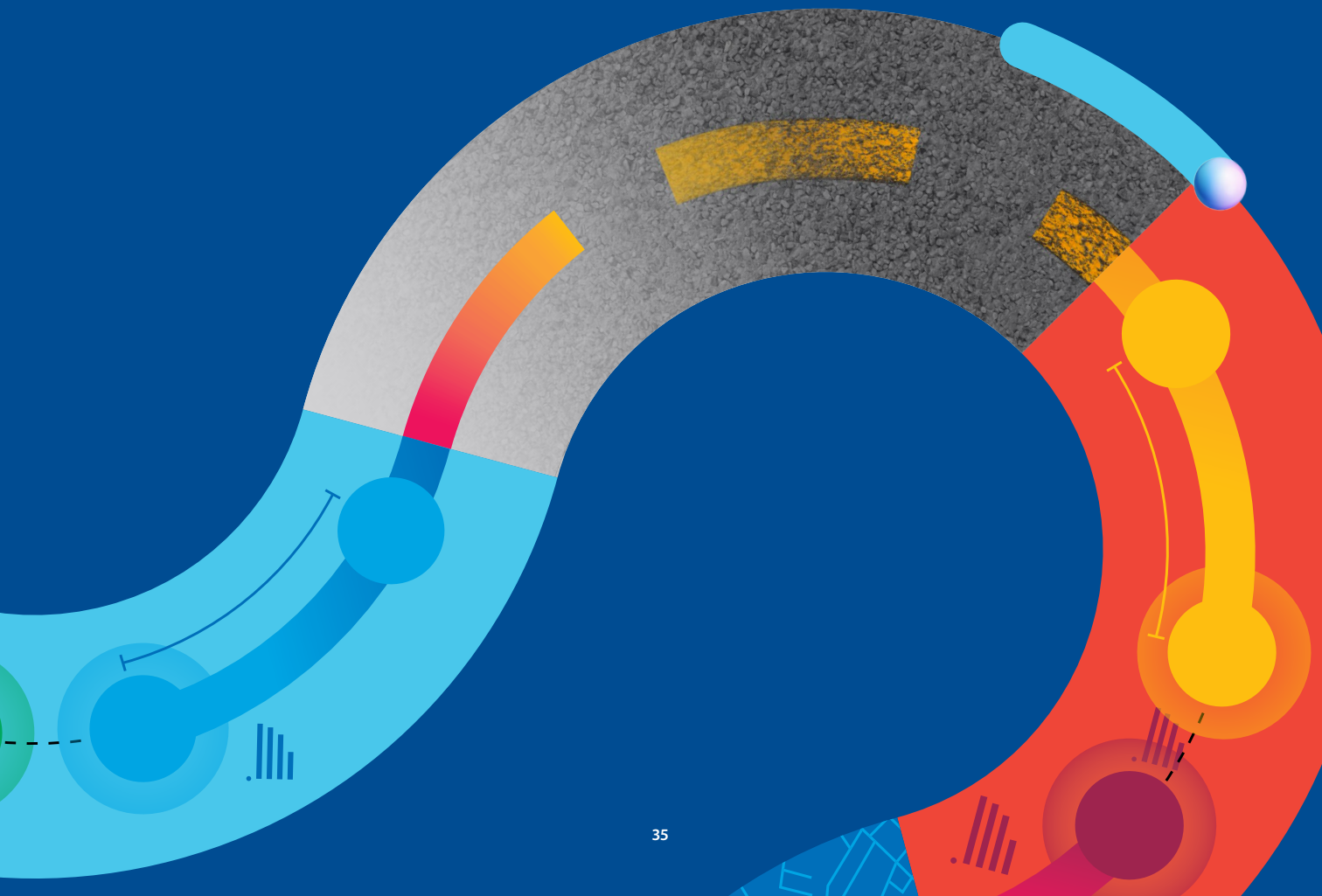
The pandemic has also highlighted the need to further assess transport planning decisions in accordance with local conditions and make transport systems more environmentally sustainable, socially inclusive, and resilient to such disruptions. Measures to address the impact of the pandemic can be divided into short- and long-term initiatives. In the short term, there is a need to restore confidence in using public transport that compliments well with other paratransit options while mitigating the risk of infection. These options include smart mobility such as MaaS and other personal micro-mobility. In the long term, the changed behaviour of travellers needs to be complimented by urban planning reforms in consideration of the concept of smart mobility and smart cities. Future proofing the transport sector against similar disruptions through resilient infrastructure, greater deployment of smart transport systems, and adherence to the philosophy of building back better is imperative to overcome future challenges from further potential outbreaks or other pandemics.

DIRECTLY RELATED ISSUES

3, 4, 5, 7, 14

Chapter 4

Opportunity areas for sustainable smart transport systems with strategies and policy plans



ESCAP supports sustainable development in Asia and the Pacific by providing a platform to promote cooperation and collaboration among Member States. It is ideally positioned to facilitate the wider deployment of smart transport systems under the banner of sustainable development to ensure that no Member State is left behind. To address the barriers identified from various ESCAP Transport Division's activities, multisectoral and multifarious actions are required at the regional level to support and enhance the effectiveness of national and subregional efforts.

ESCAP, as a regional arm that facilitates the well-preparedness and progression of Member States, has four major intrinsic functions which are:

- Providing services for technical assistance and capacity-building
- Supporting regional and global partnerships
- Strengthening national development that aligns with global and regional goals
- Generating knowledge that drives effective action

Additionally, the priority work areas of the ESCAP Transport Division's Regional Action Programme on Sustainable Transport Development in Asia and the Pacific (2022-2026) guide opportunities for regional cooperation. Special emphasis focuses on practical implementation of smart transport systems and their impacts across boundaries to achieve sustainable development. Cooperation in these areas at the subregional and regional level, which are other intersecting work areas of ESCAP, can assist and support the effectiveness of national policies and strategies. Synergistic effects with energy, air pollution, nature conservation, trade, investment, science and technology, and innovation can arise with the advent of smart transport systems. However, overarching assistance can be provided for almost all areas of responsibility related to smart transport systems by ESCAP Transport Division.

OPPORTUNITY AREA 1

Enhancing technical expertise and capacity to fully utilize smart transport systems

The logical use of smart transport systems is required to achieve sustainable transport. Further, the technical capability of smart transportation systems forms the initial step towards realizing their widespread deployment. For a balanced and efficient utilization of smart transport systems, a certain level of capacities and technical expertise is needed as the topic of smart transport systems differs from conventional transport systems. They are also more technology-intensive and generally more complicated with the advent of new technologies such as smart mobility, cooperative-ITS, connected and autonomous vehicles, and MaaS. To fully benefit from these systems, policy makers and concerned officials of Member States and all relevant stakeholders need to be well-versed and knowledgeable regarding their effectiveness and utilization.

ESCAP has been providing technical assistance and capacity-building services to Member States. ESCAP Transport Division may build on the variety of relevant technical cooperation activities on smart transport systems to support Member States in reviewing national policies and strategies, and providing technical guidance to help set up country- and subregional-specific directions. Facilitating and accelerating the dissemination of best practices, knowledge products, and technical tools to further enhance knowledge and capacities of Member States are also part of ESCAP Transport Division's roles. All these activities permit Member States at the forefront of new innovations and fully steering smart transport systems particularly towards clear and common future directions of connected and autonomous systems, Big Data analytics, and new wireless communication technologies. Greater expertise and capacity at a national and international level on smart transport systems through the support of ESCAP Transport Division will provide an opportunity to realize the goal of wider deployment of smart transport systems across the region.

OPPORTUNITY AREA 2

Fostering intergovernmental cooperation and collaboration for transboundary deployment of smart transport systems

The advantages of smart transport systems are amplified when they can be used across cities and regions. Greater cooperation and collaboration are required to ensure that Member States progress their overarching policies, plans and strategies in the same direction towards attaining maximum and optimum use of smart transport systems. Primarily, transport and digital infrastructure issues are a major concern for deployment of smart transport systems across cities and regions. Such challenges can be relieved by policy support and technical solutions.

ESCAP Transport Division can provide technical assistance to enhance Member States' expertise to maximize modal integration, expansion of connectivity to rural areas, and technical standards for operationalizing transboundary transport services. Particularly, smart transport systems require digital deployment capabilities to strengthen digital infrastructure connectivity amongst Member States. ESCAP, as the most inclusive intergovernmental platform in the Asia-Pacific region, with United Nations country teams, United Nations agencies and other development partners can support Member States in developing regional and global partnerships and promoting dialogue that enhance wider deployment of smart transport systems and emerging technologies across boundaries for seamless transport systems.

OPPORTUNITY AREA 3

Putting efforts towards home-grown measures to localize smart transport systems

The deployment of smart transport systems needs to take local and regional conditions, and special features of any given country into account. Member States may prioritize local transport issues and localize solutions from smart transport systems aligned with the regional agenda in its implementation. In particular, customized measures may be necessary for cities in vulnerable situations or Member States that need urgent support from smart transport systems to address pressing issues. A multilateral platform which can deliver unique solutions to localized smart transport systems will be essential through strong coherence with ESCAP Transport Division and local agencies.

To facilitate the multilateral platform, Member States may utilize the convening power of ESCAP to exchange local experiences which would give potential beneficial lessons to other countries. In turn, smart transport systems can be assessed and customized to address local issues within each country. Member States can share their status, challenges, and issues to be discussed with neighbouring States and experts. In addition, technical advisory services or capacity building workshops and training can benefit Member States and allow them the opportunity to discuss the realities of their transport sector, including ways to benefit from the experience and expertise of their neighbours and identify necessary supports. Member States can also make use of the advisory services and technical assistance provided by ESCAP Transport Division to identify local issues and receive proper technical guidance and produce lesson-learned and knowledge products that can be applied to other States experiencing similar conditions.

In fact, Member States within each of the five subregions of ESCAP likely have similar or comparable contexts which are appropriate for home-grown measures in some Member States with similar contexts. Similarly, the sharing of similar experiences among least developed countries, small island developing States and landlocked developing countries will be beneficial. Thematic areas of note are included for the difficulties and roles of smart transport systems from each category and related localized measures. The understanding of local conditions consequently assists Member States in the development of localized transport solutions using smart transport systems.

OPPORTUNITY AREA 4
Keeping current with evolving technical trends in smart transport systems and producing related knowledge products

The transport sector is the world's second largest producer of carbon dioxide emissions and a key driver of growth in the Asia-Pacific region which provides many social and economic opportunities. Historically, transport has prioritized the development of infrastructure to meet social and economic needs, but this approach has neglected the comparative advantages of options which would deliver sustainable development. Therefore, there is an increasing need to optimize this situation through the use of smart transport systems. With the high penetration of the Internet and wireless communications, improvements in information and communication technologies, and changes in the expectations and demands of travellers, smart transport systems are becoming a viable contributor to sustainable development.

Often, the selection and implementation of effective and optimal smart transport solutions is complicated by the range of different technologies and applications. Member States can benefit from regional knowledge hubs, and knowledge-based series and training materials. To enable knowledge sharing on the topic of smart transport systems, ESCAP Transport Division can support systematic regional dialogue on technical trends in smart transport systems. A series of knowledge products, technical guidebook, toolkits, training manuals and data-driven analyses can also be produced by ESCAP Transport Division in partnerships with relevant global and regional partners, as well as industry partners.

Chapter 5

The way forward

Historically, smart transport systems have been used for simple applications such as emergency telephone systems along motorways, vehicle detection at highways, traffic lights, and the video surveillance of tunnels under the early concept of intelligent transport systems. With technological developments, many new and varied options are available. Through rapid expansion, the intelligent transport systems sector has broadened to become smart transport systems which include route planners and shared mobility applications on smart phones, on-board navigation systems and intelligent speed control systems in vehicles, and public transit information systems on roads.

Smart transport systems integrate a vast array of digital technologies to improve the efficiency of the transport sector, thereby contributing to the achievement of SDGs and the Paris Agreement. There is recent drastic advancement of digital technologies which has naturally induced the reshaping of smart transport systems to more various forms. Emerging technologies including smart mobility, MaaS, cooperative-ITS, connected vehicles, and autonomous vehicles are part of these new innovations frequently discussed in the field of smart transport systems. Among these, it is anticipated that vehicles connected to infrastructure (V2I) or other vehicles (V2V), and vehicles with a high level of autonomous driving capability will be available in the near future. Taken independently, each emerging technology will significantly disrupt the overall environment of the transport sector but in combination, they will drive unprecedented changes in transport policy, planning and governance.

Concurrently, the ecosystem of smart transport systems has been challenged from different angles. As emphasized earlier, the traditional public sector- and supply-driven approach has become blurred with the paradigm change from "transport" to "mobility". The advent of new concepts including smart mobility and smart cities has led to user-oriented and private sector-driven services as new solutions to achieve global and local goals. This disruptive transformation is reinforced by urgent global needs such as complying with the SDGs and the Paris Agreement, tremendous technological powers with the fourth industrial revolution, and ironically, the COVID-19 pandemic. Although smart transport systems are technologically intensive, they are not only technologies, but also applications and services. The nature of this change is thus ubiquitous and concurrent and even disruptive to the industry and all levels of society.

The continuing evolution of smart transport systems according to the development and ever-increasing presence of innovative technologies has instigated their application to address current and emerging future transport problems. Despite the benefits of these systems, however, the previously discussed roadblocks still hamper the wider deployment and development of smart transport systems. Particularly, many activities related to smart transport systems are being designed and pursued locally without consideration of regional harmony owing to the missing overarching direction. This approach results in services that are fragmented and geographically limited among States. Without consensus on the direction of smart transport systems, their advantages will be underutilized in addressing sustainable development issues in the transport sector.

Against this backdrop, optimum policy guidance that is inclusive, universal, and versatile at the Asia-Pacific level can lead to the ideal use of and transition towards sustainable smart transport systems. In acknowledging this, the preparation of a shared strategy for the future implementation of smart transport systems was considered as an essential response that has culminated as a regional road map. With this regional road map, it is expected that Member States have set the course for transforming the region and delivering sustainable smart transport systems in Asia and the Pacific. This regional road map is captured within a series of strategies and policy plans on smart transport systems in Asia and the Pacific that can be implemented and facilitated by ESCAP Transport Division. The policy plans are for consideration by policy makers when drafting national smart transport-related policies, strategies and regulations which are consistent with those of neighbouring countries, and by the region as a whole. This consistency will reap many benefits in terms of harmonised plans, strategies, regulations, standards, and greater interoperability of smart transport systems across international boundaries while addressing many of the

challenges and issues for the wider deployment of smart transport systems. The policy plans within the regional road map also encourage the uptake of smart transport systems by moving from the status quo of fragmented deployment and policies to the vision of a future with greater and consistent implementation and digitization with emerging technologies including smart mobility, cooperative-ITS, connected and autonomous vehicles, and MaaS across the region's transport landscape.

The regional road map emphasizes support for the implementation of SDGs and the Paris Agreement while maintaining the universality and transformative nature of the regional road map for the different realities, capabilities, and levels of development in Member States. In line with global agendas and the Regional Action Programme, the regional road map aims to promote a balanced pursuit of the five major strategies, "connectivity", "integration", "inclusiveness", "affordability" and "resiliency", through regional cooperation in a set of priority policy plans on smart transport systems. This will eventually contribute to the achievement of SDGs and the Paris Agreement in the Asia-Pacific region. The regional road map also recognises that sustainable smart transport systems require bolstering by good governance and institutional effectiveness.

The regional road map is intended as a living document so that proposed policy plans are flexible and subject to review and revision according to the local situation of Member States. Opportunities for further discussions can take place locally, sub-regionally and regionally at any event where relevant Member States can congregate. However, there is a need for proactive actions to further the influence of the regional road map for sustainable smart transport systems. In this regard, the following is the suggested timeframe that can be considered by Member States.

FIGURE 12 The Suggested Timeframe to Implement Strategies and Policy Plans in Asia and the Pacific

GOALS	STRATEGIES	POLICY PLANS
SHORT-TERM	STRATEGY 1 Connectivity	1-1 Establish a dedicated cooperation mechanism for smart transport systems 1-2 Foster a dialogue with all stakeholders to forge international cooperation
	STRATEGY 2 Integration	2-1 Facilitate the integration for technical compatibility and interoperability with special attention to emerging technologies
	STRATEGY 3 Inclusiveness	3-1 Strengthen capacity building, training and awareness raising
	STRATEGY 4 Affordability	4-1 Facilitate a creative funding initiative through public-private partnerships 4-2 Upscale analytical work with particular development of assessment tools
LONG-TERM	STRATEGY 2 Integration	2-2 Integrate road, maritime and rail transport
	STRATEGY 3 Inclusiveness	3-2 Deepen institutional and regulatory foundations 3-3 Increase tailored policy supports for vulnerable groups and areas
	STRATEGY 5 Resiliency	5-1 Make more environmentally friendly and safer mobility services 5-2 Ensure data security and the use of Big Data in transport 5-2 Be ready for unexpected disruption