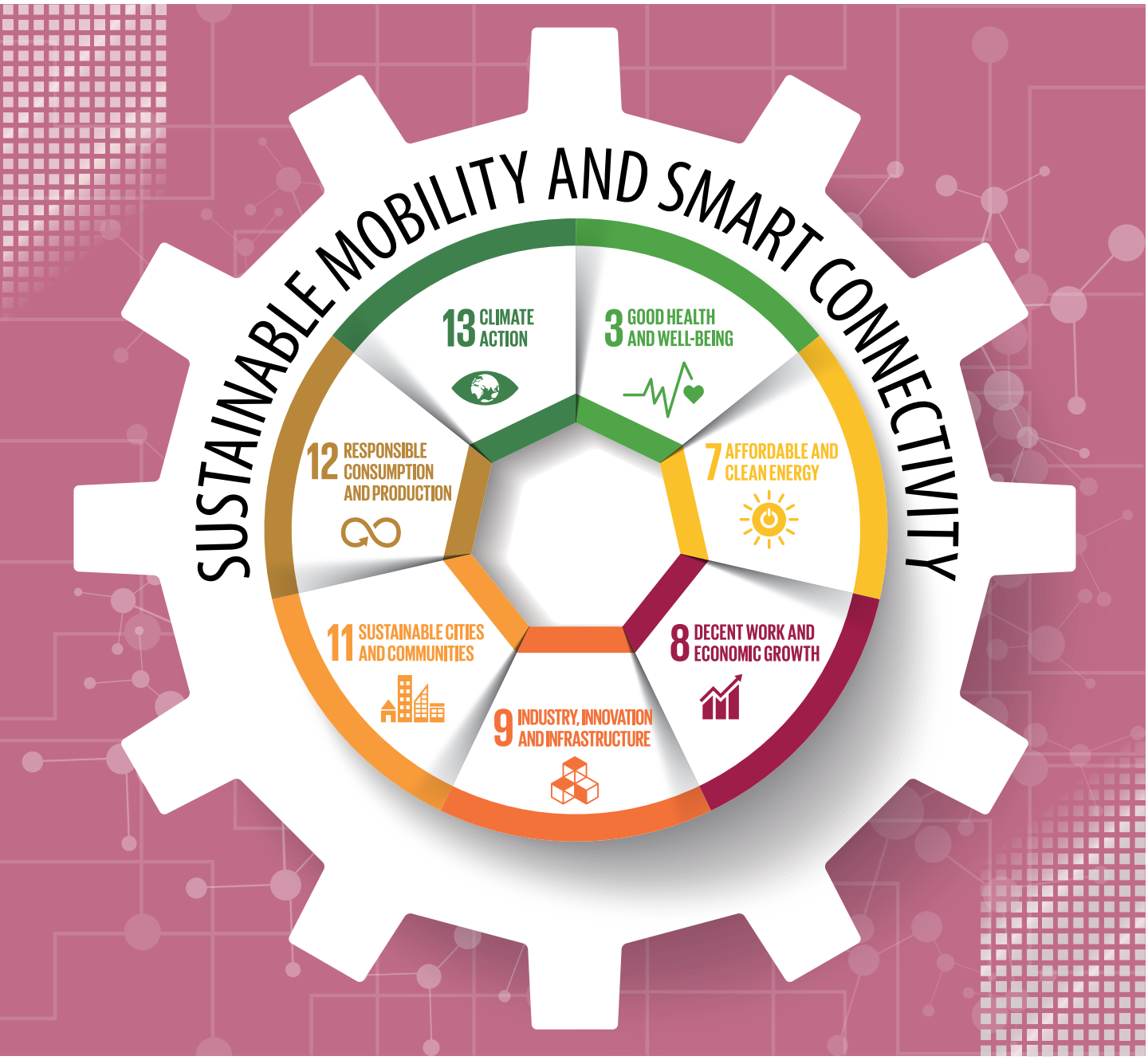
UNECE

Sustainable Mobility and Smart Connectivity



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Sustainable Mobility and Smart Connectivity

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FOREWORD

The 2030 Agenda for Sustainable Development, with its 17 Sustainable Development Goals (SDGs), provides an ambitious and comprehensive framework that opens new perspectives for policymaking and international cooperation. While progress in its implementation is being made, current efforts are far below the scale needed to deliver the SDGs within the next 10 years. Ambitious action becomes even more important in the context of the response to the COVID-19 pandemic: the SDGs are vital for a recovery that leads to greener, more inclusive economies and stronger, more resilient countries.

The United Nations Economic Commission for Europe (UNECE) supports its member States in the implementation of the 2030 Agenda through concrete and results-oriented activities in the areas of its eight subprogrammes: environment, transport, statistics, economic cooperation and integration, sustainable energy, trade, timber and forestry, and housing, land management and population.

This multi-sectoral structure has allowed UNECE to address SDG implementation in an integrated manner, in line with the interlinked character of the SDGs, and to adopt a new way of working that cuts across sectoral boundaries. Four nexus areas have been defined where multiple SDGs converge:

- Sustainable use of natural resources
- Sustainable and smart cities
- Sustainable mobility and smart connectivity
- Measuring and monitoring progress towards the SDGs.
- In each of these areas, a cross-sectoral, inter-divisional team of UNECE experts has undertaken an in-depth substantive analysis of current and future challenges and needs of UNECE member States and identified ways and means to address them, thus assisting member States to design and implement integrated policies in these areas. The findings of these analyses and corresponding policy recommendations are set out in a series of four flagship publications.

The "Sustainable mobility and smart connectivity" publication reviews the challenges affecting mobility and connectivity within the ECE region. It highlights the vital importance that mobility and connectivity play in the operation of an economy and in moving goods and people within and across borders showing that the digitalization of many of these processes are key to improving efficiency and effectiveness. Addressing the challenges in these two areas is fundamental in assisting Member States in achieving the Sustainable Development Agenda. Each country has actions to pursue in relation to meeting these challenges and this publication highlights which are the main ones.

Furthermore, the COVID-19 pandemic has shown how fundamental adequate mobility and connectivity are to the correct functioning of medical care and the economy without which vital medical relief and supplies cannot reach those most in need. The pandemic has also shown how a shift to more sustainable mobility coupled with smarter connectivity can facilitate accessibility, assist the recovery and place the economies of the region on a more sustainable track.

I trust that these flagship publications will offer useful guidance to governments and other stakeholders engaged in developing integrated solutions to the multifaceted challenges of our time and in building back better from the COVID-19 pandemic.

Olga Algayerova

Under-Secretary-General of the United Nations
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ACRONYMS

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AETR	European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport
AGC	European Agreement on Main International Rail Lines
AGN	European Agreement on Main Inland Waterways of International Importance
AGR	European Agreement on Main International Traffic Arteries
AGTC	European Agreement on Important International Combined Transport Lines and Related Installations
ASC	Accredited Standards Committee
B2B	Business-to-Business
B2C	Business-to-Consumer
B2G	Business-to-Government
BENELUX	Belgium, the Netherlands and Luxembourg
BRI	Belt and Road Initiative of China
CCL	UN/CEFACT Core Components Library
CCNR	Central Commission for the Navigation of the Rhine
CEF	Connecting Europe Facility
CEVNI	European Code for Inland Waterways
CIM	Uniform Rules Concerning the Contract of International Carriage of Goods by Rail
CIM-SMGS	Common railway consignment note for the area covered by CIM and SMGS
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIVITAS	Clean and Better Transport in Cities (although not an acronym)
CLECAT	European Liaison Committee of Common Market Forwarders
CO & CoO	Certificate of Origin
CMR	Convention on the Contract for the International Carriage of Goods by Road
CNG	Compressed Natural Gas
COTIF	Convention concerning International Carriage by Rail
CTU	IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units
CYRail	CYbersecurity in the RAILway sector
DINA	Digital Inland Waterway Area
DTLF	EU DG-MOVE Digital Transport and Logistics Forum
EATL	Euro-Asian Transport Links

EC	European Commission
eCITES	Electronic certificates issued under the Convention on International Trade in Endangered Species of Wild Fauna and Flora
eCO	Electronic Certificate of Origin
EDI	Electronic Data Interchange
EDINNA	Educational network of inland waterway navigation schools and training institutes
EEA	European Environmental Agency
EEU	Eurasian Economic Union
eIDAS	Electronic IDentification Authentication and trust Services
ELTIS	The Urban Mobility Observatory
ERA	European Union Agency for Railways
ERTMS	European Rail Traffic Management System
FAO	Food and Agriculture Organization of the United Nations
FMO	Fisheries Management Organization
ForFITS	For Future Inland Transport Systems
G2G	Government-to-Government
HS	Harmonized Commodity Description and Coding System of WCO
IATA	International Air Transport Association
ICT	Information and Communication Technologies
IEA	International Energy Agency
IoT	Internet of Things
IPPC	International Plant Protection Convention
IRTAD	International Traffic Safety Data and Analysis Group
IRU	International Road Union
ITF	International Transport Forum
ITS	Intelligent Transport Systems
IWT	Inland Waterway Transport
LNG	Liquified Natural Gas
MaaS	Mobility as a Service
NCTS	New Computerised Transit System
NTFB	National Trade Facilitation Body
OASIS	Organization for the Advancement of Structured Information Standards
OECD	Organisation for Economic Co-operation and Development
OFTP	Odette File Transfer Protocol
OSJD	Organization for Cooperation of Railways

OTIF	Intergovernmental Organisation for International Carriage by Rail
PIANC	The World Association for Waterborne Transport Infrastructure
PPP	Public-Private Partnerships
REIOs	Regional Economic Integration Organizations
RIS	River Information Services
S2S	Server to Server (i.e. computer to computer)
SafeFITS	Safe Future Inland Transport Systems
SDGs	Sustainable Development Goals
SECRET	SECurity of Railways against Electromagnetic aTtacks EU co-funded project
SMEs	Small- and Medium-sized Enterprises
SMGS	Agreement on International Railway Freight Transport
SMS	Short Message Services
SW	Single-Window
SWI	Single-Window Initiative
SUM4all	Sustainable Mobility for All
SUMPs	Sustainable Urban Mobility Plans
TAPA	TAPA: Transported Asset Protection Association
TEM	Trans-European Motorways (TEM) project
TEN-T	Trans-European transport Network
TER	Trans-European Railway project
TFA	Trade Facilitation Agreement (of the WTO)
THE PEP	The Transport, Health and Environment Pan-European Programme
TIR	The Customs Convention on the International Transport of Goods under Cover of TIR Carnets
TSI	Technical Specifications for Interoperability
TVWS	Television White Space (unused spectrum originally allocated for TV)
UBL	Universal Business Language
UIC	International Union of Railways
UNECE	United Nations Economic Commission for Europe
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
UN/FLUX	United Nations Fisheries Language for Universal eXchange standard
UN/LOCODE	United Nations Code for Trade and Transport Locations
VAT	Value Added Tax
WCO	World Customs Organisation
WTO	World Trade Organization
XML	eXtensible Markup Language

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EXECUTIVE SUMMARY

Background

The UNECE comprises 56 member States spanning from Central Asia, Europe and North America whose territory covers more than 47 million square kilometres. It includes some of the world's richest countries, as well as countries with a relatively low level of economic development.

Responsible for two-thirds of world trade, the ECE region has significant influence in how we can sustain the increasing demand from megatrends that affect every one of us and everything on the planet. From climate change, urbanization, globalization to the transformational use of innovation and technologies, we live in both challenging and opportunistic times. Sustaining our world requires, more than ever, interlinked, collaborative and resilient approaches and solutions to bring about a more prosperous future for all.

The SDGs are a call for action to promote prosperity while protecting the planet. Recognising that with the aim to end poverty, this will be linked with building economic growth and address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and to protect the environment.

To help drive and fulfil the SDG by 2030, ECE recognises that to meet these goals there is a need to re-examine and provide a further pathway to progress by focussing on key themes by:

- Assessing what is being done now and the current situation
- Identifying the main challenges and trends that the ECE region needs to address
- Supporting opportunities identified during this process.

To support member States in achieving their SDGs, ECE has identified four nexus areas where its programmes and expertise converge to help drive transformational change comprising:

1. Sustainable use of natural resources
2. Sustainable and smart cities for all ages
3. Sustainable Mobility and Smart Connectivity
4. Measuring and monitoring progress towards the SDGs.

The SDGs in themselves present significant challenges yet since the beginning of 2020, the COVID-19 pandemic is proving to be a stimulus for innovation and for forging ahead with the 2030 SDG agenda vital for a sustainable global recovery that leads to greener, more inclusive economies, and stronger, more resilient societies.

Approach and aims

This nexus is comprising the dual, interconnected themes of Sustainable Mobility and Smart Connectivity which underpin the progress for sustainable economic development, and now, recovery.

The key aspects of Sustainable Mobility and Smart Connectivity examine how to improve connectivity between people, companies, governments, economies and even goods as well as how to make mobility more sustainable. It is a very wide subject area and one which has tremendous advances but still has more to be developed if to be fully aligned with the SDGs.

By collating the aspects from the ECEs work on economic cooperation, energy, environment, trade, transport and urban development, the nexus outlines many of the key programmes, initiatives and innovations from across the region, with a view that more can be achieved with greater collaboration and potential for further UN support to help achieve the SDG aims.

More specifically:

- **Smart Connectivity** looks at trade and policy, and how to improve the economic and regulatory processes in support of economic growth and linking with other SDGs along with physically connecting infrastructure in a smart way
- **Sustainable Mobility** focusses on how to move people and goods efficiently, safely, securely, affordably and in an environmentally friendly manner using inland transportation.

For global trade to achieve its connectivity and efficiency aims, there is a high dependency on Sustainable Mobility and Smart Connectivity solutions to provide the means to adequately sustain its future growth. Meaning that trade and economic growth depend on the programmes, development and networks that enable any flow of goods according to sustainable objectives.

Within the focus themes of Sustainable Mobility and Smart Connectivity, the study examines the following dimensions by:

- Explaining the current situation of the theme in focus, describing initiatives in progress and identifying some of the challenges being experienced
- Considering trends that would affect the scope and scale of the themes discussed within the nexus and where future work activities can apply
- Recommending potential roles for UNECE in helping to address some of the key challenges identified in the report
- Recommending courses of action for member States to apply in meeting the 2030 SDG agenda.

Furthermore, the nexus identifies the strong, existing linkages for ECE and its sub-programmes to assist, support, recommend, guide and help address opportunities identified within the themes in a coordinated manner which will help advance the 2030 SDG agenda.

Throughout the study there are two recurrent themes: collaboration and harmonization. Here UNECE is uniquely positioned as a catalyst for both themes. Partnerships between stakeholders are key to the success of so many programmes which call for transformational change which this nexus is all about – changing people's lives for the better through the establishment of appropriate regulatory frameworks.

Also, the Sustainable Mobility and Smart Connectivity nexus has linkages with the following other nexus areas:

- **Natural resources**: where the impact of global trade and transport logistics are analysed in the context of their environmental impact. Transport and trade have a significant direct impact on natural resource use. Globalization has resulted in a global economy that is inherently interlinked and integrating supply chains across border comprising a complex web of integrations. Natural resources are traded and transported globally and without the means for efficient transport natural resources could not be traded globally. Transportation and trade are as enablers of natural resource use and as fundamentally relevant for the study of the Natural Resource Nexus

- **Sustainable and smart cities**: Sustainable Mobility is an integral part of smart sustainable cities in terms of the movement of people and goods. Mobility interlocks with sustainable and smart cities through innovatively digital transport technologies which provide options for city inhabitants to make more environmentally friendly choices, boosting sustainable economic growth and enabling cities to improve their service delivery

- **Measuring and monitoring progress towards the sustainable development goals**: where trade and transport activities are quantitatively and qualitatively measured against progress targets for the 2030 Agenda SDG.

Sustainable development

The dual, interconnected, themes within this nexus offer some practical examples of where UN programmes support the SDGs and targets, and also, where the UN special qualities and characteristics can help to deliver change where, for example, it does not yet have a part to play or where it can extend its roles to help achieve the future goals.

The blended 2030 Agenda for Sustainable Development outlined in full under Figure I, requires an assessment of not only the linkages but also of the potential compatibility issues between different SDGs and their targets. Many other policy instruments and commitments recognise the interlinkages between individual sectors.

This nexus directly supports several SDGs and has the potential to support many more. Links are provided to specific SDGs throughout this summary where the impact of Sustainable Mobility and Smart Connectivity can be the greatest and where there are related initiatives.

Figure II illustrates the alignment of the nexus themes with the SDGs. The study and reports explain where certain UNECE projects, programmes, initiatives, collaborations, and partnerships align with the goals. Where there is scope for further support or a role for UNECE, then these are identified throughout the report.

Figure I: 2030 Agenda for Sustainable Development Goals

Figure II: Nexus alignment with SDGs

Sustainable Development Goals	Smart Connectivity	Sustainable Mobility
 3. Good health and well-being		
 5. Gender equality		
 7. Affordable and clean energy		
 8. Decent work and economic growth		
 9. Industry, innovation and infrastructure		
 11. Sustainable cities		
 12. Responsible consumption and production		
 13. Climate action		
 17. Partnership for goals		

COVID-19

Throughout 2020, the effects of COVID-19 on every aspect of life has changed for everyone. Yet while universal in its effect, the pandemic does not affect everyone in equal measures, and discriminates against certain sectors of societies especially those who are most vulnerable.

While the nexus was aimed with specific objectives in mind aligning to the core principles of the SDG agenda, the critical issues they address across so many differing dimensions, are ever more relevant to help with the sustainable global recovery when the world has a clearer picture what can be done and how to counteract this crisis.

The nexus study and report for Sustainable Mobility and Smart Connectivity is orientated towards a situation pre-COVID-19, however most of the challenges and solutions identified in this study remain relevant and are of greater importance in the post COVID-19 recovery. As an example, within the Sustainable Mobility domain, the push for the use of sustainable transport solutions as identified within this nexus is something that is even more important now, along with ensuring that these transport options are safe. Also, within the Smart Connectivity analysis for this nexus, the dematerialization of paper throughout the supply chain is being accelerated as the paper itself is also seen as a biohazard and this can potentially reduce direct human contact.

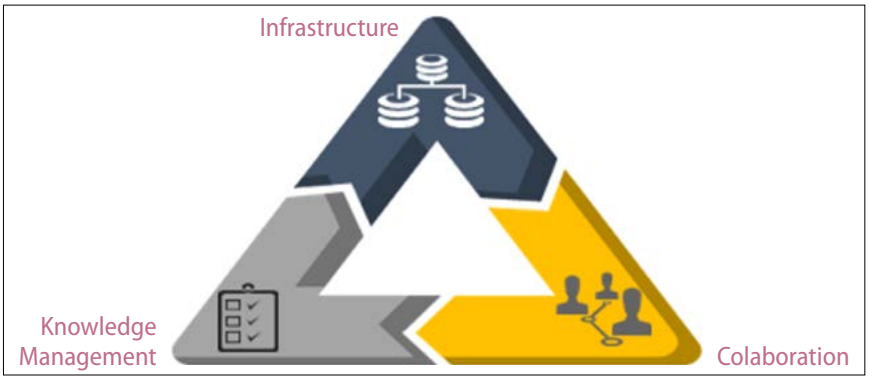
Much of the emphasis has been dealing with the immediate effects of the pandemic and developing control measures such as the use of testing kits for virus detection, provisioning of Personal Protective Equipment (PPE) for protection and vaccine research and development for prevention. Innovations will follow, such as using smarter technologies to deliver the "touchless office" or increased use of robotics to take over some of the "handling" job activities within the supply chain. Also, the UN Innovation Network (UNIN) has multiple initiatives[1] addressing COVID-19 across a wide range of dimensions including health and well-being, education, food and agriculture, employment and economics, government support and, data and information.

1 https://www.un.org/sites/un2.un.org/files/2020-06_-_unin_quarterly_innovation_update_-_second_covid-19_special_edition.pdf

Smart connectivity

We have been living through several decades of advancements in the exchange of data between trading partners, governments, and people. Transformational innovation backed by technology has driven the digital economy as we know it today. Underpinning these advancements has been the need for connectivity – it must be "smart" and continue to get smarter. To be fully effective also requires simplifying, streamlining, standardizing connections along three dimensions:

Figure III: The three dimensions of Smart Connectivity



Source: UNECE Nexus Sustainable Mobility and Smart Connectivity

- Infrastructure: the foundation of the connectivity
- Knowledge Management: free and openly available standards
- Collaboration: bringing together public service needs with private sector know-how.

Within this nexus, the effect of Smart Connectivity on global trade is examined and how the data and information is becoming essential in meeting the SDG objectives across global supply chains.

Smart Connectivity comprises the following topics:

- Smart Trade
- Smart Support for a Better Environment
- Future Trends and Opportunities.

While all themes have their part to play, the study examines Smart Trade as the principle area for assessment.

Smart trade

Smart Trade is a major pillar of Smart Connectivity. It is a complex and highly "orchestrated" process comprising many actors from the seller to the buyer of goods and all stakeholders in between, including transport service providers such as forwarding agencies and carriers, the communities of common interest such as the ports, or regulating bodies such as customs and other government agencies. All play their part, and all need information which comes from data exchange.

Key for progress in making global trade more efficient, safe, secure, and predictable is the current trend of transformational change. As global trade continues to evolve and adapt to new models of supply, demand, transport and logistics, the need for process efficiencies is accelerating at a pace which will outstrip the capabilities of the supply chain. Whether it is in how increasing amounts of data is managed, the infrastructure supporting the processes, the people managing the business or the legislative frameworks which have been, and to some extent still are, based on the paper-based principles.

The need to eliminate paper has become an imperative for the future efficiencies to sustain global trade, further requiring the operational aspects of managing the process to move quicker towards this digital transformation.

Some of the major challenges facing the future efficiencies comprise:

- Infrastructure limitations due to expensive and difficult to replace legacy systems,
- Emphasis on dematerializing individual documents instead of considering data exchange in a wholistic approach of supply chain transaction, and
- Persistent problems of data quality exacerbated by multiple actors requesting the same semantic data potentially in slightly different formats.

While the situation is improving, much more can be achieved, and here the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) is accelerating change across the ECE region with initiatives that harness the power of data blended with the comprehensive, expert driven cross-domain open standards free for all to use.

Foundation data exchange: a high level of electronic information exchange supports the transport and logistics cycle from purchasing to transportation and through to fulfilment. While multiple standards exist, and some are specific to certain modes of transport, UN/CEFACT has been instrumental in defining harmonised standards for cross-industry trade, multi-modal transport and regulatory compliance. While the standards and usage exist, there is still scope to extend the usage and uptake of digital data exchange as still 90% of transactions involve paper documents.

Recommendations: Member States and trade stakeholders from all modes of transport should increase their uptake and implementation of UN/CEFACT electronic data exchange standards, and also participate in and contribute to their development.

Foundation standards and quality infrastructure for smart trade: standards in the quality and regulatory conformance of products and services produced within the supply chain are still a barrier to progress especially for smaller enterprises and producers from low-middle income countries. This is exacerbated by lack of collaboration and coherence which add cost to some markets.

Recommendations: Goods producers/sellers, associations, non-governmental organizations, governments and ruler makers within member States should identify barriers to trade and adopt more resilient, safer and sustainable standards to support economic development. For example, those of the International Trade Centre (ITC) and ECE quality standards, including the recommendations developed by the UNECE Working Party on Regulatory Cooperation and Standardization Policies.

Smart identification for trustworthy trade: trustworthiness is a crucial element in international trade. Current operations rely on paper or documentary evidence to ensure authenticity. To eliminate paper and increase the efficiencies harnessed by digitalization, the challenge especially with regulatory processes, is to have robust standards that can be accepted and have legal recognition by regulators.

Recommendations: To remove obstacles for dematerialization of paper documents, member States need to adopt legal procedures for cross border trade to recognize and accept electronic signatures as, for example, provided by model legislation on electronic authentication, its recommendations and guidance from the Organisation for Economic Co-operation and Development (OECD). Member States should also align with legal instruments the UN Commission on International Trade Law's (UNCITRAL's) Model law on electronic signature and the UN Convention on the Use of Electronic Communications in International Contracts.

Smart authentication of trade documents: multiplicity of authentication standards and approaches adds both cost and complexity to trade. Counteracting these drawbacks is the uptake of electronic signatures progressing through several initiatives supporting the use of electronic alternatives to paper. Within the ECE region progress by the European Union (EU), Eurasian Economic Union (EEU), the United States of America (USA), and supported by the UN Electronic Communications Convention, has led to the increasing use of eAuthentications which is a major step forward. But more needs to be done to help eliminate "islands of trustworthiness in a sea of uncertainty" meaning that the universal confidence in a digital authentication is not yet there.

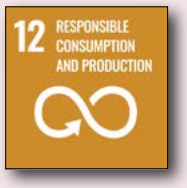
Recommendations: Member States should accept electronic authentication methods and mutual recognition programs for their governments to legally adopt ECE Recommendation Nos 14 and 34 for the acceptance of electronic signatures to eliminate the need for paper and offer supportive frameworks such as through the development of Single Windows.

Starting the Smart Trade Process: Electronic Purchasing: the process of trade purchasing involves multiple documents. Most of the data from these documents can be exchanged using some form of electronic exchange but still 90% of the documents are required in a paper form. There are multiple examples of States and communities supporting eInvoicing, but the overall lack of electronic data capture at source results in efficiencies throughout the information chain.

Recommendations: Member States should accelerate the use of common standards for the electronic exchange of structured eInvoices such as the UN/CEFACT Cross Industry Invoice, as opposed to using paper documents or niche standards devised unilaterally, to help facilitate customs processes and to improve tax collection.

Smart Goods Movement in Trade: Transport and Logistics: the transport sector has had a long history of electronic data exchange predominantly of commercial data. While Business to Business (B2B) transactions have dominated an increase in demand for Business to Government (B2G) has come notable advancements such as in the road electronic Consignment Note (eCMR) developed by UN/CEFACT and the electronic use of the customs Transport Internationaux Routiers / International Road Transport (TIR) form.

For over forty years, the transport industry has been heavily reliant on the UN/EDIFACT messages, especially in land and maritime transport. These messages developed by UN/CEFACT and its predecessor are still very much in use today and cover all aspect of information exchange linked to transport and logistics. This work is being reinforced with a Multi-Modal Transport Reference Data Model (MMT RDM) providing clear semantic anchors and linking to the rest of the global supply chain; this also provides links to other message exchanges like eXtensible Marked-up Language.



Recommendations: Member States should increase their ratification and adoption of transport and logistics standards such as the UN/CEFACT eCMR for road freight transport, with support from ECE building on its eTIR experiences to facilitate freight movements and reduce barriers at border crossing points.

Smart trade: regulatory fulfilment and enforcement: multiple submissions of data throughout the supply chain process between traders and/or regulators is required often with the same data elements being duplicated for different parties. This brings inefficiencies, cost, potential for loss of data quality, and places undue burden on all stakeholders.

Recognising these inefficiencies and the complexities of differing country regulations, UNECE conceptualised a trade facilitation framework (Rec 04) calling for a National Trade Facilitation Body (NTFB) to harmonize standards and

apply measures to help ease international trade. UN/CEFACT complemented the framework and published the first international guidance for establishing a SW (Rec 33) offering a common, harmonized, and consistent entry point between trade and government, and continues to be a focal point in the development SW projects.

In 2017 the WTO Trade Facilitation Agreement (TFA) came into force to improve global trade flows which promotes the establishment of "single windows". The UNECE region is at the forefront of SW implementations with 45 countries, representing 87% of ECE member States ratifying the TFA, and 38 establishing an NTFB. This has been a major milestone in the advancement of trade facilitation and compliance.

Reducing paperwork as well as physical barriers is essential for trade and transport efficiencies and a key objective of both Sustainable Mobility and Smart Connectivity is to improve the process based on cross-border collaboration between authorities such as the Harmonization Convention (1982). This is designed to reduce formalities between States and coordinate control procedures. In practise this opens opportunities to share more electronic data for example certificates, trade documents, dangerous goods data etc, where joint border controls can help reduce transit times and improve efficiencies.

Recommendations: To improve the flows of cross-border goods using harmonized standards, member States should increase the adoption of conventions, recommendations and best practises for implementing trade and transport facilitation. By working with ECE, member State government departments and the private sector should implement Recommendation Nos. 4 and 40 and be supported by cooperation between UN Conference on Trade and Development (UNCTAD) and the International Trade Centre (ITC) for implementation guidance and assistance.

Single Window for Import, Export and Transit-Related Regulatory Procedures: UN/CEFACT published the first international guidance for establishing a Single Window (SW) offering a common, harmonised, and consistent entry point between trade and government. This is echoed as an integral part of the WTO TFA. There are numerous SW initiatives in progress, and yet challenges still exist, such as the coordination necessary between government agencies.

The TFA also opens opportunities for the use of electronic certificates such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora and Fauna (CITES) and certificates covering other classes of special goods transported under phytosanitary and veterinary regulations. The increased use of these certificates helps to streamline the cross-border process with an immediate benefit that border crossing times and processes are reduced. This then helps the environment by reducing the levels of CO_2 produced by trucks queuing with their engines idling at the border crossing points waiting to complete their formalities.

Recommendation: Member States should establish Single Windows for trade defined through ECE SW recommendations Nos. 33, 34, 35 and 36 to streamline passage of goods across international borders. While building their capacity for increased facilitation, member States should legally validate the use of eDocuments and eCertificates as defined by UN/CEFACT standards.

Smart support for a better environment

The impact of global trade on the environment is a primary concern. The collaborative approach combining Sustainable Mobility and Smart Connectivity sets a pathway aligned to the SDGs to help address those concerns.

Smarter provision and use of data under the connectivity theme is helping to improve the sustainability of resource use whether consumable as food or as energy. While nationally provisioned that can also be exported as "products" to be traded between international partners.

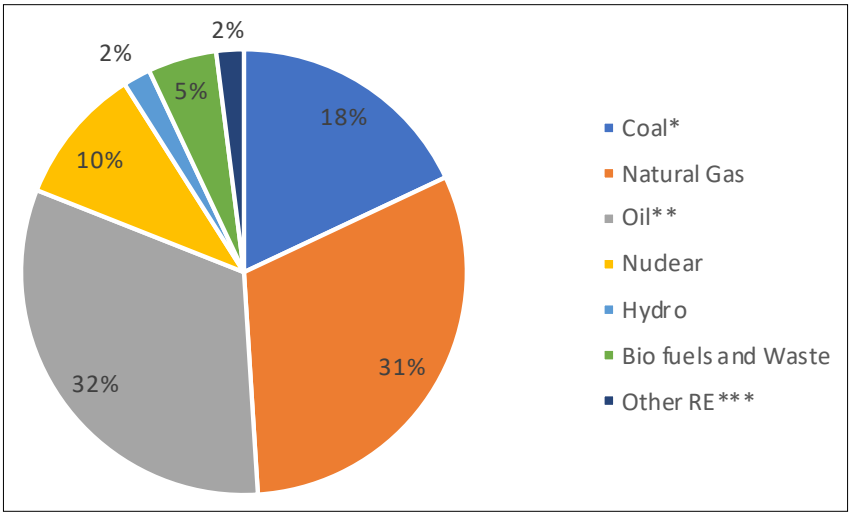
Smart conservation of both natural resources and trade: The smarter use of data is also helping to conserve natural resources such as the provision of food. Traceability of food, its sources and ingredients has become important for consumers to have insight to the food chain from farm to table. One such case applies to the fishing industry.

Overfishing has brought a need for conservation, so intelligence derived from fishing industry data is helping to track and manage fisheries and fish stocks which until recently was managed via hand-written logs. The UN/FLUX standard developed by UN/CEFACT is being used for the exchange of electronic fisheries information as an industry-wide development including data exchanges of all fishing activities and to monitor legal activities and detect damaging illegal ones.

Recommendations: To sustain fisheries with legal instruments for regulatory traceability, member States need to adopt the UN/FLUX standards to move from a paper-orientated business to one supported by improved data-driven intelligence through the uptake of electronic standards developed by UN/CEFACT.

Smart energy management: Without energy we cannot capture data, refine it into information and use it to drive a digital world. Electricity is essential for international trade and the inter-connectivity between electrical grids, both within and across countries, supporting the supply of both affordable and secure energy. In 2014, the ECE region accounted for 42% of the world's GDP, 39% of the world's total primary energy supply and 34% of the world's CO_2 emissions from fossil fuel combustion.

Figure IV: ECE region energy sources as % of supply 2014



* Includes Coal, peat and oil shale
** Includes Crude, NGL and feedstocks and secondary oil products
*** Geothermal, solar/wind/other, heat electricity
Data Source: IEA World Energy Balances.

Figure IV shows the situation that in 2014 saw the predominance of fossil fuel supply at 81% in the generation of electricity, with bio and renewables only accounting for 9%.

However more recent developments to harness renewable and thus more sustainable energy sources such as in the development of Variable Renewable Energy (VRE) is being enriched and augmented by smart grid strategies. These are founded upon the availability of reliable telecommunications networks capable of interconnecting energy generation sources, with network sensors and smart monitoring devices integrating them into the power utilities operating processes.

Faced with such challenges the practical work of ECE's sustainable energy strategy to support planning and its work on Public-Private Partnerships (PPP) for renewable energy (RE) with the development of new infrastructure pose opportunities to facilitate and accelerate the process.

Recommendations: Member States need to invest in, and develop smarter, more sustainable and renewable energy strategies supported by policies, technologies and infrastructure aligned with the practical approach defined within the ECE sustainable energy strategy and, where applicable, investments follow ECE standards for PPP in RE.

Future trends and opportunities

Innovation and inventive new technologies fuel an environment to create and evolve new process models and supportive activities. The study explores the trends and opportunities for further work throughout the ECE region.

Digital based technologies have seen and continue to see the trends fuelled by vast and ubiquitous amounts of data with the potential to develop adaptive new models in infrastructure, knowledge sharing and management and nurturing relationships both old and new in the spirit of collaboration. While the future of Smart Connectivity can be foreseen as a reality it is not without challenge as there are barriers to new technological deployment as evidenced through the dimensions of infrastructure, knowledge management and collaboration.

Particularly important is developing an awareness and understanding of appropriate uses for new technology as well as identifying and fulfilling the needs for new standards. These will be achieved through knowledge management and collaboration to develop business models disrupted by the new capabilities, which may be driven by technology as opposed through business.

Smart Connectivity only happens when the capacity provided by the infrastructure is efficiently implemented thanks to the existence of recommendations, guidelines, and shared standards, deployed in a collaborative manner. The opportunities are numerous and so the study focusses on a limited number within the scope of what may be open for the future while also being tightly coupled with the assessment of future trends.

Infrastructure: advances in technology and future trends are accelerating at a rapid pace, and the impact they are having and will be profound.

Key to the advancement of technologies will be the supply of energy. Significant advances in energy generation such as with the developments of microgrids and improved grid storage coupled with the distribution of energy from renewables is bringing vital energy to areas which until recently have been devoid of consistently reliable and cost-effective electricity.

In this framework, transport infrastructure also needs to be at the forefront of innovation and harmonization exercises to ensure that it provides the connectivity for the movement of goods and people. The development of the international agreements setting out the E-Road, E-Rail and E-Waterway networks for the pan-European region is key to this.

Further advances in telecommunications such as with 5G networks and radio based Television White Space (TVWS) extend the availability of the internet with higher speed broadband essential to handle the continuous flow of data to/from devices and the support for cloud-based data storage. This data storage can be vast and needs to be processed in massive amounts using Big Data techniques with further advancements to capitalise on the data which is captured, refined and distributed. These include Distributed Ledger Technology (Blockchain), Artificial Intelligence (AI), Internet of Things (IoT), quantum computing and edge computing. These new technologies will help us to find new and more effective solutions to old problems and therefore have a key role in future developments.

Such advances in communication technologies have paved the way for alternative "smarter" means of capturing and exchanging data as in the case of mobile devices extending their capabilities with uses far beyond the person to person communication. Mobiles and smarter devices such as data loggers using IoT technologies open up new sources of data such as with intelligent assets used to precisely track the location of goods in transit and report on the condition of the goods inside them.

The "smart" in Smart Connectivity is gaining in "intelligence" and capacity every day. At the same time, organizations change much more slowly than technology. Many managers who make decisions about technology today were trained and gained experience in environments where change took place at a much slower pace. The challenge will be to bring the latest and most appropriate technology to all to avoid the connectivity limitation constrained by the weakest links.

Most SDGs involve elements of infrastructure. Within the scope of this nexus, future advancements to support SDG aims will depend upon a combination of technology and physical infrastructure to meet the digitally driven needs for trade within Smart Connectivity, and the necessity to develop communication networks, roads, rail and buildings within Sustainable Mobility. This can involve investment on a massive scale: developing, implementing, and supporting infrastructure can cost trillions of dollars. To assist with development costs of the physical infrastructure as well as innovation, the UN has devised Roadmap for Financing the 2030 Agenda for SDG and is promoting a Public Private Partnership (PPP) for investment with guidelines for action.

To help ensure the best possible support from PPPs for the SDGs, ECE has pioneered the revision of the model as a "People First" PPP and its rebranding from a "Value for Money" to a "Value for People" approach to include social and environmental standards.

While technological infrastructure is transforming trade, good transport infrastructure and services are fundamental to the successful functioning of economies.

Sustainably efficient inland infrastructure is essential for the ECE member States ability to meet travel, trade, and their transport demands for the future. The convergence of digital technology with transport infrastructure such as with Intelligent Transport Systems (ITS) illustrate the future potential for not only "smarter" transport solutions but those which can improve transport efficiency in an environmentally sustainable way.

With the trend for utilising alternative transport modes such as rail or inland waterway, significant funding will be required to design, develop and deploy the infrastructure necessary to sustain such alternatives. Any future development will require a blend of digital technologies with physical infrastructure.

The blend of improved and efficient transport system infrastructure within Sustainable Mobility supporting the needs of Smart Connectivity for effective global trade demonstrate the interdependency of the two themes. A good example of this blend within the ECE region is the combined efficiency improvements at border crossing points and the transport networks serving them to reduce time, cost and environmental impact of travel and trade. The flow of cross-border goods can be facilitated digitally through data and eased through the border with good quality infrastructure providing improved road and rail networks including transit and border control facilities. This is facilitated through the coordinated development of the pan-European "E" transport networks mentioned above, improving cross-border efficiency by combining transport agreements with connectivity and supported by the physical infrastructure to meet future transport demand.

Recommendations: With so many diverse technological and infrastructure options available and already accelerating change, member States are facing difficult and sometimes conflicting pressures where Smart Connectivity is limited by the weakest stakeholder. To help redress this situation, member States should adopt ECE principles and standards, reinforced by its convening role particularly through the UN/CEFACT Advisory Group on Advanced Technology. Member States should continue the efficient development of transport infrastructure to facilitate connectivity and ensure that they can be at the forefront of technology, such is in the development of ITS, and orientate funding to a "Value for People" model aligning with the UN PPP approach considering social and environmental standards.

Knowledge management: knowledge management provides the tools for meeting trends and new challenges, and within Smart Connectivity its three main components comprise understanding and guidance through the provision of standards, and legal instruments through the provision of recommendations.

One of the largest and most complete cross-industry standards is provided by the UN/CEFACT Core Component Library (CCL).[2] The CCL comprises a collection of real-world business objects in a library which explains their meaning in an agreed model containing over 20,000 data elements. The standard is used throughout transport and trade helping to assure the harmonised inter-operability between all sectors of activity, all links of the supply chain and all modes of transport reducing complexity, duplication and cost.

Another key strength of the UN is that of defining guidance, standards and recommendation which are open, accessible, and free for all to use where the ECE region is at the intersection between cutting edge technologies. Recognising the importance of such advances, ECE has programmes in place to address these advances in an open and free environment bring together world leaders and experts. This impressive blend of expertise, domain understanding and technical know-how helps forge the instruments of change essential for Smart Connectivity and key to future SDG advancement.

ECE and more specifically for trade UN/CEFACT is synonymous with defining global and open and cross-domain semantic standards. This work continues as advancements in technology increase with ever more capabilities and the world of business and government changes in line with the capture of ever more pieces of information. For example, by enabling new capabilities using IoT and smart sensors technologies and to exchange data digitally via Application Programming Interface (API) as opposed to the classic Electronic Data Interchange (EDI). New possibilities will open for data and its semantic context which, may have in the past been constrained by their paper forms or by legacy technology.

Recommendations: Member States are encouraged to use and rollout sustainable cross-domain programmes which can fully benefit from the free of charge standards, recommendations and guidance material of ECE developed by multiple stakeholder groups working within UN/CEFACT. In particular the cross-industry standards provided through the UN/CEFACT CCL helps ensure the harmonization of standards and the interoperability for all actors within the supply chain.

Collaboration: a fundamental UN role is where it helps organizational and cultural change to work with different countries throughout various geographies, cultures, and socio-economic needs. It has been successful in supporting the diverse demands from the region through bringing people together for a common good in the spirit of collaboration where a good example has been in the development of the SW standards and guidelines. While SW deployments are largely government driven, the private sector has seen an increase rise in digital platforms through the exponential rise in eCommerce platforms. In addition, the rise in interest of decentralised data via distributed platforms once again sees linkages between the core information exchanges and new model platforms upon which collaboration is key.

As one of the two bywords for this nexus, there will be unlimited possibilities for future collaboration. The desired outcomes of development efforts in infrastructure and knowledge management are only achieved if organizations manage to collaborate to deploy the results through services, standards, recommendations, guidance, regulations, and conventions. In addition, the feedback from collaborative deployments increases community knowledge and can be used to support the development of updates and upgrades to those tools. International trade is a collaboration of different stakeholders ranging across the spectrum. As the principles of the TFA and Harmonization Convention are applied throughout global trade, regional collaboration between countries, especially for those sharing land borders will have to follow.

2 http://tfig.unece.org/contents/uncefact-ccl.htm

A key aspect of collaboration and to achieve the 2030 SDG Agenda will require an "all hands-on deck" approach with different sectors and actors working together in an integrated way by pooling financial resources, knowledge and expertise to work in a PPP. The PPP concept as used within the UN and development banks merging the positive elements of the public and private sectors together bringing together investment capacity and technical expertise with both sides sharing the financial risks.

Sustainable mobility

Sustainable Mobility addresses the physical world of moving people and goods efficiently, safely, securely, affordably, accessibly in an environmentally supportive way. While all modes of travel and transport have their part to play in sustainability, the nexus focuses on inland transportation, namely road, rail and inland waterway, and with a specific focus looking at urban transportation within smart cities.

Good transport infrastructure and services are fundamental to the successful functioning of all economies. They are essential for ensuring a high degree of connectivity both within and between countries as well as to ensure that mobility for people and goods is provided in the most sustainable manner possible.

The nexus shows that each inland transport mode has elements that may challenge as well as contribute to achieving sustainability. As a result, transport needs to be considered as a holistic system which supports economic and social activities at country, regional and local levels by providing mobility for people and goods.

Sustainable Mobility comprises the following focus areas:

- Transport efficiency
- Transport affordability and accessibility for people and society
- Transport safety
- Transport security
- Transport and the environment.

Transport efficiency

Efficiency is the first transport pillar supporting Sustainable Mobility and Smart Connectivity to ensure people and goods can move from their origins to destinations in the most effective way with the least possible cost, time and use of resources whether human, natural or man-made.

Providing the right infrastructure, capacity and services, supported by new technologies to help improve performance are vital to link economic centres, and to ensure efficiencies in the transport networks are sustainable.

While the physical transport system itself needs to be as efficient as possible, the processes using them defined by Smart Connectivity, also need to be fully effective. By offering a high level of facilitation where possible in the case of international transport so that the promised delivery of service (connectivity) can be delivered a promised (mobility) by the transport systems.

Part of the effectiveness of any transport system can be to offer a choice or an alternative means of transport across the same connection thereby offering options for cost, connectivity, accessibility, speed, security, capacity, and sustainability.

One such approach can be seen in the E-Road, E-Rail and E-Waterways networks developed through pan-European agreements that extend into Asia providing the infrastructural connectivity necessary for international traffic. As a further example, within the EU, these have been adopted as the basis for the EU Trans-European Network for Transport (TEN-T). Based on these "E" networks, connections have been extended beyond the ECE region through the Euro-Asian Transport Linkages (EATL) project.

Recommendations: Member States should ensure that their transport sectors are composed an optimum mix of transport modes that facilitates the efficient move of transport domestically and across borders while ensuring minimal environmental impact. The different modes should run on technically harmonized and integrated infrastructure networks such as those identified in the pan-European "E" networks.

Road transport: is central to passenger mobility and freight transport throughout the ECE region where it holds the largest modal share for most movements.

To be efficient, road transport needs suitable infrastructure of high quality, supporting passenger vehicles that can carry people comfortably and safely and for haulage vehicles with sufficient capacity to make goods transport economically efficient. It also needs appropriate regulations to ensure that both the infrastructure and services are managed to high standards that balance high capacity with high performance.

The development of Intelligent Transport Systems (ITS) is particularly useful for efficient road transport: managing traffic, tackling congestion and delivering increased safety. ITS is the application of information and communication technologies to road transport and to interfaces with other modes of transport. Benefits of a wider application of ITS have been highlighted by the ECE and include increased road safety and efficiencies, higher rates of travel time predictability, energy savings, lower pollution, and faster emergency response time, and interlocks with automatic toll fee collections.

While the road networks are extensive throughout the ECE region, there are challenges to extend the network of "E" roads and increase the use of technologies to help improve traffic flows, along with ECE backed programmes designed to break down administration barriers for improved performance and sharing of knowledge.

Recommendations: Member States need to prioritize efficiency with well maintained, high quality and safe networks to assure that each road segment can sustain the traffic volumes they need to carry. Coupled with investing in the development and deployment of ITS, further efficiency gains can be achieved where member States actively break down barriers to cross-border trade and travel, through such things as acceding to and implementing Conventions such as the CMR, eCMR, TIR, eTIR and the International Convention on the Harmonization of Frontier Controls of Goods. Member States should also look to build capacity with regulatory frameworks for future efficiencies offered by new and emerging technologies such as the use of autonomous vehicles (while mitigating risks from cyber-threats) defined within UNECE Conventions WP.29 and WP.1.

Rail transport: is becoming an increasingly important alternative to other means of transport for the movement of goods between Asia and Europe. As identified in the Phase II study for the EATL project, these flows are cheaper and, in many cases, faster than sea movements. For this to be effective though border crossing efficiency needs to be improved and harmonization of rules and, where possible, infrastructure and rolling stock needs to be implemented.

For passenger transport the rail sector remains a key mode for short, medium and long-distance travel. With increased efficiency, as seen in several countries identified in this study report, use and market share can increase further.

Several initiatives in the ECE region are aimed at redressing issues such as lack of interoperability between national networks are in progress for example as in progress by the EU Agency for Railways (ERA). These include improved facilitation at border crossing points where, for example, the Brest border cross point for Asia-Europe routes has been reduced from 36 to 10 hours. Of significant importance is also the work being carried out by ECE member States on Unified Railway Law which will create one legal regime, one contract of carriage and one liability regime for the transport of freight between Asia and Europe, removing one of the most important administrative barriers at borders.

Recommendations: Member States should focus their policy and regulatory initiatives on reducing barriers at border crossings to facilitate the movement of goods and people through the accession to and implementation of relevant UN Inland Transport Conventions and the harmonization efforts undertaken by UNECE through EATL, the development of Unified Railway Law and similar activities.

Inland waterways: provide an important alternative to other transport modes as they do not suffer from the same congestion levels and waterborne transport costs less. They also have advantages in terms of high safety levels and energy efficiency. These features contribute to reducing transport and logistics costs, as well as congestion on road networks, impacting several SDGs. However, transport by inland waterways needs further development as its potential remains largely untapped.

The sector already benefits from a strong regulatory framework thanks to the seven ECE administered Conventions and legal instruments currently in force, accompanied by the over 100 ECE administered resolutions that underpin the functioning of the sector. On this foundation, the development of inland waterway transport requires improvements/extensions in waterway navigation, overall enhancement of facilities, construction of linkages, further development of information services for navigation such as River Information Services RIS, and digitalization of the sector.

The potential for further development was identified in the recent White Paper on the Progress, Accomplishment and Future of Sustainable Inland Water Transport published by UNECE. This document highlights the main areas of focus for the sector and the role for ECE going forward.

Recommendations: Where member States have an option to utilize and enhance their transport options via inland waterways, they should build capacity where this mode of transport offers a viable alternative to other modes in line with UN Inland Transport Conventions on Inland Waterways.

Intermodal transport: All these modes of transport cannot operate individually as there is always a leg that needs to be done on road, or a section of journey that can only be done efficiently by rail. This is why intermodal transport is essential to ensuring that freight and passenger movements can be undertaken in the most efficient manner. In terms of freight transport this usually (but not always) involves the movement of containers which are swapped between different modes of transport. This form of transport also needs to be accompanied by advanced logistics solutions which act as the glue binding together different transport operations, including the pertinent data exchange solutions.

In terms of passenger journeys, efficient intermodal transport means ensuring that passengers have good connections between and within transport modes to ensure that they can have a seamless journey, for example, from their home to their place of employment.

Efficient freight and passenger intermodal transport solutions are fundamental to achieving wider environmental and sustainability goals and the work that is currently being done at UNECE in relation to intermodal infrastructure and policy is essential in achieving this.

Recommendations: Intermodal transport provides a cross sector solution that optimises the use of different transport modes to provide an efficient use of relevant resources. Member States should encourage the use of intermodal transport, where possible shifting a large part of the freight journey away from the road in order to achieve wider sustainability objectives. While extending the development of intermodal transport and logistics solutions, member States should accede to UN infrastructure agreements and develop relevant policy initiatives through the UNECE relevant working party. In addition to the physical needs of intermodal transport, member States should align their electronic systems developments with the UN/CEFACT Multi-Modal Transport Reference Data Model data exchange solution to help assure electronic interoperability using standards specifically designed to facilitate the exchange of data between different modes of transport in the most efficient way possible.

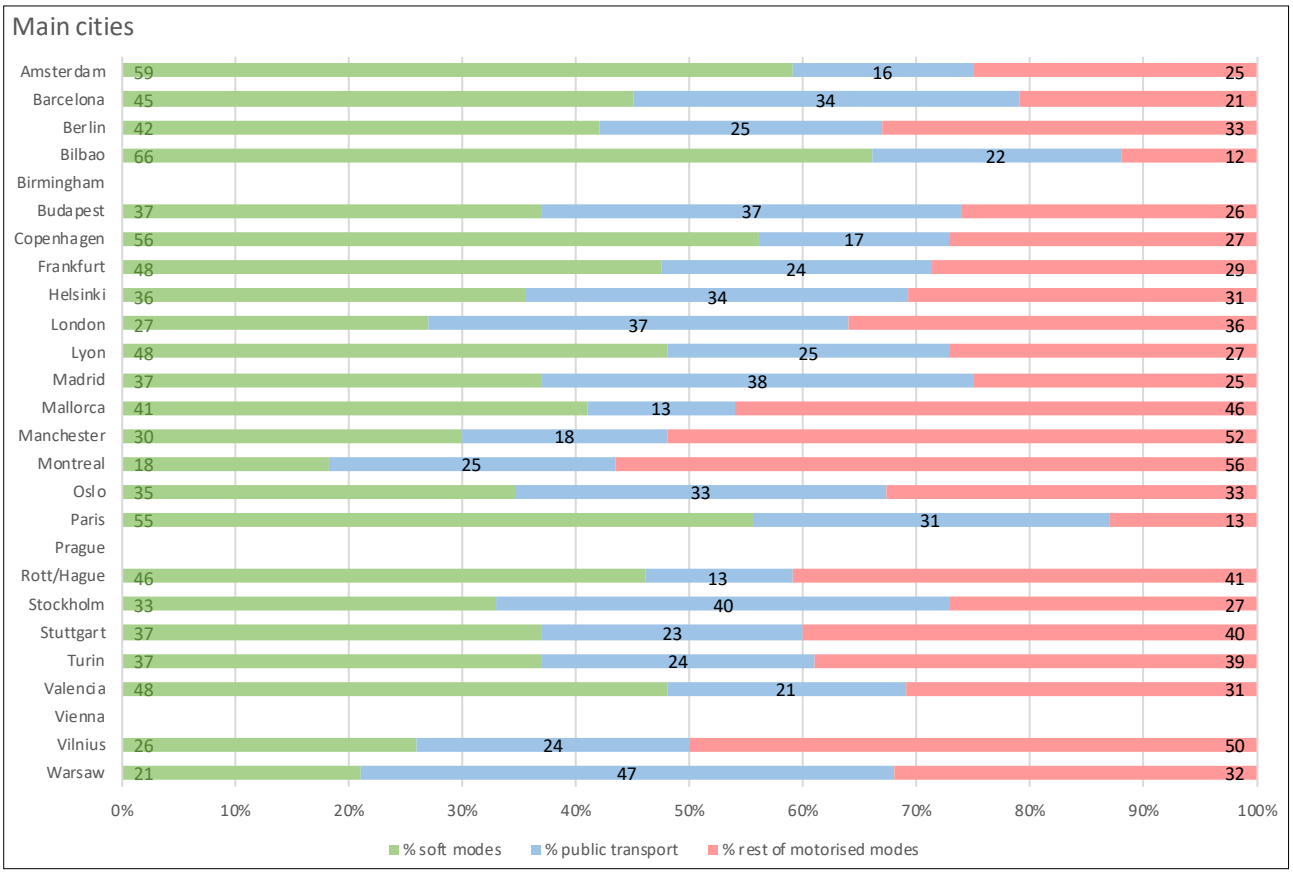
Urban transport

Urban transport comprises road and rail and sometimes waterway transport. Nonetheless, it is normally treated separately because it includes some specialized infrastructure and planning considerations. Rail and bus transport may have its own infrastructure, while other transport modes use road space that is part of urban living environments and, in historical city centres, was not intended for use by modern transport means.

The performance of transport in a city shapes the performance of that urban area. Making available and developing sustainable transport options, and options that are best suited to each person's needs and abilities as well as to city constraints is central to ensure it is accessible to all and can help to promote healthy living.

Figure V illustrates the utilization of different transport types for selected urban environments. This sample clearly shows the predominance of motorised types with "soft" modes such as walking and cycling quite prominent for many cities.

Figure V: Modal share in main cities (2017)



Source: EMTA 2019.

Proportionally, the use of public transport is lower although for some with good/extended public transport systems utilization shows a reasonable amount of comparative uptake. With still a high proportion of journeys taken by car this adds to congestion with the negative environmental and social effects that reduce the efficiency of movements in the urban environment.

Several cities are introducing solutions to tackle this inefficiency through activities such as: promoting bicycle use (seeking to reach the levels found in Amsterdam and Copenhagen); creating appropriate infrastructure and incentivizing an active mobility culture. Car use has been discouraged through penalties such as congestion charging and higher road taxes. Finally, significant investment is being ploughed into public transport to make it more attractive across the region.

While measures had been developing to encourage the use of public transport, personal mobility such as cycling and reduced dependency on private motor vehicles, the effects of the COVID-19 pandemic have had a rapid and profound impact for both urban and rural transport networks.

Measures restricting non-essential travel not only reduced demand for public transport services during lock-down periods, but as restrictions are relaxed, demand has decreased in line with a sizeable proportion of people not travelling socially nor for commuting as home-working continues to be the norm for so many businesses.

As COVID-19 evolves and its full and longer-term effects are still hard to predict, urban and rural transport strategies will inevitably have to be adaptive to whatever the future demand will be.

Technology has a large role to play in improving efficiencies within urban transport systems. ITS and automation are now widely used for public transport and information managed by such systems. With the abundance of mobile devices, usage of these offers the chance to help kick-start a sharing economy across the ECE region such as in the development of cycle sharing schemes to encourage greater use of bicycles.

While attaining higher level of urban transport efficiency through reduced congestion which benefit the environment and the overall health of the urban population (whether resident or commuter), further efficiencies will be felt in other uses of transport around the city such as in freight. Urban transport and logistics are an extremely large sector and growing with the exponential rise in e-Commerce and small parcel delivery services. While economically vibrant this rise on smaller van, personal car and petrol scooters for delivery services adds to the increase in pollution levels. Policies concerning urban logistics are often hard to develop due to the multiplicity of stakeholders with differing goals.

To promote efficient urban transport across all dimensions, the ECE member States along with the World Health Organization (WHO/Europe) are collaborating under the Transport, Health and Environment Pan-European Programme (THE PEP) with a focus on making this type of transport more sustainable and have developed a number of studies and policies on such things as green and healthy jobs in transport, cycling promotion masterplan, mobility management and eco-driving.

Recommendations: To address the multi-facetted demands from urban transport environments, member States need to take a holistic approach for the uptake of sustainable mobility solutions, and fully support the introduction of policies aimed at facilitating the switch to more sustainable means of transport. By building capacity through programmes such as THE PEP, member States can plan for and develop and then implement sustainable transport solutions in a manner which ensures integration with land-use planning, health and the environment.

Transport affordability and accessibility for people and society

For mobility to be sustainable it also needs to be affordable and accessible, as such affordability (both for the private individual and for the public sector financing it) must be seen from the point of view of society as a whole and considered for public as well as private transport.

Accessibility is of relevance primarily to people but is also important to businesses for accessing markets.

Affordable mobility for individuals and households: without affordable and adequate mobility options individuals may be marginalized or excluded from day to day activities, potentially risking livelihoods. Transport affordability is also linked with housing affordability which affects the choice of housing location i.e. closer or further from urban centres where there are potentially more prospects for work and where for some there is a trade-off between the cost of transport as opposed to the cost of housing.

Affordability is one of the key parameters in discussions undertaken under THE PEP as well as in sustainable urban mobility plans that are a requirement within EU member states.

Transport affordability for public authorities: where transport services and infrastructure are provided by public authorities suitable funding needs to be guaranteed to ensure that services function effectively as fares rarely cover the entire cost of production. Therefore, public authorities need to ensure that the solutions that are provided are the best value for money for them as decision makers serving the community.

In some cases, the private sector can help with this affordability problem. For example, the tendering of some rail services that are now run by the private sector have led to savings of 30% in costs or increased services for the same amount of funds. To help public authorities decide on whether PPP is for them or not, the ECE concept of People First PPP schemes involves guidance and how to assess setting-up such a venture.

Recommendations: Member states should work towards making sustainable transport solutions affordable for the users and the funders by choosing options that encourage modal shift as well as identifying alternative forms of financing public transport infrastructure. Coordinated activities through THE PEP can facilitate knowledge sharing and the development of best practice policies in this respect. Furthermore, member States are encouraged to apply UNECE best practises and consider the differing finance options such as the UN People-first PPPs which comprise all aspects of funding whether environmentally sustainable or promoting equality for people which can scale-up to meet the 2030 Agenda.

Accessibility for people and businesses: transport is the tool by which people and businesses have access to the goods and services they need. This involves making sure that there are transport solutions (primarily public transport solutions) for people to get from their place of residence to their place of work easily. It also involves ensuring that the transport vehicle and related infrastructure can be accessed easily with such things as step free entry and exit, and provisions for vulnerable users and people with reduced mobility. Similar accessibility requirements are necessary for the transport of goods. Accessibility is also about ensuring that alternative forms of mobility (cycling for example) are allowed for the transport environment and that due consideration is made in the planning of cities to ensure that they can be a key component of the transport mix.

Recommendations: Accessibility must be a key consideration for member States when planning, designing and developing mobility solutions, with diverse factors to consider such a rural versus urban geographies, public transport provision and the support for vulnerable people, advocated as one of the cornerstones of THE PEP activities. Outside the urban environment, member States need to ensure long distance accessibility through such things as the Inland Transport Infrastructure Agreements.

Transport safety

Sustainable mobility and smart connectivity must be safe and seen to be safe, too many accidents, and related fatalities and injuries continue to affect mobility. The largest safety gap to close is in road transport as it is clearly the largest with 1.35 million fatalities on the road worldwide per annum. While railways and inland waterways are much safer in terms of accidents, there are still improvements to be made for those modes of transport.

An effect of the COVID-19 pandemic has been that during the most restrictive periods, the use of public transport has been in some areas at a virtual standstill. Even when travel and work restrictions have been relaxed, people's concerns over safety in the public or "shared" transport systems has meant it has been the least utilised method for travel. Depending upon how the pandemic evolves, safety for those passengers who must travel and the transport workers will be a primary concern and it may take a long time before confidence in public transport as a completely safe method of travel returns.

Road: By far the largest challenge as the sector combines all road users whether travelling by car, bus, truck, van, motorcycle or scooter, bicycle or on foot. Through the UN Road Safety Conventions and Legal Instruments a framework has been developed to address in a holistic manner the reduction of road safety risks through an appropriate governance structure, the adherence to traffic rules, the safe transport of dangerous goods, the limitations on driving times and the use of safe, homologated and road worthy vehicles. Unfortunately, not all UN member States have become contracting parties to the conventions and/or effectively implemented the requirements of this framework. This has led to a continued high number of fatalities on our roads. In 2010 the UN set the goal of halving the number of road fatalities by 50% by 2020. Although significant progress was made in this period, the 50% target was not reached.

A major drive towards road safety are the regulations to make vehicles safer for their occupants and other road users such as pedestrians and cyclists. All vehicles are made according to safety standards developed by ECE (not the EU, EU legislation refers directly to ECE standards). If you use a car, get on a bus, or drive in a truck, you will see the "E" symbol on everything from side windows, to brakes, airbags, and seatbelts. The standards also extend to helmets (it is now illegal in the EU to sell helmets without ECE markings) and child seats for example.

These standards ensure a vehicle is safe being constructed according to ECE agreed regulations using only approved components and verified through periodic technical inspections. Adherence to these standards is a fundamental aspect for the road worthiness and safety of vehicles throughout their design and manufacture.

While the standards bring rigour into road safety, they form part of a wider approach which acknowledges that vehicles are driven by people, and people make mistakes. This "safe system" approach combining the design and manufacture of safer vehicles and improved road systems combine to help minimise the impact of mistakes and reduce accidents.

A major challenge is that not all ECE member states adhere to the safe system approach, so while some vehicles look the same, they may have been constructed to differing safety standards. To drive home the importance of road safety the UN Secretary General has a Special Envoy on road safety to promote the implementation the UN Road Safety Conventions to make the roads safer for all to use. This has been recently supplemented by the creation of the UN Road Safety Fund.

Road safety also has a direct correlation with efficiency as the congestion, delays and the effects of even minor collisions can have a knock on and detrimental affect especially occurring on heavily used routes causing delays, jams and increase in CO_2 due to drivers idling while queuing in tail backs.

Recommendations: Member States should renew their efforts in improving road safety, seeking to ensure that they adopt a system approach in line with recommendations and processes enshrined in UN Inland Transport Conventions, with the support of the UN Secretary General's Special Envoy for Road Safety as well as contributing to and drawing on the resources of the UN Road Safety Fund.

Rail: Accidents and fatalities are significantly lower than for road where the trend for passenger fatalities on the railways is and has declined over recent years but is affected by significant one-off incidents or by non-railway users such as trespassers or incidents at level crossings.

A number of recent initiatives have helped the improvement of safety in the sector including efforts to remove level crossings across the region and the introduction of improved safety critical signalling systems such as the European Rail Traffic Management System (ERTMS) in the EU and similar systems in other parts of the ECE region.

Recommendations: Member States should seek to invest in solutions that maintain the high level of safety experienced in the railways through such things as improved signalling, reduced interferences and upgraded level crossings.

Inland waterway: As with rail, accidents and safety incidents are less common with waterway transports. The scope of waterway safety covers: navigation rules, vessel technical requirements, crew qualifications, rules for the transport of dangerous goods. Safety could be improved by the technology enhancements concerning automated navigation. Many of these aspects are dealt with in the Inland Waterways Conventions and Legal Agreements administered by UNECE.

Further harmonization across the river basins is necessary to facilitate the development of safe solutions for the sector, including in relation to crew qualifications.

Recommendations: Member States should build on work carried out at international level to increase safety on inland waterways through the introduction and extension of use of new technologies such as RIS.

Intermodal: The increasing use of intermodal units for international transport requires a common set of rules and standards to consistently manage safety risks. Safe packing and handling of intermodal freight transported in Cargo Transport Units (CTUs) irrespective of their content, are essential to ensure safety for all workers and the public from accidents and to avoid damage to cargo or transport equipment.

Common safety standards need to apply whether CTUs are transported by road, rail, or inland waterway, and when handled for transhipment through intermodal terminals. The ILO/IMO/UNECE Code of Practice on the Safe Handling of Cargo Transport Units (CTU Code) is the reference document and standard which is increasingly being used around the world and has become the basis for national legislation in some countries.

Recommendations: Member States should seek to apply the provisions in the CTU Code to make the handling of containers, and thus making working in the sector, safer.

Transport security

Security is all about identifying threats, mitigating risks and handling incidents if they occur. It continues to be a major concern as the threats to transport and the supply chain are ever evolving as those who perpetrate them find ever more inventive ways to disrupt, damage or destroy the normal and legitimate flow of goods and travel of people.

For inland transport, each mode has its own security challenges ranging from attacks on people, infrastructure and systems, theft of assets and goods to the illegal trafficking of people, endangered species and contraband cargoes. Overlaying these is the omni-present threat of terrorism and terror related crime. These security threats have a strong impact also on connectivity. Sustainability will depend on managing the risks where multiple challenges lie for example, most infrastructure and vehicles are unprotected or have limited protection, many stakeholders are involved and require coordinating, multiple security regimes can apply, trade and traffic flows must not be disrupted.

Security also relies on the trustworthiness of those involved in international trade and transportation. As discussed within Smart Connectivity, the authenticity of digital documents and their legal accepted by regulators is essential not only to effectively remove paper from the transport chain but to make it more secure. Increased levels of stakeholder trustworthiness reduce security threats and mitigates the risks from illegal and illicit activities in transport chain.

Prevention of theft in road, rail and intermodal transport: a major concern as the incidents of thefts are increasing especially for road with theft of or from the vehicle, theft of/from trailer and hijacking with the cost of thefts running in millions. Helping to mitigate the risks to road are the Transported Assets Protection Association (TAPA) standards for secure parking of trucks citing an average loss rate from theft in Europe running at over EUR 300,000 per day. For rail, the isolation of (long) stretches of infrastructure also leave the rail mode vulnerable to theft especially of copper wire which also has a strong impact on safety.

Recommendations: Transport security transcends all modes of transport and across all borders. member States governments and stakeholder communities are encouraged to share information about thefts and other security incidents whether cyber or physical in nature, across all modes. Also, member States should provide secure and safe parking/resting facilities for road transports and their drivers aligned with existing guidelines and best practices.

Cybersecurity: with so much reliance on systems, digitalised data and the ubiquitous availability of information, cyber security poses a major issue. From government, to corporates, small and medium business, to the individual protection against malicious actors is a constant threat. Each mode of transport deploys its own measure to counteract cyber-threats and the ECE is providing the legislative framework on how to protect autonomous vehicles and all connected elements of vehicles.

Recommendations: To counteract the growing cyber-threats, member States should establish regulated policies on transport systems for all modes of transport and where appropriate certify manufacturers and suppliers for compliance. Member States are encouraged to adopt and apply harmonized cybersecurity standards within a legal framework, such as those developed within the ECE Working Party on Automated/Autonomous and Connected Vehicles (GRVA, part of WP.29).

Protection of transport infrastructure: terror attacks across transport modes have had a direct impact on the way security is treated for infrastructure with a direct impact on rail and inland waterways. Dissemination of information about security methods, standards and norms in all transport modes is key as multiple actors are engaged in the security approaches can be fragmented while the best approach is for coordination to meet and mitigate against the range of threats whether from theft, terror or cyber-attack.

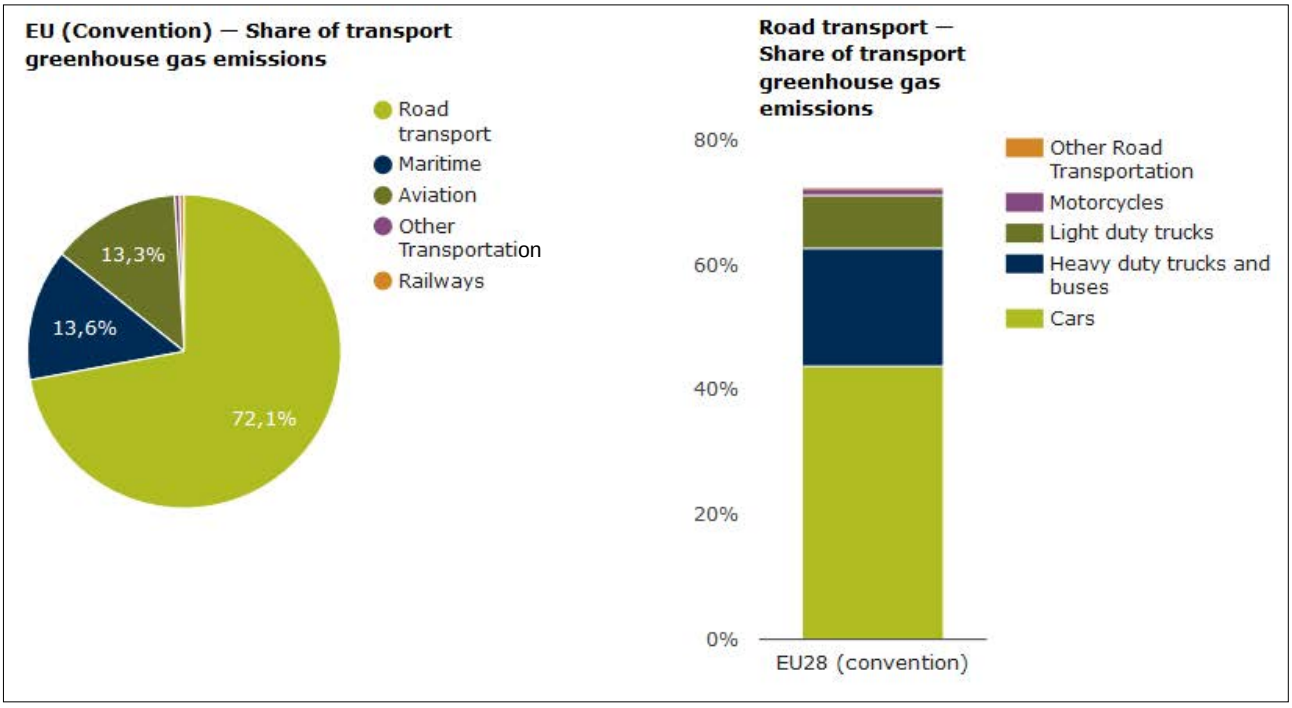
Recommendations: To assure transport safety, security and continuity, member States must place a high priority on protecting transport infrastructure from all possible threats. While risk assessment is part of national responsibility, member States are encouraged to share information more widely about security incidents, threats and the risks they pose, for example by contributing to the UNECE Rail Security Observatory and similar initiatives.

Transport and the environment

Critically important to sustainability and directly consequential of mobility is the effect of transport on the environment. Environmentally sustainable transport entails ensuring mobility while ensuring efficient energy use that reduces all forms of emissions and land use.

Transport accounts for more than 25% of CO_2 emissions within the EU. As shown in Figure VI below, in comparison to other modes of transport, road transport accounts for most of inland transport's polluting emissions and shows the need for promoting a modal shift, where possible, as well as the introduction of alternatively powered vehicles, energy saving driving methods and emission control methods.

Figure VI: Share of greenhouse gas emissions from transport and detail on the emissions by road transport for the EU28



Source: EEA, Inventory 2019.

Emissions are not limited to CO_2 though as other pollutants, including particulate matter, have a severe impact on human health. In addition, most motorised transports emit noise and cause vibration which also have a negative effect on people's health and well-being.

Transport also has an environmental impact on land use which can lead to loss of biodiversity. Large expanses of land used for road, depots and terminals change the surface areas encroaching on natural landscapes and in some cases contribute to other forms of pollution such as contaminated rainwater run-off from roads into streams and rivers. This requires careful and considered planning from the outset to assess environmental impact of development.

The challenge is to promote the use of the most environmentally friendly transport mode suitable for each transport need, also considering the type of energy used with a strong focus on ensuring a switch to the use of renewable energy.

Road and urban transport: while contributing most to pollution (emission and noise) from the effects fossil fuel supplied internal combustion engines, the paradox is that it also provides the opportunities for greener alternatives such as cycling and electric/alternative fuelled vehicles.

Efforts are ongoing to reduce emissions of vehicles thanks to the introduction of stricter emissions testing regimes as developed by member States in the UNECE World Forum for the Harmonization of Vehicle Regulations.

Recognising the increased urgency of climate change and of environmental protection, there has been a discernible shift to public transport and cycling in urban areas. Public transport requires about 3 times less energy than cars, comparing well with cars for all kinds of emissions. The increased and higher use of electrification in public transport also enables it to use more renewable energy. According to the WHO, one million deaths per year in Europe can be attribute to inactivity so an increase in active mobility such as cycling and walking positively contribute overall health, wellbeing while being highly sustainable.

Several initiatives comprising alternative means and modes of transport are progressing:

- Increased optimization of freight transport with the use of intermodal transport to deliver goods, reducing the road component to the first and last mile and making full use of rail and inland waterway solutions for the remaining legs
- Incentive schemes for the use of electric cars is helping to ensure their use is on the rise
- Eco-driving to promote responsible, safer and more considerate driving are being run by several countries and falls under THE PEP scope.

At the base of these policy decisions is the legislative framework aimed at ensuring that road vehicles emit as little as possible. This framework is developed at ECE through the vehicle regulations that establish the standards by which emissions are assessed and vehicles homologated.

Recommendations: To reconcile environmental and economic targets and in meeting international environmental commitments (including support for SDGs), member States should ensure the full implementation of UN Vehicle Regulations related to the pollution emission standards to reduce the environmental impact of road transport. In developing a holistic approach to protecting the environment, member States should participate in the UNECE Environmental Performance Reviews (EPRs) as well as contribute to, and learn from, the experiences within THE PEP on minimising the environmental impact of transport.

Rail transport: usually more environmentally friendly than road transport as a large part of rail transport is electrified. Better environmental performance may be obtained through further electrification including the use of battery power, using alternative fuels, encouraging eco-driving and reducing noise and vibrations especially when traversing built-up areas. Noise reduction measures applied to tracks and rolling stock can be expensive and may only be possible when routine repair, maintenance or replacements are scheduled.

Recommendations: Member States should continue to support the shift to rail to reduce transport's environmental footprint. In doing this it should also consider investing in the electrification of the railways to further reduce its emissions.

Waterway transport: compares well in environmental terms with other transport modes due to low emissions per tonne of goods transported and to the high capacity of the vessels which allows the removal of significant freight traffic off of roads and the freeing up of capacity on railways. A number of challenges remain to be tackled to ensure

the environmental sustainability of inland waterway transport including the use of fossil fuels for propulsion with limited possibilities for changes in the short run, use of rivers and lakes and treatments and disposal of waste. The use of low sulphur fuels is a potential remedy.

Recommendations: Building on the reduced emissions of the waterways sector, member States should seek to encourage the shift to inland waterways where possible while, at the same time, seek to improve the environmental performance of the sector with the introduction of cleaner fuels and newer, more efficient vessels. This should be coupled with efforts to minimise the impact of waterway transport on the wider environment by applying UNECE Resolution No. 21 on Pollution Prevention.

Resilience to climate change effects: acknowledging that transportation is a major contributor to climate change, adverse climatic events are also threatening transportation. Erosion, tidal surges, fires and flooding all pose a hazard to the safe and efficient operation of transport systems.

ECE is already helping to building resilience to these hazardous events by identifying climatic hotspots where adverse weather could cause disruption to transport systems. For effective and timely intervention to counteract the negative impact of these events, all stakeholders require access to information about risks and the mitigation steps to counteract them.

Conclusion, challenges and the role of the UNECE

The Sustainable Mobility and Smart Connectivity nexus covers several areas that are essential for the achievement of the 2030 Agenda for Sustainable Development within the member States of the region.

The challenges within this nexus are vast, and so are the opportunities. The world is already set on a pathway to progress SDGs and much has been achieved already. However, progress according to the pre-2020 expectations is currently unpredictable due to the continuing and accelerating effects of the COVID-19 pandemic.

Both Sustainable Mobility and Smart Connectivity themes have been affected by COVID-19, and it is still too early to confidently say what will be normal. Nevertheless, this along with the other nexus' will have a major part to play in helping define a pathway to recovery and to set the direction which eliminates an environmental crisis upon a health and well-being crisis from the pandemic.

ECE is already supporting some of the SDGs and many of the themes covered by the Sustainable Mobility and Smart Connectivity Nexus by generally facilitating the development of a sound legal framework, offering support, guidance, encouragement and to advise on the use of standards and best practise to help build capacity. Most of these activities and actions remain relevant in the current and post-COVID-19 situation focused on collaboration and harmonization.

The numerous synergies that already exist between the various sub-programmes of ECE come together within this nexus for example in relation to electronic documentation, infrastructure development, reducing environmental impact, safety and security. The extensive joint work within ECE on these aspects sets a solid foundation for further efforts in these areas to help member States recover from the COVID-19 pandemic.

Therefore, to meet the challenges identified in this document and facilitate member States in implementing the recommendations identified above, ECE should consider the following for:

Smart Connectivity: continue as a focal point for electronic business, helping all stakeholders meet their needs for data exchange and use by applying the UN/CEFACT semantic model, while defining the legal framework to help member States to facilitate the cross border exchange of electronic data. This should be coupled with encouraging the further dissemination of electronic documentation for trade and transport and a coordinated development of infrastructure and border crossings to facilitate international connectivity.

Sustainable Mobility: continue development of a robust legal and regulatory framework for the sustainable mobility of passengers and freight, through existing and future Conventions, legal agreements, regulations and resolutions to help member States to harmonize cross border transport services, drive transport innovation via the use of innovative technologies and improve efficiency, safety, security, and environmentally friendly and sustainable solutions for all modes and means of inland transport.

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INTRODUCTION

This report on Sustainable Mobility and Smart Connectivity was prepared in support of the NEXUS approach of the UNECE. The objective of this programme is to support the United Nations SDGs in an innovative, cross-sectoral and integrated manner.

"Sustainable Mobility and Smart Connectivity" is one of four Nexus and it looks at how to better connect people, companies, governments, economies and even objects.

Within the UNECE:

Sustainable Mobility looks at how to physically connect and move people and goods efficiently, safely, securely, affordably and in an environmentally friendly (i.e. sustainable) manner via inland transport.

Smart Connectivity has a special, but not single, focus on trade and looks at how to better connect economic and regulatory processes (and their transactions) in support of economic growth and other SDGs.

Both of the above require:

- Free, openly available and harmonized standards, guidance and regulations, in order to promote seamless mobility and information exchanges.
- Bringing together public service needs with private sector innovation and financing capabilities.
- Infrastructure that meets the needs of both citizens and businesses.

Within this context, the work on Sustainable Mobility is centred more on intergovernmental agreements, physical infrastructure planning and guidance (for roads, railroads, waterways, etc.) and standards for vehicles. On the other hand, Smart Connectivity is centred more on information and communication technologies; data standards; and simplified, improved and innovative processes.

Because of the nature of the Nexus, this document was created by an inter-sectoral team soliciting input from all UNECE subprogrammes. It looks at the current situation of Sustainable Mobility and Smart Connectivity across the region and seeks to identify future challenges and areas where the UNECE could contribute to both meeting these challenges and supporting the SDGs.

The document has been structured as follows:

- **Section 1 on Smart Connectivity** considers information and procedural connectivity issues in end-to-end economic processes. In this context, air, inland and sea transport are looked at together with commercial and payment processes in a holistic approach.
- **Section 2 on Sustainable Mobility** zooms in to focus on the inland transport section of economic processes – which are particularly important in the ECE region with its large land masses and many landlocked countries.

The objective of this approach, going from a wider perspective on connections to a more focussed perspective, is to better highlight common and complementary areas of activity as well as to better support the identification of potential areas for future work and cooperation.

SECTION 1 SMART CONNECTIVITY

1.1 Introduction to Smart Connectivity

This section aims to identify key issues related to smart connectivity within the ECE region and their potential impact on achieving the following Sustainable Development Goals as well as guidance on areas where further work may be needed:

- **8.** "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"
- **9.** "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"
- **12.** "Ensure sustainable consumption and production patterns"; and
- **17.** "Strengthen the means of implementation and revitalize the global partnership for sustainable development".

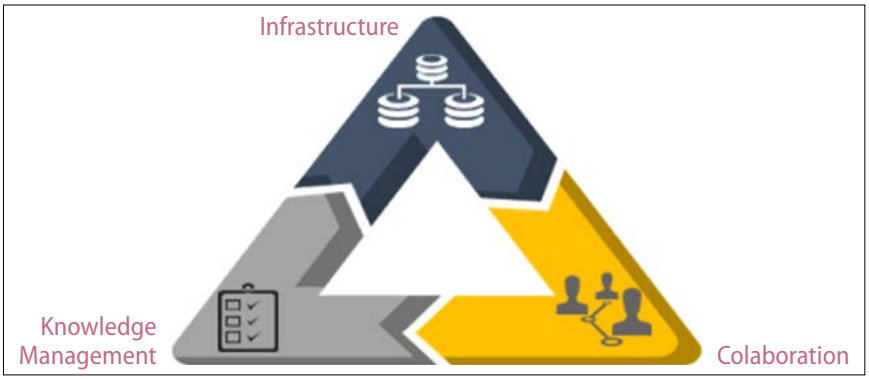
Related UNECE deliverables that contribute positively as well as areas where the UNECE could potentially play a future role are also identified.

1.1.1 What do we mean by Smart Connectivity?

Recent decades have seen an impressive growth in all types of data exchanges between entities; governments, organisations, businesses, people and things (via the Internet of Things (IoT)). Technology, and the accompanying digitalisation of information, has been the main driver behind this growth. At the same time, more than just technology is required in order for connectivity to be "smart". It also requires simplifying, streamlining, standardizing connections along three dimensions:

- **Infrastructure**; the foundation of the connectivity, which consists of **physical infrastructure (roads, optical networks, electricity, etc.), Information and Communication Technologies (ICT), legal frameworks and innovation policy and processes**.
- **Knowledge Management**; Free, **openly available and harmonized standards, recommendations, guidance, regulations and conventions**[3] that promote, create and facilitate efficient connectivity and seamless data exchanges.
- **Collaboration**; Bringing together public service needs with private sector know-how and/or private sector knowledge across sectors in order to support innovation and financing for **knowledge management and to develop, finance and operate sustainable connections**.

3 **Standard**: "something used as a measure, norm, or model in comparative evaluation"; "a form of language that is widely accepted as the usual form"; **Recommendation**: "a suggestion or proposal as to the best course of action, especially one put forward by an authoritative body"; **Guidance**: "advice or information aimed at resolving a problem or difficulty, especially as given by someone in authority."; **Regulation**: "a rule or directive made and maintained by an authority."; **Convention**: "a way in which something is usually done"; "an agreement between states covering particular matters, especially one less formal than a treaty" (definitions from the Oxford dictionary).



This section looks at these dimensions within the ECE region, with a **focus on the exchange of services and physical goods between countries, i.e. global trade**. Another key aspect of connectivity, and also trade, is transport and sustainable mobility which is covered by the second section of this publication.

1.1.2 Smart connectivity in practice

Before developing different aspects of connectivity, here is a practical example of connectivity (or the lack of it) in today's international trade. A term such as "net weight" can appear in dozens of trade related documents, to name a few: Contract, Purchase Order, Proforma invoice, Tax Invoice, Packing list, Inspection certificate, Certificate of Origin, Airway bill/Bill of Lading, Letter of credit, Customs declaration, Import certificates from the different authorities, etc. In some places, all of these documents will be printed on a physical, paper form with the information keyed in manually at each step for inclusion in the many different systems which are used in order to print these documents. This re-entry of the data by multiple parties can lead to human errors and reinterpretation of what value is actually meant.

In contrast, in a supply chains based on smart connectivity, this information would either be directly extracted from the seller's system (or some other central repository) or exchanged in a smooth information flow via electronic interfaces all along the supply chain, up until the delivery of the goods to the end buyer and payment of the invoice.

This highest level of smart connectivity is possible when the following conditions are in place along the three dimensions described earlier:

- **Infrastructure**
  - All systems are connected to a network (which could be the public Internet).
  - The network(s) either share a common data resource or are interfaced (directly or through third-party platform(s).
  - The systems each have an identity that is recognised by the others and authorize the electronic transfer of data.
  - The data that is exchanged is legally recognized, whenever that is needed and appropriate.
  - Knowledge Management
  - The process is the most efficient possible, with all steps adding value as a result of thoughtful process analysis and knowledge provided by recommendations and guidance published freely by recognised bodies.
  - Authorities have supported process improvements through regulations that were developed in consultation with stakeholders and by participating in relevant international conventions.
  - Electronic systems identify the data automatically and correctly based on agreed syntax, and understand the values correctly based on agreed semantics.
- **Collaboration**
  - Formalities, procedures and trade documents are aligned and, for neighbouring countries, working days/hours are aligned at border-crossing facilities.

- Risk analysis allows physical controls to be limited to the strict minimum, based on the use of ICT and on coordination between the relevant regulatory entities (customs, inspection authorities, ministries, etc.) domestically and internationally.
- Changes in regulations, procedures, systems and knowledge management tools support constant improvement through consultations with all relevant stakeholders and appropriate public-private partnerships.
- Evolution in technology, processes or information exchanges is discussed in collaborative platforms which ensure that standards are implemented, information is available to all stakeholders and assistance with implementation is provided when needed.

The gains that such smart connectivity can provide in terms of efficiency and error reduction is staggering. As all environments are evolutionary, it is normal that not all of these conditions exist in each dimension. At the same time, the situation described above is still far from the norm and smart connectivity is not without challenges. So why has more progress not been made?

The main answer is that smart connectivity is currently identified by people in responsible roles as being potentially more expensive than the status quo (paper or reduced connectivity). The key reasons being the following:

- **Infrastructure**
  - Old legacy systems, which may represent millions of dollars of investment, are difficult and expensive to modify or interface.
  - Lack of communication capacity and/or access (e.g. fixed or mobile broadband).
  - Lack of continuous energy, to ensure 100% electronic utilisation.
  - Lack of mobile devices to use digital data remotely (e.g. on a truck or at a mobile or remote checkpoint).
  - Lack of universally and multi-laterally accepted identification/authentication systems for documents (i.e. information "packages") and electronic signatures.
  - Laws and regulations on electronic information which evolve much more slowly than the technology.
  - Lack of trained staff.
- **Knowledge Management**
  - Developers and/or IT managers are not aware of existing semantic and syntax standards; partners are not using them and/or their legacy systems do not have them implemented.
  - Processes are not viewed from a business/facilitation perspective.
  - Authorities are reluctant to modify practices, regulations and/or laws, including the implementation of international data standards.
  - Uncertainty on the part of government agency staff (customs agents, inspectors, etc.) as to what is required/permitted.
- **Collaboration**
  - Regulatory entities have internal targets and challenges, which limit their will to cooperate both among one another and with the private sector at a national level.
  - Legislation and regulatory frameworks do not always encourage cross-border cooperation.
  - Efficient collaboration platforms can be difficult to develop and manage.

There is often a lack of financing for collaborative platforms and/or no entity with the authority and responsibility for ensuring that collaboration happens. In the following chapters, we will highlight specific practices that can help to overcome some of these challenges. As often the examples are limited to single improvements, the last chapter of this section will develop on general opportunities to impact positively the international supply chain.

1.1.3 Smart Connectivity supports the Sustainable Development Goals

Smart Connectivity has the potential to support many of the United Nations SDGs. However, this paper will focus on the following SDGs where the impact of smart connectivity can be the greatest and when related initiatives are presented in this paper, they will be linked to an SDG's targets.

- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Goal 8).
- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Goal 9).
- Ensure sustainable consumption and production patterns (Goal 12).
- Strengthen the means of implementation and revitalize the global partnership for sustainable development (Goal 17) which includes two highly relevant sub-goals;
  - 17.10 "Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system …"; and
  - 17.17 "Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships."

1.2 ECE region

The ECE region comprises 56 member States from Central Asia, Europe and North America whose territory covers more than 47 million square kilometres. It includes some of the world's richest countries as well as countries with a relatively low level of economic development.

The 2019 UN Global Survey on Digital and Sustainable Trade Facilitation[4] gives some insights on the ECE region for the government-led connectivity elements.

- **On the questions related to technology implementations of best practices identified and/or developed in the knowledge management dimension** (e.g. electronic Single-Window, electronic submissions, laws and regulations for electronic transactions, etc.), which can be extracted from the topics of the survey: "Paperless trade measures" and "cross-border paperless trade measures", the rates of implementation have been between 20.63% (Electronic exchange of Certificate of Origin) to 100% (Automated Customs System).[5]

- **On the questions related to the collaboration dimension** which can be extracted from the topics of the survey: "Institutional arrangement and cooperation measures", the rates of implementation have been between 72.2% (Government agencies delegating controls to Customs authorities) to 87.3% (National legislative framework and/or institutional arrangements for border agencies cooperation).[6]

The following discussion on smart connectivity in international trade is not meant to be exhaustive, but rather to cover some key aspects of smart connectivity and its impact. In this context, the focus is on those processes that involve the largest number of different parties (Customer, Supplier, Authorities and Intermediaries) and, therefore, are where smart connectivity has, or could have, the greatest impact.

4 https://untfsurvey.org/

5 For the respectively forty and forty-two countries that responded to these questions of the survey.

6 For the forty countries that responded to these questions of the survey.

1.3 Smart Trade

1.3.1 The First Foundation: Data Exchange

Current situation

SDG 8.2 Achieve higher levels of productivity of economies …

The Warrant Group (a UK-based freight forwarder) has implemented the UN/EDIFACT EDI standards (which is free, neutral, and open source) to simplify their processes (and thus reduce the number of standalone, customized links with its clients). The resulting efficiency gains allowed the Warrant Group to reallocate a portion of its IT staff from the maintenance of customized-customer data connections to value added-development.

In six months during 2017, Warrant exchanged 4,000 shipping instructions, 15,000 bookings and about 2.2 million status messages.

Today, the electronic exchange of information is everywhere and is performed in many different environments and sectors using dozens of open or proprietary protocols, messages and file formats.

Two building blocks are required for exchanging data between digital applications: common data elements with standardized definitions (i.e. a common vocabulary); and a syntax which allows the identification of data (equivalent to a grammar in spoken languages).

In the past, this data has frequently been packaged in standard messages which combine data elements and syntax into a structured business message which is similar in concept to a paper document and these are sent between parties. More recently, new exchange methods are beginning to be used. These are based on the storage of data in a common "data source" from which users retrieve the data when they need it. This ensures that all users have available the most recent, and the same, version of the data. Some examples of such common data storage areas are "data pipelines", "X-Roads", X-Rooms" and blockchains, the differences between them depend on how data is stored and retrieved.

Information exchange in business-to-business transactions has been facilitated through Electronic Data Interchange (EDI) since the 1980s. The first prominent EDI specifications, such as UN/EDIFACT, translated the paper-document environment into electronic messages having a defined and limited number of characters. This allowed the direct transfer of structured business data between computers by electronic means, i.e. the paperless transfer of business "documentation".

This form of EDI remains advantageous for large, highly standardized data transmissions because the formatting syntax creates smaller files with less overhead than newer technologies, so it places less stress on storage and transmission resources.

The most common documents exchanged via this form of EDI are purchase orders, invoices, and advanced shipping notices and customs declarations. But there are many others, such as bills of lading, customs documents, inventory documents, shipping status and payment documents.

Beginning from the late 1990s, another EDI syntax, eXtensible Markup Language (XML), became increasingly implemented. XML opened up new possibilities because of its flexible message structure, the definition of which is carried within the message itself. These message structures can also be used to generate human readable (paper or on-screen) information. The use of this "heavier" data structure was made possible by new technology for increased data storage and faster transmission.

Initiatives underway

The electronic exchange of information cannot operate efficiently without common standards and, over the years, progress has been made in drawing together different standards, depending on specific industries or regions as well as the technology in question.

There are variations of fixed-length EDI standards, some of them unique to specific industry sectors. The most common of these, which are also inter-sectoral, are:

- Internationally (predominantly in Europe and Asia): the UN/EDIFACT standard, initiated, maintained and further developed through the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT).[7] UN/EDIFACT is also the foundation for slightly modified "subsets" that are promoted by other organizations such as the World Customs Organization (WCO) data model used for customs data and GS1 EANCOM in the retail sector.
- North America: X12 EDI (or ASC X12), developed and maintained by the Accredited Standards Committee X12, chartered by the American National Standards Institute.

For XML, there are "many flavours" most of which are developed in house by individual companies. They then negotiate with their partners on the exchange of messages and create bridges between the messages they receive and their internal standard. As the messages can change depending on needs, the creation and maintenance of such bridges can be a full-time job. International XML standards do exist, such UN/CEFACT or the WCO data model. The European Union, for example, has approved the use of two XML standards for e-invoices exchanged in c communications: the UN/CEFACT cross-industry invoice and the Universal Business Language e-invoice[8] of the Organization for the Advancement of Structured Information Standards.

In the Eurasian Economic Union, a single data model[9] has been developed to support diverse types of interstate information exchanges (S2S,[10] G2G, B2G, B2B), with eighty common processes identified. The purpose of the Union's data model is to support the use of a single harmonized methodological approach and consensus decisions on e-document structures. In the future, the coverage of the Union's data model will be expanded in order to: (a) extend the list of interstate (cross-border) e-services which have the highest priority for implementation, and (b) harmonize B2G interaction procedures and the documents used by these procedures.[11]

Challenges

One barrier in using standards for the electronic exchange of information is the cost in time and money required for their initial setup, including the need to modify existing legacy systems and the need for all parties participating in the exchange to make this investment. As a result, the principle drivers for the use of standards are very large users (like an automotive company or a retail chain) or groups of users (such as an industry association) or governments who dictate the use of one or more selected standards across their supply chains and in other activities. For example, the European Union directive on electronic invoicing,[12] the use of GS1's EANCOM[13] in the retail sector or the use of the WCO data model by customs administrations,[14] These actions then create "communities" of users with a volume of data exchange that is large enough to create significant benefits, albeit restricted by their corresponding scope.

7 UNECE contributes to this by supporting UN/CEFACT, as its subsidiary intergovernmental body of the UNECE Committee on Trade.

8 See the last paragraph of section 2 and section 4A at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:590:FIN.

9 UNECE contributes to this by having developed the UN/CEFACT UMM 2.0 methodology on which the EAEU data model is based.

10 S2S: Server-to-server.

11 www.eurasiancommission.org/ru/Documents/2797_1_EEK_%D0%A6%D0%98%D0%A4%D0%A0_%D0%B0%D0%BD%D0%B3%D0%BB__sait_rasv.pdf.

12 European Commission eInvoicing Directive 2014/55/EU: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0055&locale=en.

13 A subset of UN/CEFACT standards.

14 Base on UN/CEFACT standards but with some limited modifications.

In addition, there is a general lack of knowledge about which standards already exist and how they can be used. One result of this is that large potential user groups sometimes start new standards initiatives which duplicate existing standards. As a result, raising awareness among potential users of standards and their benefits is a constant challenge.

Fixed-length EDI standards are supposed to be unambiguous, but there is a tendency among some users to make modifications to better fit their internal needs. Such modifications are understandable, as business evolves, nevertheless making small changes without working collaboratively within the standards process to modify the existing standards results in the development of isolated "standards" user communities who cannot easily exchange electronic messages between one another even though the "standards" they use are based on the same work. There is, therefore, a need to raise awareness of the importance of remaining aligned, and of updating standards with increased information and semantic content that can be used by all stakeholders.

SDG 12 Responsible Consumption and Production

Since 2016, and with the help of UNECE, stakeholders from Central Asia's Fergana Valley, an agricultural area spread across Kyrgyzstan, Tajikistan and Uzbekistan implement a UNECE standard for Dried Apricots which takes into consideration production criteria specific to Central Asia. The standard offers producers in the region a sustainable way to pool their production and increase their competitiveness on international markets. One of the major achievements associated with this development is strong public and private sector collaboration to introduce and further develop new quality inspection practices, the inclusion of dried apricots in export promotion plans by national agencies, and the business community's eagerness to realize this sector's potential. To support this, UNECE organizes training, sets up technical support groups and helps develop training material and illustrated guides to support practical use of the standard by farmers, packers, traders and standardization agencies.

With regard to XML messages, the benefits obtained through the flexibility of this syntax (message structure) have brought other challenges. Many companies and administrations have created their own XML messages and created bridges to link with other entities' solutions; this results in a never-ending updating of these links which computer experts can testify is not a difficult task, but is it really the vocation of companies or administrations to dedicate resources to this non-substantial task? Many of these XML messages are based on a pure electronic equivalent of a paper document without simplification and without including the semantic context (i.e. the context that gives the data a precise meaning). This lack of context can result in messages that function well in a narrow context between a small number of parties but whose data may not be directly usable, even for the same "content", other messages even within a same entity. For example, a "date/time of arrival" used in a contract may not be the same if it is a maritime shipping document (arrival in port), a customs document (arrival at border) or a commercial document (arrival at warehouse or destination).

Two ways have been identified to respond to this challenge:

1. Collaborative development of a common data "dictionary" which avoids reinventing data definitions and the matching/modification of definitions between entities every time a new connection is established.

   This calls for a common, standardised library of semantics (definitions) that allows the use of unambiguous, clear and defined standardised terms and codes. The largest and most complete library of this kind is the UN/CEFACT Core Components Library (CCL). At the same time, the development of such a library is a "never-ending task" because, as more and more users come on board, more data elements and codes need to be defined and/or updated.

2. In the future, Machine Learning and Artificial Intelligence may, at least in some cases, allow a receiving IT system to understand the exact semantic meaning of messages and their data based on the context. However, the technology still needs to be developed in order to do this cost effectively and the levels of accuracy required would be difficult to attain, at least with current technology.

1.3.2 The Second Foundation: Standards and quality infrastructure for smart trade

Current situation

SDG 9.B Support domestic technology development and industrial diversification

The powerful role of trade in determining an economy's development trajectory cannot be over-emphasized. Non-tariff barriers to trade inflate transaction costs, undermine export competitiveness and create a disincentive to investment in new economic activities.

UNECE develops studies on Regulatory and Procedural Barriers to Trade upon the request of member States in order to identify these barriers and make recommendations for reducing them.

www.unece.org/trade/studies-on-regulatory-and-procedural-barriers-to-trade.html

Standards are an essential aspect of connectivity, providing the technical infrastructure that allows goods to flow across borders and from producers to consumers. For traded products, standards define a required or agreed level of quality and performance. Such standards have an important role in international trade, allowing a "fair playing field" for competition where everyone has to meet the same criteria while also protecting the safety and well-being of the public. They also protect business as incidents caused by the sale of defective or unsafe goods can have a disastrous impact on consumers and entire supply chains, including those of suppliers, wholesalers and retailers who sell products that are standards conformant. Many scandals have occurred due to goods that were not safe or were mislabelled such as the 2013 scandal in Europe when several brands of frozen meals were found to have been using horsemeat in products labelled as containing only beef.

Standards support economic development in three ways: (1) ensuring consumer safety, (2) providing technology transfer opportunities; and (3) creating greater opportunities for cooperation and coordination across borders as well as between corporate entities.

On the other hand, as standards and certification marks become widespread, it is becoming more and more difficult for consumers to have a clear vision as to what they mean or their origin which could be: the companies producing or selling the goods; third party companies; associations of producers; non-governmental organisations (NGO); or even governments.[15]

Initiatives underway

Standards promote international regulatory coherence; and can help companies, communities and organizations move toward a more resilient and sustainable model of production and consumption.

International, free and openly available standards are important for ensuring their availability to SMEs and companies in low- and medium-income countries. The use of such standards will help them: improve the sustainability of their production, build local markets and access new export markets, all of which improve the livelihoods of farmers, traders and particularly women.[16] The UNECE is an important provider of such standards in the areas of agriculture, information technology and transport. Information standards for transport are developed by a range of organizations, most of them being focussed on one mode or topic. The most well-known multi-modal, global transport messages are developed by UN/CEFACT under the work on Smart Connectivity in the UNECE. As with all of its work, this is done in cooperation with relevant organizations such as the International Maritime Organization (IMO), the International

15 For example, ITC identifies over 150 sustainability standards www.standardsmap.org/Index.aspx.

16 UNECE contributes to this by encouraging rule makers to base their regulations on international standards (www.unece.org/trade/wp6/welcome.html) and by having developed over 100 agricultural quality standards to facilitate international trade (www.unece.org/trade/agr/welcome.html).

Association for Port Community Systems, the International Federation of Freight Forwarders Associations, and, for inland transport, the experts supporting work on Sustainable Mobility in the UNECE.

Standards for inland-transport infrastructure, vehicles and dangerous goods transportation are developed under Sustainable Mobility with, as mentioned, cooperation in several areas, some of which are highlighted in this document.

Challenges

Standards for products have two faces with regard to connectivity; they can foster it by opening new markets and broaden the customer base for producers or, on the other hand, they can reduce connectivity by becoming a barrier to international trade. These barriers consist of increased costs caused either by (i) the use of standards that exceed the requirements for meeting regulatory objectives; or (ii) by similar but different requirements implemented by different parties for meeting the same objectives.

As noted earlier, there is also an increasing number of standards and certification programmes used in the marketplace. Some of these overlaps and their multiplication has sometimes put SMEs and producers in low and middle-income countries at a disadvantage because of the costs associated with having to conform with (and/or become certified for) multiple standards covering the same product.

These non-tariff barriers represent a global and regional collaboration challenge, as rule makers need to work on enhancing regulatory coherence and avoiding added costs to trade created by requiring more than what is needed for supporting regulatory objectives, or setting different requirements than those used by other countries for achieving the same objectives – thus forcing suppliers to comply with multiple, similar but different standards, regulations and/or tests/certifications.

Recommendations to address many of these and related issues have been developed by the UNECE Working Party on Regulatory Cooperation and Standardization Policies, the challenge now being to move toward their practical implementation by countries and other relevant international organizations.[17]

1.3.3 Smart Identification for Trustworthy Trade

Current situation

Trustworthiness is a crucial element in global trade and is based on three key elements of an exchange.

The first element is the identification of the parties to the contract. Today, this is a managed primarily at a national level, for both individuals and legal entities with little or no exchange of information across borders, increasing the opportunities for fraud and criminal activities. New anti-money laundering laws and know-your-customer initiatives are being implemented to address these issues, but they are still managed at a national level and their implementation has had a negative impact on the level of financial services offered to businesses in developing countries where it is more difficult and more expensive to meet these new requirements. In addition, traditional methods for the authentication of identity remain the general rule in most countries. These include witnesses, signatures, seals and government-issued identity credentials (e.g. passports for individuals) – almost all recorded on paper.

The second element is the clear identification of the goods to be delivered. For international trade the universally accepted identifier for goods is the Harmonized Commodity Description and Coding System (HS)[18] of WCO. This international, six-digit code is harmonized at the international level and governed through a convention that handles its application. However, this coding system can remain rather broad at the six-digit level, covering multiple products and there may be some differences in interpretation. In addition, in order to apply fiscal and other regulations, each country has extended the HS with national coding, resulting in codes that are interoperable on the broad six-digit

17 www.unece.org/tradewelcome/tradewp6/recommendations.html
18 www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx

level, but which require extensions that are not harmonized in order to understand the taxation and laws to be applied. That being said, the six-digit base does provide sufficient information to be able to understand the actual goods to be delivered.

The third element is the identification of the location (or electronic delivery address) where goods or services are to be delivered or implemented (for example, the loading berth at a seaport for transportation). For physical locations, business is increasingly aware today that the street addresses used by postal services are often not sufficiently accurate. This is especially true in developing countries with under-developed postal systems, but it is also true in many locations in developed countries (such as large industrial or port facilities), and there can be additional confusion when there are locations with similar names in the same country (for example, in France, the town Saint-Sauveur exists in at least eleven different locations – each with the same name).

Then, after establishing the underlying contracts, the international supply chain goes into motion and today it is complex, paper intensive and fragmented. Information and documents can be exchanged digitally across borders, but the authentication of this information remains a major challenge as well as its legal recognition.

Most of the time, a physical signature remains the principle proof of legal commitment and, therefore, of the level of trustworthiness established between two entities, even if this signature is then transferred into an electronic equivalent. Ensuring the legal significance (i.e. validity) of electronic interactions is a complex problem and includes legal (infrastructure), organizational (collaboration) and technical (standards/knowledge management) aspects.

Initiatives underway

The electronic verification of the identity or credentials of any entity is a challenge from a legal standpoint, especially when that verification crosses borders. There exists model legislation, guidance documents and recommendations on this topic, including the Organisation for Economic Co-operation and Development's (OECD's) recommendation and guidance on electronic authentication[19] as well as the United Nations Commission on International Trade Law's (UNCITRAL's) Model law on electronic signature,[20] its Model law on electronic transferable records[21] and the United Nations Convention on the Use of Electronic Communications in International Contracts (which has only 12 signatories).[22] In addition, the UNECE has developed a Recommendation on Authentication of Trade Documents.[23] At the same time, there has been limited implementation and acceptance of the legal validity of electronic information of extra-territorial origin (i.e. from outside the jurisdiction of the entity which needs to recognition the information). Existing agreements have been primarily negotiated on a bilateral level or are multilateral, but with a limited in geographic scope.

One example of a multilateral initiative which is has been implemented in the European Union is the issuance and validation of digital IDs for businesses and consumers which is implemented in line with Regulation No. 910/2014 on "electronic identification and trust services for electronic transactions in the internal market" (eIDAS Regulation).[24] This provides access across the European Union to on-line services and business transactions where the use of secure and legally recognised electronic identification is required.

Another option for identification for legal entities is the "Global Legal Entity Identifier". These are issued by a foundation that was established in 2014 by the International Financial Stability Board.[25] The Foundation[26] issues unique identifiers to verify (i) who's who; (ii) who owns whom; and (iii) who owns what. Its original purpose was to

19 www.oecd.org/internet/ieconomy/38921342.pdf
20 www.uncitral.org/pdf/english/texts/electcom/ml-elecsig-e.pdf
21 https://uncitral.un.org/sites/uncitral.un.org/files/media-documents/uncitral/en/mletr_ebook_e.pdf
22 https://uncitral.un.org/en/texts/ecommerce/conventions/electronic_communications
23 www.unece.org/fileadmin/DAM/cefact/recommendations/rec14/ECE_TRADE_C_CEFACT_2014_6E_Rec14.pdf
24 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0910&from=EN
25 www.fsb.org
26 www.gleif.org/en/

support the implementation of Anti-Money Laundering and Know Your Customer rules, but its use has grown to include other applications.[27]

Location information is another kind of identifier that is important for international trade transactions, both for delivery and transport. There are a number of widely used identifiers for this purpose, and one of these is the "United Nations Code for Trade and Transport Locations" (UN/LOCODE)[28] which is maintained by the UNECE and includes over 103,034 locations in 249 countries, territories and installations in international waters. UN/LOCODEs are widely used in trade and transport. For example, they are required for the identification of ports under the IMO FAL Convention on the International Facilitation of Maritime Traffic (which determines the data that international cargo ships are required to communicate to ports).[29]

Challenges

One of the main challenges is the development of international, "easy" to implement processes for verifying the identities of legal entities and individuals participating in international trade. It is unlikely that there will ever be "one" such process, but menus of options that meet the varying needs of different stakeholders for accuracy, security and privacy while simplifying implementation would help. In addition, as electronic communications and partners that exchange information multiply at unheard of speeds and in numbers that defy human counting – it becomes more and more essential that common vocabularies and meanings for codes and terms used in international trade, and commerce in general, be agreed upon.

To improve the acceptance and give legal recognition to cross-border electronic information exchanges, the main challenges are regional and global collaboration, as well as in-grained and hard to change paper-based administrative cultures. Most legal texts address only the domestic acceptance of electronic documents or signatures, with limited implementation of bilateral agreements or the rare existing multilateral agreements. In addition, even when legislation allows the use of electronic documentation, sometimes it is difficult to move to actual usage because of organizational resistance to change. Thus, unconnected and non-interoperable infrastructures and systems impact the reliability, traceability and integrity of electronic data transfers as well as the ability of many to participate in modern trade. The result is a fragmented landscape with "islands of trustworthiness in a sea of uncertainty". The only areas where collaboration in support of the use of electronic information is moving forward seems to be in economic unions which have a common legal framework (e.g. the European Union). Therefore, multilateral recognition, through international conventions and agreements of electronic "documents" has to be developed in order to facilitate global trade and solutions found to improving trustworthiness at a larger scale between all the entities participating in trade.

1.3.4 Smart authentication of trade documents

Current situation

Generally physical documents used in international trade still include handwritten signatures, be it for legal or operational reasons. Because of its physical characteristics, the traditional paper document is accepted as evidence. It is durable, and changes or additions will normally be clearly visible (or at least this was the case prior to the latest developments in scanners, photocopiers and image manipulation software). The same electronic information is typically different, being recorded in a magnetic medium whose data content can be changed at any time, currently without changes or additions being marked. There is now technology that can create digital originals where all changes are indicated – but this is not yet widely available and probably will not be for the next five or more years as technical issues are resolved and investments in systems development take place.[30]

27 As of May 2019, there were 1,415,388 Legal Entity Identities issued globally. The main economies represented include the United States of America (13% of the total), the United Kingdom of Great Britain and Northern Ireland (10%), Germany (8%), Italy, and the Netherlands (7% each); see pages 70 and 71 of: www.adb.org/sites/default/files/publication/523896/asia-pacific-trade-facilitation-report-2019.pdf.

28 www.unece.org/cefact/locode/welcome.html

29 www.imo.org/en/OurWork/Facilitation/ConventionsCodesGuidelines/Pages/Default.aspx

30 See the UN/CEFACT Whitepaper Overview of Blockchain in Trade: www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain.pdf.

Moving to electronic signatures for document authentication brings challenges, as electronic signatures require three elements for their use: identification (release of electronic credentials), evidentiary (verification/confirmation of the identity) and attribution (confirmation of the capacity to act of the identified person). Due to these elements, there is a tendency to develop elaborate solutions for the use of electronic signatures that are costly in terms of maintenance and development and so are limited in their deployment.

Initiatives underway

A number of approaches to addressing the issue of document authentication exist in the ECE region:

- The United Nations 2005 Convention on the Use of Electronic Communications in International Contracts (the "Electronic Communications Convention"), ratified by twelve countries, including three UNECE members: Azerbaijan, Montenegro and the Russian Federation.[31]
- The Eurasian Economic Union[32] adopted a digital agenda in 2017 which includes, among other activities, an integrated information system, using digital signatures and the development of a "transboundary trust space" to support the cross-border recognition of electronic signatures.
- In the European Union, the 2014 Electronic IDentification Authentication and trust Services (eIDAS) regulation[33] ensures that people and businesses can use their national electronic identification schemes (eIDs) in other European Union countries where eIDs are available by ensuring that they will work across borders and have the same legal status as paper-based processes. The regulation defines the following services:
  - Electronic signature (eSignature): which is the expression in an electronic format of a person's agreement to the content of a document or set of data. Qualified eSignatures have the same legal effect as handwritten signatures.
  - Electronic seal (eSeal): which is similar in function to the traditional business stamp. It can be applied to an electronic document to guarantee the origin and integrity of a document.
  - Electronic Timestamp (eTimestamp): links an electronic document, such as a purchase order, to a particular time, providing evidence that the document existed at that time.
  - Electronic Registered Delivery Service (eDelivery): allows the user to have proof of the sending and delivery of a document and protects their company against the risk of loss, theft, damage or unauthorised alterations of the document.
- In the United States of America, there are "eSignature Laws" at the Federal level and another for adoption at the State level: (1) The Electronic Signatures in Global and National Commerce Act[34] which in section 301 addresses international e-commerce; and (2) the 1999 Uniform Electronic Transactions Act;[35] on the use of electronic records and electronic signatures which was drafted by the National Conference of Commissioners on Uniform State Laws and recommended for enactment in all States (it is currently enacted in all but three States).[36]

31 https://uncitral.un.org/en/texts/ecommerce/conventions/electronic_communications

32 Members states are Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia; www.eurasiancommission.org/ru/Documents/2659_1_eng_Цифры и факты_04Итоговый итог.11.2017.pdf.

33 https://ec.europa.eu/futurium/en/content/eidas-regulation-regulation-eu-ndeg9102014

34 www.govinfo.gov/content/pkg/PLAW-106publ229/pdf/PLAW-106publ229.pdf

35 www.uniformlaws.org/committees/community-home/librarydocuments?communitykey=2c04b76c-2b7d-4399-977e-d5876ba7e034&tab=librarydocuments

36 www.uniformlaws.org/committees/community-home?communitykey=2c04b76c-2b7d-4399-977e-d5876ba7e034&tab=groupdetails

Increasing electronic authentication of trade "documents" is a major achievement. At the same time, the importance needs to be emphasized of undertaking business process analysis and re-engineering activities in a first phase in order to:

1. Reduce/Remove redundant information/document exchanges.
2. Reduce/Remove the requirement for an authenticated signature (physical or electronic) whenever possible.[37]
3. Ensure the shared availability of (access to) key data for related "documents" (i.e. providing the required information, such as "net weight" once for use in multiple documents without re-submission).[38]

Challenges

As in the previous section, the main challenge remains regional collaboration in order to avoid the creation of "islands of trustworthiness" which do not allow trustworthy communication between one another.

In addition, there is a need to look at the implementation of existing regulations and their interpretation (specifically implementing legislation and procedural manuals for civil servants such as Customs officers). Even in countries that have good eCommerce laws, some international trade policies and regulations still include paper-based references, such as references to "hand-written signatures" and "number of copies" which limit the ability to electronically sign and transfer documents. As a result, there are even regulations which require the advance submission of electronic information before customs clearance, but then require original paper documents to be submitted within a certain time period. It has become important to look at how to better align and modernize national regulatory environments, especially as the World Trade Organisation (WTO) Trade Facilitation Agreement (TFA) is promoting the utilisation of electronic copies in the Art. 10.2 "Acceptance of Copies".

In addition, another growing challenge to electronic commerce, particularly in services, is governments which have regulatory restrictions with regard to the management of data flows and/or data localisation (e.g. requiring that data be kept in servers located in their country, which reduces the ability to use cross-border data exchange).

1.3.5 Starting the Smart Trade Process: Electronic Purchasing

Current situation

Electronic purchasing is used by trading partners, to electronically exchange and monitor transaction documents between one another and to ensure that the terms of their trading agreements are being met. The supporting electronic documents may include invoices, purchase orders, debit notes, credit notes, payment terms and instructions, and remittance slips. These data may be exchanged in a variety of formats, including EDI, XML, and "comma-separated values" (CSV) files.

Today, 90% of these documents are managed on paper. The private sector was the main driver of the development of electronic purchasing in the first phase; however, it is now being increasingly pushed by governments. Invoices are a key document in most export and import declarations and when customs receive them electronically this can facilitate risk analysis. In addition, efforts by authorities to reduce the VAT gap[39] is increasingly becoming the main accelerator for the digitalization of business, reporting, inventory, trade and logistical documents. For example, taxpayers are increasingly required to use real-time clearance models with government tax authorities. In this case, organizations have to submit invoices to tax authorities, or to submit at least key invoice data in electronic format.[40]

37 UNECE contributes to this by the UN/CEFACT recommendation No. 14, www.unece.org/fileadmin/DAM/cefact/recommendations/rec14/ECE_TRADE_C_CEFACT_2014_6E_Rec14.pdf.

38 UNECE contributes to the by the UN/CEFACT Supply Chain Reference Data Model (SCRDM), www.unece.org/uncefact/mainstandards.html#ui-accordion-jfmulticontent_c66359-panel-0.

39 The VAT Gap is the difference between expected VAT revenues and VAT actually collected. It provides an estimate of revenue loss due to tax fraud, tax evasion and tax avoidance, as well as due to bankruptcies, financial insolvencies or miscalculations.

40 https://b0wms2ojuok4bi2s1zhfjksf-wpengine.netdna-ssl.com/wp-content/uploads/2019_Billentis_Report_The_e-invoicing_journey_2019-2025.pdf

There have already been many e-purchasing developments in the ECE region, launched by the tax authorities with the aim of reducing tax evasion.

Some examples follow:

- Hungary; businesses are required to have a direct data connection to the tax authority, to report sales invoice data.
- Italy; B2G and B2B e-invoicing is mandatory
- Kazakhstan; since 2019, all VAT payers and importers are required to exchange invoices only electronically; with mechanisms for cross-border e-invoice exchanges with Eurasian Economic Union member countries.
- North America; as there are no VAT schemes, the challenge is different, and the objective is to optimise the purchase-to-pay process between B2B. Two thirds of companies are sending their invoices in PDF by e-mail. However, only 20% are issuing structured e-invoices by means of EDI.
- Portugal; invoice issuers are required to report to tax authorities in electronic form.
- Russia; e-invoicing activities began relatively late; but are now developing dynamically for the approximated three billion invoices exchanged every year in B2B and B2G segments.
- Spain; businesses are required to report invoice records and other fiscal data electronically to tax authorities within 4-8 days of the transaction.
- Turkey; the Turkish Revenue Administration established a state-owned e-invoicing platform; with the capacity to send end-users pdf format invoices, if they are not connected electronically.

Initiatives underway

The European Union issued a directive on e-invoicing in 2014 (Directive 2014/55/EU). The directive defines an e-invoice as "an invoice that has been issued, transmitted and received in a structured electronic format which allows for its automatic and electronic processing". Beginning in April 2020 (April 2019 for central-government bodies),[41] the directive requires all purchases within the public sector (B2G) to be electronically invoiced (e-invoicing) in a standardised structured data format that provides for the automatic reading of the data into computer systems.[42] The standard to be used is a new European standard which proposes two alternative syntaxes, one of which is the UN/CEFACT Cross Industry Invoice.[43] This means that all suppliers to the public sector must send e-invoices that comply with the new standard and all public sector organisations must be able to receive these invoices.

In the United States of America, one key development is the Government invoicing (G-invoicing) solution which must be used by all United States of America federal programme agencies by 30 June 2021.[44]

Challenges

In many cases, standardisation initiatives have failed to convince stakeholders to use them. A lack of information about existing standards combined with the pride of some organisations has resulted in the re-invention of dozens of niche standards (with a domestic or industry focus). As governments increasingly roll out requirements for the use of electronic invoicing this situation may be improved in some cases and made worse in others, depending upon the governments' willingness to use international standards.

41 Central government bodies are those at the country level (Ministries, administrations, etc.) as opposed to regional or municipal administrations.

42 UNECE contributes to this by having the UN/CEFACT cross industry invoice XML message as one of the two approved syntaxes for electronic invoices in the European Union.

43 European Standard on e-invoicing (EN-16931).

44 https://fiscal.treasury.gov/files/g-invoice/g-invoicingplaybook.pdf

1.3.6 Smart Goods Movement in Trade: Transport and Logistics

Current situation

A very wide range of information is exchanged electronically in trade, and much of this information is of a commercial nature. All of these exchanges create connectivity and we have started our examples with electronic purchasing. Next, we are moving to transport and logistics which play a key role in smart trade and where we can illustrate how data connectivity can add the "smart" to physical connectivity in supply chains and trade. In transport and logistics, you have both business to business and business to government data exchanges, the last providing a good bridge to the next topic which is the "Regulatory Fulfilment and Enforcement".

Business-to-Business

Rules for transporting goods internationally by road are covered by the United Nations Convention on the Contract for the International Carriage of Goods by Road[45] (CMR), which entered into force in 1961 and has fifty-five Contracting Parties in Europe, the Middle East, North Africa, and Central Asia (including all ECE countries except Canada, Iceland, Israel and the United States of America).

A CMR consignment note contains information about the shipped goods and the transporting and receiving parties.

In some countries, the CMR note is accepted by regulatory authorities and law courts as evidence of a contract of carriage by road and it is also frequently requested by banks as part of the documentation for letters-of-credit.

Not long ago, CMR notes were only issued in paper form. However, recent joint work by the teams supporting Smart Connectivity and Sustainable Mobility has resulted in an electronic CMR note (e-CMR). More information about the e-CMR can be found below under "Initiatives underway" and in annex III, box 1.

Business-to-Government (transit)

Customs transit is the customs procedure under which goods are transported under customs control (and without imposing customs duties) from one customs office to another.[46] It is a trade facilitation mechanism, but there is a certain risk of non-payment of duty involved in the transit procedure and, therefore, it is done under customs supervision. Consequently, a guarantee must be lodged for each consignment.

The legal agreements and ICT infrastructure used to support transit freight shipments varies across the ECE region:

Globally

The Customs Convention on the International Transport of Goods under Cover of TIR Carnets (TIR Convention), has been ratified by all ECE region countries except Iceland.

An international transit operation under the TIR system does not require national customs documents and a national guarantee. Because the containers are securely sealed, the goods are also not subject to physical inspection. This international cargo transit system provides the maximum possibilities for carriers to move across borders:

- Without mandatory full-border checks;
- In sealed trucks (containers);
- Shipments of goods from customs in one country to the customs of another country;
- With security and guarantees.

The TIR system can also be used for international multi-modal transport as long as at least one leg of that operation is carried out by road.

45 https://treaties.un.org/doc/Treaties/1961/07/19610702%2001-56%20AM/Ch_XI_B_11.pdf

46 Source: WCO Revised Kyoto Convention: www.wcoomd.org/en/topics/facilitation/instrument-and-tools/conventions/pf_revised_kyoto_conv/kyoto_new.aspx.

Europe

One recent development is the "New computerized Transit System" (NCTS) with a perimeter that includes the European Union, the "European Free Trade Association" (Switzerland, Liechtenstein, Norway and Iceland), Turkey, the Republic of North Macedonia and Serbia. It is a system of electronic declaration and processing that traders must use to submit a transit declaration electronically. For transit shipments between participating states this system provides a single procedure from the start of the transport to the final destination, with all the customs authorities linked electronically.

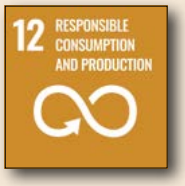
Other ECE countries which have shown an interest in participating in the NCTS system for transit include Albania, Azerbaijan, Bosnia and Herzegovina, Georgia, Republic of Moldova and Ukraine.

North American UNECE member States

There is only a single border between Canada and the United States of America, therefore the great majority of the transborder road freight between the two countries uses direct import or export schemes.

An objective supported by both Smart Connectivity and Sustainable Mobility are improved processes based on cross-border collaboration between authorities. For such collaboration at inland border crossings, In the area of cross-border collaboration, it is important to mention the "Harmonization Convention" (from 1982);[47] "(...) this Convention aims at reducing the requirements for completing formalities as well as the number and duration of controls, in particular by national and international co-ordination of control procedures and of their methods of application." and "(...) wherever possible, provide simple and speedy treatment for goods in transit, (...)".

SDG 12.4 The environmentally sound management of chemicals and all wastes



The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, known as the Basel Convention, is an international treaty designed to reduce the movements of hazardous waste between nations and, specifically, to prevent the transfer of hazardous waste from developed to less developed countries. It requires the management of many documents by the parties involved in the regulatory process.

To simplify this process, UN/CEFACT developed a Transboundary Movements of Waste solution that provides a standardized, interoperable way of interchanging structured electronic data on waste movements (look under "Environment" at www.unece.org/uncefact/mainstandards.html).

From a practical standpoint, this Convention facilitates the exchange of standardized information and documents and at the:

- Domestic level; it harmonizes the interventions of customs and other control services (i.e. medico-sanitary, veterinary, phytosanitary, technical standards, and quality); and includes the option of delegating to customs the carrying out of inspections
- International level; describes arrangements for and promotes joint border controls so that shipments are controlled only once and not twice (on the export side and on the import side), through the provision of shared facilities, alignment of opening hours, etc.

The Harmonization Convention covers all ECE region countries except Canada, Iceland, Israel, Malta and the United States of America and also has nine signatories from outside of the region. It was developed and is maintained as part of the work on Sustainable Mobility (Section 2, under Road transport and border-crossing facilitation) and is promoted as a trade facilitation tool under Smart Connectivity.

47 www.unece.org/fileadmin/DAM/trans/conventn/harmone.pdf

Initiatives underway

Customs authorities in China fully implemented TIR at all border checkpoints and inland customs offices in June 2019. This is an important step for the development of the Belt and Road Initiative (BRI) road corridors between China and Europe which pass through Central-Asia and Russia.

The development of a new e-CMR standard by the UNECE based on UN/CEFACT standards[48] has been an important step towards the CMR becoming fully electronic, which will make the transport of goods by road less cumbersome for trading parties. The technical standards specify a set of consignment data that can be exchanged between businesses and even between regulatory authorities and businesses, describing each step of the trade and transport process starting from the issuance of the consignment instructions, to the contract between parties, up to delivery of the goods. The e-CMR was officially launched in January 2017 with the first ever border crossing to use electronic consignment notes between France and Spain.

Challenges

The challenges are identified in the chapters on "sustainable mobility".

1.3.7 Smart Trade – Regulatory Fulfilment and Enforcement

National Trade Facilitation Bodies

Current situation

Numerous commercial and government documents and data submissions are required in international trade and transport, many containing duplicate information. Such administrative tasks can bring bureaucratic delays and result in increased errors; therefore, posing a burden for traders. Trade facilitation—the simplification, standardization and harmonization of the procedures and associated information flows required to move goods from seller to buyer and to make payment[49] has, therefore, emerged as an important issue for the world trading system.

In parallel, each country has different historical, political, legal, economic and geographic contexts and each national member of the trade community has its own responsibility with regard to trade processes. As a result, all countries have regulatory histories and existing systems and it is a challenge for countries to change and move toward simplified, standardized and harmonized regulatory processes which could facilitate trade. For supporting such change, both internationally and in the vast majority of countries, the benefits have been recognized of permanent frameworks for consultation and co-operation between all national stakeholders. These stakeholders include all public administrations involved in the clearance of imports and exports as well as representatives of relevant private sector interests such as transporters, freight forwarders, exporters and importers. Such frameworks are not new – the first UNECE recommendation on the establishment of such national advisory or consultative bodies for implementing trade facilitation was approved in 1974 and the last revision in 2015.[50]

In 2017, the WTO TFA entered into force, placing a new emphasis on trade facilitation. It contains provisions for expediting the movement, release and clearance of goods, including goods in transit. It also sets out measures for effective cooperation between customs and other appropriate authorities on trade facilitation and customs compliance issues as well as provisions for technical assistance and capacity building. The TFA stipulates, that countries "shall establish and/or maintain a national committee on trade facilitation or designate an existing mechanism to facilitate both domestic coordination and implementation of the provisions of this Agreement" (Article 23.2).[51]

48 www.unece.org/uncefact/mainstandards.html#ui-accordion-jfmulticontent_c66199-panel-1
49 http://tfig.unece.org/details.html
50 Recommendation No. 4 at: www.unece.org/uncefact/tfrecs.html.
51 www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm

Initiatives underway

Within the ECE region, 87% of the countries (45 out of 52) have ratified the TFA. And 73% of the countries (38 out of 52) have implemented a National Trade Facilitation Body (NTFB).

NTFBs are uniquely positioned to define how the national trade community can collaborate in reviewing processes, developing solutions, aligning procedures and defining the standards that will be used to exchange information. Key success factors for an NTFB are favourable governments policies for economic development and trade, a robust and dynamic private sector, availability of resources to develop analyses and proposals and a strong political will to modify the status quo.[52]

Members of NTFBs are uniquely positioned to transform trade processes from within, members; therefore, often participate in training and workshops provided by international institutions. To transform ideas into plans, NTFBs can develop National Trade Facilitation Roadmaps using guidelines such as those issued by UNECE.[53] These identify the priorities and the actions that countries aim to achieve in order to either fulfil the commitments under the WTO TFA and/or otherwise facilitate trade as an economic development initiative.[54]

Challenges

Developing the collaboration dimension in a NTFB, where the views and opinions of public and private members are embraced, is challenging as the members have different responsibilities and objectives, some of which may be at odds with one another (for example private sector objectives for speed and lower costs can be at odds with public sector objectives for protecting public safety and ensuring the payment of taxes/duties).

NTFBs are often under the chairmanship of major public sector stakeholders (Ministry of Trade or the Customs administration), and private sector members, which rarely speak with a single voice, can find themselves in the position of being observers and not equal members. This is most often encountered in economies where the private sector has previously had little representation in such discussions and where they may fear retribution by state agencies if they openly express criticism. On the other side, there is a risk of the forum being misused by the private sector for voicing grievances against government agencies, but without presenting concrete recommendations or workable solutions. Another risk is that certain public sector offices that are mandated to attend do not want to participate. This risk can be further amplified if the "rotation technique" is used, where the representative from that office changes so frequently that there is no continuity or accountability. It is not an easy task to create an environment in which both public and private sector representatives feel comfortable with the process of dialogue.

Ideally, the public sector should feel that it gains from the interaction and that the interaction helps them to perform their duties better and contribute to their country's economic growth while the private sector should feel that they are achieving better processes while at the same time helping government agencies to fulfil their legislated mandates.

Top-level leadership within the public sector, both at the governmental (prime minister and presidential levels) and agency levels is extremely important for the process to be successful. If there is no real commitment at the top, then public-sector engagement is certain to fail.[55]

52 UNECE contributes to this by providing the recommendation No. 4 on "National trade Facilitation Bodies" and No. 40 on "Consultation approaches Best Practices in Trade and Government Consultation on Trade Facilitation matters".

53 UNECE contributes to this by providing guides, such as the one "to drafting a National Trade Facilitation Roadmap" (www.unece.org/tradewelcome/outreach-and-support-for-trade-facilitation/guide-to-drafting-a-national-trade-facilitation-roadmap.html).

54 UNECE contributes to this by training and workshops, as for Tajikistan in 2018 (www.unece.org/fileadmin/DAM/cefact/cf_plenary/2019_plenary/ECE_TRADE_C_CEFACT_2019_03E.pdf).

55 OSCE-UNECE handbook; www.unece.org/trans/publications/wp30/best_practices.html and www.osce.org/node/88200.

Single Window for Import, Export and Transit-Related Regulatory Procedures

Current situation

Single-Window (SW) is a trade facilitation concept. At the beginning, the idea was to have a facility that allowed parties involved in trade and transport to lodge standardized information and documents at a single-entry point to fulfil all import, export, and transit related regulatory requirements. Almost twenty years ago, when the concept was first launched, the implementation of the SW was also envisaged for a manual environment with the co-operation of all border authorities. It did not imply the use of an IT system; the emphasis was on all information being submitted only once.

In the TFA, the article mentioning SW (art. 10.4) adds that "Members shall, to the extent possible and practicable, use information technology to support the single window". (Art. 10.4.4)

Nevertheless, today, most of the references to a SW, refer to an electronic platform. An important principle for such platforms is that, when information is electronic, then individual data elements should be submitted only once. It is important to underline that the objective is not the electronic platform, but the trade facilitation that it can offer.

If implemented effectively, a SW project can achieve the following benefits:

- For the government as a whole, an increase in government revenue, enhanced compliance with rules, improved efficiency in resource allocation, better trade statistics.
- For economic operators such as traders, faster clearance times, a more transparent and predictable process and less bureaucracy.
- For an administration such as Customs, improved staff productivity through upgraded infrastructure, an increase in customs revenue, a more structured and controlled working environment and enhanced professionalism.
- For the national economy as a whole, improved transparency and governance as well as reduced corruption due to fewer opportunities for physical interaction.

The ECE region is a leader in terms of the development of SWs in its countries. Depending on the source, the implementation rate is between 71% (UN global survey on digital and sustainable trade facilitation; "electronic Single Window system") and 83% (WTO TFA; Art.10.4 "Single Window" implementation).[56]

Initiatives underway

An example of a successful SW deployment is Canada.[57] As the face of the Canadian Government at the border, the Canada Border Services Agency (CBSA) administers more than 90 acts, regulations and international agreements on behalf of other government department partners. Its activities are carried out at approximately 1,200 service points across Canada and in several international locations. These border services include the verification and collection of forms, permits and licenses related to regulated commercial goods, the inspection and detention of goods, and the collection of commercial import statistics.

Canada – United States of America trade rules require the trade community to spend a significant amount of time completing paperwork. For example, when bringing a refrigerator into Canada from the United States of America, nine separate government departments are interested, of which three require submission of paper forms prior to entry of the goods. The Single Window Initiative significantly reduced this paperwork burden by developing a SW programme and associated electronic system that enables importers to electronically submit to CBSA all information

56 The variation is due to not all the ECE countries having ratified the TFA, some because they are not WTO members. https://untfsurvey.org/eKeKV/ and www.tfadatabase.org/.

57 UNECE contributed to this by providing the references used by the Canada Border Services Agency to develop and implement their SW; UN/CEFACT recommendation No. 33 – Recommendation and Guidelines on Establishing a SW; recommendation No. 34 – Data Simplification and Standardization for International Trade; and recommendation No. 36 – SW Interoperability.

and documents (Licenses, permits and other documents) required to comply with government regulations (customs and other departments). The CBSA then transmits this pre-arrival information internally to those departments that regulate the goods. The various government departments then review and make decisions, based on this information and traders receive border-related decisions electronically prior to the arrival of the goods at the border. This makes the import process easier for business and enables government agencies to effectively administer regulations.

The SW Initiative delivered three high-level business outcomes for the CBSA:

(a) Improved electronic data submissions that:
  (i) Allow for the electronic assessment of regulatory compliance
  (ii) Are aligned with international data standards
  (iii) Enable timely border-related decisions.

(b) Improved information requirements for imports that:
  (i) Are aligned with the United States of America
  (ii) Have redundant information requests eliminated
  (iii) Are based upon consultations with the importing community
  (iv) Are limited to what is essential for regulatory compliance and transactional border-related decisions.

(c) Improved business processes that:
  (i) Eliminate redundant processes between government departments;
  (ii) Enable future risk assessment and inspections; and
  (iii) Eliminate paper-based processes.

It took four years, from 2013 to 2017, to have the SW connected to ten government agencies in addition to the CBSA. In May 2019, the volume of transactions in the Canadian SW system reached 1,146,382 monthly declarations.

Most of the countries in the ECE region have developed a SW or are working on it. In addition, decisions have been taken to create a regional SW in the Eurasian Economic Union, by developing national SW strategies in member States (Decision 123) and then exchanging information between them (Decision 39).[58]

SDG 17.10 Promote a universal, rules-based, open, non- discriminatory and equitable multilateral trading system …

In Ukraine, in 2015, the Port Community System (PCS) in the Odessa region was funded by the Ukrainian business community, through a Public-Private Partnership. The PCS substantially increased the efficiency and transparency of customs procedures in its ports, facilitating trade and making it easier for Ukrainian and foreign companies to do business. For example, the PCS led to a 15% decrease in waiting time for trucks to enter the port. The project was conceived as a pilot for a wider roll-out of a Single Window system for trade in Ukraine, which started in 2018.

The development of an SW electronic platform requires significant investments and one interesting model that supports collaboration as well as financing is public-private partnerships (PPPs). This is a model where governments and the private sector work together in a long-term relationship to deliver important public services. Such models for IT platforms have so far been used primarily outside of the ECE region, but they have interesting advantages, because they combine the financing and expertise from the private sector with the public sector capacity to ensure long-term services and benefits for end-users. To support such funding and capacity building opportunities, the UNECE

58 Members states are Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia: http://eec.eaeunion.org/en/Pages/default.aspx.

has developed a People-first approach to PPPs and a programme for its promotion. It has also developed a specific Recommendation on PPPs in trade facilitation.[59]

One example of a trade facilitation PPP in the region is the Portnet-system, a maritime SW in Finland. It is a cooperation project between the Finnish maritime administration, Finnish Customs and all twenty-eight Finnish commercial ports, primarily owned and run by the city, town or other municipality in which they are located. Some port organisations are joint stock companies, which adds pressure on Portnet to support their profitability.[60]

The idea of the Finnish Portnet is very simple: when a ship enters the port, one notice to Portnet is enough, the message contains all the relevant information for the supply of provisions, various official charges levied on the ship (fairway, pilotage and port dues), customs operations as well as maritime safety (dangerous cargo, etc.). A Portnet notice is accepted by customs for declaration purposes as a general notice. The funds for running the system and its maintenance come from fees which the operating organization collects in connection with receiving notices.

Challenges

The main challenge for SWs is that international trade is fundamentally a Business-to-Business (B2B) transaction, whereas an SW is a Business-to-Government (B2G/G2G) platform. There will always be discrepancies between B2B and B2G requirements and both are constantly evolving, and, therefore, SW deployments also need to continuously evolve in line with new business practices, new technologies and new legislation.

Here is the testimony from Canada, which summarizes well the challenges faced in SW deployment projects around the globe:

- Funding; SW Initiative funding was granted via a joint Treasury Board Submission across 10 departments. Without the ability to report funding at an interdepartmental level it was difficult to report on and track funding for the initiative as a whole.
- SW Initiative Obligation; as the Initiative was not mandated it was difficult to promote the uptake of the integrated import declarations across the different departments.
- Benefits Realization Management; without a clear indication of how the SW Initiative would benefit its stakeholders (e.g. time and cost savings) uptake proved difficult. In addition, for interdepartmental initiatives with numerous sub-projects, benefits may not be realized until well after project close-out. For a project like the SW Initiative, which encompassed nine government departments and their 38 associated programs, benefits took longer to realize.
- Governance; executive-level governance is just as important in the final months/years of the project as it is at inception. Without access to key executive decision-makers throughout the lifecycle of the project, decisions are unable to be expedited in a timely manner potentially affecting the advancement of project objectives.
- Time (Schedule) Management; without a comprehensive roadmap outlining all impacted initiatives, timelines and deliverables it is difficult for internal and external stakeholders to prioritize and align their work amongst conflicting priorities.
- Legislation/Regulation; with such a large and varied group of stakeholders it was difficult and time consuming to ensure that all legal and/or privacy issues concerning the sharing of data was addressed throughout the project lifecycle through appropriate vehicles such as existing legislation and/or written collaborative agreements or memorandums of understanding.

59 UNECE contributes to this through frameworks for PPPs, such as the People-first Public-Private Partnerships (PPPPs), These PPPP models ensure that, out of all stakeholders, "people" are given priority. Its focus is on improving the quality of life of communities, particularly those that are fighting poverty and hunger, by creating local and sustainable jobs, and promoting: well-being; gender equality; access to water, energy, transport, and education for all; social cohesion and justice as well as by working to prevent all forms of discrimination based on race, ethnicity, creed and culture; www.uneceppp-icoe.org. See also: UN/CEFACT recommendation No. 41: Public-Private Partnerships in Trade Facilitation (www.unece.org/fileadmin/DAM/trade/Publications/ECE_TRADE_430E_Rec41.pdf).

60 Source: UNECE; annex II of "Principles for Implementing a PPP Approach in the process of establishing a Single Window (SW) and Port Community System (PCS) in Ukraine"; 2014 (http://singlewindow.org/upload/publications/Principles%20for%20PPP%20implmtt.pdf).

This testimony confirms that SW deployments require strategic vision from top governmental decision makers; it is a long process; and it requires continuous realignment and support for collaboration between participating agencies as there are requirements for collaboration without short-term benefits.

In addition to the challenges of developing a "single" SW in one country, we could add the following challenges:

- To increase the benefits from SW domestic deployments, regional SW initiatives have been foreseen over the years, but none have been realized. The key challenge is to have a champion capable of aligning and enforcing collaboration among the different administrations. What is already difficult domestically, as identified in the Canadian experience, is extremely difficult at the regional level.
- In some countries, several competing "SW" initiatives have been developed. Different champions (either ministers and/or administrations) are interested in managing a SW platform and they do not collaborate. This greatly reduces the efficiency gains from the SW initiative, as there is redundancy in infrastructure and processes, and this can also create an ambiguous environment for traders.

Electronic Certificates

Current situation

Depending on the type of goods and the law/regulation, certificates from authorized entities are required in international trade to either transport, export or import goods. Such certificates attest that the product listed therein has met certain criteria.

Some example of prominent certificates required in international trade include:

- Documentary proof of origin (i.e. CoO); this is used to apply a preferential tariff treatment (Preferential CoO) or to apply regulations (Non-Preferential CoO).
- Conformity certificates that confirm the special nature of a product.
- Inspection/Laboratory Certificates (Health, Veterinary, and Plant Health certificates such as Sanitary/ PhytoSanitary (SPS) Certificates).
- CITES Certificates.[61]
- Documents to support a claim for entry (or exit) under a tariff quota, for excise purposes or to support a claim for VAT relief.

Initiatives underway

With the development of electronic platforms, such documents have become increasingly available in electronic formats. Electronic certificates are not only a means to facilitate trade and provide a secure trading environment, they also save time, reduce costs and increase transparency.

Their use is included in the TFA, as:

- "(...) for advance lodging of document in electronic format (...)" Art.7.1;
- "(...) to accept paper or electronic copies of supporting documents required for import, export, or transit formalities" Art. 10.2.

61 CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. (https://cites.org/eng/disc/what.php).

Certificates of Origin (CoOs) – Smart Preferences

Millions of CoOs are issued per year. To keep pace with the demand and reduce fraud, Chambers of Commerce have started to issue "Electronic Certificates of Origin" (eCoOs). There are two types of eCoO services:

1. The application is performed electronically, but the CoO is manually issued, on paper, by the Chamber.
2. The entire process between the trader and the Chamber is integrated and paperless. The eCoO is issued electronically with electronic signature, stamps and other security features.

Electronic Agri-food certificates – Smart Phytosanitary Controls

Trade in agricultural products is highly regulated by governments to protect human, animal and plant health. The importing authority sets standards for products crossing their borders and requires certificates. Certification is subject to international trade principles as set by authorities such as WTO or the International Plant Protection Convention (IPPC, part of the Food and Agriculture Organization (FAO)) and taking into consideration specific border protection issues and bilateral arrangements. Certification requirements are dependent on agreed market access conditions and may change in response to disease outbreaks, environmental issues and consumer-driven concerns.

A number of countries are managing the transition to electronic certificate formats for Sanitary and Phytosanitary (SPS) certificates, laboratory test results and certificates for the tracking and tracing of animal products These are being transformed into standardised messages, as is the case of the IPPC,[62] which is recognised by the WTO as the relevant standard-setting body for plant health and encourages its members to harmonize their sanitary and phytosanitary measures based on the IPPC's international standards.[63] IPPC launched an important initiative in 2017, to develop a "trusted third party" system to support the government to government (G2G) exchange of sanitary (human and animal health) and phytosanitary (plant health) electronic certificates (which implement the UN/CEFACT eCert standard). The objective of this initiative is to reduce the resources required in every country to develop the electronic tools for producing and receiving electronic certificates as well as for negotiating agreements with trading partners to allow for their exchange. This system allows SPS certificates to be exchanged, downloaded or viewed directly on the web. Ten countries participated in a successful pilot to exchange electronic certificates using this system[64] and the system "e-Phyto Hub" is now operational.[65]

In the Eurasian Economic Union, the electronic veterinary certification systems of Russia and Belarus were harmonized in 2018, as a first step in tracking the movement of livestock products "from field to counter" in the Union in order to reduce the amount of illegal food on the market.[66]

eCITES – Smart protection of endangered species

The vast majority of today's procedures for issuance and control of CITES permits (which allow for controlled trade in some endangered species) are still paper based. The lack of automation in permit issuance and control provides opportunities for corruption and prevents the fast and efficient verification and control of permits using modern methods of border control such as automated risk management and collaboration between border agencies for targeted inspections. The CITES secretariat, with support from UN/CEFACT has developed eCITES certificates[67] to support traceability and customs controls. Some developing countries such as Brazil, China, Kenya, Republic of Korea,

62 www.ippc.int/en/ephyto

63 UNECE contributes to this by developing standard messages for the simplification and automation of trade in agriculture and fishery products, such as the standard for the electronic Sanitary and Phytosanitary certificate (eCERT), electronic management and exchange of laboratory messages (eLAB), Tracking and Tracing animal and products (TT). The eCERT standard is recommended by IPPC for electronic certificates.

64 www.ippc.int/static/media/files/publication/en/2018/05/IPPC_ePhyto_hub_pilot_report_FINAL.pdf

65 www.fao.org/3/ca2696en/CA2696EN.pdf

66 http://eec.eaeunion.org/en/nae/news/Pages/08-11-2019-2.aspx

67 UNECE contributed to this by developing the eCERT, which is the basis of the CITES electronic permit; when printed, it is aligned with UN Layout Key and its use for traceability is developed in consultation with UN/CEFACT Agriculture Domain Group.

South Africa and Thailand[68] have already started to implement the exchange of electronic CITES permits (eCITES)[69] between customs and border control agencies' systems, in order to put an end to current practices where fraudulent paper permits are used to hide illegal trade in endangered species in the international supply chain.

Challenges

With some exceptions, the automation and use of electronic certificates remains limited to the application process (between the exporter and the exporting country's regulatory authority). In most cases, the resulting "electronic document" is emitted in a pdf format for uploading into the importing country's electronic customs system or, in the worst case, it is printed-out and submitted physically to the importing authorities who then either scan it or re-key the data into their system. In other words, the importing regulatory authority is seldom able to automatically process the data in the received "electronic certificate".

There is still an important gap to be bridged before the entire process from export up until receipt of the goods by the purchaser can be digitalized. The ideal being for the authenticated, non-repudiated and secure data included in the certificate issued by the exporting country to be directly available to the competent authorities in the importing country (as is the case with the IPPC's e-Phyto Hub). Direct digital exchanges of data would bring significant benefits by dramatically reducing the opportunity for submitting fraudulent data and/or documents.

The principle obstacles to this "end-to-end" digitalization are complex, but one of the most difficult issues to address is the legal uncertainty surrounding electronic documents. Many countries have passed laws supporting electronic commerce and the use of electronic signatures. However, these laws are applicable and enforceable only within the national jurisdiction in question. Some regional groupings such as the European Union, EAEU (Eurasian Economic Union) and ASEAN have regional agreements on the acceptance of e-documents, but these agreements also do not extend beyond the members of these regional groupings. Thus, in the absence of an international convention recognising the validity of "foreign" electronic documents, regulatory authorities are left in question with regard to the enforceability of data received electronically from foreign parties, be they government agencies or private sector parties.

In the case of eTIR, eCMR, IPPC phytosanitary certificates and eCITES certificates there are international conventions underlying the use of these procedures, where the parties to the convention can legally agree to accept one another's electronic documents (in some cases through the use of additional protocols to the original convention). However, this is not the case for many other certificates, including Certificates of Origin.

There is a final complication with linking such certificates to the actual clearance of goods either at export or import as the timing to request such certificates is not the same as the timing for the clearance of the goods. There can be difficulties to align these processes and the resulting data. It is for this reason that such certificates are sometimes not integrated into a Single Window facility.

Smart and more efficient trade processes can contribute to a greater capacity to manage the environment more effectively.

One immediate benefit of more efficient trade processes can be the reduction or even elimination of truck queues at ports and border points which are an important source of CO_2 pollution as many of the trucks, especially in winter, when they sit with their engines running. Trade can also sometimes result in the sale of goods that require significantly less CO_2 in their production (for example, food harvested manually instead of through use of machines).

Open markets can improve access to new technologies that make local production processes more efficient by diminishing the use of inputs such as energy, water, and environmentally harmful substances. In addition, as a country becomes more integrated within the world economy, its export sector becomes more exposed to environmental requirements imposed by the leading importers. Changes needed to meet these requirements, in turn, flow backwards along the supply chain, stimulating the use of cleaner production processes and technologies.

68 2019 report; https://cites.org/sites/default/files/eng/prog/e/eCITES_policy_brief.pdf.

69 https://cites.org/eng/prog/eCITES

Smart technologies also create opportunities for implementing traceability which can greatly increase the effectiveness of environmental certification such as certificates for organic production, certificates for sustainable forest management, etc.[70]

The transport of waste and dangerous goods can also be better managed with electronic documentation and data, thus reducing the likelihood of accidents. Trade in waste products is based on agreements such as the Basel Convention[71] on the control of transboundary movements of hazardous wastes and their disposal.[72] In such trade, the use of electronic documentation can greatly reduce costs and increase the effectiveness of controls by making fraud more difficult. One of the most used set of standards in this area is the suite of 10 electronic messages developed for Transboundary Movements of Waste by UN/CEFACT[73] and supported by the classifications developed under the Globally Harmonized System of Classification and Labelling of Chemicals.

The Globally Harmonized System and conventions covering the inland transport of dangerous goods (being complementary to the Basel convention since they include hazardous wastes) are maintained by the UNECE as part of its work on Sustainable Mobility (chapter on Safety).

An important example of smart connectivity supporting environmental conservation is the implementation of data exchange to conserve fisheries and an example of smart systems for better managing energy use and supporting the use of renewable energies. Detailed descriptions of these examples are given below.

1.4 Smart Support for a Better Environment

1.4.1 Smart Conservation of Both Natural Resources and Trade (Fishery)

In addition to the above described electronic CITES certificates for protecting endangered species while allowing controlled trade, an important area where electronic data exchanges are allowing a smarter conservation of natural resources while permitting trade is fisheries. These are key areas where the status quo was not producing the desired results and, together with other measures, electronic messaging is supporting crucial steps in the right direction.

Current situation

The identification of the origin of food ingredients and food sources is of prime importance for the protection of consumers. Traceability facilitates the withdrawal of unsafe food, especially if all of the participants in the food chain (from farm to table) can be identified and documented.

In the case of traditional regulated food, the producer/trader requires a permit/authorisation from the country's food safety authority to place the food on the designated market.

For hundreds of years, fish were an abundant resource that were there for the taking; today this is no longer true. The pressure on fish stocks is increasing. In recent decades, world fisheries have become a market-driven, dynamically developing sector of the food industry. Coastal States have striven to take advantage of new opportunities by investing in modern fishing fleets and processing factories in response to growing international demand for fish and fishery products. By the late 1980s it became clear, however, that fisheries resources could no longer sustain

70 Sources: www1.oecd.org/trade/topics/trade-and-the-environment/, www.wto.org/english/tratop_e/envir_e/climate_impact_e.htm and www.unenvironment.org/news-and-stories/story/why-trade-can-save-planet-if-we-do-it-better.

71 www.basel.int

72 UNECE contributes to this by developing technical specifications to support data exchange on the transboundary movement of waste. These are in use in Austria, Belgium, Finland, Germany, Luxembourg, Netherlands, Slovenia, Sweden and Switzerland (www.unece.org/info/media/news/trade/2016/uncefact-protecting-human-health-and-the-environment-through-electronic-data-exchange/doc.html).

73 See "Environment" under www.unece.org/uncefact/mainstandards.html

such rapid and often uncontrolled exploitation and development, and that new approaches to fisheries management embracing conservation and environmental considerations were urgently needed.[74]

The management of fisheries and fish stocks to date has been largely based on the collection and exchange of large sets of data between fishery management organizations (FMOs). However, data management remains largely insufficient, and the low level of data collection coupled with the lack of timely and accurate data are key challenges. This means that FMOs are not able to use data effectively for tracing fish catches and managing fish stocks, and for managing trade in fish and fish products. In many cases, data is sporadic, different data sets are used, and paper documentation is widespread. The associated data management costs are also very high.

Initiatives underway

Up until very recently, the practice in fishery management has been for fishing vessels to record and report their activities using handwritten logbooks or in trial electronic logbook systems. In addition, these systems do not yet cover all the requirements for effective fishery management.

The United Nations Fisheries Language for Universal Exchange (UN/FLUX) standard[75] developed by UN/CEFACT has been created for the electronic exchange of data for fisheries management. It provides a harmonized message standard that allows FMOs to automatically access the electronic data from fishing vessels needed for stock management, such as vessel and trip identification, fishing operations (daily catch or haul-by-haul) or fishing data (catch area, species and quantity, date and time, and gear used).

The FLUX e-Business standard is enacted by law in the European Union as an obligatory standard both for national use and for reporting that is linked to the importation of fish. It is recommended that developing countries study the implementation experiences with FLUX in Europe for a possible implementation of this standard in their own countries.

UN/FLUX messages have been developed for the following domains:

Vessels: This domain aims to standardize the exchange of fishing fleet data, and more specifically the information directly related to fishing vessels and vessels supporting fishing operations.

Fishing Activities: The fishing activities domain refers to data exchanges on fishing activities performed by vessels during a fishing voyage. They include data on all vessels' activities, including departures and arrivals into ports, entry and exit from fishing areas, and other movement related to a fishing trip. These data also include fishing effort, transhipments, relocations (transfer of catches outside the vessel or to another vessel) and total landings.

Vessel Positions: The objective of this domain is to provide a standard for the communication of vessel position information between monitoring centres.

Fishing Licenses, Authorizations and Permits: The objective of this domain is to standardize the exchange of data between stakeholders in the context of requests for fishing licenses, authorizations or permits.

Aggregated Catch Data Reporting: The objective of this domain is to standardize the exchange of aggregated catch data between stakeholders.

Challenges

The FLUX standard is currently used in a limited number of regions and countries (Brazil, Indonesia, Thailand and European Union member States). A more comprehensive deployment of the standard will support better accuracy in the overall fishing data of different parties managing fishery around the world (among others FAO and FMOs) in order to effectively and efficiently manage sustainable fishery and detect and combat illegal, unreported and unregulated fishing.

74 FAO Code of Conduct for responsible Fisheries: www.fao.org/publications/card/en/c/e6cf549d-589a-5281-ac13-766603db9c03.

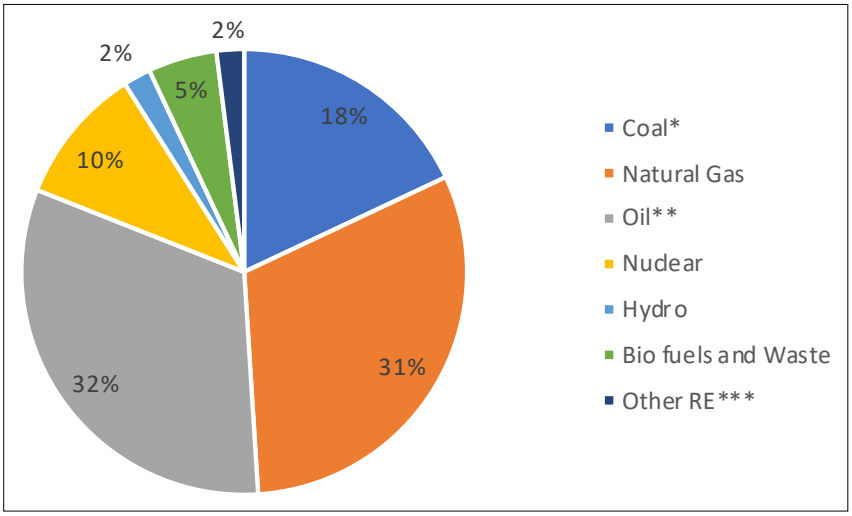
75 UNECE contributes to this by having introduced and developed the standard in 2016 (UN/CEFACT).

1.4.2 Smart Energy Management (electricity grid)

Current situation

Electricity is a key component of the infrastructure dimension of international trade and connectivity between electrical grids, both within and across countries, supports both affordable energy and energy security.

Figure 1: ECE region energy mix (% of total primary energy supply, 2014)



* Includes Coal, peat and oil shale
** Includes Crude, NGL and feedstocks and secondary oil products
*** Geothermal, solar/wind/other, heat electricity
Source: IEA World Energy Balances.

In 2014, the ECE region accounted for 42% of the world's GDP, 39% of the world's total primary energy supply,[76] and 34% of the world's CO_2 emissions from fossil fuel combustion.[77]

The region has almost universal household electrification. However, simply having physical access to a grid is not a guarantee that the energy supply available on that grid is sufficient to meet needs and the quality of energy services and energy networks is far from homogeneous across the region.[78]

Initiatives underway

An electrical smart grid is an electricity network based on digital technology that manages the supply of electricity to consumers based on two-way digital data exchanges (for example, on electricity supplied, electricity generated (i.e. solar or wind) and energy used). This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce energy consumption and cost, and maximize the transparency and reliability of the energy supply chain.[79] Some of these characteristics are particularly important for the integration of sustainable energy sources into grids.

76 As defined by the International Energy Agency (IEA), total primary energy supply (TPES) (in terajoules [TJ]) is production plus net imports minus international marine and aviation bunkers plus/minus stock changes. Data sources: Energy balances from the IEA, supplemented by UN Statistical Division for countries not covered by IEA.

77 World Bank and IEA: Global Tracking Framework. Progress Toward Sustainable Energy. http://gtf.esmap.org/.

78 www.unece.org/fileadmin/DAM/energy/se/pdfs/comm_gen/Publications/2017/UNECESustainableEnergyPub.pdf

79 www.techopedia.com/definition/692/smart-grid

A smart grid system includes the following principal characteristics:[80]

- Self-healing from power disturbance events
- Enabling active participation by consumers in demand response
- Operating resiliently against physical and cyber-attack
- Providing power quality for twenty-first century needs
- Accommodating all energy generation and storage options
- Enabling new products, services, and markets
- Optimizing assets and operating efficiently.

All smart grid strategies and visions are founded upon the availability of a telecommunications network that is capable of interconnecting energy generation sources, network sensors and/or smart meters and integrating them into the power utilities' operating processes.

The integration and deployment of "variable renewable energy" (VRE; notably solar and wind) into grids is developed over four stages.[81] Each stage has its own specific characteristics and operational priorities.

- First phase, wind and solar plant output are subject to daily variations in power demand. Annual variable renewable electricity shares are limited to around 3% of annual electricity generation.

- Second phase, operational practices, such as intelligent forecasting of variable renewable electricity output, are introduced. ECE countries in this phase include the Netherlands, Sweden, Austria, and Belgium. They have variable renewable energy electricity shares ranging from 3% to almost 15%.

- Third phase, variability affects overall system operations, including that of other power plants. In this phase, power system flexibility is paramount. The power system must accommodate substantial uncertainty and variability in the supply-demand balance. The two main flexible resources to date are dispatchable power plants (electrical power systems that can be turned on or off) and the transmission grid (through interconnection with other countries grids to manage local versus national or regional offer and demand) which relies upon well-managed connectivity but demand-side options and new energy storage technology are growing in importance. Countries in this phase include Germany, Greece, Italy, Portugal, Spain and the United Kingdom of Great Britain and Northern Ireland, with VRE electricity shares ranging from 15% to 25%.

- The fourth and final phase, sees "highly technical" and "less intuitive" challenges that require resilience in the face of events that could disturb normal operations on very short time scales. Only Denmark and Ireland can be considered to be facing these challenges, with variable renewable electricity shares ranging from 25% to 50% in annual generation. Countries with historically high hydroelectricity shares in their power systems like Norway have been early adopters of policies and market techniques that manage annual hydroelectricity variability.

Challenges

The existing institutional and technological infrastructure in most ECE countries was designed to use fossil fuels with a base load model.[82] It is not obvious how to upgrade and convert these systems to include renewable energy.

Technology has, and will continue, to provide completely new energy technologies for countries to exploit. In order to be able to benefit from these advances, a new set of energy policies and practices are required to create the data

80 www.unece.org/fileadmin/DAM/energy/se/pdfs/eneff/eneff_h.news/Smart.Grids.Overview.pdf

81 IEA (2017b): Getting Wind and Solar onto the Grid. www.iea.org/publications/insights/insightpublications/getting-wind-and-solar-onto-thegrid.html.

82 Demand can be classified as "peak" and "average". Average electricity demand is otherwise known as "base" demand. While base demand is relatively constant and similar day-to-day, peak demand is the maximum demand, and this may only happen for a very short period of time.

and physical connectivity needed to enable the integration of distributed sustainable and renewable energy options. These options are typically solar photovoltaic, wind, biogas, biomass, small hydro and geothermal energy, but can also include gas-fired microturbines. Many features of renewable energy make them difficult to integrate into existing energy infrastructure, including national transmission grids and local distribution networks.[83] As a result, practical work like the UNECE's sustainable energy strategy for the region to support planning and its work on Public-Private Partnerships in renewable energy[84] to support the development of new infrastructure are very important.

1.5 Future Trends in Smart Connectivity

New technology creates the foundation for developing new processes and activities. The barriers to deployment are in the same areas as discussed at the beginning: infrastructure, knowledge management and collaborative dimensions. The last two being, in the majority of cases, more important than infrastructure. Particularly important is developing an awareness and understanding of appropriate uses for new technology as well as identifying and fulfilling the needs for new standards (knowledge management) and developing business models which make it interesting to disrupt the status quo (collaboration).

In the coming years, it will be interesting to see how the latest technological transformations move from ideas and pilot projects into widespread implementation around the world.

1.5.1 Infrastructure

The opportunities provided by developments in technological infrastructure are extraordinary. We can only envision the impact of current trends which include:

- Energy microgrids[85] and vastly improved Grid energy storage[86] will increase the ability to access and use renewable energy sources everywhere. In addition, these facilities will provide increased, more secure and less expensive energy for areas that the main electrical grid does not reach and which, today, must depend on the use of generators using fossil fuels. In trade, such locations include remote border control posts, particularly in developing countries, and sometimes port facilities.
- Telecommunication: The spread of high-speed broadband and enhanced mobile networks (TVWS[87] and 5G cellular networks)[88]
- Big Data: Real-time collection and processing of massive data from disparate sources.
- The Cloud: A shift to remote data storage and applications accessed via network connections, thus reducing the requirements for ICT infrastructure investments.

83 UNECE contributes to this by promoting sustainable energy development strategy for the region (www.unece.org/energywelcome/about-energy-programme.html) and especially Public-Private Partnership in renewable energy (www.unece.org/fileadmin/DAM/ceci/documents/2018/PPP/WP/ECE_CECI_WP_PPP_2018_07-en.pdf).

84 www.unece.org/fileadmin/DAM/ceci/documents/2018/PPP/Forum/Documents/UNECE_PPP_Renewable_Energy_Draft_v2.1.pdf

85 A microgrid is a local group of electricity sources and users that typically operates in conjunction with the traditional centralized grid (macrogrid), but which can also disconnect and operate autonomously as physical and/or economic conditions dictate (https://microgridknowledge.com/definition-of-microgrid/ or, for a more technical explanation https://building-microgrid.lbl.gov/about-microgrids).

86 Grid energy storage (also called large-scale energy storage) is a collection of methods used to store electrical energy on a large scale within an electrical power grid. Developments in battery storage have enabled commercially viable projects to store energy during peak production and release during peak demand.

87 TVWS is Television White Space, that part of the radio spectrum allocated to television that is not being used and which can be re-allocated for broadband Internet use. For more information see: https://learn.canvas.net/courses/1456/pages/lecture-what-is-tvws-background-to-the-technology.

88 For more information on 5G cellular networks see: www.pcmag.com/article/345387/what-is-5g.

- IoT: which is "The interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data"[89] Innovation in the form of miniaturization, particularly of sensors and data communications (for example RFID chips) and in low power consumption devices, has supported the fast development of IoT. Increased use of IoT devices will come as 5G networks are rolled out with the ability to handle more signals and do so at higher speeds. The use of IoT in trade and transport is already widespread and growing as more and more products, packages and shipping containers are traced along their supply chains using IoT devices.
- Artificial intelligence (AI): Self-teaching systems (often referred to as deep machine learning) that can learn from experience. Such AI systems require large volumes of data to "learn from", data which IoT networks and other Internet sources can supply. Among the applications of AI that can be foreseen in trade are operating and regulatory risk analyses as well as the solving of complex routing and sequencing problems.
- Cryptography: is "The art of writing or solving codes"[90] and is a discipline based in mathematics. Cryptography is the basis for all the security features found in the Internet and recent cryptographic innovations have provided the foundation for blockchain and distributed ledger technology. In the future, further innovation can be expected as researchers and practitioners seek to improve the characteristics of distributed ledgers, including blockchains.
- Cybersecurity: Increases in digitization brings benefits, but it also presents challenges for data security and user privacy. As the quantity of systems and data increases exponentially, they become a more attractive target for hackers. Thus, increasing and continuous innovation and investment in this field will be needed.

These infrastructure developments will positively impact smart connectivity in trade and will help to address its challenges, in the first place by reducing the cost of electricity, devices, communication, IT developments and interfaces for all stakeholders. In the second place, by providing new data that was previously unavailable such as the internal temperature and conditions in a container, the real-time location of packages and the tracking and tracing of goods.

In addition, new technology platforms will certainly emerge to facilitate interactions between stakeholders in the trade community. At the same time, there are also investments to be made and governance challenges that will need to be met. These are important issues for everyone, but particularly, for lower-income countries in the region for whom it is important to identify technology implementation that is compatible with existing operating conditions and the means for investing in key new technologies so as not to be left behind.

1.5.2 Knowledge Management

Innovation in technology provides opportunities, but the most important challenges come in developing meaningful applications of that technology and guiding the transformation from existing systems to new systems, Knowledge Management provides the tools for meeting these challenges, and within smart connectivity its three main components are:

(i) Understanding and Guidance which has two levels, the first is knowledge management tools to help government policy makers and business leaders understand the potential and limitations of new technologies as well as how they can most effectively be used in different sectors. At a second level, there is a need for practical guidance material to help implementors apply new technologies at an operational level, including guidance on the use of related standards.

89 www.lexico.com/en/definition/internet_of_things for more detailed information see: www.steves-internet-guide.com/internet-of-things/.

90 www.lexico.com/en/definition/cryptography

There exists a wide range of tools that can be used at both levels ranging from seminars and workshops, to briefing notes, white papers and detailed guidelines.[91]

(ii) Standardization codifies best practice and creates a common basis for harmonizing technology implementations and creating interoperability, where this is needed. Standards are also a tool for technology transfer and facilitating the deployment of technology because they explain to those who were not involved in developing the technology how it can be implemented.

Smart connectivity in trade as well as in other areas, requires the "seamless" (or close to seamless) transfer of data across devices and systems. To make this happen, semantic standards are a key requirement. Semantic standards ensure that data originating in one system or device can be understood and correctly interpreted as it travels along its "smart connectivity paths".

One of the largest and most complete cross-industry semantic standards is the UN/CEFACT Core Component Library (CCL),[92] which contains the definitions for more than 20,000 data elements allowing to identify classes (like a party or means of transport), and information entities (like consignor or vehicle) as well as codes for putting these into their business context (like importer of the transport contract or vehicle at entry into an economic territory). The CCL is also important because it is technology and syntax (format) neutral, thus allowing it to support connectivity across devices and systems.

Standardization is an ongoing activity as both technology and the supply chain environments into which technology is implemented are in constant evolution and, therefore, so are the requirements for shared knowledge and common terminology to facilitate adoption of the technology.

(iii) Legal instruments, sometimes legal agreements and/or guidance are required for connecting across borders or using technology for the implementation of legal obligations, be they commercial contracts or regulatory requirements. This can take the form of recommendations, model laws or international conventions.

1.5.3 Collaboration

Organizational Culture

In the past, it has been rare, both within governments and in the private sector, to find organizational cultures that encouraged and rewarded collaboration across organizational identities (i.e. departments, ministries, agencies, offices, etc.). And this is still true today, even though the situation has improved. As a result, one key challenge for collaboration is creating the needed changes within and between organizations so that they can move from pure competition to "co-opetition" where competitors collaborate on essential infrastructure and/or common projects for society (such as mitigating climate change or facilitating trade).

One example is the collaboration needed to have an effective National Trade Facilitation Body. This commonly requires the active participation and collaboration of 10 or more government offices and agencies and private sector representatives. The experience of the UNECE in over 30 years of work with countries on the establishment of NTFBs is that the most difficult challenges are those related to creating collaboration, including obtaining the right level of government and management commitment, ensuring that all voices are heard and developing mechanisms for ensuring accountability.

91 UNECE contributes to this by developing white papers on new developments which identify scenarios for implementations, such as Data Pipeline (www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperDataPipeline_Eng.pdf and https://worldcustomsjournal.org/Archives/Volume%203%2C%20Number%201%20(Apr%202009)/04%20Hesketh.pdf), Blockchain (www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain_TechApplication.pdf) or Smart container (www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePapers/WP-SmartContainers_Eng.pdf).

92 For more information see www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/ExecutiveGuides/CCL-CCTS-ExecGuide_Eng.pdf and http://tfig.unece.org/contents/uncefact-ccl.htm.

The rise of digital platforms

"The world's most valuable resource is no longer oil, but data" (The Economist, 2017).[93] With the rise of the technology giants (Apple, Alphabet/Google, Amazon, Alibaba, Facebook, etc.), this statement resonates with everyone who understands that each action taken on a digital platform is recorded, traced, analysed and potentially monetized in order to better target offers and advertisements, and, perhaps, to train AI systems that support product development and promotion systems.

In supply-chain markets, there has always been a competition between solution providers, each one wishing to become the "solution of choice" for their clients.

In eCommerce, economies of scale and the benefits to be derived from obtaining the greatest levels of connectivity with others, has resulted in the development of massively huge platforms, (walled gardens) which are closed ecosystems where all operations can be performed on the same digital platform (ordering, logistics, payments, etc.). Closed ecosystems have great advantages, as they give an increased level of quality control and reliability to their clients and by connecting participants directly and bypassing intermediaries, they provide an efficient means of sharing and exchanging information.

On the other hand, there are both economic and operational risks in concentrating data and information in single entities. As noted in a Harvard Business Review article on this question, "While creating real value for users, these companies are also capturing a disproportionate and expanding share of the value, and that's shaping our collective economic future. The very same technologies that promised to democratize business are now threatening to make it more monopolistic".[94]

Today, there are no comprehensive solution platforms in business to business international supply chains (B2B)[95] which could match the hegemony of ecosystems observed in the e-commerce (B2C) sector. However, this is a trend that could be repeated if one or more collaborative closed ecosystems are created that bring the same benefits as those that supported e-commerce development with: better quality, efficiency, reliability and cost reduction.

Decentralized ledgers (blockchain technology)

One of the main benefits in trade to use blockchain technology is the ability to have trustworthy copies of electronic documents, i.e. electronic information where one can be confident that it has not been modified since its creation. Another benefit is the ability to have reliable identities that allow for better risk analysis and know-your-customer processes.

One of the main obstacles to widespread use of blockchain technology in trade is the need for economies of scale. For example, it is of limited use to have a blockchain "notarized" bill of lading if one of the goods' transporters (there may easily be three or more in a supply chain) does not have an "identity" that can be used on the blockchain where the bill of lading is stored. And the transporter may not find it interesting to use blockchain "notarized" bills of lading if it has fifteen clients who use eight different blockchains for this purpose. Therefore, at this point, the best option for creating such economies of scale is via the creation of consortia (within industries or supply chains) where competitors would need to cooperate in order to provide a common underlying resource (a blockchain and related applications).

Unfortunately, blockchains have not yet overcome the main challenges in developing collaborative platforms which include the existence of competing platforms, a lack of trust between collaborators, inadequate early stage incentives (platform "pioneers" need additional benefits to compensate for the initial small number of parties available to connect with) and, as discussed above, traditional organizational cultures that resist attempts at making them collaborate with others.

93 www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data

94 https://hbr.org/2017/09/managing-our-hub-economy

95 There are mostly dedicated sectorial initiatives (e.g. "online retailers selling medical equipment to hospitals" or brokering logistic platforms; www.intracen.org/uploadedFiles/intracenorg/Content/Publications/SMECO2018.pdf).

Nonetheless, there are several platforms that now use blockchain technologies to provide services in the supply chain, but so far none have been able to provide a breakthrough that transforms the sector. Among the many trade-related applications being developed based on blockchain technology are exchanges of documents such as bills of lading (which give the owner rights over the goods), letters of credit (used to finance trade) and container tracking.

1.6 Opportunities for future work

As developed above, smart connectivity only happens when the capacity provided by the infrastructure is efficiently implemented thanks to the existence of recommendations, guidelines and standards (knowledge management) and is deployed in a collaborative manner. This is a vast field of work, so only selected examples of possible future work, linked to previous information in this document, are presented.

1.6.1 Infrastructure

Innovation in infrastructure is led by the private sector in cooperation with specific sectoral institutions (e.g. academic research departments and relevant international technical organisations like the International Telecommunications Union or the Internet Engineering Task Force). Governments play a more facilitative role by ensuring innovation friendly environments (legal, educational, technical, etc.) as well as through procurement and tax policy. On the other hand, "hard infrastructure" projects (power plants, road, rail, fibre-optic cable, etc.) are more often led by countries' governments with possible support from development banks (World Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, Asian Development Bank).

Physical Infrastructure

Physical infrastructure, be it fibre-optic cables, roads, railways or ports are a prerequisite for connectivity and many, if not all, SDGs have significant physical infrastructure components, amounting to trillions of dollars. As a result, it is fair to say that governments and development banks are very far from having the necessary funds for achieving the SDGs. To meet this challenge, United Nations member States have approved the Addis Ababa Action Plan[96] and the United Nations Secretary General has issued a Roadmap for Financing the 2030 Agenda for Sustainable Development for 2019-2021.[97]

In his roadmap the Secretary General makes two requests to the UN system that are relevant to future work on smart connectivity, these being:

(i) Create a shared understanding of sustainable investing practices and improve the quality and availability of SDG investment data in developing countries; and

(ii) Promote a healthy fintech environment in developing countries and strengthen partnerships with development and private finance providers to invest in digital finance solutions for the SDGs.

The UNECE is contributing to the first of these through its work on People-first Public Private Partnerships and the guidelines which it is developing for their implementation in different sectors.

The second is being supported by work under UN/CEFACT to support digital solutions, in finance but also in other sectors related to the SDGs.

More information on both of the above areas of UNECE's work is discussed in more detail below under Knowledge Management and under Collaboration.

96 www.un.org/esa/ffd/wp-content/uploads/2015/08/AAAA_Outcome.pdf

97 www.un.org/sustainabledevelopment/wp-content/uploads/2019/07/UN-SG-Roadmap-Financing-the-SDGs-July-2019.pdf

Innovation

Innovation has long been recognized as a key driver of economic growth. OECD defines innovation as "… the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.". This goes far beyond more narrow definitions and includes products, services, production methods, governance arrangements, and partnerships that are new to the specific context. This would include taking ideas that have worked elsewhere and adapting them in, for instance, transition countries of UNECE.

This makes innovation central to smart and sustainable mobility, where the central problem is the need to commodify capacity, be it freight demand, vehicle traffic, or trade in services. The central obstacle to this is transaction costs: the main reason, for instance, that many people still commute to work alone in their cars is that there is no way of knowing who else is travelling the same route at the same time. Innovation plays a central role through experimentation with different solutions to, in this case, aggregating and intermediating supply and demand.

Innovation in rule-making and governance is also essential. Interestingly enough, standards are critical tools for innovation; one of the best examples is the intermodal standardized container, which supported global trade expansion following the standardization of containers' sizes in 1961.[98] Assuming that the technology continues to evolve, it stands to reason that the leading obstacle to a switch in the medium term to autonomous vehicles will be the lack of common standards, incentives, and rules of the game – and the emergence of a strong lobby opposing changes which may undermine their existing privileges, as by some estimates the transport sector and activities depending on it make up as much as a third of employment.

Importantly, most of the potential for innovation have little to do with cutting-edge technology. New ideas may use technology well, but most of the time it will be existing technology used in a different fashion – and costs of technology and connectivity have fallen and will continue to fall, in many cases to zero. Development, through mobile money, of formal financial services in places where the largest portion of the population was "unbanked", was first implemented using "appropriate technologies", i.e. starting with "simple" messages such as SMS.[99] This innovation was more a result of the collaboration of key public and private stakeholders who had a vision and a clear understanding of the available fit-for-purpose infrastructure (i.e. the standard mobile network), rather than of transformative technology.[100] Another example is an electronic data exchange platform, such as Single Window, which is deployed through collaborative engagement of the trade community. After such a deployment, there is often incremental innovation with the addition of services that were not foreseen during the planning or development stages and which can be implemented with minimal modifications to the existing infrastructure (e.g. payment of additional tax components or service fees).

At the same time, policy makers also need to take account of the simple fact that the overwhelming majority of innovative initiatives fail – it is the ones that succeed that create sufficient value to make up for losses. This runs counter to the way many countries are used to conducting public policy, stuck in a system where incentives are to only pick up projects that are likely to succeed – an approach that is fundamentally inimical to innovation. This is evident, to take but one example, in the area of technical solutions formulated and agreed around specific technologies rather than impact.

Rather, policy makers need to focus on creating the fundamentals and the incentives that allow from broad experimentation across all of society, defraying some of the risk, learning from what does not work, and scaling up what does. Broad stakeholder involvement is important to get this right; but governments also need to be wary of their independence – if governments consult with the automotive industry about the transition to autonomous vehicles, for instance, it will only get the view of an industry whose long-term survival will depend on maintaining the

98 www.worldshipping.org/about-the-industry/history-of-containerization/the-birth-of-intermodalism

99 SMS: "Short message services" and USSD: "Unstructured Supplementary Service Data"; both simple messages protocols developed with cellular networks "Global System for Mobile Communications (GSM)" used for mobile telephony.

100 www.researchgate.net/publication/330716526_Mobile_Phones_for_Financial_Inclusion_What_Explains_the_Diffusion_of_Mobile_Money_Innovations

status quo, especially as existing automakers may not be good at producing autonomous vehicles, and as demand for vehicles will drop sharply as personal transportation turns into a service rather than a commodity (people will have no reason to own their own cars anymore). We have already witnessed this kind of dynamic around the discussion of how to regulate apartment sharing through AirBnB and other platforms, with hoteliers often lobbying for stronger regulation that would constrain competition.

As these examples illustrate, innovation is a complex process that requires multi-stakeholder involvement in policymaking, clear targets, continuous monitoring and evaluation and, most importantly, the wherewithal to embrace failure and adapt to emerging circumstances and maintain competitive markets. Comprehensive national innovation frameworks are essential to encouraging innovation activity and facilitating industry-science linkages and collaboration in the innovation process. The UNECE supports the development of such innovation frameworks with activities that aim at knowledge sharing, the exchange of experiences gained and lessons learned, the identification of good practices leading to the formulation of better policies, as well as policy advice and capacity building (www.unece.org/ceci/ic.html).

1.6.2 Knowledge Management

As noted in the introduction, knowledge management in support of smart connectivity consists of free, openly available and harmonized standards, recommendations, guidance, regulations and conventions.

Guidance and recommendations

Technology is evolving faster than ever before in human history and its primary impact is on smart connectivity. The world and the ECE region are at the intersection of several cutting-edge technologies that are redefining interactions between the physical and virtual world, driving disruption and enabling new business models for trade and for government services. These include Distributed Ledger Technology (blockchain), Artificial Intelligence, Internet of Things, Quantum Computing and Edge computing. These new technologies will help us to find new and more effective solutions to old problems and thus have a key role in implementing SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The "smart" in smart connectivity is gaining in "intelligence" and capacity every day. At the same time, organizations change much more slowly than technology. Many managers who make decisions about technology today were trained and gained experience in environments where change took place at a much slower pace.

In addition, managers are bombarded with information, without guidance as to what is accurate or relevant, what is outdated and what is new. On 7 December 2019 at least one search engine returned the following number of responses to the following questions.

Question	Number of responses
What is Artificial Intelligence?	444 million
How to implement artificial intelligence in trade?	55 million
How to implement artificial intelligence in certificates of origin?	6 million 500 thousand
How to implement artificial intelligence in freight forwarding?	30 million 600 thousand

Under these circumstances, supporting the use of new technologies to improve smart connectivity and implement the SDGs requires guidance and forums for managers to exchange their experiences and ask questions that will receive specific and relevant replies.

For this reason, UN/CEFACT recently established an Advisory Group on Advanced Technologies in Trade and Logistics which met for the first time in January 2020. This group will provide advice on advanced technologies as well as implementation challenges (such as regulatory obstacles). This includes the potential impact of these technologies on standards, services and everyday operations. Among the planned outputs are synopses of good practices on selected issues and support to senior managers on how UN/CEFACT standards and UNECE recommendations can be used in the context of new technologies.

Standards

Global standards are preferable for stakeholders in order to reduce costs and support cross-industry and cross-border connectivity. Achieving global standards requires the:

Inclusion of all relevant stakeholders in standards development;

- Development of comprehensive standards for all scenarios which can be updated over time;
- Engagement with the business and government communities to avoid having projects being launched to "re-invent the wheel" or develop new "niche standards" when more generic standards could be used;
- Substantial and continuous communication, including guidelines on the use and implementation of standards; and
- Training on the use of standards in various forms and situations.

SDG 17.6

UN/CEFACT supports activities dedicated to improving the ability of business, trade and administrative organizations, from developed, developing and in-transition economies, to exchange products and relevant services effectively. Its principal focus is on facilitating national and international transactions, through the simplification and harmonization of processes, procedures and information flows, and so contributing to the growth of global commerce.

In order to promote the widest possible adoption of its specifications, UN/CEFACT issues specifications that can be implemented without fees or restrictions.

As previously noted, one key requirement for developing effective, harmonized standards, recommendations, guidance, regulations and conventions is the availability of qualified international experts (from the relevant industry, government, academia, professional associations, NGOs, etc.). In addition, these experts must be ready and able to spend time and effort to collaborate in the development these standards.

Outside the perimeters of their organizations (companies, associations or governments), few international platforms exist to exchange knowledge and share practices with a vision to developing harmonized standards with widespread input which are freely and openly available. The practice of many standards organizations is to develop standards with input only from their members (who pay in order to participate or are restricted to a specific sector) and to distribute standards either through direct charges or membership fees.

A recognised platform for developing free, openly available and harmonized standards with input from, and for use by, all stakeholders (from all geographies, roles and financial capacities and sectors) is of key importance to ensuring that global standards support implementation of the SDGs. This means that they should represent input from the largest possible range of users and support needs related to a wide range of implementation environments.

Increased need for semantic standards

Global trade includes more and more stakeholders and parties and to be efficient these stakeholders need clear, unambiguous information, including in the identification of parties and places.

As working environments change and more parties, with different needs, use United Nations standards, these standards need to be constantly updated which represents both an organizational and a resource challenge.

One such example is the UN/LOCODE which was first launched in 1981 and must be continuously updated in response to requests from governments and the trade community (it currently includes over 103,034 locations).[101] Over the years, the number of annual code submissions has increased and ambiguities in parts of the code definition have resulted in duplicate codes and other issues. In response to this situation, in 2018 the UNECE launched a UN/LOCODE Advisory group which is looking at issues such as the development of better, less ambiguous definitions for the term "location"[102] and for the types of locations covered by UN/LOCODE.

Technologies such as the radio chips and micro sensors which send information from the IoT, mobile apps which communicate with applications on the Internet "cloud" and application programming interfaces (APIs) which support the exchange of information between technologically different systems and distributed ledgers (blockchain), have resulted in exponential increases in the amount of data exchanged every second and minute over the Internet.[103]

As a result of this explosion in interconnections it is becoming more and more important, for business, to have standardized definitions for data that is technology neutral. In other words, the definition and form (length, numeric or alpha, etc.) does not change – regardless of the technology used for the transmission. These standardized definitions are called semantic standards and they facilitate communications between systems and users as well as migrations from one technology to another because these standards allow the data to remain the same, even as the technological "envelopes" and "mail carriers".

The result of not using semantic standards can be that relevant information is not clearly identified and/or interconnected systems collect and then exchange different data (based on their respective interpretations). Such cases can have important quality impacts, as errors will occur and create loss in efficiency.

The main challenges for major developers of semantic standards, such as the UN/CEFACT Core Components Library (CCL) are to:

- Educate technologists at all levels as to the importance and use of semantic standards, especially for interoperability and eliminating unnecessary bridges between standards;
- Provide guidance to users on how to use semantic standards, in particular in conjunction with new technologies;
- Increase the coverage (sectors and activities) in order to allow the exchange of information between sectoral silos and remain constant and trustworthy throughout the supply chain and thus better support smart connectivity;
- Encourage users to bring their needs to the standards forum instead of taking an existing directory and making customized changes which may be faster but also results in incompatible versions. This will also help to develop robust standards that can cover the needs of all stakeholders; and
- Obtain the resources necessary for regular publication and maintenance.

1.6.3 Collaboration

The desired outcomes of development efforts in Infrastructure and Knowledge Management are only achieved if organisations manage to collaborate to deploy the results (services, standards, recommendations, guidance, regulations and conventions). In addition, the feedback from collaborative deployments increases community knowledge and can be used to support the development of updates and upgrades to those tools.

101 The UN/LOCODE is a five-character system that provides a coded representation for the names of ports, airports, inland clearance depots, inland freight terminals and other trade and transport related locations which are used for the movement of goods for trade.

102 www.unece.org/fileadmin/DAM/cefact/cf_plenary/2018_plenary/ECE_TRADE_C_CEFACT_2018_20E.pdf

103 https://leftronic.com/big-data-statistics/

The parties who need to collaborate in order to deploy harmonized tools include public and private decision makers, industry/process managers and industry/process end-users. This is where communications and guidance on available collaborative mechanisms have an important role. Project "champions" need assistance in helping stakeholders to understand the benefits of change since they will normally only challenge their current status quo if the benefits are clear and achievable. The chapter on current practices has discussed the important role of major stakeholders in effective standardization deployment initiatives. Such major stakeholders are often administrations or regulators (customs, regional political or economic union, etc.) but they may also be major business partners (such as Airbus or Boeing in aerospace). Still, such standardization efforts risk staying within the perimeter of the major stakeholder and may lack the expected ripple effect beyond them.

The following sections identify other collaboration frameworks which can be used to support and spread the implementation of free, openly available and harmonised standards.

Public-Private Partnerships (PPP)

The achievement of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals will require "all hands-on deck". It will require different sectors and actors working together in an integrated manner by pooling financial resources, knowledge and expertise.[104]

Public-Private Partnerships have been used for a long time; and started, essentially, with transport infrastructure concessions (rail, roads, etc.) in the nineteenth century. It is now a widely used term, but since there is not a consensus on the definition of PPP it may be used for any infrastructure development contract between the public and private sector.

However, the PPP concept as used within the United Nations and development banks is meant to bring the positive elements of the public and private sectors together: the Public with its long term vision and the need to provide services to citizens and the Private with its investment capacity and technical expertise; with both sides sharing the financial risks.

To help ensure the best possible support from PPPs to the Sustainable Development Goals, the UNECE has pioneered the revision of the PPP model and its rebranding from a "Value for Money" to a "Value for People" tool including social and environmental standards, which is expected to address some of the weaknesses of traditional forms of PPPs.

This has resulted in guidelines and frameworks for People-first PPPs[105] (both of a generic nature and by sector). This approach to PPPs can be defined in terms of the critical outcomes that are needed to achieve the SDGs, including:

(i) Economic effectiveness, i.e. offering value for money while not resulting in unsustainable levels of public debt and offering employment opportunities to local communities;

(ii) Replicability and scalability, i.e. including activities to achieve the transfer of skills that can allow more projects to be implemented;

(iii) Responsible and comprehensive engagement with all stakeholders so that they are fully involved in the design and operation of the project;

(iv) Increased access to essential services and reduced social inequality and injustice, by focusing on projects that consider the needs of the socially and economically vulnerable and contribute to eliminating inequalities; and

(v) Enhanced environmental resilience and responsibility, including the development of resilient infrastructure and improving environmental sustainability by cutting greenhouse gas emissions.

104 https://sustainabledevelopment.un.org/sdinaction

105 The People-first PPP concept has been developed by UNECE in response to Paragraph 48 of the Addis Ababa Action Agenda on Financing for Development which calls for the promulgation of guidelines for the appropriate structure and use of PPPs. See: www.unece.org/ppp/standards.html.

SDG 17.17 Encourage and promote effective public, public- private, and civil society partnerships

In Tajikistan, the Pamir Private Power project created a reliable electricity supply for the poor and isolated inhabitants of Eastern Tajikistan. The Project was designed to contribute to Tajikistan's poverty reduction strategy by providing basic services, as well as supporting economic growth.

Under a 25-year concession agreement a privately owned "Special Purpose Vehicle" (SPV) is responsible for all existing electricity generation, transmission and distribution facilities, while the Government of Tajikistan remains as the principal owner of all physical assets.

A very important component of the Project is the social protection scheme under which households (which account for 98 per cent of all consumers) pay reduced tariffs consistent with their standard of living.

In international trade, a PPP can be a great collaboration platform, as it starts with a partnership between at least two organisations, i.e. public and private, but can have many more. As identified above, there is always a risk component when starting a PPP, otherwise the public sector could easily finance and develop the project on its own. One of the challenges for the public sector is the identification of this risk factor in comparison with the opportunity, so that appropriate returns can be negotiated for the private sector. There have been cases where the imbalance of understanding between risks versus opportunities made PPP projects too beneficial for the private sector and therefore, created a project too expensive for the public sector while also reducing benefits for the citizen (in the United Kingdom of Great Britain and Northern Ireland, The Department of Education has estimated that the expected costs for one group of schools run under a specific United Kingdom of Great Britain and Northern Ireland PPP model to be forty percent higher than a traditional project financed by the government alone).[106] On the other hand, if a project provides inadequate compensation for risk, it is likely that no private-sector partners will be found (or the partner will be of "quality").

As discussed earlier, PPPs are a cornerstone of smart connectivity, especially for developing collaborative digital platforms which require infrastructure and knowledge management such as Port Community Systems and Single Windows. Since the biggest challenge for such platforms is to bring together communities; having engagement from the public sector (laws, regulatory authorities and, sometimes, the physical port) and the private sector (financing, agility, expertise and efficiency); PPPs create a positive formula.

An example of the utilisation of PPP in trade was the Build-Operate-Transfer Model developed to renew the border checkpoints in Turkey. The investments, such as buildings, search hangars, contraband storage, platforms, weigh bridges, social facilities, truck park areas, X-Ray vehicle scanning systems, card pass systems, closed circuit camera and security systems were constructed or deployed by the commercial partner – which operates the food and beverage stores, banks, souvenir shops and duty-free stores – leaving the institutional and regulatory activities to customs and other border-control government agencies.[107]

With the adoption of the 2030 Agenda, the challenge today is to move away from existing PPP models so as to enlarge the scope of partnership models and implement projects that, from inception to termination, create "value for people" and support the SDGs. On one side, the UNECE is working toward this objective by developing, in a timely manner and with adequate technical and global input, additional guidelines and standards on People-first PPPs for different types of projects and sectors. On the other side, the challenge for UNECE is to promote the existing Guiding Principles on People-first PPPs and People-first PPP standards,[108] including the UNECE Standard on a Zero Tolerance Approach to Corruption in PPP Procurement, by raising the awareness of government officials and providing training on their use.

106 www.nao.org.uk/wp-content/uploads/2018/01/PFI-and-PF2.pdf

107 www.gtias.com.tr/en/yap-islet-devret

108 UNECE Standard on a Zero Tolerance Approach to Corruption in Public-Private Partnership Procurement.

People-first Public-Private Partnerships also have an important role to play in the financing of transport infrastructure which is a key aspect of Sustainable Mobility. These are discussed in Section 2 under "Transport affordability for public authorities".

Single Window and Port-Community Systems

Over the last two decades, collaborative electronic platforms known as "Single Windows", together with Port Community Systems, have become fundamental solutions for bringing efficiency to the international trade process. This was recognised internationally by the call for implementing Single Windows in the World Trade Organisation's Trade Facilitation Agreement (Art. 10.4).

- A Single Window is a facility that allows parties involved in trade and transport to lodge standardized information and documents with a single-entry point to fulfil all import, export, and transit-related regulatory requirements.[109]
- A Port Community System is an electronic platform which connects multiple systems operated by the variety of organisations that make up a seaport, airport or inland port community.[110] Its primary purpose is to enable all exchanges for the operations within a physical location linked to the port. Depending on the context, a Port Community System can also act as a National Single Window or be integrated into one.

Among the main reasons of success for these platforms is that they connect the trade community, including regulators, and as a result: (i) remove the requirements for paper documents (if the relevant laws and regulations allow this) and/or (ii) the requirements for members of a trade community to have bilateral agreements or Memorandum of Understanding with all the other members in order to interconnect their systems and/or contract for services on-line.

To be efficient and prepare for future opportunities for cross-border data exchange, a Single Window or a Port Community System should use international standards on their platform for the exchange of trade data and documents. Their ability to do this depends on their internal data strategy and their influence/the members of the trade community ability and push for the use of standards. At the same time, the cost of maintaining individual electronic links in different formats is high and standardization should be a natural process within such collaborative data platforms.

As a result, maintaining contacts with Single Windows and Port Community Systems and ensuring they understand the benefits and have the necessary tools for using standardized semantic standards for data and exchange formats is important. They are key centres for data exchanges across sectors and partners, where the use of standards has significant potential for ripple effects.

The first Single Window Recommendation[111] was issued by the UNECE in 2004 and a revision was recently finalized, in addition three other recommendations[112] to support SW implementation have been issued as well as a Recommendation on Single Submission Portals[113] which can be used by Port Community Systems and similar platforms.

The challenge now is to improve the smart connectivity of these "collaborative data islands" by supporting recommendations, guidelines and standards for cross-border data flows and the use of new technologies. In addition, there is a need to foster communications and the sharing of experiences between SWs, as well as between Port Community Systems, in particular with regard to the implementation of standards and recommendations.

109 www.unece.org/fileadmin/DAM/cefact/recommendations/rec33/rec33_trd352e.pdf

110 www.unece.org/fileadmin/DAM/trade/Trade_Facilitation_Forum/BkgrdDocs/HowToDevelopPortCommunitySystem-EPCSAGuide.pdf

111 www.unece.org/uncefact/tfrecs.html

112 See UNECE recommendation No. 34 "Data Simplification and Standardization for International Trade" (www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-400E_Rec34.pdf); UNECE recommendation No. 35 " Establishing a legal framework for international trade Single Window (www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-401E_Rec35.pdf); UNECE recommendation No. 36 "Single Window Interoperability" (www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-431E_Rec36.pdf).

113 See UNECE recommendation No. 37 "Single Submission Portals" (www.unece.org/fileadmin/DAM/cefact/cf_plenary/2019_plenary/ECE_TRADE_C_CEFACT_2019_06E.pdf).

Integrated Risk Management

A good way to develop collaboration efforts is to start with the internal benefits for each stakeholder. In terms of the public sector, one of the mandates of each administration engaged in border control is to perform it diligently, while facilitating trade (i.e. to the maximum extent possible without blocking cargos or performing long physical inspections). Comprehensive integrated transversal risk management between customs authorities and other border-control authorities is therefore becoming a priority; especially as it is aligned with the WTO Trade Facilitation Agreement Art. 7.4.3 on Risk Management "Each member shall concentrate customs control and, to the extent possible other relevant border controls, on high-risk consignments and expedite the release of low-risk consignments.".

In addition, if border-control authorities do not have joint-inspection agreements, the use of different risk management systems by different authorities can result in less trade facilitation as shipments that are flagged as being risky by more than one agency become subject to multiple inspections.

Risk management is based on the analysis of data, either knowledge based (risk criteria based on historical data) or dynamic (looking for outliers in a large grouping of data). The best and most efficient risk management system is the one which can access the largest volume of data (from all potential sources) with the right quality. But again, to be effective, it requires knowledge management in the form of data standards for the communications between regulatory authorities and between them and the providers of the original data (for the most part traders). Georgia has implemented this kind of collaboration tool since 2016.[114]

Regional collaboration for land transport

Global trade transactions are, by their nature, part of international supply chains. These have mainly grown with the development of maritime transport and, today, maritime transport is the backbone of international trade and the global economy. In 2017, around eighty per cent of global trade by volume was carried by sea and handled by ports worldwide.[115]

One positive aspect of maritime transport is that it reduces the number of interfaces with regulatory authorities, as most of the journey is performed in international waters outside of national jurisdictions.

Land transport is a different challenge. The preliminary chapters have identified different initiatives taken to facilitate multimodal transport across land segments (transit, CMR, TIR), but countries that are willing to participate in the growing number of land corridors have to collaborate in order to develop standardized processes and agree upon the use of standardized data. Regional Single Windows, together with the Harmonization Convention discussed above and in Section 2 (under Road transport and border-crossing facilitation) could support such cross-border projects and have been proposed in several regions, but with very limited implementation to date.

At the same time, land corridors and efficient land transportation in general are key economic objectives for landlocked countries that can only import via the most expensive transportation alternative (air) or via road and rail links that pass through neighbouring countries. Bringing efficiency into international supply chains is a key element for their economic development.

In terms of infrastructure, cross-border collaboration in support of inland transport can conceptually evolve in different steps. The standard border situation today is to have two separate border posts, this can evolve into a common physical border post (such prescribed by TFA Art 8.2 (e) "establishment of one stop border post control" and described in the above mentioned Harmonization Convention) with a single control as has been implemented in several cases

114 With the "Unified concept of Operations of Analysis (ConOps) and the Catalogue of Analytical Products" legislation, and development of a single IT platform ("Border Operations Reporting System – BORS" (http://eapmigrationpanel.org/sites/default/files/files/matrix_compilation_ibm_en_final.pdf).

115 https://unctad.org/en/PublicationsLibrary/rmt2018_en.pdf

in Europe (between the Republic of Moldova and Ukraine [116] and between North-Macedonia and Serbia)[117] then into a "Smart border" with limited physical controls, based on pre-arrival declarations, risk-management technology and strong cooperation between the countries, as best illustrated by the borders between Norway and Sweden (European Union).[118]

Another good example is the Middle corridor of the BRI,[119] which includes countries such as Azerbaijan, China, Georgia, Kazakhstan and Turkey before reaching Europe.

Such an initiative, to be successful, will require more than just physical infrastructure, collaboration between all stakeholders is needed together with effective knowledge management to ensure the efficient exchange of information.

In such environments, the collaboration challenge is at its peak, as the stakeholders include multiple private companies (shippers, logistic providers, transporters, etc.), and multiple regulatory authorities in each of several countries. There is, therefore, the need to develop neutral collaboration platforms, where all stakeholders can engage openly and develop consensus for the benefit of the community; and in alignment with the SDG principles.

116 https://gov.md/en/content/moldova-ukraine-open-new-joint-border-crossing-point
117 www.wb6cif.eu/2019/08/27/serbia-and-north-macedonia-open-integrated-border-crossing-for-better-regional-cooperation/
118 www.europarl.europa.eu/RegData/etudes/STUD/2017/596828/IPOL_STU(2017)596828_EN.pdf
119 Initiative for a "digital route" (http://en.portnews.ru/news/278952/).

SECTION 2 SUSTAINABLE MOBILITY

2.1 Introduction to Sustainable Mobility

This section reviews the current status of inland transport with respect to sustainable mobility and smart connectivity. Good transport infrastructure and services are fundamental to the successful functioning of all economies. They are essential to ensuring a high degree of connectivity within and between countries as well as to ensuring that mobility is provided in the most sustainable manner possible. For transport mobility and connectivity to be sustainable it needs to be:

- Efficient
- Safe
- Secure
- Affordable and accessible, and
- Environmentally friendly.

In order to identify the role of transport in sustainable mobility and smart connectivity this chapter reviews the role of transport in relation to these five pillars. Where appropriate the discussion is further divided by transport mode (with urban transport treated as a distinct "mode"). While this will be the broad structure, there are, of course, cases where there are overlaps and interconnections between these areas. For example, safety and security are connected to efficiency; while affordability and efficiency sometimes address contrasting goals; and efficiency demands need to be aligned with environmental concerns.

The main text is supported by boxes that provide some key examples and links to the SDGs that are core to the NEXUS (3, 5, 7, 8, 9, 11, 12, 13, 17).[120]

Each inland transport mode has elements that may challenge as well as contribute to achieving sustainability. Road transport needs to overcome safety and security challenges but is efficient for some types of journeys. Rail transport is safer and more environmentally friendly than road but it is suitable mostly for larger flows of traffic and may pose affordability issues for public authorities as well as cybersecurity issues. Inland waterway transport is primarily for freight and for long distances but is not available everywhere and the enhancement of waterways may pose environmental challenges. Urban transport presents safety and affordability issues but ensures access to mobility and the functioning of cities.

As a result, transport needs to be considered as a holistic system which supports economic and social activities at country, regional and local levels by providing mobility for people and goods. Taking into consideration all of its sustainability aspects, the performance of a transport system shapes the performance of the regions and cities that it serves.

In order to develop policies that make mobility sustainable it is important that there is a solid transport statistics basis. This has a direct impact on efficiency, safety, security, affordability, accessibility and on environmental impact. Challenges and initiatives in relation to transport statistics are highlighted in each of the sections.

120 SDG 3: Good health and well-being; SDG 5: Gender equality; SDG 7: Affordable and clean energy, SDG 8: Decent work and economic growth; SDG 9: Industry innovation and infrastructure; SDG 11: Sustainable cities and communities, SDG 12: Responsible consumption and production; SDG 13: Climate action; SDG 17 Partnership for the goals.

2.2 Transport efficiency

2.2.1 Introduction

Efficiency is the first transport pillar supporting sustainable mobility and smart connectivity. It means ensuring that passengers and freight are moved from origin to destination with the least possible cost, time and use of resources (human, natural and man-made).

Efficiency in transport can be ensured through:

- The provision and maintenance of infrastructure linking economic centres and having features suitable for carrying the expected transport flows.
- The provision of services able to meet customers' needs.
- The implementation of new technologies to improve infrastructure and service performance.
- The facilitation of international transport through the harmonization of documents and procedures as well as international cooperation among stakeholders.

In addition, the efficient provision of alternative transport modes for the same connections contributes to overall transport efficiency as a result of the holistic system approach mentioned previously.

2.2.2 Road transport

Introduction

Road transport remains central to passenger mobility and cargo transport throughout the UNECE area where it holds the largest market share for most movements. For road transport to be efficient it needs suitable infrastructure of high quality, passenger vehicles that can carry people comfortably and safely and freight vehicles with sufficient capacity to make goods transport economically efficient. It also needs appropriate regulations to ensure that both the infrastructure and services are managed to high standards that balance high capacity with high performance.

Quality road transport infrastructure

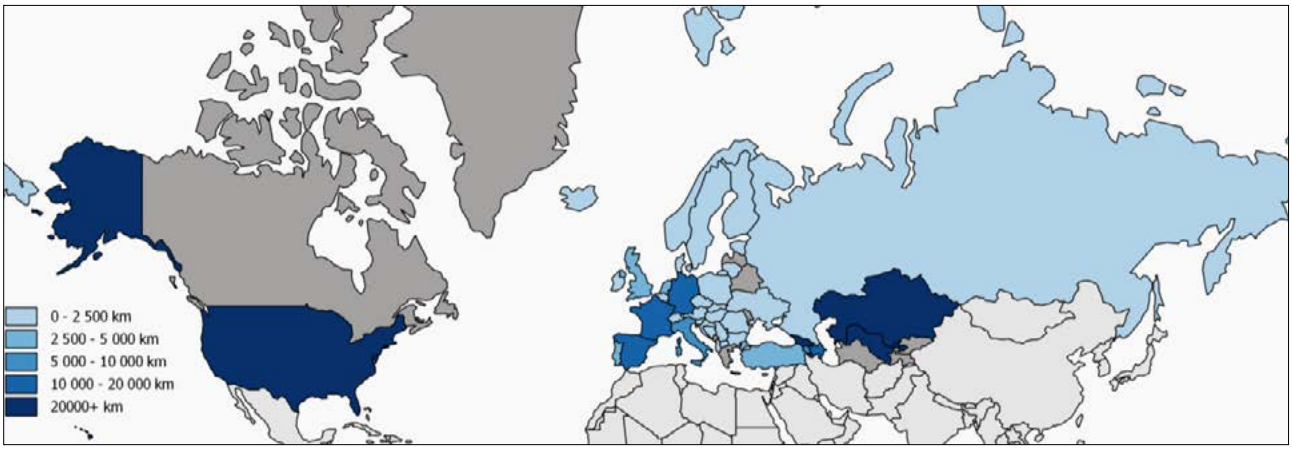
Current situation

Passenger and freight transport on roads is based on the availability of infrastructure (Figure 2), its quality, and safety, which differ across countries. Limited and/or poor-quality road infrastructure is a significant challenge in many countries and has a negative impact on national economic development and international trade. Differences in quality have been noted by the 2018 WEF report[121] which indicated that along with the high quality, extensive networks of countries such as Switzerland, the Netherlands and Portugal there are countries whose road networks lag behind, such as Bosnia and Herzegovina, Kyrgyzstan, Republic of Moldova and Ukraine.

The provision of well-maintained and safe infrastructure, having features that are consistent with the flows that each road segment is intended to carry, is crucial to sustaining and enhancing efficient road transport locally, nationally and internationally – and especially in an environment where road traffic is continually increasing.

121 World Economic Forum. The global competitiveness report 2018.

Figure 2: Total length of motorways, kilometres (latest values available on the UNECE Transport Statistics Database)



Note: Dark grey indicates no data was available

Initiatives for efficient road transport infrastructure

A number of regional initiatives have been put in place to increase the efficiency of road transport. The first of these is the creation of the E-Road **network** established by the European Agreement on Main Traffic Arteries (AGR). This agreement lays the foundation for the development of a pan-European network by:

Defining the main European road infrastructures;

- Classifying road links by their importance;
- Defining road infrastructure features and facilities; and
- Providing directions for their maintenance.

The standardized numbering and signing defined under E-Roads is used throughout the ECE region as a consistent way to indicate main road arteries and international axes. In addition, the European Union has established the TEN-T network.[122] This is a hierarchical network of roads as well as infrastructure for other modes developed in order to define the backbone of the transport network in European Union member States and prioritize funding. The road components of the TEN-T network overlap partially with the E-roads network. Other initiatives aimed at increasing the harmonization of the road network include the Trans-European Motorways (TEM)[123] project and the Euro-Asian Transport Links (EATL)[124] project.

Ensuring a high level of quality in road surfaces is fundamental to ensuring smooth operations as well as safety (discussed further below). Efforts in European Union countries in this area have had a direct, positive impact on road transport efficiency, whereas poor surface quality has had the opposite impact in some other parts of the ECE region.

Finally, lack of harmonization in the different weight limits for vehicles further hurts efficiency. For example, the maximum weight of articulated vehicles are 40/42 tonnes in Georgia and Hungary while they are 48 tonnes in the Czech Republic and 36 tonnes in Armenia. This is an issue causing inefficiencies in cross border transport but also may be relevant within countries where domestic weight limits may also vary due to differences in road quality (UNECE, 2017a).

122 Established with regulation (European Union) No. 1315/2013 of the European Parliament and of the Council.

123 www.unece.org/trans/main/tem.html

124 The Euro-Asian Transport Links (EATL) project: www.unece.org/trans/main/eatl.html.

Efficiency through the use of new technologies in road transport

Current situation

Technological developments in the road sector have been shaping economic development for decades. While there are too many past developments to discuss them here, there are a number of areas that are of note for the future: Intelligent Transport Systems, Automation and Digitalization (the last of these is covered by the discussion on electronic documentation under the section on border crossing facilitation).

Intelligent transport systems (ITS) are particularly useful for efficient road transport, in order to manage traffic, tackle congestion and deliver increased safety. ITS is the application of information and communication technologies to road transport and to interfaces with other modes of transport. Benefits of a wider application of ITS have been highlighted by the UNECE (2012) and include increased road safety, increased road transport efficiency, reductions in travel time uncertainty, energy savings, lower pollution, and faster emergency response, including for road transport of dangerous goods. Achieving those benefits effectively and on a wide scale requires international harmonization and cooperation so that questions such as standards, interoperability, liability, and data protection may be discussed and solved drawing from best practice. Unfortunately, this harmonization is not happening evenly across the region, both in terms of technology used and in terms of the extent of ITS usage. This is resulting in a disjointed network which creates inefficiencies for cross-border passengers and freight movements.

The main challenge for the future of transport efficiency is the role of automation, especially in the road sector. And, in particular, how to ensure the efficiency benefits from technology, such as autonomous cars, while also ensuring a safe environment. Full driving automation could increase the amount of time a vehicle is in operation and provide occupants with more time to undertake other tasks, thus increasing efficiency. However. this needs to be done in a safe environment where regulations are harmonized both for the infrastructure and the vehicles (through the work of UNECE's WP.29 and WP.1)125 in order to avoid the development of divergent regulations that could limit future cross border movements.

The need for supporting governments and managers in the use of new technologies to implement the SDGs through guidance and forums for the exchange of experiences is also discussed in Section 1 under "1.6.2 Knowledge Management".

Initiatives underway

At the same time, there are already a number of ITS applications that are improving transport efficiency. For example, European Union member States are implementing a joint Electronic Tolling System which will break down barriers within the European Union for cross border transport that are primarily slowing down freight transport. Other examples include the:

- Information system for the management of public transport in Munich, with transit signal priority for trams and buses, including 240 signal systems.
- Electronic ticketing systems in Karlsruhe, Lodz, Minsk and Toulouse.
- Motorway control system in Gothenburg with incident and queue detection and variable speed limits.
- Real time information systems about road and public transport conditions such as in Moscow and Istanbul.
- Urban road user charging in London with Closed Circuit Television and Automatic Number Plate Recognition.

There are also a number of other automation tests being carried out across the region with varying degrees of success. What these tests show is, primarily, that there is still a lot of work to be done before full automation of the road network can be considered a reality. They also show the importance of developing complete and harmonized regulatory frameworks, as mentioned above, which, that at the same time, does not stifle developments in automation.

125 World Forum for Harmonization of Vehicle Regulations (WP.29) and the Global Forum for Road Traffic Safety (WP.1).

In relation to wider ITS issues, UNECE and global ITS stakeholders have been working since 2012 to implement the 2012-2020 ITS Road Map126. The implementation of the road map relies on UNECE as an international forum for institutional work on ITS and seeks to harmonize understanding and policies on items such as a common definition of ITS, international policies (to allow for international travel), interoperability (to facilitate innovation, trade, and international transport), liability, security and safety.

Road transport and border-crossing facilitation

Current situation

Road-transport efficiency should not stop at national borders. This is a significant challenge when considering how to treat goods and people at borders. There is little benefit from building high quality roads to speed up domestic journeys when border infrastructure and procedures are such that all the time that is gained domestically is lost in lengthy border crossing tasks.

To support the role of road transport in international trade it is important that:

- Border security controls are facilitated, to reduce time and formalities at borders.
- Transport related procedures are harmonized, even while taking into account the security needs of different countries. In particular, harmonization is required for the proof-of-transport contracts (consignment notes) so that they can be easily used across countries and independently of the languages used as well as allowing for the use of electronic documents.
- Vehicles may be temporarily exported in order to carry out transport of goods or people and the insurance cover remains valid when these vehicles cross borders
- Provisions for goods which require particular transport conditions, such as foodstuff or pharmaceuticals, are preserved across borders.

Initiatives underway

Within Regional Economic Integration Organizations, such as the European Union, the creation of a single market has resolved many of the issues restricting border crossing movements. Goods (and passengers within the Schengen Area) move across borders seamlessly.

Another example of improving border crossing times by road in the ECE region is the programme in Georgia to streamline border procedures and the movement of some of these processes to inland locations thus improving transit times significantly.[127]

There are three key international Conventions that facilitate the crossing of borders and the international harmonisation of documents in road transport: the TIR convention, the CMR Convention and the Harmonization Convention.

(i) The Transports Internationaux Routiers Convention[128] (TIR) has for many years allowed the swift international transport of goods based on checks carried out on the goods at the Customs office of departure, on the integrity of the container or truck that carries them, and on the TIR carnet (a Customs document which is also the proof of a guarantee for Customs duties. The Convention implies the mutual recognition of Customs controls across countries. This system is currently being digitalised through the e-TIR to allow for the use of electronic documentation.

126 UNECE (2012) Road Map for promoting ITS 20 global actions 2012-2020.

127 The results of these actions are highlighted in the WCO Time Release Study carried out by the Georgian Customs between 2013-2019 on five border crossings. The report highlights time reductions Cutoms control,indicating significant improvements.

128 Customs Convention on the International Transport of Goods under Cover of TIR Carnets, of 1975.

(ii) The CMR[129] Convention defines the carriage contract conditions, the contract document (the consignment note) as well as the carrier's liability limits in case of total or partial loss of the goods carried or in case of delay. The consignment note is a legal confirmation of the existence of the contract of carriage. Currently a small number of countries are testing the electronic version of the CMR consignment note, known as e-CMR[130] (annex III box 1).

(iii) The Harmonization Convention[131] has as its objective to reduce barriers to international trade and facilitate the movement of goods by reducing the number of border formalities as well as the number and duration of controls, in particular, through national and international coordination of control procedures and of their methods of application. More information on this Convention can be found in Section 1 under, "Smart Goods Movement in Trade: Transport and Logistics".

Another document for the facilitation of border crossings which also increases the efficiency of road transport is the Green Card[132] document maintains the validity of third-party liability insurance coverage when travelling abroad. Faster border crossings also allow perishable foodstuffs to be transported by road. To ensure this is effective, the Agreement concerning the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP)[133] has been developed to provide an international legal framework for transport equipment for perishables and ensure the international validity of equipment approvals.

A further agreement that facilitates freight transport by road is the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) which is discussed in the section on safety below.

Other measures that can improve the fluidity of road transport across inland borders are discussed in Section 1 under "Smart Goods Movement in Trade: Transport and Logistics" and "Smart Trade – Regulatory Fulfilment and Enforcement".

Challenges

There are several long-standing challenges concerning efficient road transport in the ECE region including:

- Gaps in features and maintenance of road infrastructure that limit the efficiency of the E-road network. Those require coordination across states (particularly through accession to the infrastructure agreements) as well as targeted and sustained funding.
- The efficient use of technology in the road sector.
- The digitalisation of transport documents.
- Information gaps: the E-road census is obtained by collecting information related by national statistics offices but the coverage is limited and differs across the census years.

UNECE already has a central role in regulating road transport through its Conventions and legal agreements and, therefore, as a promoter of efficiency in road transport. However, there remains a lot of work to be done in these areas at UNECE in order to break down the barriers that remain to an efficient transport system. Filling information gaps is central to enable correct decisions on infrastructure prioritization, therefore UNECE should foster extended participation among its member countries to its statistical endeavors.

With regard to the digitalization of transport documents, there is expertise on digital documents in UNECE's United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and cooperation between the road

129 The Convention on the Contract for the International Carriage of Goods by Road (CMR) came into force in 1956.

130 The e-CMR is defined by the Additional Protocol to the Convention on the Contract for the International Carriage of Goods by Road (CMR) concerning the Electronic Consignment Note.

131 International Convention on the Harmonization of Frontier Controls of Goods (1982).

132 The green card system was founded in 1949 following recommendation No. 5 adopted by the Working Party on Road Transport of the Inland Transport Committee.

133 Agreement concerning the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP), concluded in 1970 and updated several times since.

transport experts and UN/CEFACT experts is already well underway through, for example, the e-CMR described above and also discussed in section 1. The extension of this collaboration to other areas could bring mutual benefits to all parties involved.

2.2.3 Rail transport

Introduction

Railway transport offers an efficient way to carry large numbers of passengers over almost any distance and large quantities of goods over long distances. Efficiency in rail transport is achieved by limiting costs and transport times and increasing reliability. These are all important for maximizing the comparative advantage of rail in the transport mix and are best done by:

- Making appropriate infrastructure available for rail operations.
- Ensuring that the infrastructure and vehicles are interoperable.
- Developing market reform initiatives to increase choice and reduce costs.
- Simplifying cross border operations to facilitate international movements.

Rail transport infrastructure

Current situation

Railways have historically been developed nationally as isolated single systems comprising infrastructure, vehicles, rules of operation and safety provisions as well as legislation. In particular, infrastructure has been developed to different extents and often with dissimilar characteristics in different countries. Figure 3 shows the density of the railways across the ECE region and Figure 4 shows the prevailing track gauge in the same countries, identifying the primary challenge for railways across the ECE region – one of lack of harmonization and limited interoperability. If railway infrastructure and equipment were interoperable, vehicles could be used across borders, thus providing for efficient international passenger and freight transport. Different track gauges separate railway systems, whereas other infrastructural and operational differences such as different traction power systems, signalling systems, loading gauges etc. determine the type of vehicles and the loads on the trains, thus creating breaks in systems at borders. This is coupled with infrastructure that was planned over a century ago, with parameters that are no longer suitable for current traffic (e.g. steep inclines on Alpine routes).

Railway infrastructure also suffers from conflicting requirements between passenger and freight transport (which often share the same infrastructure) and, in many countries from decades of underinvestment. This last issue leads to permanent speed restrictions on some networks, bottlenecks and missing links across the ECE region. Even where lines are present there are often administrative or operational issues related to accessing terminals, as well as a general lack of sufficient intermodal terminals.

For passenger transport there is an increasing need for high-speed lines which have given railways a new role in connecting economies and allowed the reduction of air travel on a number of routes. Figure 5 depicts the recent rapid increase of high-speed rail lines (designed for speeds of at least 250 km/h) in the ECE region with a more than six-fold increase between 2000 and 2017.

Action to provide rail infrastructure that ensures efficient connectivity should include its regular upgrading in order to conform with changing requirements, whether present or planned, and to harmonize its features -based upon the role of each leg or terminal- in order to deliver consistently appropriate levels of service and, ultimately, interoperability. This requires regional and national coordination and prioritization of projects, which also are necessary in order to ensure that railways increase their share of transport performance. While each country evaluates and prioritizes investment in infrastructure, regional coordination ensures continuity of access and is most important for countries that are landlocked and require cross-border rail infrastructure continuity for their trade, both to carry goods to ports and to exchange goods with other countries.

Figure 3: Total length of railways, kilometres (latest values available on the UNECE Transport Statistics Database)

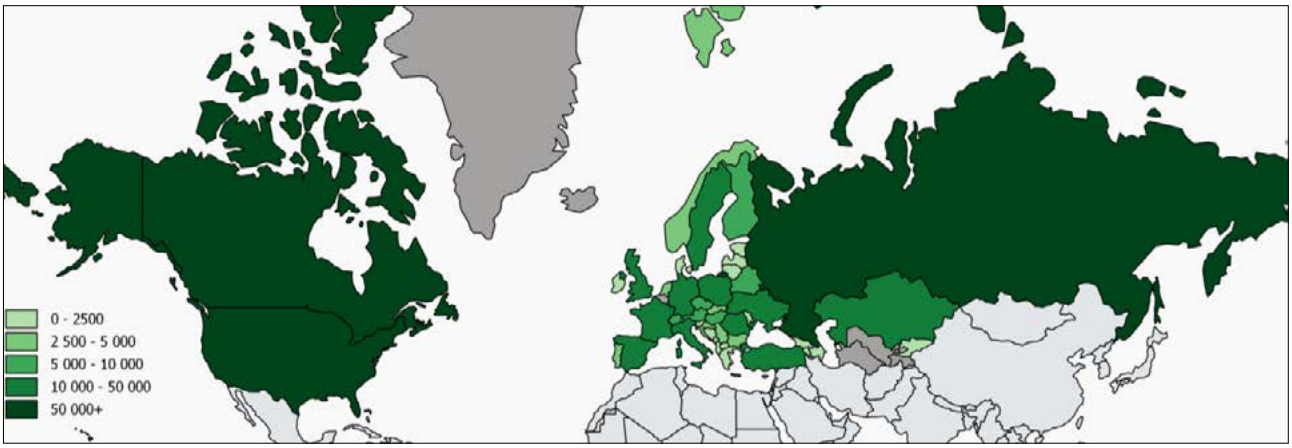


Figure 4: Prevailing railway track gauge in the countries of the ECE region

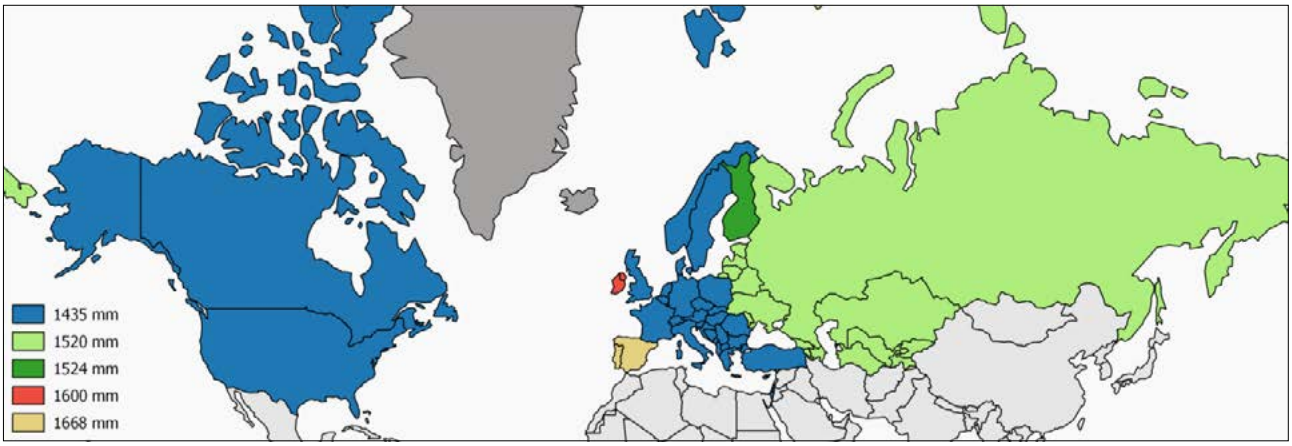
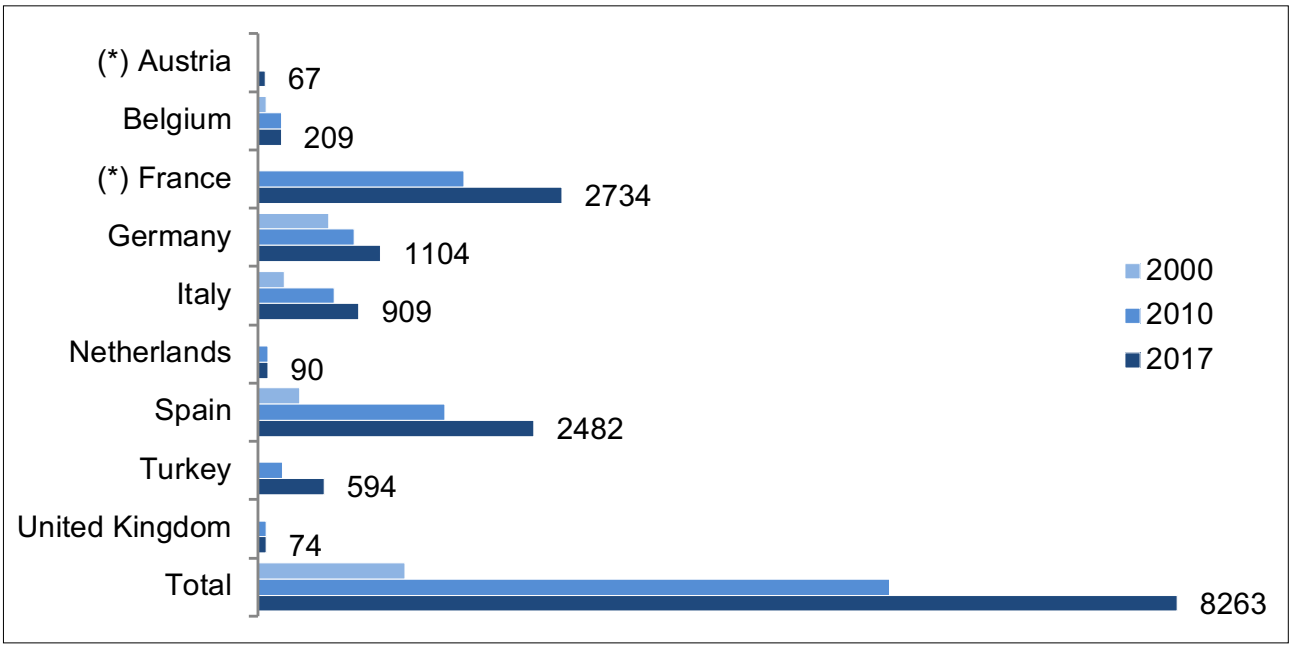


Figure 5: Length of high-speed lines in the ECE region in the years 2000, 2010 and 2017. An (*) indicates cases where data for the year 2000 is missing. The figures shown refer to the length of the lines as of 2017



Source: UIC database

Initiatives underway

A number of initiatives have been set in motion to increase interoperability between countries. Initial efforts focused on international level to harmonize technical parameters across the ECE Region through the European Agreement on Main International Rail Lines[134] (AGC) which aimed to foster the development and upkeep of efficient rail infrastructure and establish alignments and standards to which main rail lines are to be built or upgraded. A corresponding Agreement serviced by UNECE concerns combined transport: the European Agreement on Important International Combined Transport Lines and Related Installations[135] (AGTC) which defines railway lines and terminals of international importance for combined transport and sets out minimum requirements for both.

A number of sub-regional initiatives have subsequently followed. Of note are efforts within the European Union to make railways interoperable through the creation of a number of technical standards for interoperability through European Union Directives and, connected to this, the work of the European Union Agency for Railways (ERA) which is aimed at reducing and removing specific national rules that limit cross-border movements and vehicle interoperability as discussed in the next section.

In addition, a number of member States have invested significantly in building new lines aimed at increasing efficiency and promoting the use of the railways. For example, Switzerland is building new base tunnels to allow for longer and heavier freight trains, also cutting journey times. Many countries, including Canada, Kazakhstan, Russia Federation, Turkey, United States of America, Uzbekistan and several European Union countries (UIC, 2018) are building, or have built, high-speed passenger lines to take advantage of the benefits that this type of rail transport provides in terms of economic efficiency. Furthermore, many lines need upgrading to meet the needs for growing demand and include projects for electrification, for increased speeds as well as track doubling. Such projects have been undertaken, for instance, in Azerbaijan, Russia Federation and Uzbekistan (UNECE, 2017a). In Azerbaijan, for example, this work was aimed at increasing the speed of freight trains up to 60 km/h and the speed of passenger trains up to 100 km/h.

In the European Union, investment in railway connections is carried out following the TEN-T framework.[136] This has included the development of collaboration among infrastructure managers so that operators that need to set-up international train services can interface with only one infrastructure manager rather than with all of those involved. Investments in the TEN-T network also include efforts to achieve interoperability. An example is the replacement of wider Iberian gauge tracks with tracks that are standard International Union of Railways (UIC) European gauge on railways in the Iberian Peninsula. A further example is the harmonization of the loading gauge across systems to allow the carriage of containers and semitrailers on trains.

As mentioned above, coordination is a fundamental requirement for increased infrastructure efficiency. In Central, Eastern and South-Eastern Europe, the Trans-European Railway[137] (TER) project is an example of this, as a sub-regional project to coordinate rail development efforts across countries. Another example is the Euro-Asian Transport Links (EATL) project, a joint undertaking between UNECE and UNESCAP aimed at promoting transport between Europe and Asia and identifying a number of corridors where investment should be focused (annex III, box 2).

Interoperable vehicles and new technologies

Current situation

New technologies in rail transport may provide ways to overcome the functional breaks mentioned above and achieve greater interoperability. As previously discussed, standards and requirements for vehicles differ from country

134 The European Agreement on Main International Rail Lines (AGC) entered into force in 1985. Complementary to the AGC, UNECE issued resolution No. 66/Rev.2 concerning the system of Marshalling Yards of Major European Importance that includes the marshalling yards of the AGC network. www.unece.org/trans/main/sc2/sc2_agc_text.html.

135 European Agreement on Important International Combined Transport Lines and Related Installations: www.unece.org/trans/wp24/agtc_text.html.

136 Established with the Regulation EU No. 1315/2013.

137 The Trans-European Railway (TER) project: www.unece.org/trans/main/ter.html.

to country. This leads to a lack of overall standardization and higher costs for vehicles, including the increased cost and time needed for authorizations in each country. Thus, even when vehicles are technically suitable for cross border traffic, multiple authorization processes result in high costs and long times before equipment can be used in operations. A recent study undertaken by the European Parliament estimated that between €4.2 billion and €7.3 billion could be saved by 2035 if rolling stock was standardized across the European Union.[138] This would include all on-board systems requirements including signaling. The harmonization of authorization processes alone would add another €1 billion to those savings.

Initiatives underway

The deployment the European Railway Traffic Management System (ERTMS)[139] as a single uniform traffic management and control system across the European Union provides a key example of a new technology that overcomes the obstacles to cross border traffic due to railway signaling and safety systems that have evolved differently across countries. Similar (but not identical) systems are also being used in other parts of the world which could create barriers at borders in East-West rail movements. Related to this is all the activities of ERA as mentioned previously.

Similar harmonization initiatives are also being undertaken in other sub-regional initiatives such as the Intergovernmental Organisation for International Carriage by Rail (OTIF), and the Organization for the Cooperation of Railways (OSJD) as well as the International Union of Railways (UIC).

Market reform

Current situation

To improve its efficiency and increase its modal share, the railway sector needs an organizational set up able to deliver efficient services, thus meeting the needs of passengers and shippers. This entails separating functions and having them carried out by specialized operators, opening such roles also to private enterprises. This also entails ensuring that incumbent operators are able to compete on a level footing without having the burden of excessive debt levels. It also means, where relevant, allowing operators from other countries to enter domestic markets (cabotage). For example, the aforementioned Cost of Non-Europe study estimates that full market access for freight and passenger services could entail savings of between €15.8 billion and €41.8 billion to 2035 for the European Union.

Initiatives underway

A reform of the railway sector along such lines is taking place in most ECE countries, and is evolving in different ways, according to local situations (UNECE 2017 for more details). The shift to different specialized operators emphasizes the interfaces among functions and operations. For railways to work as systems there is a need to bring together the different national and international stakeholders involved and their associations. While reform has been taking place across European Union railways for a number of years, of recent note are efforts in Azerbaijan, Turkey and Ukraine to reform the railways to make them more competitive and efficient and capture key flows in East-West traffic.

Rail and intermodal cross-border transport facilitation

Current situation

In addition to the physical infrastructure barriers that persist in railways, there are also administrative barriers that limit international passenger and freight movements. Solving or improving infrastructure problems without

138 The Cost of Non-Europe: Railways and Road Transport. European Parliament (2014).

139 European Railway Traffic Management System (ERTMS): www.ertms.net.

equivalent procedural improvements at borders is not sustainable. The Harmonization Convention discussed earlier partially addresses some of these issues through joint border crossing checks for passengers, while for rail freight, the existence of two legal regimes is creating an efficiency barrier and, in this situation, some form of international law is needed to break this administrative barrier.

Initiatives underway

For passengers, initiatives within Regional Economic Integration Organizations (REIOs) such as the Schengen agreement for parts of the European Union (and beyond) have meant that passengers can seamlessly pass borders without stopping for passport controls. For other countries, the new UNECE Convention on the Facilitation of Border Crossing Procedures for Passengers, Luggage and Load-Luggage carried in international Traffic by Rail will reduce the burden at borders and increase efficiency.[140]

Reductions in transit times for freight trains at borders are being pursued along Euro-Asian routes but remain significant. For instance, at the Brest border crossing between Belarus and Poland, the processing times for trains stopping for the trans-shipment of containers were reduced from 36 to 10 hours (UNECE, 2017a). In addition, there are also bilateral agreements between some countries, such as the agreement between Republic of Moldova and Ukraine to exchange information in order to improve border controls and reduce related processing times.

The main administrative issue that divides the ECE region is the existence of two different legal regimes for regulating the transport of goods by rail. The western part of the region relies on the Uniform Rules Concerning the Contract of International Carriage of Goods by Rail (CIM)[141] whereas the Agreement on International Railway Freight Transport (SMGS) is in effect in the eastern part of the ECE region. The two systems entail different consignment notes so obtaining both added a step to the exchange of goods across these sub-regions. To overcome this limitation, joint work by the two international bodies maintaining the CIM and SGMS legal regimes[142] has resulted in a common CIM/SGMS consignment note, valid under both legal regimes (UNECE, 2018d).

Nonetheless, a single legal regime would be better for facilitating transport than a common consignment note. In 2013 the Ministers of the governments interested in Euro-Asian rail transport signed a joint declaration to promote rail transport and to work towards a Unified Railway Law.[143] That endeavour has recently resulted in draft legal provisions being completed which provide a single contract of carriage, a single liability system and a single consignment note. The completion of this work and its entry into force will significantly improve efficiency in the movement of freight on rail from Asia to Europe.

Other measures that can improve the fluidity of rail transport across inland borders are discussed in Section 1 under "Smart Goods Movement in Trade: Transport and Logistics" and "Smart Trade – Regulatory Fulfilment and Enforcement".

Challenges

The role of ECE in resolving many of these rail efficiency issues continues. Efforts in relation to Unified Railway Law will create the largest efficiency improvements for the railways, but efforts to improve interoperability and the harmonization of different railway systems will also continue through the work on the AGC. In the future, international rail passenger transport will continue to grow, therefore, if member States are to benefit from and encourage this growth it is essential that the legal agreements between them be fit for this purpose. Going forward, continued

140 Convention on the Facilitation of Border Crossing Procedures for Passengers, Luggage and Load-Luggage carried in international Traffic by Rail, adopted by the Inland Transport Committee on 19 February 2019, which replaces the previous Convention done in 1952, now outdated.

141 Operationalizing the Convention concerning International Carriage by Rail (COTIF)

142 Those are OTIF for CIM and OSJD for SMGS. OTIF is Intergovernmental Organization for International Carriage by Rail and OSJD is Organization for Cooperation of Railways.

143 Joint Declaration on the promotion of Euro-Asian rail transport and activities towards unified railway law, done at Geneva on 26 February 2013.

efforts to foster innovation in order to meet the challenges of the future and ensure railways' continued comparative advantage in certain transport flows will also be a key work area.

UNECE has long been established as a leading platform for discussing and agreeing on international harmonization in transport and, given the foreseen increase of transportation flows across its entire region, it is in an excellent position to continue in and to build upon this role. As infrastructural and functional gaps exist and are bound to worsen as rail traffic increases, the coordinating role of UNECE for the development of infrastructure should be strengthened. As with road transport, capacity building and best practice exchange on infrastructure management should be further fostered as well as the exchange of best practices in market reform, which is still ongoing and where there is no single best model to follow. All this needs to be based on robust statistical data. The gathering of transport statistics by UNECE (for example through the E-Rail census) is of particular importance but it is important that there is increased participation from member States on this.

2.2.4 Inland water transport

Introduction

Waterways provide an important alternative to other transport modes as they do not suffer from the same congestion levels and waterborne transport costs less. They also have advantages in terms of high safety levels and energy efficiency. These features contribute to reducing transport and logistics costs, as well as congestion on road networks, impacting significantly several SDGs. However, transport by inland waterways needs further development as its potential is still largely untapped. The development of inland waterway transport requires the:

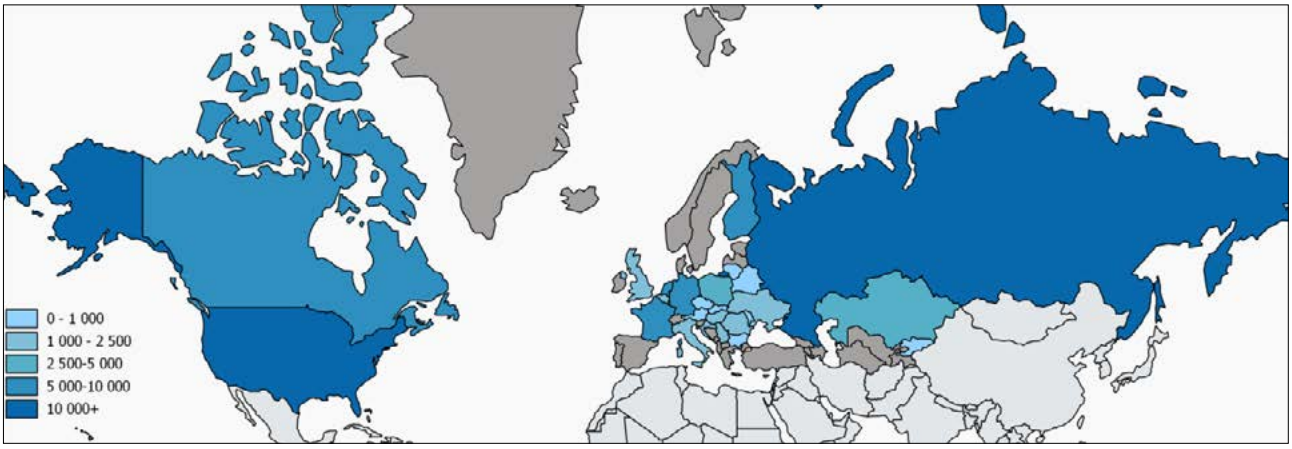
- Improvement of the navigable sections of waterways (i.e. fairways)
- Improvement of facilities across much of the region
- Construction of links that are still missing
- Deployment of information services to facilitate navigation
- Digitalisation of the sector.

Infrastructure for inland water transport

Current situation

Infrastructure for inland waterway transport is made up of navigable rivers, lakes and canals, as well as ports and facilities such as locks and lifts. In some cases, inland waterways link to coastal waterways and seaports thus providing effective ways to connect deep-sea and inland waterborne transport. Figure 6 presents an overview of the extension of inland waterways in the ECE region.

Figure 6: Total length of inland waterways, kilometres (latest values available on the UNECE Transport Statistics Database)



The availability of waterways and their place in the overall transport mix varies across countries that have inland water transport infrastructure. As for the previous modes of transport, infrastructure efficiency is very much dictated by its quality. Many waterways suffer from inconsistent quality during the year because of tides and weather patterns. In this context, infrastructure providers need to carry out significant measures on an annual basis to ensure the navigability of their waterways. In doing this, they need to make sure that their networks are conform with certain quality parameters. Performance limits and bottlenecks are not only due to the characteristics of the navigable sections of waterways: the features of the locks and the dimensions of their chambers as well as the clearance under bridges can have a strong impact on performance, as well as the quay lengths and handling equipment in ports.

Because many waterways and much of the traffic on them are international (in the European Union in 2018, 52% of inland waterways' traffic was cross border and 21% was transit traffic); therefore, coordination is essential to standardize the features of waterway networks in order to achieve their full potential.[144]

Initiatives underway

The key instrument for coordinating the development of international waterways across the region is the European Agreement on Main Inland Waterways of International Importance (AGN)[145] serviced by UNECE. The progress made in maintaining and developing the AGN network as well as issues encountered are regularly reported in the Blue Book.[146] For example, much work is focused on upgrading the infrastructure to allow for larger vessels in order to increase efficiency through economies of scale.

Planning and works are also ongoing to create connections between rivers as is the case for the works to link the Oder basin and the Vistula basin which could accommodate freight flows currently on roads and rail (UNECE, 2019). In the Azov-Black-Caspian seas basin, studies, including environmental studies, are ongoing to restore the Dnieper-Vistula waterway and Belarus is rebuilding canals and locks to higher standards.

In the European Union, transport policy on waterways has been developed in the NAIADES[147] packages aimed at developing the TEN-T network of waterways. As well as the networks themselves, these packages cover fleet investments, emission reduction, skills development and the integration of inland navigation into logistic chains. Investments supported by the European Union have concerned developing navigable waterway sections, locks and terminals, especially on corridors linking the Netherlands and Belgium with France and the Mediterranean Sea and on the Rhine-Danube basin, as detailed in INEA (Innovation and Networks Executive Agency) (2018).

While improvement and expansion of the waterways network are being pursued, UNECE (2019f) noted that the smaller canals, up to class IV, may end up being little used because the smaller vessels that can navigate on them are becoming older and are being decommissioned without being replaced.

Fundamental to the correct functioning and interoperability of waterways is ensuring that the users are subject to well recognized signs and signals. The European Code for Inland Waterways provides for this although it is important to note that it is yet to be fully applied across the region.

New technologies and information sharing in inland water transport

Current situation

Only second to the provision of efficient and networked infrastructure, up-to-date information on waterways is critical to navigation. Some navigation parameters relating, for instance, to water levels, traffic, and maintenance are variable and these must be known and up to date. For instance, water levels affect draught and clearance under bridges and,

144 This work is carried out by UNECE Working Party on Inland Water Transport, SC.3.

145 AGN entered into force in 1999 and is amended as part of the works of the UNECE Working Party on Inland Water Transport (SC.3).

146 Inventory of Main Standards and Parameters of the E Waterway Network (Blue Book), third edition, UNECE, 2017.

147 https://ec.europa.eu/transport/modes/inland/promotion_en

therefore, the load that may be carried by vessels. Traffic conditions, due for instance to time required to pass locks or lifts, affect estimated times of arrival at destination. Maintenance of infrastructure may also affect the navigability of segments of waterways. All of this information whether actual (planned temporary blockages of waterway sections) or forecast (water levels, ice, weather) is required in advance of loading the vessels and looking forward, for the duration of the journey. To provide up-to-date information exploiting current communication technology, River Information Services (RIS) are being developed in the ECE region and those that exist are being further enhanced (annex III, box 3).

Initiatives underway

Services included in RIS can serve as the basis for other digitalization projects such as the DINA initiative launched in 2015 by the European Commission that aims to better integrate inland water transport into multimodal transport chains by developing further the electronic data exchange in RIS.

RIS services may also be the basis for the automation of river transport.[148] Navigation companies would welcome further automation to reduce costs and to compensate for current staff shortages. There are several initiatives testing automation, but this has yet to reach deployment as there are related technical, legal and human challenges. AUTOSHIP (Autonomous Shipping Initiative for European Waters) is an example of a test project that will test the operation of fully unmanned vessels in Belgium. The level of automation that may eventually be deployed will depend, among other elements, on the creation of a suitable legal framework (UNECE 2018f).

Other measures that can improve the fluidity of inland water transport across borders are discussed in Section 1 under "Smart Goods Movement in Trade: Transport and Logistics" and "Smart Trade – Regulatory Fulfilment and Enforcement".

Challenges

Challenges related to efficiency of inland waterway transport where the ECE's role could be strengthened include:

- Building the missing links required to complete the E-waterway network as well as to maintain the existing network. Construction and restoration efforts are required but need to consider environmental issues. There is also a need to facilitate action in support of climate resilience across member States in a consistent manner.
- Promoting inland waterways as transport means and also as a part of multimodal transport chains.
- Addressing differences in the organisation of inland waterway transport in different countries that affect the possibilities for operating transport services across borders (i.e. cabotage).
- Encouraging further innovation that builds upon the successful deployment of RIS.
- Reducing fragmentation of the sector especially in western European countries where this is also linked to an ageing fleet.
- Dealing with the shortage of new staff to take over from those who retire.
- The limited availability of statistics for the sector.

UNECE should also foster the exchange of best practices and support countries in their efforts to increase the role of inland waterway transport, including through the facilitation of inland transport projects and cooperation.

As UNECE is central to the Conventions and Agreements making international waterway transport possible and efficient as well as in defining the characteristics of the vessels, it should also take up a role in the harmonization of automation in order to ensure that vessels, as they travel on waterways and across jurisdictions, are able to communicate with all relevant waterways' management and information systems.

148 Pauwelyn (2018) discusses possible automation developments in inland waterway transport.

2.2.5 Efficient transport in urban environments

Introduction

Urban transport comprises road and rail and sometimes waterway transport. Nonetheless, it is normally treated separately because it includes some specialized infrastructure and planning considerations. Rail and bus transport may have its own infrastructure, while other transport modes use road space that is part of urban living environments and, in historical city centres, was not intended for use by modern transport means.

The performance of transport in a city shapes the performance of that urban area. Making available and developing sustainable transport options, and options that are best suited to each person's needs and abilities as well as to city constraints is central to:

- Ensuring access to all
- Keeping under control negative externalities
- Promoting healthy living.

In reality, the provision and performance of an efficient transport system as well as the control of externalities are major challenges for many cities in the ECE region and worldwide.

Efficient urban transport may be obtained by:

- Providing appropriate transport options to all city areas which are suitable for short- and long-range urban travel, and are useable by all city dwellers.
- Supporting multimodality from the planning to the operational stage, taking into consideration the complementary role of alternative transport means.
- Facilitating the use of the most efficient modes.
- Considering that space is often shared with other urban functions.
- Considering the interaction between transport and land use.

Efficient transport modes in urban areas

Current situation

The urban environment relies on a number of different transport modes. Figure 7 shows that the share of different transport modes differs significantly by urban area, although motorized modes are generally the most used.

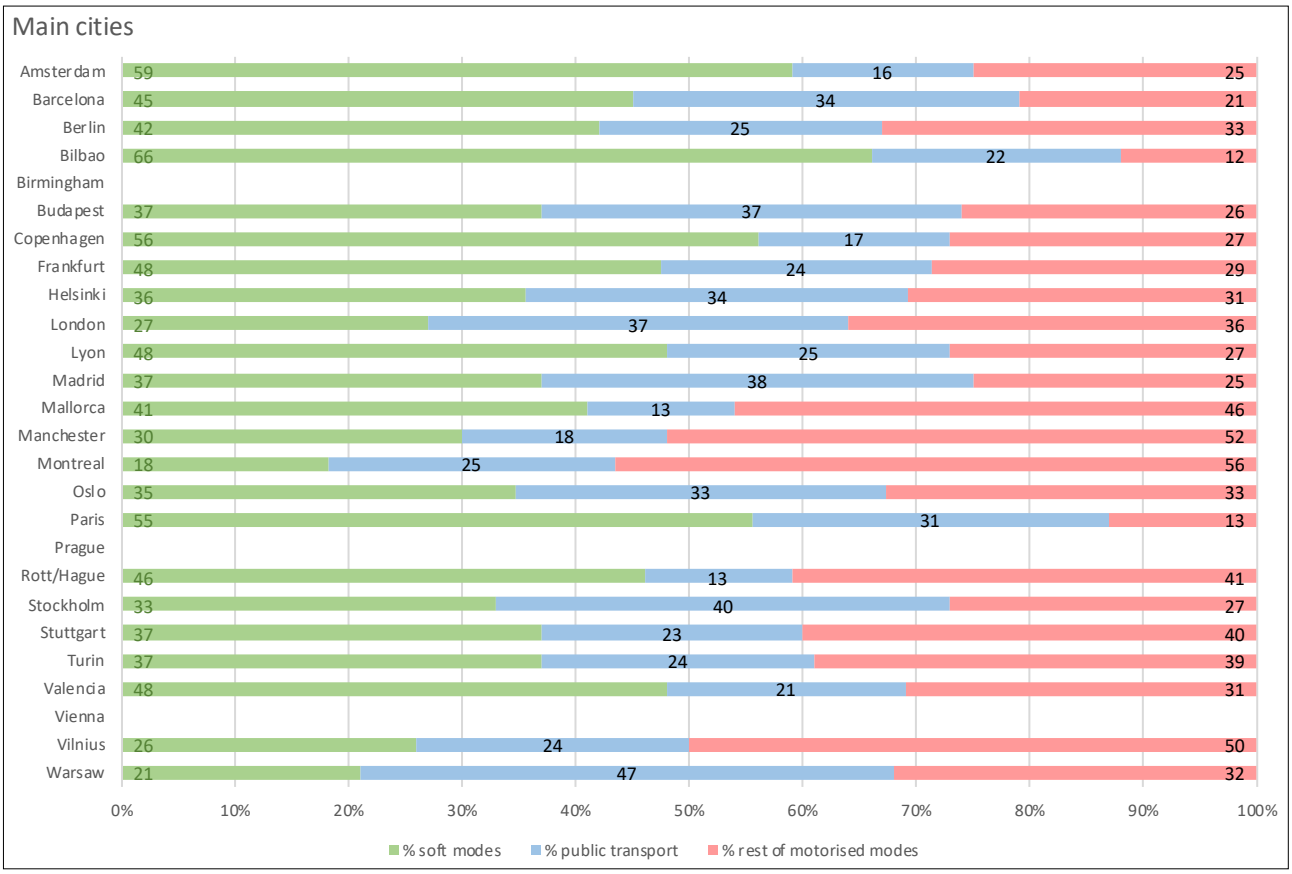
Efficiency in urban transport is about ensuring the optimal mix of modes in the urban environment which implies minimising journeys taken by private cars or deliveries made by (almost) empty goods vehicles. It, therefore, relies on the use of public transport as a significant provider of journeys (rail, light rail, tram, bus, etc.) on trunk routes where more passengers need to be carried and also includes the use of new transport tools such as those provided via the sharing economy and active mobility such as walking and cycling to feed into these trunk routes and allow the first and last mile to be covered. As shown in the figure above, many cities still rely heavily on motorised transport. This creates congestion and negative environmental and social effects that reduce the efficiency of movements in the urban environment.

Initiatives underway

A number of cities are introducing solutions to tackle this inefficiency through activities such as: promoting bicycle use (seeking to reach the levels found in Amsterdam and Copenhagen); creating appropriate infrastructure and also incentivizing an active mobility culture. Car use is also being discouraged through penalties such as congestion charging and higher road taxes. Finally, significant investment is being ploughed into public transport to make it more attractive across the region. For example, significant investment is being made in Tashkent, Uzbekistan in order to renew the bus fleet and extend the metro to meet the growing needs of the city and provide a viable alternative for car users.

The UNECE/WHO Europe Transport, Health and Environment Pan-European Programme is one of the UNECE initiatives focused on ensuring efficient, clean and safe urban transport.

Figure 7: Modal share in main cities whose transport authorities belong to the European Metropolitan Transport Authorities, 2017 data



Source: EMTA, 2019.

New technologies as enablers of efficient urban transport

As with the other transport sectors, the introduction of new technologies can significantly increase efficiency in urban transport. The challenge is to make sure that what is introduced is harmonized and has a direct benefit to users and, therefore, can be used optimally. ITS and automation have already been identified as potential areas for action.

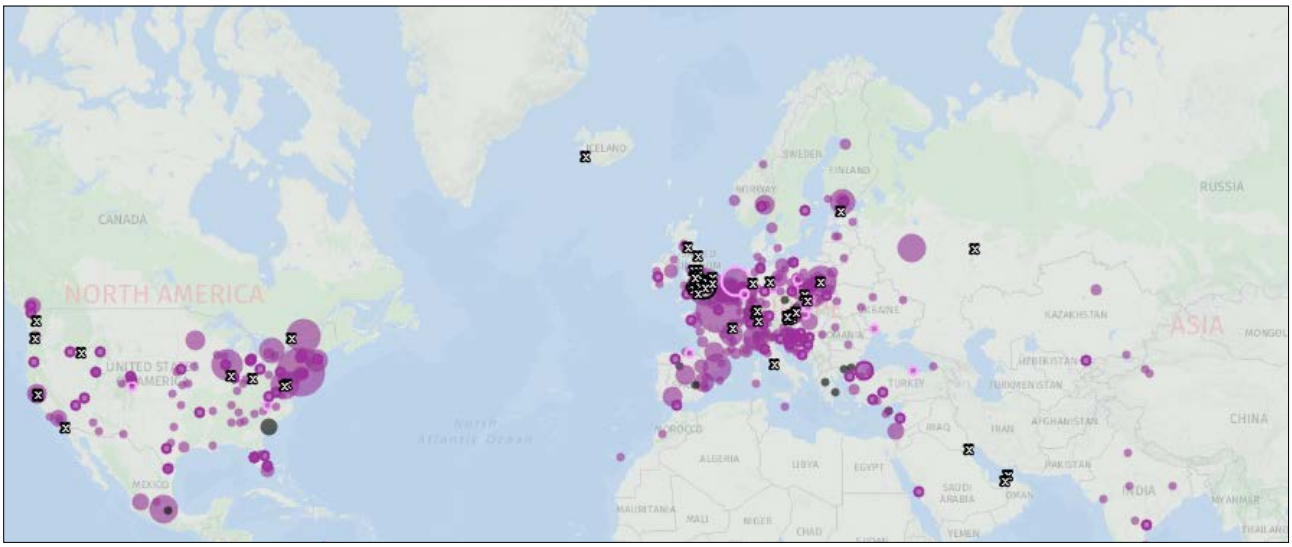
ITS is now widely used in public transport and information managed by such systems is used by all parties involved in the provision and use of transport services: for instance with location information, travellers can better execute their journeys, contracting authorities can keep track of the service actually delivered and operators can control their fleets and take faster action when operations require.

There are applications of such ITS in many cities: for example, the systems to provide bus priority in Prague, Malmö, and Toulouse. Among the many other examples of ITS providing real time public information are those of Moscow, Ljubljana, Iasi, and Aalborg. Very often, ITS systems provide several functions; for example, the same system may optimize traffic and also deliver real time information.

Mobile electronic devices, notably smartphones, are now the tool being used to kick-start the sharing economy across the region. For example, bike sharing systems can be used to foster the urban use of bicycles and are increasingly widespread: a recent study counted more than 1,250 bike sharing systems worldwide.[149] (Figure 8)

149 www.rolandberger.com/en/Publications/Bike-Sharing-Cornerstone-of-future-urban-mobility.html

Figure 8: Locations of bike sharing systems in the ECE region. Circle sizes are proportional to the number of bikes; x marks indicate discontinued systems



Source: https://bikesharemap.com/

Similar to bike sharing, the participation in car sharing schemes is a strong alternative to car ownership. Examples of such schemes are visible in many cities in Europe (for instance: Helsinki, London, Milan, Moscow, Munich).

Technological developments in e-ticketing, that is the issuance of tickets and passes without the need for a paper ticket or use of a contactless card are further increasing the efficiency of operations as they eliminate the need to queue for a ticket.

All these, and other, similar initiatives are now coming together in Mobility as a Service (MaaS) platforms[150] that pool the visibility and availability of different transport means and make them readily available to users via portable electronic devices. MaaS requires interconnecting the IT systems of several transport modes and providers to offer trip planning by aggregating real time information and, for some MaaS systems, the purchase of access to a bundle of transport services that are used to complete a journey like, for instance, the sequence bike sharing, public transport, train. Currently such systems are still in their infancy with a limited number of examples (for instance: UbiGo in Stockholm and Whim in Helsinki) and they are setting the scene for future, more complete integration.

Managing mobility to increase efficiency and environmental friendliness

The promotion of transport modes that are consistent with relevant policy and planning is also the basis of mobility management that, rather than being based on technology as MaaS, relies on dialogue with travellers to understand their mobility needs; raise awareness of sustainable mobility choices –typically cycling (annex III, box 4) and public transport; and provide feedback on mobility needs to public authorities. The aim is to change the attitude of travellers and their behaviour by facilitating the shift to sustainable modes with information, education and support (for instance, by providing rewards for distances covered by bike instead of by car, or by assisting financially with the purchase of bikes). Mobility management is often based on schools, workplaces and communities, in order to reach people that share the same trip destinations and, therefore, a part of their mobility needs. The change in demand fostered by mobility management improves the effectiveness of infrastructure provision (cycle paths, parking racks) and its participatory nature results in the provision of more useful infrastructure.

150 Informal document WP.5 (2019) No. 7 of the Working Party on Transport Trends and Economics "Mobility as a Service" provides a thorough outlook of MaaS, detailing how it links with transport modes as well as current experience and perspectives.

There are many successful mobility management examples. Some are reviewed in UNECE (2019h) and include the scheme at the company Infineon in Villach, Austria, that comprised the improvement of the public transport connections, free annual public transport tickets, upgrading of bicycle parking facilities, reserved parking spaces for car-poolers, a carpooling app and options for sometimes working from home or other locations (smart working). Another example, is the development of a mobility labelling system applied initially to the public transport system of Plovdiv, Bulgaria, where the city measured changes in use and benchmarked the score it achieved with other cities as part of the European Union co-funded project MoMa.Biz. Examples of successful school mobility management include "walking buses" and "bike buses" in Reggio Emilia, Italy, whereby kids go to school in groups on foot or by bike.

Urban freight transport

As mentioned above, a key challenge in efficiency is also the delivery of goods in the urban environment. The distribution and collection of goods in cities is necessarily widespread with vehicles calling at residences, service providers and store outlets at different times of day and, sometimes, of night. The time of delivery is linked to the operating hours of transport operators and the recipients of the goods as well as the type of transport services being supplied. Urban transport and logistics is an extremely large service sector, independently of the recent increase in urban parcel deliveries due to e-commerce. Much urban goods transport is carried out with vans and trucks, which create the same externalities as cars, such as road congestion, reduced safety, use and less availability of space during loading/unloading, poorer air quality, more noise, etc. Some solutions to these problems include control of the use of road spaces, setting up local distribution centres, electrification of vans as well as the use of cargo bikes. Policies concerning urban logistics are often hard to develop due to the multiplicity of stakeholders with different goals.

Planning for efficient urban transport

For these sustainable urban mobility solutions to work effectively, there is a need for efficient urban planning. A complex system such as the transport system of a city needs to be governed using appropriate policy development and implementation which considers all the transport modes and other systems as a whole and works to link them together. This also entails considering the environment and the effects on health of municipal choices, including transport choices as is done in THE PEP.[151] Given the constraints on resources in a city (space, time, environment, and individual as well as municipal finances) and with the number of urban dwellers set to rise worldwide, the planning of transport services should:

- First define the future transport system that a city needs
- Determine which actions across the system are best suited to reach that future system
- Continually check progress
- Periodically review the measures implemented in order to measure progress toward the desired future and taking corrective actions, if needed.
- The idea of planning using these steps and reviewing them again at regular intervals underpins the guidelines for Sustainable Urban Mobility Plans (SUMPs) that were developed by the European Commission[152] in 2013 and revised in 2019 to consider elements such as sharing, MaaS and micro-mobility which were not included in the original guidelines. Central to both sets of guidelines are the need to cooperate within and across institutions and the importance of involving citizens and stakeholders in making decisions for their cities.

151 THE PEP was set up in 2002 to make the link between transport, health and environmental choices and planning www.thepep.org.

152 www.eltis.org and Rupprecht Consult (ed) (2019).

Challenges

Public authorities are clearly central to the governance of transport in cities and must face challenges due to the complexity of cities and the multiplicity of stakeholders. Each city needs to tailor solutions to its own situation. At the same time, the need to move towards common goals such as the SDGs and the importance of learning from the experiences of others make the sharing of knowledge key to the development of sustainable urban mobility. This can be done through promotion and capacity building activities like THE PEP relay races initiated by UNECE and similar training and dissemination actions that UNECE and THE PEP Partnerships should sustain and develop further. For instance, they could provide capacity building on how to implement effective cycling systems or on how to make the most of micro-mobility and MaaS and continue disseminating already defined best practices such as Eco-driving[153] (section on Eco-driving below).

2.3 Transport affordability and accessibility for people and society

2.3.1 Introduction

For mobility to be sustainable it also needs to be affordable and accessible. Affordability must be seen from the point of view both of the individual and of society as a whole. If a trip on public transport ends up costing too much of an individual's income, they will not take it. In the same way, if the provision of a public transport network is too expensive, national or municipal authorities will direct their expenditure elsewhere. Therefore, to achieve, in particular, SDGs 3, 5, 7, 8 and 11[154] it is essential that transport be affordable for all. Accessibility is of relevance primarily to people but is also important to businesses for accessing markets.

2.3.2 Affordable mobility for individuals and households

Current situation

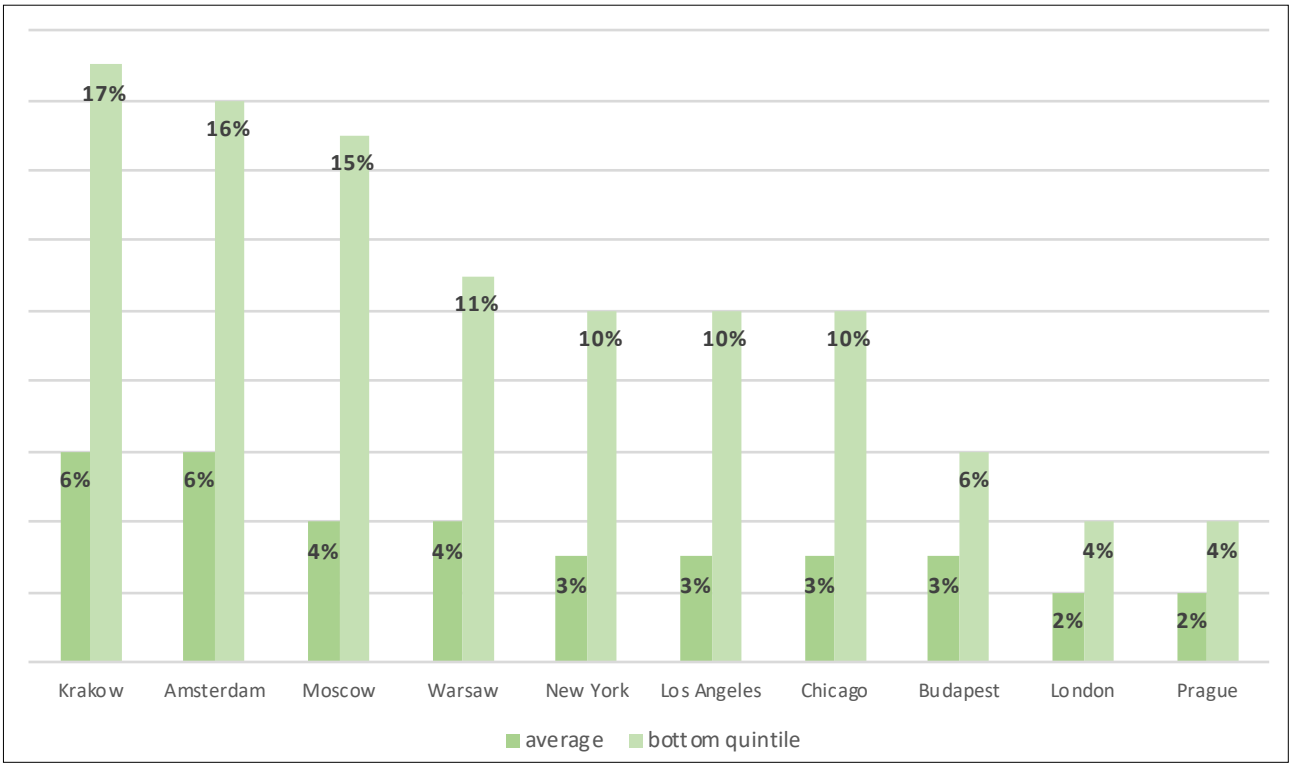
Without affordable mobility options, individuals and households may be marginalized or even excluded from day-to-day activities including jobs and education. Difficulties are higher for people and households with lower incomes, for whom the percentage of transport costs out of total expenses is higher. However, for transport to be sustainable, personal mobility should not be limited by income. Cities may tackle the issue by supplying infrastructure for active transport such as cycling or by making available some services on demand such as car sharing. But availability does not imply affordability. Effective action may result from the provision of affordable public transport. A study by the World Bank in 2005 compared the affordability of public transport in different cities across income groups. Figure 9 reports the results for the cities considered in that study which are located in ECE countries, and it shows a marked difference in the percentage of expenditure on public transport across income groups and across cities, which implies that, for some, the affordability of public transport remains limited.

The issue of transport affordability is also linked with housing affordability as the choice of living location often results from a trade-off between housing and transportation expenses, leading those who have less disposable income to choose peripheral areas typically less served by public transport. Urban design has led to entire parts of cities where mobility relies on private automobiles which, besides imposing the expenses associated with vehicle ownership, can create regressive taxation problems due to high fuel taxation (Mattioli et al., 2019).

153 A detailed explanation of Eco-driving can be found in the section of that name below.

154 SDG 3: Good health and well-being; SDG 5: Gender equality; SDG 7: Affordable and clean energy, SDG 8: Decent work and economic growth; SDG 11: Sustainable cities and communities.

Figure 9: Affordability index as percentage of monthly expenditure on public transport on household income, on average and for the bottom quintile group



Source: Carruthers, Dick and Saurkar, 2005.

Initiatives underway

Transport affordability has gained attention through a number of research initiatives, including a 2003 study by the British Social Exclusion Unit which recommended a change in approach to mobility and access planning. This report noted that, in England, the social costs of poor transport had not been considered in planning until the year 2000. The report suggested initiatives such as reduced fares and enhanced transport provision in rural areas and for the elderly and disabled. It also called for a change in the approach to planning in order to ensure that locations could be accessed by public transport, cycling and walking. Additionally, it called for appropriate land planning that reduces the need to travel. In 2012 a note by the Campaign for Better Transport remarked that accessibility planning had not been effective as low-income households relied heavily on bus transport and that transport poverty needed to be defined more carefully, especially when considering expenditures on motor vehicles. The need to ensure affordability, particularly of public transport, is now included in the guidelines of the European Union for Sustainable Urban Mobility Plans (2019) and in the UNECE Handbook on Sustainable Transport and Urban Planning (2019b) and is part of the priority objectives of THE PEP.

THE PEP has also developed a study UK to improve transport affordability such as those reported by CIVITAS (2016):

- The provision of regular and on demand bus services in Merseyside, Halton and Deeside (United Kingdom) to link deprived residential areas of high unemployment to key employment sites. In the same area jobseekers get weekly trips to potential employers via a training company.
- The Workwise project in the West Midlands (United Kingdom of Great Britain and Northern Ireland) whereby jobseekers are provided free tickets for travel to job interviews and free travel passes for eight weeks once they get a new job.

Since transport affordability connects to other household spending, research efforts account for this but data and methodologies often differ. To get a comparable view of the housing and transport affordability in different areas, the United States of America Department of Housing and Urban Development (HUD) developed the Location Affordability Index (LAI) which evaluates for each neighbourhood reference costs for transport and housing (Babinard, 2014).

Challenges

Providing accessible public transport through extensive coverage as well as affordable transport options (including cycling) is a challenge for many cities. However, attention to affordable transport is essential to deliver SDGs such as No. 3, 5, 8, 11. To tackle affordability challenges it is necessary to:

- Have a clear understanding of transport affordability, quantifying its definition and understanding how locations and families are affected.
- Disseminate best practices for overcoming transport affordability issues and social exclusion.

UNECE is in a position to widen its role and support countries and cities through THE PEP (with WHO/Europe): initiatives such as the "Relay races"[155] may be used to foster awareness of affordability and social exclusion issues and provide best practice examples and capacity building.

Additionally, UNECE could act as a centre to develop the harmonization of transport affordability measurements thanks to its position with respect to member countries and international organizations working on this issue, such as development banks. UNECE can also support the harmonized collection of statistics which will enable robust substantiation of policies as well as the ability to measure progress.

2.3.3 Transport affordability for public authorities

Introduction

Public authorities fund the construction, maintenance and operation of infrastructure (roads, railways, waterways and respective terminals) and also fund the operation of services, in the form of subsidies, when public service obligations are imposed or when funding is intended to help achieve wider targets such as environmental targets. Funding for these aims competes with funding for other infrastructure and services provided by public authorities. Therefore, there is a general need for robust prioritisation and, where suitable, the introduction of private capital.

Introducing reforms to increase affordability

Current situation

The provision of public transport services such as bus and rail lines, waterway lines as well as urban transport services (typically metro, trams, buses) are expensive to build and run with authorities often finding it difficult to cover the costs of operations with fare income (given the need to also make the journey affordable for users). As a result, the European Metropolitan Transport Authorities note an increasing reliance on non-fare forms of funding, including subsidies, with these covering an average of about 45% of costs (EMTA, 2017 and EMTA 2019).

Initiatives underway

In some parts of the region, market reforms have been introduced into the procurement of public transport services that have led to service improvements. For instance, van Dijk (2007) reported subsidy savings in the initial rounds of tendering of regional railway services subject to public service obligations in the Netherlands whereas Alexandersson and Hultén (2009) reported both increases and decreases in similar cases in Sweden. The European Commission estimates that tendering for rail public transport services has introduced savings of about 30% for local authorities tendering these services. Some of these savings have then been used to fund other activities within the local authority budgets while others have been ring-fenced to provide higher quality public transport services (e.g. new trains, more services, station upgrades, etc.).

155 More information on THE PEP Relay races can be found here: https://thepep.unece.org/relay-race-workshops.

Similarly, the use of other types of Public Private Partnerships in the construction of necessary infrastructure can make transport solutions more affordable. This is common for major transport infrastructure projects. However, several technical and financial aspects make designing and running a PPP a task for expert authorities. This is even more true if the outcome expected from the PPP extends beyond the provision of infrastructure to its operation according to a quality standard. To support such work, the UNECE has developed the concept of People first Public Private Partnership.[156] In addition, the UNECE has taken up the challenge of supporting the deployment of People first Public Private Partnerships for infrastructure by providing guidance as to how the assessment and the set-up of Public Private Partnership elements can be designed to support the eradication of poverty, the creation of economic opportunities through improved transport, as well as transport that is efficient, less dependent on fossil fuels, and provides access and mobility to vulnerable members of society (UNECE, 2019a). People first Public Private Partnership standards on roads and railways are already available from the UNECE International Centre of Excellence in Public-Private Partnership while those on urban rail are being developed.[157] The UNECE International Centre of Excellence in Public-Private Partnership is also collecting examples of PPP procurements that aspire to be People first Public Private Partnerships and that are in operation. For each case study the relevance to the SDGs is explained. These case studies include the Maintenance of the Barcelona Ring Roads[158] and the design, financing, building, and operation of tram lines in Barcelona[159] as well as other examples from outside of the ECE region.

In addition, the mixed success of Public Private Partnerships has led international organizations to develop guidelines and knowledge bases. The World Bank, for instance, has a legal Resource Centre on PPPs with a section dedicated to transport projects.[160] It also maintains, with other entities, a Private Participation in Infrastructure Database[161] focused on low- and middle-income countries, including sections on transport projects.

Several multilateral development banks and international organizations, including UNECE, maintain the PPP Knowledge Lab[162] which collects information from around the world on Public Private Partnerships including reference material and case studies. In addition, the European Investment Bank has created the European PPP Expertise Centre.[163]

2.3.4 Accessibility for people and business

Current situation

In considering issues of affordability it is also important to evaluate the level of accessibility for individuals to the wider community and, in particular, to jobs. A key pillar for sustainable mobility is accessibility for all. The UNECE publication: "Transport for Sustainable Development – The case for Inland Transport" identifies the following as being key challenges in this area:

- Rural accessibility which is a challenge in all regions
- Rapid urbanization which requires the redesign of urban mobility solutions
- Insufficient access to public transport solutions in many urban areas
- Soft mobility solutions such as walking and cycling are often not possible or are unsafe
- Infrastructure quality is unsatisfactory in several countries (efficiency chapter)
- Insufficient infrastructure for people with reduced mobility
- Congestion is limiting accessibility.

156 People first Public Private Partnership at the UNECE International PPP Centre of Excellence: www.uneceppp-icoe.org/people-first-ppps.

157 Completed PPP Standards – https://wiki.unece.org/display/pppp/Completed+PPP+Standards.

158 Comprehensive maintenance of the Barcelona Ring Roads, Spain – www.uneceppp-icoe.org/people-first-ppps-case-studies/ppps-in-road-transport/comprehensive-maintenance-of-the-barcelona-ring-roads-barcelona-spain/.

159 Barcelona Tram Service, Barcelona, Spain – www.uneceppp-icoe.org/people-first-ppps-case-studies/ppps-in-road-transport/barcelona-tram-service-barcelona-spain/.

160 World Bank Public-Private-Partnership Legal Resource Center – https://ppp.worldbank.org/public-private-partnership/.

161 PPI Database – Private Participation in Infrastructure Database – https://ppi.worldbank.org/en/ppi.

162 PPP Knowledge Lab – https://pppknowledgelab.org/.

163 European PPP Expertise Centre – www.eib.org/epec/.

Accessibility issues for the business community are very much linked to their ability to move goods effectively and as such are very much linked to the transport efficiency issues covered in the efficiency chapter.

Initiatives underway

Both national and local authorities across the ECE region are implementing solutions to improve accessibility for the entire population. This often involves promoting alternative forms of transport where possible (discussion on affordability) through dedicated investment in, for example, bicycle lanes and introducing bike or car sharing schemes. UNECE, through its collaboration with WHO/Europe in THE PEP is also working extensively to provide member States with the opportunity to discuss solutions and good practice in improving accessibility. In addition, the infrastructure agreements mentioned in the efficiency chapter also provide solutions for ensuring accessibility for people and businesses.

Challenges

Affordability and accessibility remain a key challenge for ensuring sustainable mobility and transport. UNECE has a number of mechanisms at its disposal to help member States address this aspect of sustainability. UNECE transport working parties already deal with issues of financing transport infrastructure. These work in parallel to the wider work that is being undertaken on PPPs described above. Closer coordination of these activities going forward would be to the benefit of member States. For example, knowledge collection and sharing on transport-related PPPs are critical. The work of the UNECE International Centre of Excellence in Public-Private Partnership to develop guidelines and to document effective People first implementations of the PPPs is essential, as demonstrated by the relevance of this work beyond the ECE region.

The integrated transport, health and environment role of THE PEP is a further tool to identify affordable solutions for sustainable mobility whilst ensuring that accessibility aspects are considered. The strengthening of the work on THE PEP that will should follow the Fifth High-level Meeting of THE PEP will further cement its key role in this area.

The provision of intergovernmental platforms for sharing of good practices through THE PEP as well as through its working parties remains a strong tool at the disposal of the UNECE to facilitate efforts to increase affordability and accessibility. In the same way, the continual evolution of the infrastructure legal agreements (e.g. AGC, AGN, AGR, AGTC) means that UNECE has a central role in facilitating accessibility.

Looking to the future, there is no harmonized international approach to facilitating accessibility to transport for people with reduced mobility. This is a potential area of further work for UNECE.

2.4 Transport safety

2.4.1 Introduction

Sustainable mobility must also be safe: there should be no fatalities, injuries or property damages due to transport. This currently is not the case even though it is widely recognized that many accidents, and related fatalities and injuries, are preventable. The gap to close in road transport is clearly the largest since data show that it is the least safe transport mode.[164] While railways and inland waterways are much safer, there are still improvements to be made in those sectors.

164 Those are SDG 3: Good health and well-being and SDG 11: Sustainable cities and communities, as discussed in section 0 on 2.4.2 Road safety.

2.4.2 Road safety

Introduction

The UN proclaimed the period 2011-2020 as the Decade of Action for Road Safety[165] "with a goal to stabilize and then reduce the forecast level of road traffic fatalities around the world by increasing activities conducted at the national, regional and global levels". The Resolution of the UN General Assembly also set out the areas where work is required: road safety management, road infrastructure, vehicle safety and road user. In essence, a systemic approach is necessary.

SDG 3 "Good health and well-being" set a challenging target for road safety: by 2020, halve the number of global deaths and injuries from road traffic accidents[166] (compared to 2010). In fact, based on current figures from the International Traffic Safety Data and Analysis Group – IRTAD (2019) indicated that it is unlikely that the target will be met even though, for many countries, 2018 statistics reveal significant reductions in fatality rates.

Figure 10 compares fatality rates for 2007 and 2017 showing that there are marked differences across countries in terms of road safety. Fatality rates were reduced over this ten years' period in the vast majority of ECE countries, with the countries with the lowest rates in 2007 further improving their road safety results. In addition, countries with the highest fatality rates in 2007 also markedly improved their fatality statistics. However, much more work is required to fill the gap between those countries and the safest ones. As a comparison, WHO has indicated that the average global mortality rate in 2017 was 183 road deaths per million inhabitants.[167]

Road safety involves all road users: Figure 11 shows that many road casualties are vulnerable road users such as pedestrians and cyclists and that the relevance of this problem differs by country. In fact, with bicycle transport becoming more popular, bicycle safety records in countries such as Sweden, the Netherlands and Norway have worsened (IRTAD, 2019). The same statistics also show that vehicle occupants are those who continue to benefit the most from road safety improvements. Further, Figure 12 underlines the importance of road safety is a particular issue in cities. UNECE (2010) and IRTAD (2019) also noted that speeding, drunk driving, and the use of mobile devices are prominent factors in fatal crashes. In order to achieve substantial improvements in road safety it is crucial that a systemic approach is implemented across the ECE region which covers:

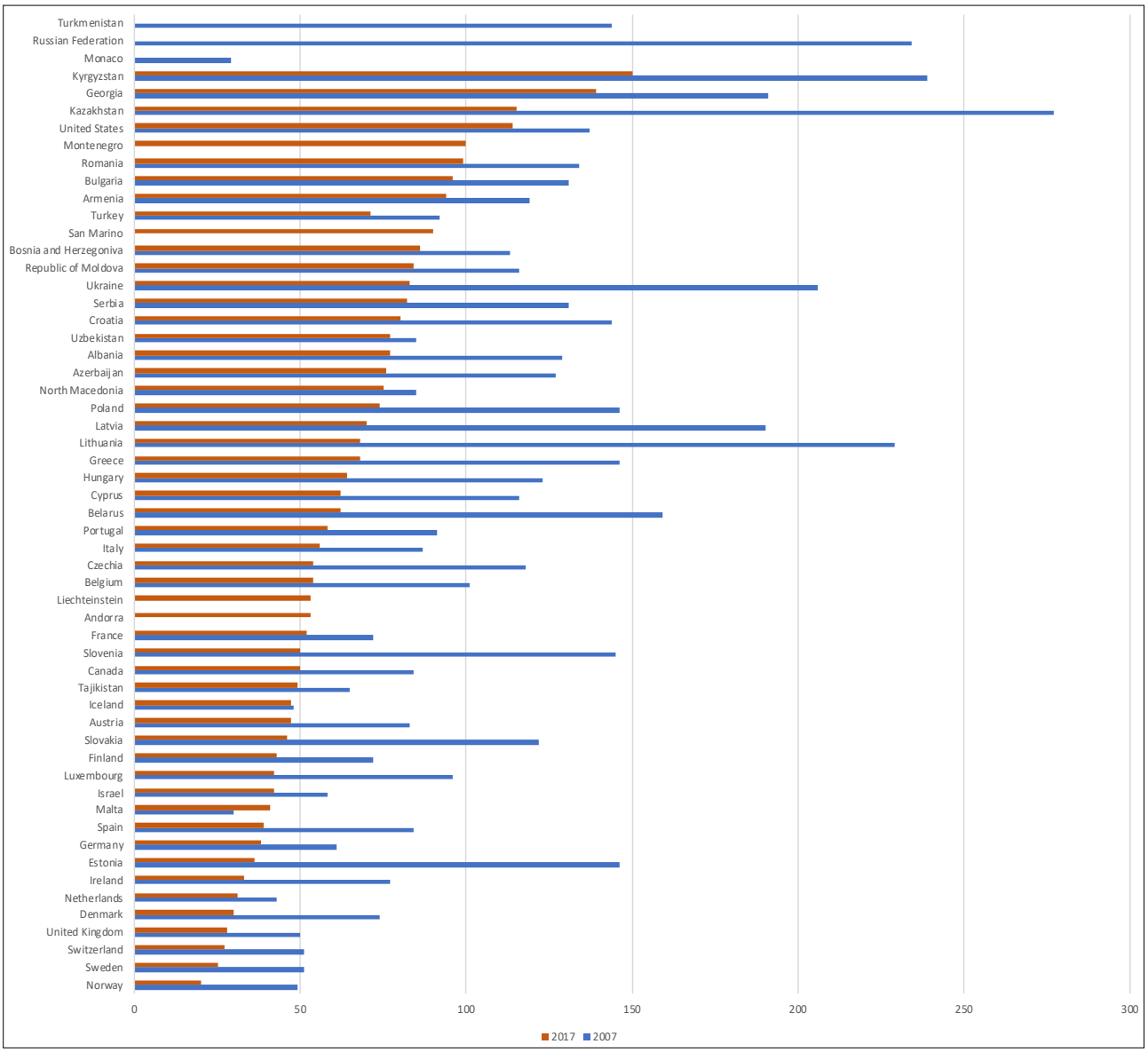
- Road traffic rules that are in place and compliance.
- Vehicles that are designed and built to provide high safety levels for both the occupants and other road users.
- Road safety management systems which follow an approach that considers all the elements making up the traffic system.
- Specific attention to vulnerable road users such as pedestrians, cyclists, and motorcyclists
- Giving a prominent role to safety provisions in transport policy and planning
- Professional drivers implementing rules that safeguard their own safety and that of other road users
- The treatment and transport of goods that pose particular risks according to procedures that guarantee safety along the entire transport chain.

165 United Nations General Assembly resolution 64/255 on Improving global road safety.

166 Further, SDG 11.2 target is: "by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.".

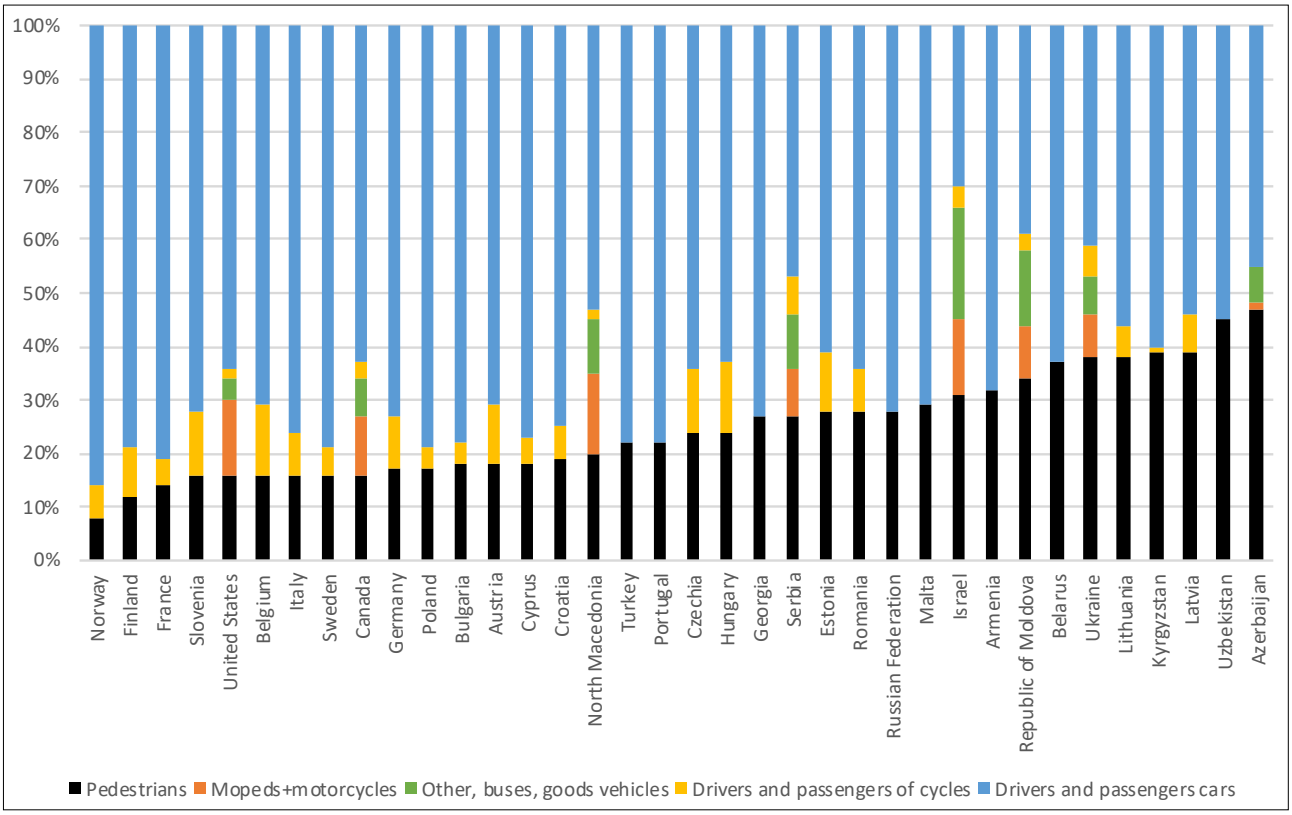
167 WHO. Global Status Report on Road Safety. 2018

Figure 10: Comparison of 2007 and 2017 road fatalities rates in the ECE countries, ordered from the highest to the lowest rate recorded in 2017; 2017 data for Monaco, Russian Federation and Turkmenistan are not available



Source: UNECE.

Figure 11: Fatalities as a share of classes of road users. Latest data available for each country. Not all statistics consider separately all classes of road users



Source: UNECE Transport statistics database.

Road traffic rules

Current situation

For the safe and efficient use of infrastructure, vehicles must be operated in a safe and consistent manner with users having a clear understanding of how they are expected to behave in any situation that may occur.

Prescriptions on the appropriate way to drive vehicles are set out in national road codes which include descriptions of the meaning of signals. National road codes need to evolve with changing needs and vehicles, for instance prescribing the use of new safety systems (as was the case for safety belts) or considering new vehicles and their interaction with other road users (for instance e-scooters). Enforcement of these rules is critical, as is the sharing of good practices between countries on how best to apply laws.

Initiatives underway

Most traffic codes across the world are based on the 1949 Convention on road traffic[168] which prescribes the rules of the road for vehicles and pedestrians, conditions for the admission of road vehicles in international traffic and the conditions for drivers to obtain or renew a driving licence. Models for standard national and international driving licences are also defined in order to ensure their international recognition. The 1949 Convention was followed and updated by the 1968 Convention on road traffic.[169] Best practices and guidance on the practical application of the

168 Convention on Road Traffic, of 19 September 1949.

169 Convention on Road Traffic, of 8 November 1968.

Conventions is discussed in the Consolidated Resolution on Road Traffic[170] which reviews issues such as speed and its effects, driving under the influence of alcohol or other substances, seat belts and the use of mobile phones by drivers.

The Convention on Road Signs and Signals[171] is another key legal instrument established in 1968 to facilitate trade and ensure road safety. It is the base of most national road signs globally and defines their shapes, colours and graphic symbols.

Vehicles

Current situation

Vehicles need to be as safe as technologies allow, best safety standards on vehicles should be adopted widely and, at the same time, vehicles and parts should be traded freely. For this to happen, the characteristics of vehicles, subsystems and parts must undergo a process of continuous updating to follow technical progress. In order to share improvements across countries and allow trading of vehicles and subsystems without the need for multiple approvals (trade in motor vehicles and motor vehicle parts is among the most important worldwide) it is necessary that vehicles, subsystems and parts are made to the same standards.

Initiatives underway

Standards are defined globally by the World Forum for Harmonization of Vehicle Regulations of the UNECE[172] and are based on three Agreements:

- The 1958 Agreement on Vehicles Construction Regulations,[173] which deals with the approval of vehicles, systems and parts concerning, in particular, safety, environmental protection (including maximum emission levels), energy efficiency and theft prevention;
- The 1998 Agreement on Global Technical Regulations[174] which runs in parallel to the 1958 agreement and allows countries to develop UN Global Technical Regulations for vehicles and components covering the same aspects mentioned above;
- The 1997 Agreement on Periodical Technical Inspections[175] which sets the legal framework and defines uniform conditions for periodical technical inspections of wheeled vehicles and their international recognition.

The Agreements by the World Forum for Harmonization of Vehicle Regulations are open to contracting parties outside of the ECE region, making them truly global. Current work at the World Forum for Harmonization of Vehicle Regulations includes the development of regulations for ITS and autonomous vehicles.

Even while this work is global in nature, not all countries around the world have applied these requirements. This means that two cars bought in different parts of the world may look the same on the outside but actually have different systems on-board meaning that occupants and other road users do not benefit from the same level of safety. Harmonization to the highest level would be to the benefit of all users and increase sustainability for all road users.

170 Consolidated resolution on road traffic (R.E.1) (January 2010).

171 Convention on Road Signs and Signals, of 8 November 1968.

172 WP.29 is the UN World Forum dedicated to technical regulations applied to the automotive sector, addressing the safety and environmental performance of wheeled vehicles, their subsystems and parts. See UNECE (2019) World Forum for Harmonization of Vehicle Regulations (WP.29) – How It Works, How to Join It. www.unece.org/index.php?id=51355.

173 Agreement concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations done at Geneva on 20 March 1958, including the amendments entered into force on 14 September 2017.

174 Agreement concerning the establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles, signed in Geneva on 25 June 1998.

175 Agreement concerning the adoption of uniform conditions for periodical technical inspections of wheeled vehicles and the reciprocal recognition of such inspections, done at Vienna on 13 November 1997.

The safe system approach to road safety

Current situation

Road safety policies and initiatives should be designed to make roads safe for all users. The common approach to road safety is concerned with accidents and considers road users to be responsible for them. Consequently, road safety action is mostly about changing road users' behaviour to minimize accidents. Better results can be obtained with the safe system approach that focuses on bringing the number of fatalities and serious injuries down to zero.

The safe system approach is a change in road safety policy.[176] It places the responsibilities for fatalities and serious injuries within the system, in which the road users are one element, rather than the only responsible agent. People are at the centre of the system and it is acknowledged that they may make mistakes resulting in accidents, fatalities and serious injuries. The system accounts for this by being forgiving, anticipating and accommodating people's mistakes. The responsibility for a safe system is therefore shared by those designing and operating it rather than falling only on the shoulders of road users. The system should include technology to forgive mistakes: vehicle technologies preventing crashes, for instance, and also proper vehicle maintenance. Roads should be designed and operated to avoid creating situations that cannot be tolerated by the human body; design should anticipate mistakes by including lower speed limits and protection for pedestrians. At the same time, road users remain responsible for following the traffic rules, assisted by education and information to increase the awareness of their role.

Initiatives underway

The safe system approach was first developed in Sweden in 1994 with the Vision Zero strategy and became part of its law concerning road safety in 1997. The Netherlands tested the approach and adopted a modified version in 1997 which considers education and information to be a key part of the approach as drivers are not assumed to always comply with traffic rules. This approach also has been included as best practice in the Global Plan for the Decade of Action for road safety.[177] Several countries in the ECE region are using or adopting the safe system approach including: the Czech Republic, Finland, Germany, Ireland, Lithuania, Luxembourg, Norway, Slovenia, Spain and the United Kingdom. The European Union adopted it recently, in 2018, and is developing related action plans (IRTAD, 2019). These countries stand out among the safest in the region as shown in Figure 10. It is urgent that a similar road safety culture be taken up in other countries so that their safety records also improve.

UNECE is fostering the safe system approach in several activities including the Road Safety Reviews for UNECE and non ECE countries[178] and the Road Safety Audit guidelines for the TEM network.[179]

For planning, a wide approach which considers the five inter-related elements of road safety (management, infrastructure, vehicle, user, and post-crash services) is at the heart of the Safe Future Inland Transport Systems (SafeFITS) model[180] that was made available in 2017 by the UNECE. This is used for assessing road safety intervention scenarios and forecasting the effects of combinations of measures.

Furthermore, the work of the UN Secretary General's Special Envoy on Road Safety has been a driving force in promoting this approach and the implementation of the road-safety-related UN transport legal agreements and Conventions. Promotion of the safe system approach as well as other initiatives focused on improving road safety will be further facilitated with the introduction of the United Nations Road Safety Trust Fund which will provide funding for specific projects aimed at improving local, regional or national road safety.

176 OECD (2008) Towards Zero – Ambitious Road Safety Targets and the Safe System Approach.

177 WHO Global Plan for the Decade of Action for Road Safety 2011-2020: www.who.int/roadsafety/decade_of_action/plan/plan_en.pdf.

178 Delivered for Albania, Georgia, Cameroon: www.unece.org/trans/wp1/publications.html.

179 UNECE (2018) Road Safety Audit and Road Safety Inspection on the TEM network: www.unece.org/fileadmin/DAM/trans/main/tem/Road_Safety_Audit_and_Road_Safety_Inspection_on_the_TEM_Network.pdf.

180 SafeFITS – A road safety decision-making tool – www.unece.org/trans/theme_safefits.html.

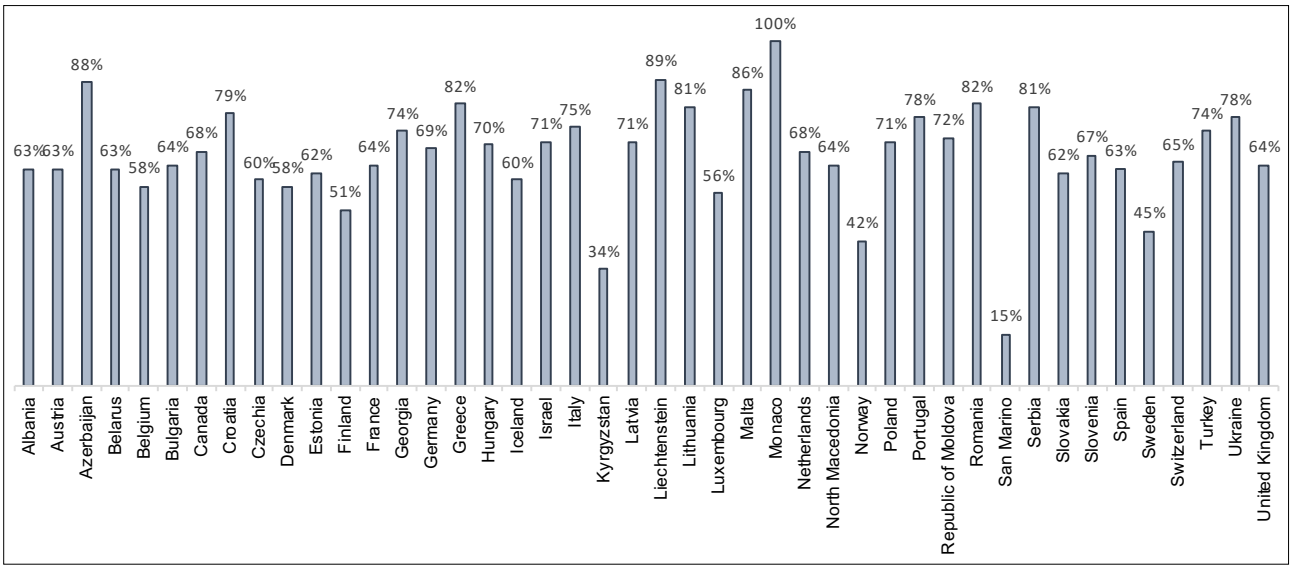
Urban road safety

Current situation

Road safety is also a precondition for sustainable cities and urban transport. Figure 12 shows that, in the vast majority of countries, road accidents happen more frequently in urban areas than elsewhere. SUM4all[181] indicates that fatality risks for car occupants are much lower than for motorcyclists, cyclists and pedestrians. People who travel by bus are ten times safer than by car which is in line with SDG target 11.2 aiming to improve road safety by expanding the role of public transport, which is particularly relevant for cities.

As urban road safety is about tackling the problem of deaths and injuries, it requires analyzing local situations and devising ways to enhance overall safety (including awareness initiatives and preventive action on topical issues such as speeding, drunk driving, helmet wearing, and mobile phone use) as well as promoting safer forms of transport, and taking into consideration the numerous vulnerable road users in cities. For instance, in London, all vehicles used by city contractors must have blind spot pedestrian detection systems.

Figure 12: Percentage of road accidents in built up areas in 2017



Source: UNECE Transport statistical database.

Initiatives underway

Urban road safety is addressed by the European Union guidelines for Sustainable Urban Mobility Plans[182] (SUMPs) which advocates the Safe System approach described above and is included in the third European Union Mobility Package of 2018. In particular, the SUMP guidelines on road safety and active travel[183] suggest that improving road safety should be part of a wider effort to increase active travel and travel by public transport whose uptake -in turn- increases road safety, as in the Vision Zero action plan of London (2018). The guidelines also suggest coordination among actors and citizens on wide ranging actions. Monitoring and criteria for selecting actions within the safe system framework are suggested with pointers to a number of existing information platforms that cities can use to learn from one another's experience. One example is the Safer City Streets[184] network managed by the International Transport

181 SUM4all Global Mobility Report 2017 – www.sum4all.org/publications/global-mobility-report-2017.

182 Rupprecht Consult (ed) (2019) Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, second edition.

183 Urban Road Safety and Active Travel in Sustainable Urban Mobility Planning: www.eltis.org/sites/default/files/urban_road_safety_and_active_travel_in_sumps.pdf.

184 Safer City Streets: www.itf-oecd.org/safer-city-streets.

Forum (ITF) which also hosts data on helmet and seat-belt wearing in urban areas. Indeed, the sharing of experiences among urban areas in order to fill knowledge gaps is identified as one of the main results by an ITF study.[185]

UNECE is contributing to building effective frameworks for tackling urban road safety with the activities of THE PEP, which produced a guide to developing national transport, health and environment action plans[186] (NTHEAP) and a Handbook on Sustainable Transport and Urban Planning UNECE (2019b), which was at a draft stage in late 2019. These two documents use an approach similar to the European Union's SUMPs, though the NTHEAP has a wider scope and makes the link between transport, health and environment.

THE PEP has also developed a study on signs and signals for cyclists and pedestrians that builds on a comparison of best practices in several countries in order to use signing to promote active mobility.[187]

Road professionals

Current situation

Road professionals often drive long hours and are, therefore, exposed to fatigue which has been identified as an important risk factor for road safety as reported in Peden et al. (2004). In Europe, driver fatigue is a significant factor in about 20% of commercial transport crashes. The same report also mentions a survey revealing that long-haul drivers have admitted that at some time during their careers they have fallen asleep while driving and reported data from a study that found that fatigue was a factor in about 30% of fatal crashes involving heavy goods vehicles. Roads must be made safer by taking adequate measures to prevent fatigue, including for professional drivers.

Initiatives underway

Appropriate working hours and rest times for professional drivers have long been monitored with mechanical tachographs thanks to the European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport (AETR)[188] issued in1970. The Agreement sets out maximum driving hours per day and per week and prescribes breaks and rest periods, requiring a tachograph to ensure proper application. At a sub-regional level, in 2005, the European Union made digital tachographs compulsory on new vehicles for goods transport[189] (with a mass of 3.5 tonnes or higher) and for passenger transport (for more than nine people). The European Union Directives were also created to prevent and deal with possible digital tachograph tampering. Starting in June 2019 a new kind of device, the smart digital tachograph, became compulsory for new professional transport vehicles in the European Union. The new tachograph includes connectivity features such as satellite positioning of vehicles and transmission of information to authorities via short range communication technology. Current regulations on driving and rest times in the European Union are set by the Regulation (EC) 561/06.

Road transport of dangerous goods

Current situation

Road is the most important mode for inland transport of chemicals[190] which are the most traded type of good worldwide and include many dangerous products. Dangerous goods include flammable, explosive, toxic and

185 Safer City Streets. Global Benchmarking for Urban Road Safety: www.itf-oecd.org/sites/default/files/docs/safer-city-streets-global-benchmarking-urban-road-safety.pdf.

186 Developing national action plans on transport, health and environment.

187 Signs and signals for cyclists and pedestrians: https://thepep.unece.org/sites/default/files/2017-05/Signs_and_signals_for_cyclists_and_pedestrians.pdf.

188 European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport (AETR): www.unece.org/trans/main/sc1/sc1aetr.html.

189 Regulation (EU) 2135/1998 and Regulation (EU) 3821/1985.

190 CEFIC and Deloitte (2011) Chemical Logistics Vision 2020: https://cefic.org/app/uploads/2018/12/Chemical-Logistics-Vision-2020-190911_REPORT_TRANSPORT_AND_LOGISTICS.pdf.

corrosive products, among others. They are part of many supply chains and also are transported internationally in large quantities, which are regularly increasing. Special safety procedures must be followed to ensure the safety of those who transport these goods and of the areas across which their transport is carried out. Safety procedures need to be consistent across borders in order to maintain the same safety levels and facilitate trade.

Initiatives underway

The international legal framework for managing the transport of dangerous goods is the European Agreement concerning ADR,[191] serviced by UNECE. The ADR exists to determine which goods may be transported internationally and how transport should be carried out so as to prevent accidents or minimize their effects. Staff working on the transport of dangerous goods is required to undergo appropriate training which is internationally recognized. Internationally consistent communication of information about the dangerous goods transported is ensured by the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) which is used also during the production and consumption of these goods.

Challenges

The challenges for improving road transport safety are still those highlighted by the United Nations General Assembly resolution 64/255: road safety management, road infrastructure, vehicle safety and road user behaviour.

Harmonization of regulations on the use of roads and for vehicles remains prominent as does the exchange of best practices. UNECE has a well-established pivotal role in these areas which should be sustained. However, as situations vary widely across countries and rules and regulations are not always implemented and enforced with the same intensity, UNECE should take a further step and look into implementation, starting with data collection and best practices and going further in order to sustain the efforts of the countries that lag behind.

Implementation support should also be provided with capacity building to support adoption of the safe system approach, so that the results and recommendations from safety reviews and the more general work of the UNECE find actual application. Appreciation of the safe system should be fostered across professionals dealing with transport, including through its introduction into their education and training, so that the safe-system approach to thinking is mainstreamed and action on safety goes beyond localized remedial measures. Actions along this line include further fostering comprehensive planning approaches with capacity building exercises as well as the development of pilot projects demonstrating application of the safe system approach.

2.4.3 Railway safety

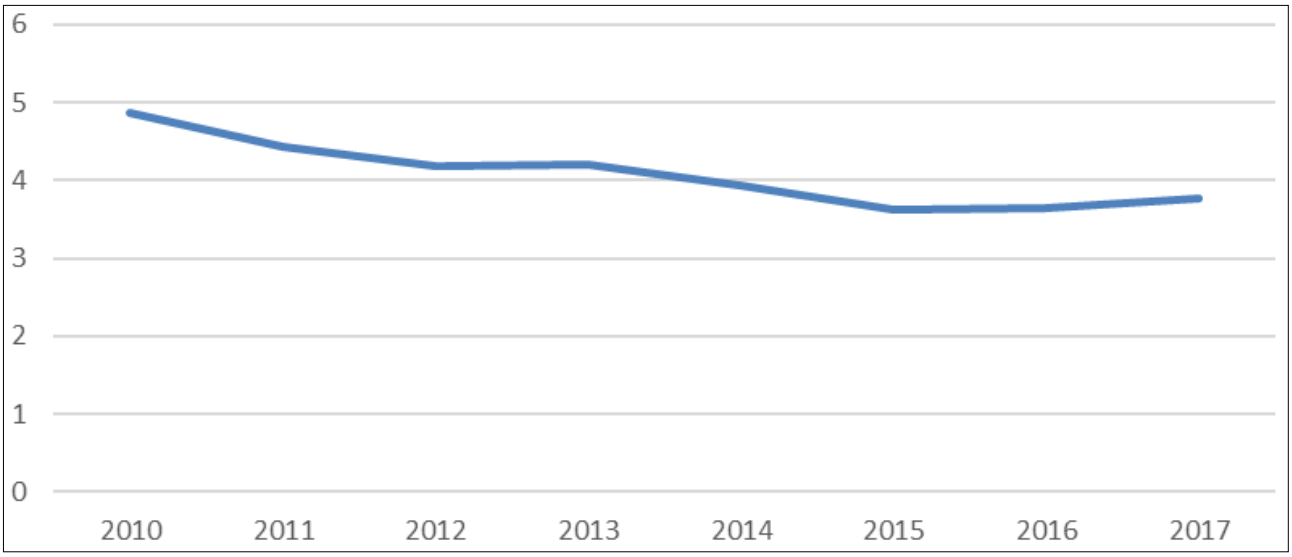
Introduction

Railway related accidents and fatalities are significantly lower than those on roads and have been improving over recent years with reductions in the number of significant incidents. UIC's[192] accident data, which covers most ECE countries, and is summarized in the UIC global safety index that weights types of incidents and consequences, shows an improving trend. Also data discussed by UNECE (2019c) considering the whole of the ECE region, shows improving safety records with fatalities decreasing form 2010 to 2017 (Figure 13). However, the same report noted that behind the general trends national values are extremely varied.

191 ADR entered into force on 29 January 1968 whose global scope has been underlined in May 2019 with the adoption of an amendment to remove the word "European" from the title of the ADR: www.unece.org/trans/danger/publi/adr/adr_e.html.

192 UIC safety DB – https://safetydb.uic.org/.

Figure 13: Evolution of UNECE rail accident fatalities (total fatalities per billion passenger-km), 2010-2017



Source: UNECE, 2019c.

Notwithstanding the generally good performance rail also requires improvements in safety. A prime source of concern revealed by both UIC and UNECE data is the number of accidents involving individuals hit by trains, often trespassers, as well as the number of accidents at level crossings.

There are also other aspects of railway safety, namely those concerned with the safety of infrastructure use and train circulation. Circulation control and safety systems differ in each country but the latest developments, such as the adoption of the European Rail Traffic Management System (ERTMS), endeavour to standardise these safety aspects across borders and provide for harmonised safety rules and equipment, thus building on existing best practice and the latest technological developments.

Management of railway safety

Current situation

Railway safety has historically been developed separately in each country resulting in different regulations concerning train safety and circulation as well as separate lineside and on-board safety equipment. Further, notwithstanding international cooperation among railways, methods to measure safety results and safety targets have differed.

Initiatives underway

The European Union has developed a system of regulations and equipment to unify railway safety in its rail system and replace national rules and standards. Unified railway safety equipment is part of ERTMS, mentioned earlier and is being deployed in Europe according to an action plan adopted in 2017 and starting with the main transport corridors, as it also enables safety at high speeds. ERTMS is also being deployed in countries outside of Europe. To ensure actual interoperability of ERTMS systems, market solutions must be approved by the European Union Agency for Railways. This is a result of the technical pillar of the Fourth European Union Railway Package[193] which also mandates the adoption of railway safety management systems and sets indicators to measure progress toward common targets.

193 The technical pillar of the 4th Railway Package is composed of Regulation (European Union) 2016/796 on the European Union Agency for Railways (ERA) and repealing Regulation (EC) n° 881/2004; Directive (European Union) 2016/797 on the interoperability of the rail system within the European Union (Recast of Directive 2008/57/EC); Directive (European Union) 2016/798 on railway safety (Recast of Directive 2004/49/EC): https://ec.europa.eu/transport/modes/rail/packages/2013_en.

The same Package mandates the progressive harmonization of national technical rules as the Technical Specifications for Interoperability (TSI) are being extended. The TSI define the features of each railway subsystem from infrastructure to rolling stock, operation and traffic management.

Safety action on level crossings

Current situation

Accidents at level crossings have been the focus of many rail safety actions in recent years. Measures to improve level crossing safety include the replacement of the crossings with underpasses or overpasses or the replacement of passive level crossings with active ones (which warn or protect crossing users at the time of train arrival). However, improvements are still required given the importance of these accidents as indicated by the data collected by UIC and by UNECE. UIC Statistics reveal that these accidents decreased between 2013 and 2015 but there has been no further improvement since then. In fact, most such incidents concern collisions with road vehicles and between 2013 and 2018 there has been an increase in resulting fatalities.

Initiatives underway

UIC and its member companies run specific initiatives on level crossing safety such as the European Level Crossing Forum, which has gathered railways since 2005 to exchange relevant information and best practices, and the International Level Crossing Awareness Day, a specialized yearly event that takes place in 28 countries. A further information initiative by the UIC, along with the International Road Union and Operation Lifesaver Estonia, was the development of safety guidance for transport professionals.[194]

UNECE facilitated the work of a specialized group of experts on Improving Safety at Level Crossings that delivered its results in 2016.[195] The final report noted the lack of consistent data across countries (indicating which indicators should be regularly collected) and provided a number of recommendations, among which the application of the safe systems approach in order to develop more suitable safety measures.

Rail transport of dangerous goods

Current situation

As railways compare well in terms of safety with road and are suitable to transport efficiently large shipments of cargo over long distances, they are particularly suitable for carrying the large and growing traffic of dangerous goods. To facilitate the safe international transport of dangerous cargo by rail, harmonized regulations are required that account for possible hazards, transport conditions and procedures in order to manage them in a consistent way.

Initiatives underway

International transport of dangerous goods by rail is regulated by the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID)[196] which are an appendix to the Convention concerning International Carriage by Rail (COTIF). RID is based on the UN Recommendations on the Transport of Dangerous Goods[197] and provides an international framework for admitted goods, vehicles and procedures, similarly to the ADR for road

194 LC Safety Tips: www.ilcad.org/LC-Safety-Tips.html.

195 Assessment of safety at level crossings in UNECE member countries and other selected countries and strategic framework for improving safety at level crossings: https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-2017-4r.pdf.

196 Regulations concerning the International Carriage of Dangerous Goods by Rail (RID), current version in effect as of 1 January 2019: https://otif.org/en/?page_id=1105.

197 UN Recommendations on the Transport of Dangerous Goods – Model Regulations. Nineteenth revised edition (2015): www.unece.org/trans/danger/publi/unrec/rev19/19files_e.html.

transport. As of May 2019, the RID does not apply to Belarus, Republic of Moldova and the Russian Federation. For those countries there is an annex to the SMGS which is aligned with the structure of the RID issued in 2001.

UNECE is facilitating the work to align the regulations concerning transport of dangerous goods by different inland transport modes: RID for rail, ADR for road transport and European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (AND) for waterways, based on the UN Recommendations on the Transport of Dangerous Goods.[198]

Challenges

The differences in safety levels across countries point to the need for harmonization of safety approaches and for setting up safety targets and initiatives with wide geographical scope. The UNECE could take up a leading role in coordinating an initiative for railway safety as it does with road safety, also considering that the stakeholders involved, such as states and rail safety agencies, can be more appropriately reached by UNECE than by the UIC, which is an association of operators. UNECE could also have a reference role with respect to safety statistics which are to a great extent already harmonized through the inter-agency activities of UNECE, Eurostat and the International Transport Forum and the joint publication on a Glossary on Transport Statistics. In this case UNECE's role would be to seek further international harmonization outside the ECE region and to increase coverage to better assess the effect of safety policies.

UNECE could also take a coordinating role in the development of interoperable safety systems and the further automation of railways in order to obtain more uniform safety levels across the region. This could parallel the work of the World Forum for Harmonization of Vehicle Regulations and would complement the efforts described elsewhere in this report to ensure the continuity of rail infrastructure and transport legal systems.

2.4.4 Inland waterway transport (IWT) safety

Introduction

Accidents on inland waterways do occur albeit in limited numbers. Accidents statistics show erratic trends that differ by country (Figure 14) and only a small portion of these concern dangerous goods. Safety in inland waterway transport needs to cover:

- Navigation rules
- Vessel technical requirements
- The qualifications of crews
- Rules for the transport of dangerous goods.

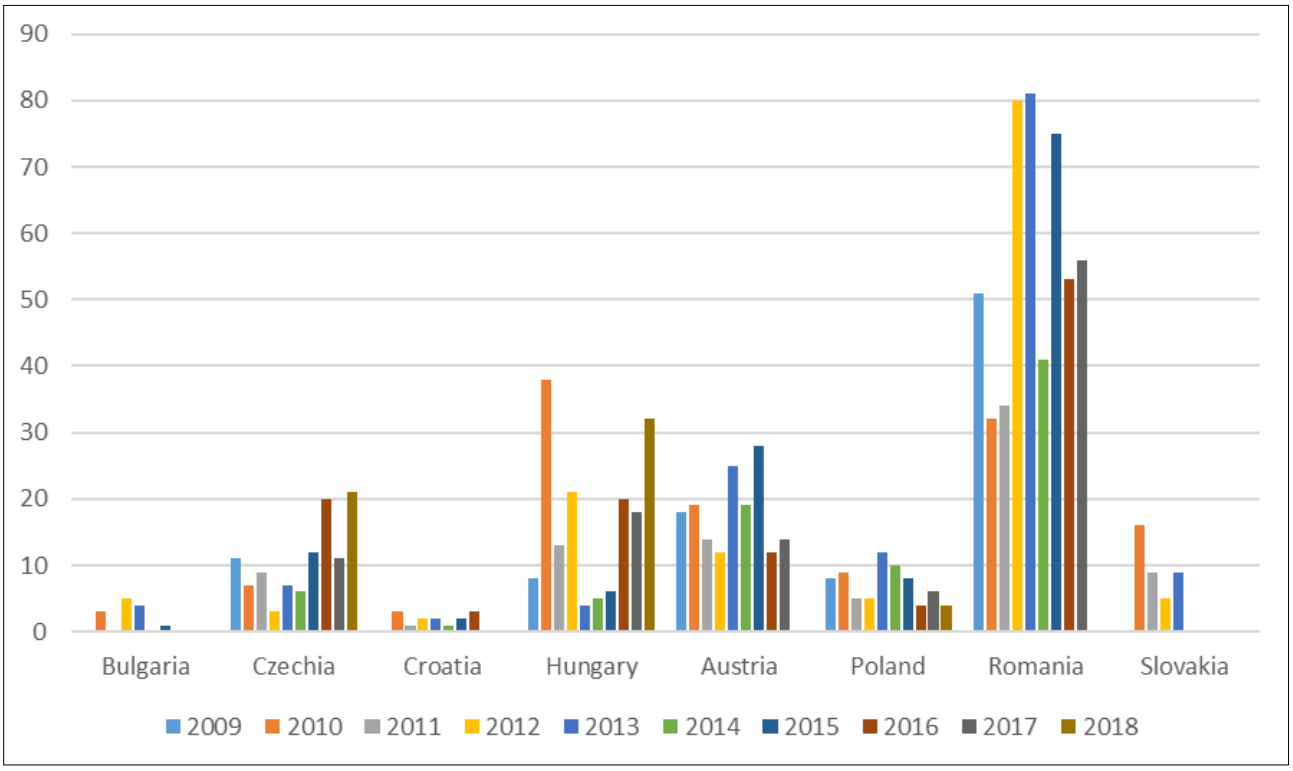
It also needs to ensure that new technological developments concerning automated navigation are taken into consideration both as a safety enabler (with partial automation assisting boat masters with manoeuvres) and as a safety issue due to full vessel automation.

It is noted in Mintjes and Boll (2016)[199] the sector lacks a general safety culture, which exists instead in maritime navigation, and that there are several different safety regimes in effect. This is compounded by the lack of reliable and easily accessible statistical data on inland waterway accidents.

198 Harmonization of RID/ADR/ADN with the UN Recommendations on TDG (WP.15/AC.1/HAR): www.unece.org/trans/main/dgdb/har/har_age.html.

199 www.unece.org/fileadmin/DAM/trans/doc/2016/sc3wp3/ECE-TRANS-SC3-WP3-2016-Pres03e.pdf

Figure 14: Number of inland waterway accidents in a selection of European Union countries



Source: Eurostat.

Navigation rules

Current situation

Navigation rules are essential for inland waterway transport security as they provide the basis for safe and consistent behaviour by users and for the coherent communication of messages to boat masters through signs and radio communications. However, sub-regional regimes persist in this area and the ECE level system set out in the European Code for inland waterways (CEVNI) and on the Guidelines for Waterway Signs and Marking (SIGNI)[200] are only applied in a subset of member States. The same is also true for the framework defining standard radio communications.[201]

Vessel technical requirements

Initiatives underway

Technical requirements for vessels need to be regulated to ensure that vessels unfit to meet safety standards are not allowed to navigate. ECE initiatives in this area include the framework for the harmonisation of technical features of vessels and the international recognition of ship's certificates which has been in place since 1975 as part of a UNECE recommendation (resolution No. 61) which also concerns manning requirements on vessels. A separate resolution[202] provides guidelines for passenger vessels to ensure they are suited to carry people with reduced mobility. Technical requirements for vessels carrying dangerous goods as well as provisions for their certification, international recognition of certifications, and operations are contained in the European Agreement concerning the International Carriage

200 CEVNI and SIGNI: www.unece.org/trans/main/sc3/how.html.
201 Standardized UNECE Vocabulary for Radio-Connections in Inland Navigation – Resolution No. 35.
202 Guidelines for Passenger Vessels also suited for carrying Persons with Reduced Mobility – Resolution No. 69.

of Dangerous Goods by Inland Waterways (ADN).[203] In parallel, sub-regional systems persist. For example, national rules in Germany, the Netherlands and Hungary are generally based on provisions of the Central Commission for the Navigation of the Rhine (CCNR).

More recently, the European Union formed with the CCNR a European Committee for standards in the field of inland navigation (CESNI) whose work resulted in the alignment of European Union and CCNR regulations that now form the Technical Requirements for Inland Navigation vessels (ES-TRIN).

Qualifications of crews

Initiatives underway

Non-harmonized qualifications of crews create a potential risk for safety. Bringing all the various systems together would create a common framework or syllabus for crew education (a pressing need also in view of the increasing age of the crews now working) and the recognition of certificates. Work of the European Union and CCNR is currently focused on harmonizing the existing regulations. UNECE deals with requirements for boat masters' certificates as well as the framework for their international recognition with resolution No. 31 while resolution 61 indicates working and rest hours of ships' crews.

Mintjes and Boll (2016) in a review of safety on Northern European waterways noted the lack of a safety culture in the sector and the need for a common language for crews and staff at hydraulic works that could be borrowed from RIVERSPEAK, the simplified English developed by EDINNA (the Educational network of inland waterway navigation schools and training institutes)[204] and the Central Commission for the Navigation of the Rhine.

IWW Transport of dangerous goods

Initiatives underway

Eurostat data indicate that in 2017 dangerous goods transport on European Union waterways (primarily in the Netherlands) was almost exclusively for flammable liquids. The carrying capacity and the safety level afforded by vessels make inland waterways an attractive option for the transport of hazardous substances.

Appropriate safety levels are guaranteed by regulations and vessel inspections. Also, in the case of transport of dangerous cargo the CCNR led the way in developing its own set of rules. Work with UNECE resulted in 2000 in the ADN which entered into force in 2008. The ADN was also transposed into European Union legislation with Directive 2008/68/EC concerning all inland transport of dangerous goods.

Challenges

Inland waterway safety requires better statistical records to assess policy needs and effectiveness and UNECE should take up a role in standardizing and improving the collection of such data.

Harmonization of regulations covering Inland Water Transport is still ongoing with the exception of the ADN for dangerous goods which is already harmonized. UNECE should explore the remaining needs and act as platform for further work, building on its collaboration with the various River Commissions.

There is scope for UNECE initiatives in the education of crews. UNECE could also foster relevant training of present crews, putting forward best practice that considers the size of the companies (with many family-run vessels in the Western part of the region and shipping companies running several vessels in the Eastern part).

203 European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways, entered into force in 2008.

204 www.edinna.eu

Automation of the sector is being explored building on the deployment of RIS. UNECE should support the further deployment of RIS and the development of technical standards for the safety of automated vessels in a way similar to the role it currently has for road vehicles.

2.4.5 Intermodal transport safety

Appropriate loading of intermodal transport units

Current situation

Intermodal transport safety concerns the safe transport and transhipment of intermodal units irrespective of their content to protect workers and the public from accidents as well as to avoid damage to cargo or transport equipment. As several stakeholders are involved in intermodal transport, a common set of rules is needed in order to consistently manage safety risks. Safe packing and handling of this cargo is essential to ensure safety for all workers.

Initiatives underway

The IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code) is the reference document and standard in this area. The instructions it provides indicate how best to handle these units (mainly containers) and thus minimize injury. The CTU Code is being used increasingly across the world and has become the basis for national legislation on the matter in Japan and South Africa. It is important that UNECE continue its activities of promoting and updating the CTU Code to ensure that intermodal transport becomes safer.

2.5 Transport security

2.5.1 Introduction

Inland transport security concerns a wide array of risks including:

- Attacks on people, damage to goods, damage to or attack on assets including infrastructure, vehicles, control and communication systems;
- Theft of assets, such as vehicles, and theft of goods, including dangerous goods;
- Illegal border crossing/trafficking of people and goods.

To ensure sustainability, security risks and events must be prevented and managed. These are challenging tasks since:

- Most inland transport infrastructure and vehicles are unprotected or have limited protection;
- A large number of stakeholders with different remits and status are involved, including police and security services, and their work needs to be coordinated;
- There are national or industry security requirements to comply with;
- Measures to protect passengers, goods and assets must allow smooth movement of passengers and freight on transport networks.

The following sections review a selection of security challenges and initiatives across inland transport modes.

2.5.2 Prevention of theft in road, rail and intermodal transport

Current situation

Theft of cargo may occur at different steps along the supply chain. Road and intermodal cargo is particularly vulnerable to theft when trucks are in parking areas. However, vehicle parking is unavoidable in order to comply with: rest periods for drivers, general stops to the circulation of heavy goods vehicles and when vehicles are queueing to access facilities.

Appropriate measures and procedures must be put in place to minimize the risk of theft in parking areas. Transport managers and drivers need to be informed about such measures and be able to choose parking areas that guarantee suitable security.

Transport infrastructure is also subject to theft, with railways being particularly susceptible to the theft of key materials along railway lines. This creates an economic cost to the railways but can also create safety risks if the stolen material is safety critical for railway operations (for example, equipment necessary for signalling systems).

Initiatives underway

The International Road Union (IRU) and the **International Transport Forum (ITF)** have developed TRANSPark a free online tool covering 40 countries that transport operators may use to locate parking areas based on the facilities available, including security features.

The Transported Asset Protection Association (TAPA), a global non-profit trade body has developed security standards for inland transport including **Freight Security Requirements, Trucking Security Requirements** and Parking Security Requirements. TAPA standards are internationally recognized, also thanks to a certification system. The standards specify security requirements and how to maintain them as the cargo is travelling. In the case of parking facilities, the TAPA standards classify secure parking according to security levels determined by layout, perimeter set up and controls in place.

Many railways across the region are putting in place systems to monitor their networks in order to stop the theft of copper wire that annually has a significant effect on railway performance and, as mentioned above, can also create significant safety risks.

2.5.3 Cybersecurity

Cybersecurity in rail transport

Current situation

Digitalization is ever more pervasive as it is proving a remarkable means to achieve efficiency in transport. Further digitalization of transactions and the control of systems via ICT is being pursued in all inland transport sectors. One particularly striking example is the full automation of vehicles and infrastructure already achieved in several metro systems (Budapest, Copenhagen, Istanbul, Lille, New York, Paris and Vancouver to name a few in the ECE region).

However, systems controlling traffic and assets as well as transactions can be subject to cyber-attacks. Such attacks may be intended to create physical damage; to delete, corrupt or steal data; to extort money; or create damage to the reputation of operators (Hintsa, 2016). All such risks need to be identified, for existing and new systems, and suitable countermeasures must be put in place.

Railways are a critical and easily accessible infrastructure and ICT is used both for transactions and for traffic safety, as well as for high speed lines. For instance, the traffic control systems currently being deployed rely completely on ICT. The large number of systems and stakeholders that need to be connected can create security weak points. In fact, even the efforts to harmonize technologies in the interest of efficiency may create security concerns since the result also harmonizes the vulnerabilities.

Initiatives underway

Railways have been working on developing risk assessments, methods and guidelines to secure their IT system. For instance, the European Union project SECRET that ran between 2012 and 2015 produced recommendations to deal with the vulnerability of safety critical communication devices to electromagnetic attacks, that could even be misinterpreted as technical failures. The project CYRail – Cybersecurity in the RAILway sector, which ran between

2016 and 2018, developed technical recommendations to achieve cybersecurity in railway systems by design. The results followed a cyber security assessment of railway systems with the specification of suitable countermeasures and mitigation strategies.

Cybersecurity in road transport

Current situation

Road and intermodal transport cybersecurity threats include some that are common to those faced in other trade areas. In particular, small- and medium-sized enterprises may be more vulnerable due to limited financial means and human resources to invest in measures for counteracting possible cyberattacks (Hintsa, 2016).

One emerging point of interest is the cybersecurity of autonomous vehicles. Cybersecurity is "the condition in which road vehicles and their functions are protected against threats to electrical or electronic components".[205] This implies that security needs to be ensured from design through to the scrapping of vehicles and this is particularly challenging as systems need to be flexible enough to accommodate new countermeasures for as yet unknown security threats. Vehicle systems should also be designed to respond to attacks and avoid the propagations of risks to other systems. There are many cybersecurity risks ranging from those concerning back end servers, to communication channels, to vehicle software.

Initiatives underway

The European Automobile Manufacturers' Association (ACEA) in 2017 published principles for automotive cybersecurity. In the United States of America, the Auto Alliance in 2015 set up the Automotive Information Sharing and Analysis Center (Auto-ISAC)[206] with the aim to share best practices. With automated, connected vehicles, manufacturers are shifting the focus of much of their work to introducing state-of-the-art telecommunications solutions to address concerns with cybersecurity. This has called for joint endeavours across industries. For instance, Volkswagen has set up a subsidiary company to collaborate with security and communication experts.[207] Other vehicles manufactures are funding research programmes.[208]

UNECE is working on cybersecurity though its Working Party on Automated/Autonomous and Connected Vehicles (GRVA,[209] part of WP29). The GRVA has a worldwide scope and is drafting a Regulation on cybersecurity and software updates, which foresees flexible provisions in order accommodate the very dynamic nature of the sector and to leave the development of systems to manufacturers. In order to ensure vehicle lifetime cybersecurity, the draft Regulation calls on manufactures to set up Cyber Security Management Systems and national or regional authorities to assess them and issue or withdraw safety certificates accordingly.

2.5.4 Protection of rail infrastructure

Current situation

Following several terrorist attacks targeting rail passengers in past years there has been an urgent need to improve the security of rail infrastructure and terminals that are typically easily accessible.

205 ECE/TRANS/WP.29/GRVA/2019/2: www.unece.org/fileadmin/DAM/trans/doc/2019/wp29grva/ECE-TRANS-WP29-GRVA-2019-02e.pdf.

206 Automotive Information Sharing and Analysis Center (Auto-ISAC): https://autoalliance.org/connected-cars/cybersecurity/.

207 Volkswagen enters into cooperation with top Israeli experts to establish an automotive cyber security company: www.volkswagen-newsroom.com/en/press-releases/volkswagen-enters-into-cooperation-with-top-israeli-experts-to-establish-an-automotive-cyber-security-company-1715.

208 Connected Cars & Cyber Security, a new Télécom ParisTech Chair with Nokia, Renault, Thales, Valeo and Wavestone: https://media.group.renault.com/global/en-gb/groupe-renault/media/pressreleases/93595/connected-cars-and-cyber-security-nouvelle-chaire-de-telecom-paristech-avec-nokia-renault-thales-val1.

209 Working Party on Automated/Autonomous and Connected Vehicles: https://www.unece.org/trans/main/wp29/meeting_docs_grva.html.

To ensure security there must be preventive measures and response procedures to avoid malevolent acts and mitigate possible effects. However, preventative measures need to balance security requirements with what passengers deem acceptable and with costs. Response procedures need to be based on ready and reliable information.

Initiatives underway

Physical measures may be readily set up in railway stations to prevent unauthorized vehicles from entering the facilities and to store potentially dangerous items, such as unchecked luggage away from most the crowded areas and the tracks. The introduction of physical measures may be eased by the renovation or redevelopment of main stations – if these are designed with security concerns in mind.

Security gates can be used at stations to check passengers and luggage as done for Thalys services since 2015 at Paris Gare de Lyon and at the Lille Europe station in the North of France. These need to be balanced with the potential loss of travellers that related queues can cause.[210] For effective and less intrusive controls, railways are employing other active security measures such as technologies associated with security cameras. These cameras are often supplemented by cost effective security methods that use satellites to track exact train locations and detect possible obstacles on the lines[211] as developed by the French railways (SNCF) and the French National Space Studies Centre (CNES). New technologies are also assisting with cargo security and infrastructure security, such as the unmanned aerial vehicles used by the Polish railways to monitor trains, which reduced cargo losses by almost 60% (UNECE 2017a).

2.5.5 Dissemination of information about security methods, standards and norms in rail and road transport

Current situation

As mentioned in the introduction, a large number of actors are involved in providing transport security. All these actors have developed methods and best practices, often separately by transport sector or, sometimes, by country. More effective security can be delivered by overcoming this fragmentation of information and by exchanging methods and best practices, including governance frameworks for cooperation among stakeholders. Effective information exchange requires centralizing it in authoritative sources and keeping the information current.

Initiatives underway

IRU has published voluntary guidelines for goods transport[212] and for passenger transport[213] that address theft of cargo and attacks as well as terrorist threats. They are intended for use by drivers and managers of transport companies and include best practices and checklists. In 2018, the European Commission, the Cross-border Research Association and TAPA published the ROADSEC[214] security guidance for road transport operators. This includes operational information for drivers and managers as well as some indications on how technology might be used to support security.

In the railway sector, UIC maintains an extranet archive with a wealth of railway security related documents. Most recently, UIC noted the need for a user-oriented source of documentation. They also realized that rail security information lacks a unique, trustworthy access point, that is functional and up to date (Colliard, 2018). To that aim, in 2018 UIC made available a private web platform called "Security hub" which includes security measures and data. The platform is open to community inputs and may also be used to contact a network of responders with specific questions: answers are provided in 15 days and result in technical papers that are posted on the platform. UNECE has published on the internet a Rail Security Observatory in the form of a portal accessible only to authorized parties which collects information on rail security projects and publications, including outputs from relevant UNECE workshops.

210 Brodin (2016) Innovative technologies for secure transport systems.
211 Brodin (2016) Innovative technologies for secure transport systems.
212 IRU Road Goods Transport Security Guidelines.
213 IRU Road Passenger Transport Security Guidelines.
214 ROADSEC.

Challenges

The discussion above illustrates that there are a number of tested and applied governance arrangements, operational procedures and technical solutions for security that can be deployed across transport networks. Dissemination to stakeholders is central to building on existing practice. UNECE is already supports this by providing an authoritative and up-to-date platform for information about rail transport security. This role, in cooperation with sector stakeholders, could be extended to other transport modes.

Cybersecurity standards could be unified within the railway and the inland waterway sectors, in the interest of security and the interoperability of devices and software. UNECE could lead this process with an approach similar to that followed for cybersecurity in the automotive sector.

Although not discussed above, stakeholders have noted the lack of inter-governmental bodies dealing with inland waterways security (Vorontsov, 2013). UNECE could take up this role, given the level and breadth of stakeholders the topic involves. A first step could consist in facilitating the preparation of inland waterway transport security assessments and, subsequently, appropriate guidelines for the sector.

2.6 Transport and the environment

2.6.1 Introduction

Environmentally sustainable transport entails ensuring mobility while reducing and limiting energy use, all forms of emissions and land use.

All transport requires energy. If the energy to operate motorized inland transport means is obtained from the combustion of fossil fuels it leads to the emission of local pollutants and greenhouse gases (CO_2 among others). However, not all transport modes require the same quantity of energy to move the same number of people or amount of cargo, as shown in Figure 15. The challenge is to promote the use of the most energy efficient transport mode suitable for each transport need, considering also the type of energy used. Energy from renewable sources should be preferred since it leads to no or limited harmful emissions. At present, the use of energy from renewables in transport is limited, although increasing, as exemplified by the data in Figure 16, though data covering the entire ECE region is not available yet. Fostering the use of renewables is a challenge as is the promotion of electric transport means that, in addition to enabling the use of renewables, ensure no tailpipe emissions.

Figure 17 reveals the significance of different transport modes in the European Union for the emission of greenhouse gases and highlights the role of road transport as the source of almost all the greenhouse gas emissions in the inland transport sector. Further data from the European Environmental Agency (EEA) indicate that greenhouse gas emissions are increasing over time and that their significance varies very significantly by country as do the level of increases over time, pointing to the need for more urgent action in some countries. For instance, in the Czech Republic, Ireland, Poland and the European Union show the largest increases in emission from transport over the 1990-2016 period.

Road transport accounts for most of inland transport's polluting emissions as illustrated in Figure 18. This shows the need for promoting a modal shift, where possible, as well as the introduction of alternatively powered vehicles, energy saving driving methods and emission control methods as discussed in UNECE (2016).

All transport modes generate noise and vibrations albeit to a different extent. Noise and vibrations cause effects such as stress, heart disease and sleep disturbances. This issue is relevant to all motorized modes. The challenge in this case is to adopt measures to mitigate noise and vibrations that are cost effective and acceptable to those affected.

Also, the location where transport needs occur determines the available sustainable transport options. This is particularly the case for urban transport where public transport as well as active modes should be promoted to reduce energy use and emissions.

Land use and loss of biodiversity are significant environmental issues related to transport infrastructure, including terminals that may require large surface areas. Transport infrastructure may also encroach on sensitive natural

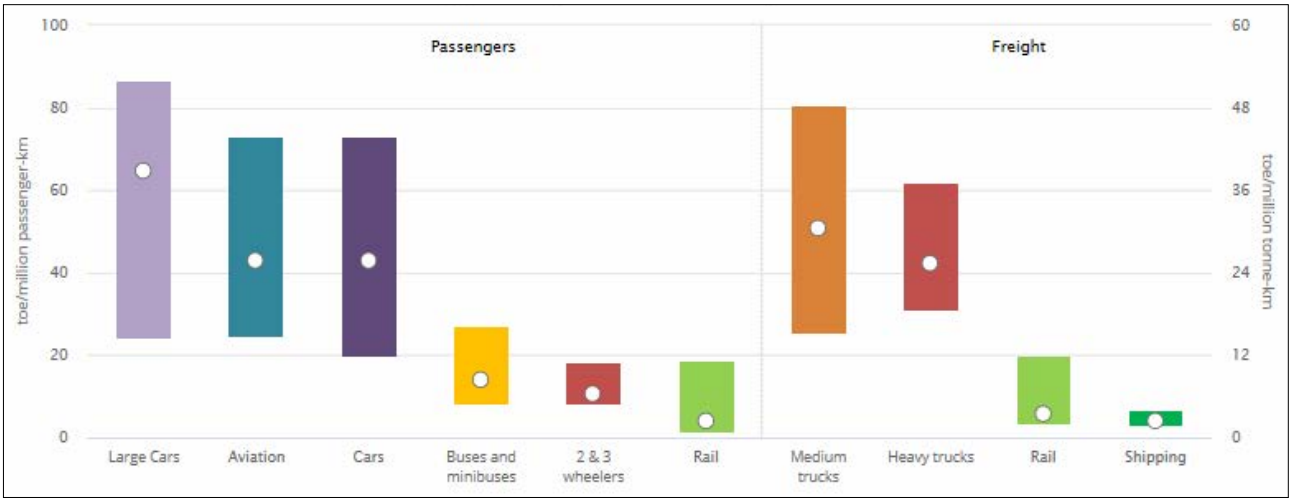
environments. Land management and strategic environment impact assessment should start at the planning stage for infrastructure and begin with comparative environmental impact assessments of locations and feature options and the development of appropriate mitigation measures.

A common challenge remains access to transport by groups with disability. More in terms of infrastructure and vehicles needs to be done. More data and attention should also be paid in mainstreaming the gender perspective in mobility.

Member States can assess the impact of their policies on the environment thanks to Environmental Performance Reviews (EPRs). The EPR Programme assists and supports ECE member countries in improving their environmental management and performance; promotes information exchange on policies and experiences among countries; helps in the integration of environmental policies into economic sectors; promotes greater accountability to the public; strengthens cooperation with the international community; and contributes to the achievement and monitoring of relevant Sustainable Development Goals.

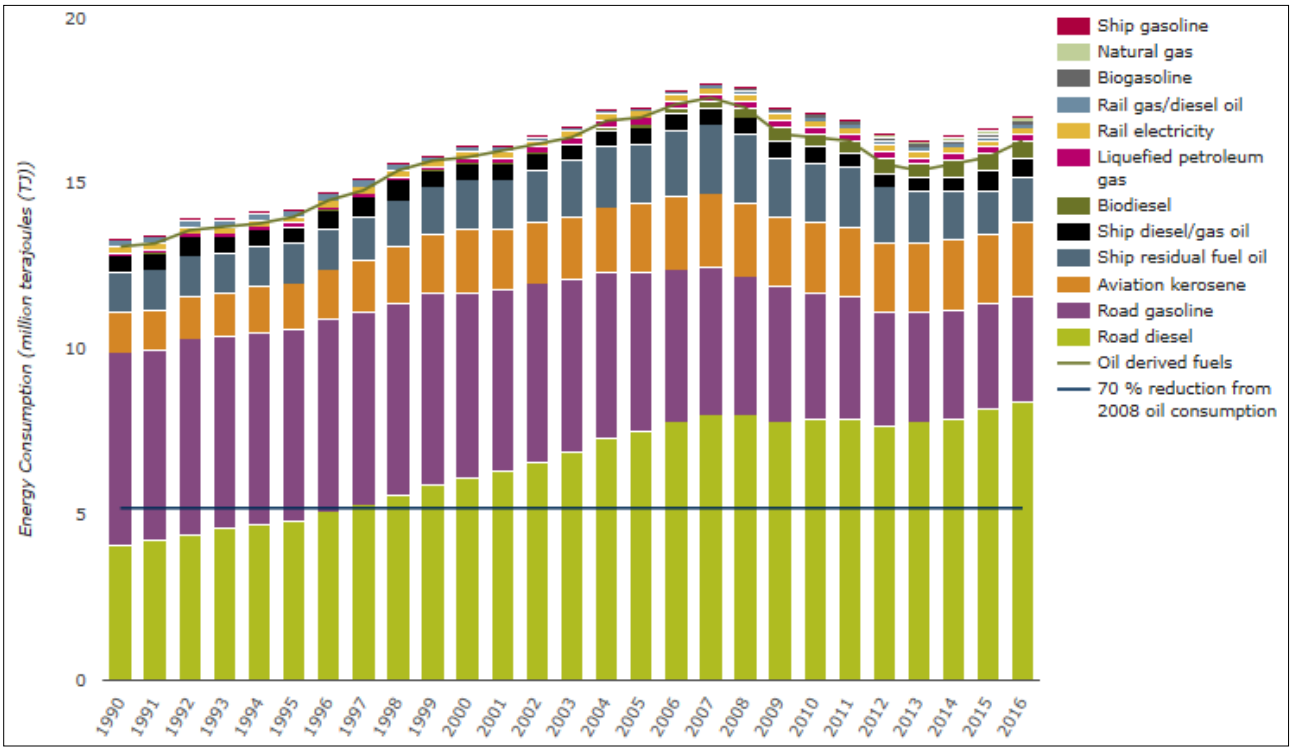
Upon request by the country under review, a chapter on transport and environment is included in the EPR report. A transport and environment chapter provides an overview of the transport sector and its infrastructure, describes environmental pressures from different transport modes and transport infrastructure, analyses road safety and evaluates the transport sector's impact on and adaptation to climate change. The chapter describes transport sector policies and the sector's legal and institutional framework and analyses how the reviewed country participates in international agreements and processes related to transport. The EPR Review includes a comprehensive ForFITS analysis when the report has a separate transport and environment chapter.

Figure 15: Comparison between the energy intensity of different transport means. Figures refer to transport worldwide



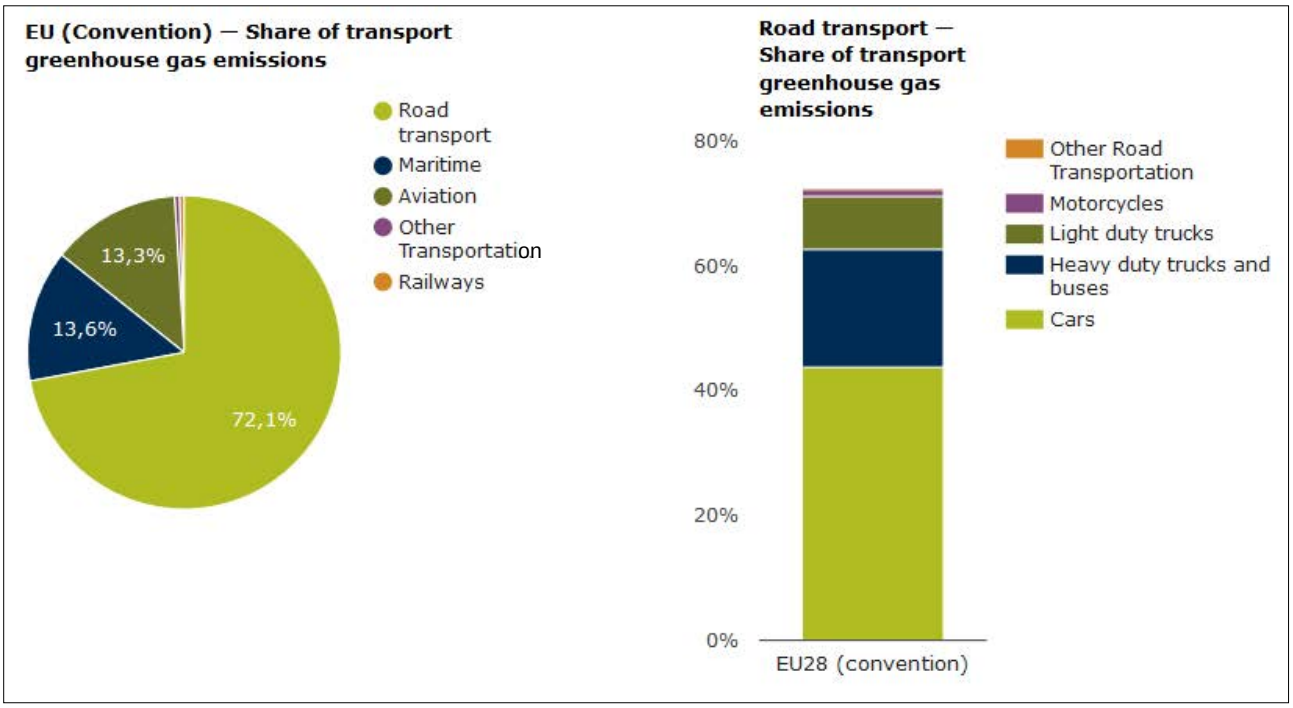
Source: IEA (2019).

Figure 16: Energy consumption in transport in the European Economic Area



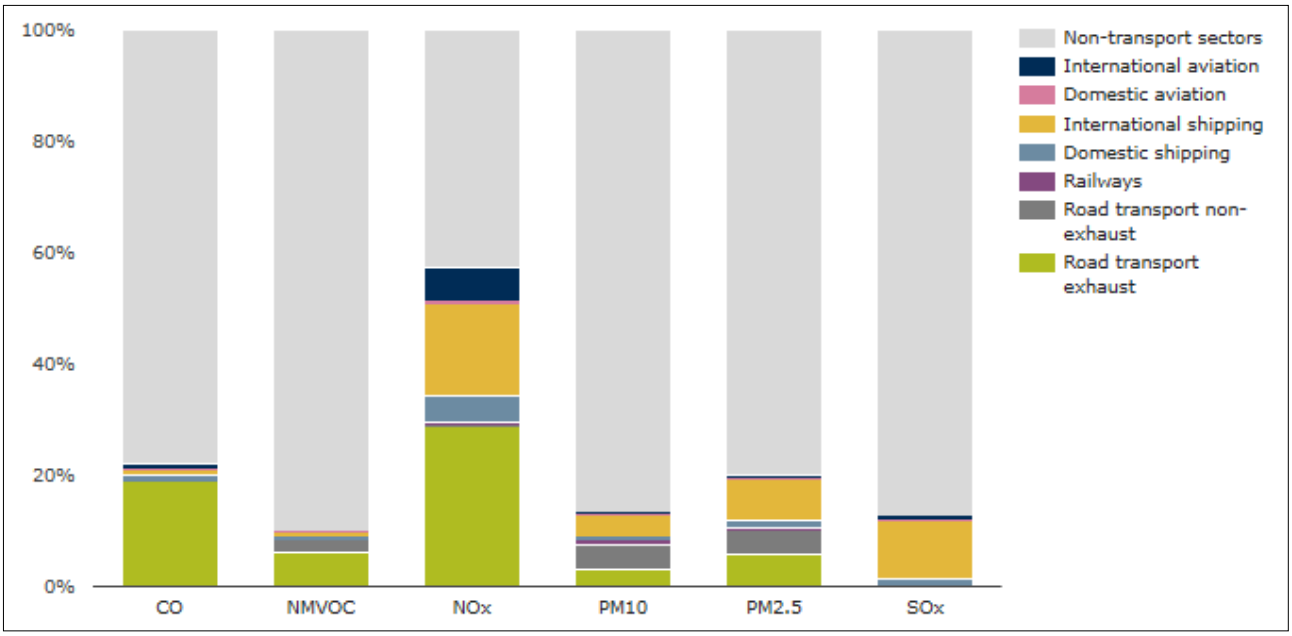
Note: The green line represents total oil derived fuel, while the blue line represents the 70 % reduction from 2008 oil consumption by 2050.
Note: LPG is liquefied petroleum gas.
Source: EEA.

Figure 17: Share of greenhouse gas emissions from transport and detail on the emissions by road transport for the EU28



Source: EEA, Inventory 2019.

Figure 18: Contribution of the transport sector to total emissions of the main air pollutants in the European Economic Area



Source: EEA.

2.6.2 Road and urban transport

Introduction

Most road transport is powered with internal combustion engines running on fossil fuels. While road transport will remain the most important transport mode thanks to the access it affords, the overall environmental performance may be improved by:

- Encouraging a shift to public transport and alternative transport modes,
- Improving engine performance and introducing alternatively powered vehicles
- Introducing eco-driving for commercial and private road transport.

In addition, issues with noise may be tackled with the transition to alternatively powered vehicles.

Examples and the challenges of each are discussed in the following sections.

Shift to public transport and cycling in urban areas

Current situation

Public transport requires about 3 times less energy than cars[215], and compares well with cars for all types of emissions (as noted in Kalenoja, 1996; and UNECE 2019b). Additionally, public transport is electrified in many of the cities that have metro, trams, trolleybuses and e-buses which enables it to use increasing shares of renewable energy. However, UNECE 2016 notes that trams and trolleybuses are a source of heavy metal emissions. Active mobility such as cycling clearly does not require fossil fuels. Therefore, public transport and cycling should be preferred for urban mobility in order to reduce pollutant emissions and greenhouse gases as well as energy use. Additionally, active mobility has health benefits since the WHO associated physical inactivity to one million deaths per year in the European region. Uptake of public transport and active mobility varies by location as shown in Figure 7, as do the uptake trends over time. To foster public transport and active mobility, cities should make them convenient and safe for travelling in all areas.

215 www.odyssee-mure.eu/publications/efficiency-by-sector/transport/specific-consumption.html

Initiatives underway

Efforts in that direction start with integrated transport planning, as described in THE PEP and its partnership on cycling promotion (annex III, box 4). Integrated planning is important also for public transport so that it works as a network of connecting services and there are fluid interchanges with other transport modes, as described in the European Union and UNECE guidelines on urban transport planning and in the section on efficient urban transport in this report. Examples of integrated planning include: the Accessibility Programme' in the city of Lyon, a sustained action plan promoting and linking several transport means; the Sustainable Urban Mobility Plan of Basel; and the transport policy of Tbilisi, focused on public transport and non-motorized mobility. Infrastructure dedicated to cycling and to public transport is also important, as is mobility management to inform users about possible changes and support them. Examples of effective promotion of cycling as a connection to public transport include: safe cycle parking facilities at Dutch railway stations; the provision of an extensive cycle network and parking facilities in Malmö (Sweden); the "Promotion of cycling and development of cycling infrastructure in the municipality of Almetyevsk" in Russia including the construction of infrastructure and the development of awareness raising initiatives; and the construction of a network of cycle paths in Tyumen, Russia, that also includes improved public transport services (UNECE, 2019b).

Shift to intermodal freight transport

Current situation

Road transport is normally required for the local collection and distribution of freight. However long-distance transport may be efficiently provided with rail and waterway transport that, as indicated in the introduction, are more environmentally sustainable.

The shift to intermodal transport requires that goods can be loaded in intermodal units (containers, swap boxes, semitrailers), that there exist rail or waterway terminals close to the departure and arrival locations, and that overall transport costs and times, including transshipments, are acceptable to shippers. For this to occur, the transport needs to be over long distances, approximately longer than 300 km. This often implies cross-border transport, which requires the kind of facilitation mentioned in the chapter on efficiency.

Initiatives underway

One key issue in shifting road shipments to rail are added costs that governments may offset with subsidies and combined initiatives. This is the case for the Swiss heavy goods vehicles distance-based tax that is used to finance new rail infrastructure and subsidies for intermodal transport. The Swiss government also supports single wagonload rail transport (i.e. where one or more wagons (but not the entire train) make up a consignment and the train contains multiples of these consignments), as does the Austrian government. Examples of targeted subsidies include those by the Italian government to set-up and sustain for a number of years new combined transport services. Similar schemes were set-up in Romania and in Slovakia while in Bulgaria rail infrastructure charges for intermodal transport are reduced. Germany provides financial support to transshipment terminals and the French government provides financial support to both rail and inland waterway transport.

In general support policies are primarily at a national rather than a regional level. An example of regional financial support was the Marco Polo programme of the European Union. Furthermore, several examples of initiatives for the promotion of intermodal transport are available in a dedicated repository maintained by the UNECE.[216]

216 National Policy Measures to Promote Intermodal Transport: https://apps.unece.org/NatPolWP24/.

Alternatively powered road vehicles

Current situation

Alternatively, powered road vehicles include battery or hybrid electric vehicles as well as vehicles that use biofuels or hydrogen. The advantages of electric and hydrogen vehicles are the absence of tailpipe emissions and the reduction of noise, as well as the possibility to rely entirely on renewables. Biofuels have lower carbon emissions than fossil fuels while vehicles running on compressed natural gas provide reduced emissions of pollutants, greenhouse gases and noise compared to using other fossil fuels.

Initiatives underway

Recent attention to electric vehicles comes from the availability on the market of several car models which are either fully electric or hybrid (working with an internal combustion engine as well as with an electric engine). It is, however, worth noting that trolleybuses are fully electric and have been part of the public transport fleets of cities throughout the ECE region for decades (for instance: Ankara, Athens, Baku, Boston, Geneva, Helsinki, Milan, Moscow, Sarajevo, Vancouver, Yerevan and many more). They are still a successful solution to electrifying public transport with makers marketing modern models.

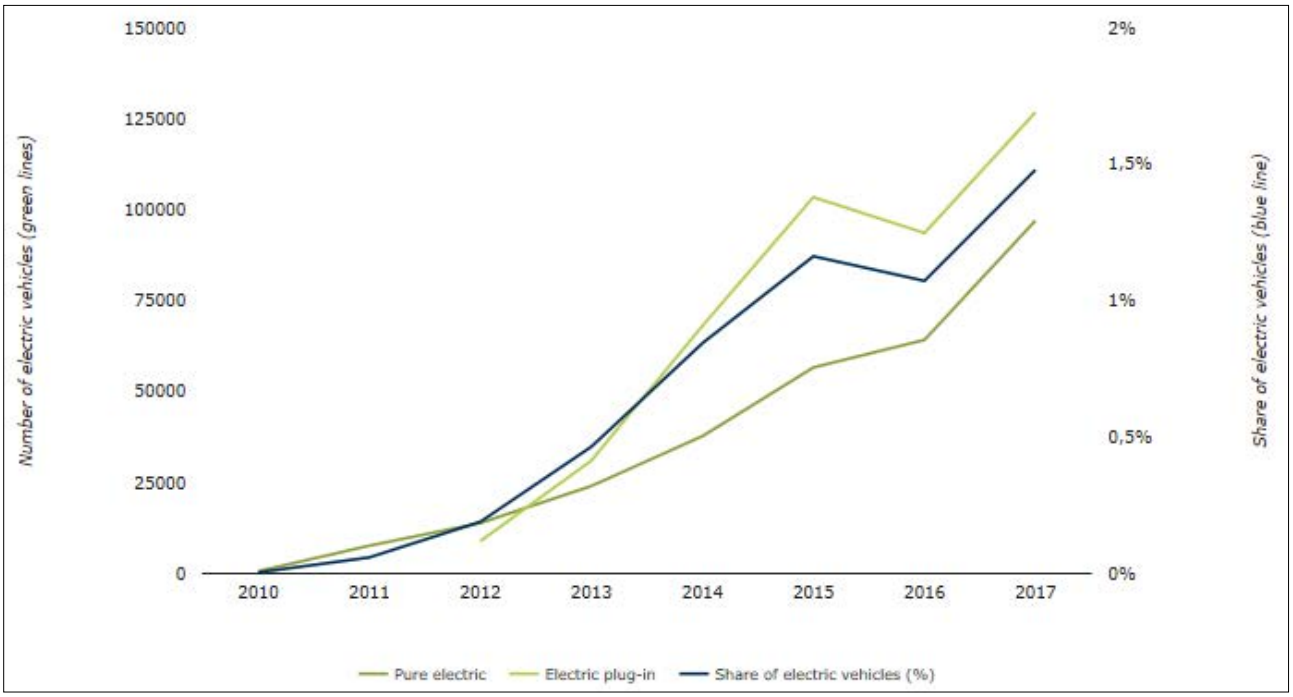
Apart from trolleybuses, electric or hybrid vehicles are experiencing a rapid increase in sales even though they remain a small proportion of the total stock of vehicles in ECE countries, which is also a consequence of their being available on the market only recently. Figure 19 shows their market share in European Union countries. Norway's large market share for electric vehicles (46%) is an exception as other leading countries such as Sweden and the Netherlands have market shares respectively of 7.9% and 6.6% (IEA, 2019). The same report notes that electric trucks and two wheelers are almost only found on Chinese roads, China being the world's largest market for electric vehicles.

Electric cars are also being used in car-sharing schemes such as those in several locations in France, Germany and Italy. Interestingly, electric car-sharing is a means for cities to foster the use of electric cars thanks to the widespread introduction of charging points and the opportunity for citizens to experience the technology. For a larger diffusion of electric vehicles, a wider availability of charging points is required as well as incentives to purchase electric vehicles that are currently more expensive than those with internal combustion engines. ACEA (2019) reviewed the incentives in place in European countries noting that they are very different in terms type and value (they include measures such as tax exemptions, co-funding for purchases, free parking, and access to restricted city areas).

There also exist hydrogen fuel cell cars on the market while hydrogen buses are being tested in Italy and the United Kingdom of Great Britain and Northern Ireland as part of the European Union co-funded JIVE project, and some companies are aiming to add some to their fleet, as indicated by Flixbus. Key hurdles for hydrogen fuelled vehicles are the supply and the cost of the fuel as well as of the vehicles, although the cost of the vehicles will decrease over time with their adoption.

Bus transport is also experiencing a shift to alternatively powered vehicles due to the need to operate in urban environments. Several cities are adding electric or hybrid buses to their fleet, although their overall number in the ECE region is still limited. Fleets of electric buses without contact lines operate in several countries. Examples of e-bus operations may be found in the Netherlands (around Schipol airport, in Rotterdam and The Hague), in Germany (Hanover), Sweden (Gothenburg) and in the United Kingdom of Great Britain and Northern Ireland (London).

Figure 19: Share of electric vehicles and number of electric vehicles sold in the EU-28



Source: EEA.

Eco-driving

Current situation

Eco-driving[217] is a way of driving vehicles that reduces energy use and improves safety. It essentially consists of anticipating driving changes, thus avoiding unnecessary acceleration and braking, maintaining a steady speed with the engine running at low regime. Proper vehicle maintenance is also required, for instance to ensure appropriate tire pressure. Eco-driving can be initiated with minimum effort through appropriate drivers' training and applies to all drivers, to vehicles of all ages and types (cars, trucks, public transport vehicles, trains). It is also a way to improve the range of electric road vehicles.

Results from eco-driving are varied but substantiate the value of its application. Early evaluations at the end of the TREATISE project (TREATISE, 2005) indicated average fuel savings of between 5-10%. The International Road Union remarks that it can save up to 15% of fuel[218] whereas, for an application to public transport in Geneva, savings in energy amounted to 40%.[219] Pilot training projects in Almaty, Kazakhstan, resulted in savings of between 6-22% of fuel.

Initiatives underway

For eco-driving to become widespread, it needs to be included in basic drivers' training and follow-up refresher courses.

There are several initiatives on eco-driving, all focusing on promotion and training. The Netherlands started as early as 1999 with a national eco-driving programme. The International Road Union runs courses aimed at commercial

217 A full explanation of Eco-driving can be found at: https://thepep.unece.org/sites/default/files/2018-07/Information%20note%2005a%20Draft%20THE%20PEP%20Guidelines%20on%20EcoDriving%20Draft%20June2018.pdf.

218 IRU Eco driving factsheet: www.iru.org/system/files/IRU%20Academy%20FS%20ECO%20Driving%20EN.pdf.

219 Decarbonisation: the public transport contribution: www.uitp.org/sites/default/files/Decarbonisation%20-%20the%20public%20transport%20contribution.pdf.

drivers.[220] In Austria, Klimaactiv, a public agency that is part of the Austrian Energy Agency, runs training programmes throughout the country and a certification programme. The same agency is also collaborating with the partnership on eco-driving set up by THE PEP. As part of this collaboration it runs training activities in several countries such as Kazakhstan and Russia and is developing THE PEP guidelines on eco-driving.[221]

Challenges

All these areas remain challenges for member States across the region. Decarbonizing urban transport by promoting public transport and cycling requires planning efforts that can be supported by continuing initiatives such as the relay races of THE PEP and by pilot collaboration actions with local planning bodies. The same applies to the promotion of eco-driving.

Fostering private alternatively powered vehicles and the use of renewables may occur through information (energy and carbon labelling), taxation (differentiated by fuel), and financial aid (taxes or rebates). UNECE could promote the exchange of best practices and the extension and harmonization of efforts. This work should take into consideration issues relating to ageing fleets, supporting countries that have to manage the importation of (second-hand) older vehicles. Also, affordability and efficiency concerns should be considered as alternatively powered vehicles do not solve congestion issues. Extended use of alternative power should be particularly encouraged for fleets such as public transport and in this, again, the UNECE could contribute by fostering the exchange of best practices and capacity building. For example, on the assessment of life cycle costs at the procurement stage for vehicles. A further role could be to facilitate agreement on targets for the use of alternative fuel vehicles based on statistical data documenting the environmental effects of introducing these vehicles in cities.

To improve air quality, UNECE member States use another instrument to reduce air pollution in the region through the Convention on Long-range Transboundary Air Pollution. The Convention sets emission limit values for various air pollutants, which have proven to be an effective tool in stimulating investments in best available techniques for mobile sources of emissions.

In addition, Parties to the Convention regularly exchange information about best policies and strategies to abate emissions in different sectors, such as in the transport sector.

The UNECE Aarhus Convention and its Protocol on PRTRs help to ensure that the development and implementation of plans, programmes and other decisions related to transportation in urban areas have the effective engagement of inhabitants, NGOs and other interested stakeholders. In addition, PRTRs help to identify the most suitable place for different components of urban planning (houses, green zones, industrial facilities, transportation routes), thereby helping to minimize potential risks for the environment and health.

2.6.3 Rail transport

Introduction

Rail transport is usually more energy efficient than road transport as a large part of rail transport is electrified. Still better environmental performance may be obtained through:

- Further electrification of rail both by electrifying infrastructure and by using battery powered trains
- Using alternatively fuelled trains
- Fostering eco-driving for trains
- Reducing noise and vibrations from train movements, which are particularly relevant when lines cross built-up areas.

220 IRU academy fuel efficiency training: www.itf-oecd.org/sites/default/files/docs/eco-driving-training-smith.pdf.

221 THE PEP Guidelines on eco-driving programs, draft of July 2018: https://thepep.unece.org/sites/default/files/2018-07/Information%20note%2005a%20Draft%20THE%20PEP%20Guidelines%20on%20EcoDriving%20Draft%20June2018.pdf.

Rail electrification, renewables, alternatively powered trains and eco-driving

Current situation

The efficiency of rail transport stems from its overall energy efficiency and from the sustained use of renewables (historically using hydropower, where available and, more recently, wind power).[222] The International Energy Agency (IEA 2019) indicates that, worldwide, three-quarters of passenger rail services are powered by electric traction, an increase from 60% in 2000, making rail the only transport mode that is widely electrified.

UNECE (2019g) indicated that, across passenger and freight railways, 56% of railway traction in its regions is electric. The remaining 44% is diesel. While the replacement of internal combustion engines with further electrification of railway traction is desirable from the environmental viewpoint, the electrification of lines requires significant investments and is typically warranted by traffic needs (for instance: electric locomotives provide greater power). Solutions include the use of electric engines without requiring overhead lines and the introduction of alternative fuels.

Initiatives underway

Canada, United States of America and the Russian Federation are using or deploying gas powered freight locomotives. This fuel reduces carbon and nitrogen oxide emissions, although it does not eliminate them. UNECE (2019g) recalled that the Florida East Coast railway in the United States of America already converted its fleet of locomotives to liquefied Natural Gas, while another railway in Chicago is converting its fleet to use Compressed Natural Gas. In the Russian Federation tests to run heavy freight locomotives on Liquefied Natural Gas have been successful and Russian Railways (RZD) are now introducing 22 such locomotives in their fleet.

Electric trains powered by batteries are currently being tested or are at the initial stages of deployment; for example, in a number of German Lander.

The use of hydrogen is being researched as part of the European Union co-funded projects under the Shift to rail and Fuel Cells and Hydrogen Joint Undertaking. Successful tests on two hydrogen fuel-cell trains used in regular service in Germany have already resulted in the order of 14 additional trains that will be in service from 2021. Expectations are so high that the French national operator SNCF expects to replace their diesel rolling stock with fuel cell hydrogen trains by 2035 (UNECE, 2019g). It is, however, worth noting that, so far, battery electric and hydrogen train developments pertain only to passenger rolling stock.

An additional source for improvement in rail energy performance is eco-driving, with drivers being assisted in choosing their speed according to the lines, the schedule and actual traffic. Eco-driving is at different stages of deployment in different countries. When applied to electric trains, eco-driving requires measuring the energy actually consumed by locomotives which is not common except in Germany. Metering of energy on electric trains is, however, becoming more widespread with metering deployment programmes in France, Italy, Switzerland and the United Kingdom of Great Britain and Northern Ireland. Eco-driving pilot tests have resulted in a number of positive results. For example, a study in Sweden recorded 19% energy reductions, and a Dutch application resulted in 4% energy savings (Poncin and Slats, 2014). In fact, UIC (2018b) noted energy savings between 5-10% for simple driver advisory systems and savings rising to 8-12% when those are connected to traffic management systems.

Noise and vibrations

Current situation

Train movements, along lines and in stations, are a source of noise and vibrations that are harmful for those exposed to them and against which there is growing sensitivity among people living close to railways. Noise, in particular, can be contained with lineside barriers that limit its propagation or reduced at the source with technical solutions on railway lines and vehicles. As barriers have negative effects on the landscape and are not welcome by local residents, parallel actions need to be taken on rail lines and vehicles.

222 www.ns.nl/en/about-ns/sustainability/energy/sustainable-energy.html

Initiatives underway

The replacement of jointed tracks with welded tracks assists with the reduction of both noise and vibrations. Belgium is applying targeted track maintenance specifically to address this issue. The European Union TSI mandates noise limits for new and upgraded vehicles, and a number of operators are working to retrofit their fleet to limit noise emission, for instance with new brakes (UIC, 2016). Financial instruments to support such actions have been setup in Germany, the Netherlands and Switzerland, including reduced line access charges. In fact, in Switzerland, the rail undertaking SBB cargo announced the retrofitting of its entire wagon fleet with silent brakes by the end of 2019 since Switzerland has forbidden the use of wagons not fulfilling the TSI requirements on noise from January 2020. However, the change process for railways is expensive and other countries have taken limited, if any, action.

Challenges

The points mentioned in the introduction remain challenges throughout the railway sector, and more so in countries where operators or infrastructure managers are unable to afford the extra costs to replace rolling stock with electric or alternatively powered traction or to retrofit them with silent brakes.

UNECE could foster the further electrification of rail transport by ensuring that the relevant projects on the E-rail network are carried forward. In addition, UNECE could support the exchange of best practice in the use of alternative fuels that, at present, have only been implemented in isolated cases. A further element of action for UNECE could be to lead the development of internationally agreed standards on energy use and emissions by rail vehicles.

UNECE should also foster the exchange of best practices for eco-driving, which is also in the best interest of operators, especially when running diesel engines. Further UNECE action in this area could provide support for capacity building and pilot projects.

On noise, besides best practice exchanges on cost-effective measures, UNECE could take up a role in promoting internationally agreed standards aimed, in the first instance, at the most sensitive areas for controlling noise such as cities.

2.6.4 Waterway transport

Introduction

Inland waterway transport compares well in environmental terms with other transport modes due to low emissions per tonne of goods transported and to the high capacity of the vessels which allows the removal of significant freight traffic off of roads and the freeing up of capacity on railways.[223] Still, a number of challenges must be tackled to ensure the environmental sustainability of inland waterway transport including:

- The propulsion of vessels, which is mostly by fossil fuels, with limited possibilities for changes in the short run
- The use of natural resources such as rivers and lakes to ensure navigation
- The treatment and disposal of waste.

The following sections discuss these items.

223 UNECE (2019f) noted that a 110 m-long vessel transports around 3,000 tonnes of cargo corresponding to more than 200 TEU and equal to the capacity of more than 100 journeys of 40-tonne trucks. ECA (2015) reported than a convoy with four pushed units may carry the equivalent of 175 railway wagons and 280 trucks.

Vessel propulsion

Current situation

Inland waterway transport runs on fossil fuels. Vessels are powered by diesel engines and use diesel generators to obtain the electricity used on-board. UNECE (2019f) notes that this is unlikely to change in the short run. The renewal rate of the fleet is very slow: for instance, the average construction year of dry bulk vessels in the Rhine is 1965 and many of these vessels still have their original engine. Ownership is very fragmented with limited investment possibilities and barge owners would not replace engines that are still functional. More modern engines designed according to the latest European Union regulations are only just becoming available.[224] Additionally, treatment of exhausts requires the most expensive type of scrubbers to avoid releasing pollutants into waterways.

Initiatives underway

Low sulphur diesel is already an industry standard but propulsion by engines running on other fuel has had limited uptake or is not yet ready. The former is the case for Liquefied Natural Gas (LNG) since tanks are expensive and space consuming, and refuelling infrastructure is not sufficiently available. UNECE (2019f) notes that this will be a risk for any possible alternative fuel, such as hydrogen. Hydrogen propulsion and use of battery powered engines are currently being tested, and the current use of electric engines is with power supplied by diesel generators.

Linde at al. (2018) report on the development of an eco-driving tool for inland vessels (which optimizes speed and course) and mentions the existence of a commercial software for the same purpose and the development of a similar tool as part of the European Union co-funded project MoVeIT! The positive effects on emissions of eco-driving for inland vessels are noted also by UNECE (2016) together with guidance on the best methods to control emissions from vessels and other vehicles.

Using rivers for navigation

Inland water navigation has a direct effect on the water environment by altering tides and eroding riverbanks as well as altering the natural habitat along rivers. This is something that is looked at in detail by the River Commissions who dedicate significant resources to ensuring the waterway environment is not affected by navigation with targeted preservation investments however it is not always possible to cover the entire network.

The treatment and disposal of waste

Inland waterway vessels produce waste and carry products that can pollute waterways if not appropriately handled and treated. To limit the negative effects of this, resolution No. 21 of the UNECE Working Party on Inland Water Transport provides clear guidance on gathering and disposing of on-board waste appropriately, on making sure that there are appropriate reception facilities on quays and also on dealing with spills that may occur from vessels. This Resolution provides a clear framework whereby the environmental impact of spillage and waste can be minimized.

Challenges

Changes in vessel propulsion and the adoption of eco-driving remain challenges.

UNECE could foster changes in vessel propulsion by promoting debate on possible initiatives such as incentives and on possible decarbonization targets towards which the initiatives should be coordinated. UNECE could have a direct role in pilot projects on eco-driving similar to that of THE PEP for road eco-driving.

224 European regulations for Non-Road Mobile Machinery (NRMM) (stage V requirements in Regulation (EU) No. 2016/1628.

As for resilience to climate change effects, the UNECE could encourage the exchange of best practices and support capacity building, as this is a challenge that requires targeted planning. River Commissions and Multilateral Environmental Agreements, including UNECE's Espoo Convention and SEA Protocol, contribute to assess the environmental impacts of projects for new navigation channels at national and transboundary level. Furthermore, based on the experience of pilot projects, a Global Network of Basins Working on Climate Change was created in 2013. The creation of this Network is one of the outcomes of the Sixth World Water Forum and coordinated by UNECE and International Network of Basins Organizations.

2.6.5 Resilience to climate change effects

Current situation

While transport is considered to be one of the forces driving climate change, it is also important to note that it is negatively affected by these changes. Climatic events are eroding transport infrastructure and, in some cases, sweeping it away altogether as happened in 2019 to a stretch of motorway in Italy. Tidal surges for example, are affecting railway lines along coasts, sometimes the only infrastructure connecting two parts of a country.

In recent years climate change has affected the water levels on several waterways, such the Rhine and the Danube. There have been periods of low-water levels limiting navigation and carrying capacity as well as periods of high-water levels with the same effects (due to clearance under bridges). In addition, floods are becoming common, causing damage and affecting traffic.

Initiatives underway

UNECE is working on identifying climate change hot spots within its region where weather events could potentially disrupt transport infrastructure and services. Resilience to such events should be part of the planning and maintenance of waterways. UNECE (2019f) mentions methods for the re-naturalization of rivers to give space to water when its level becomes high. UNECE (2013) reports several actions to counteract climate change effects such as the technical adaptation of locks (with wider and deeper chambers, heating and drainage systems) and the re-planning of dredging to ensure navigability in Canada and United States of America, as well as the replacement of river bank features to reduce sedimentation and allow for the passage of fish. Furthermore, when it comes to basin management, a Global Network of Basins Working on Climate Change was created in 2013. The creation of this Network is one of the outcomes of the Sixth World Water Forum and coordinated by UNECE and International Network of Basins Organizations.

Building resilience to climate change effects is only possible as long as the government, public and other stakeholders has timely access to adequate information on the potential risks of and actions for climate change mitigation. The transport and infrastructure related decision-making should be transparent, participatory and inclusive through the whole cycle from the legislation development to projects implementation. Parties to the UNECE Aarhus Convention and its Protocol on Pollutant Release and Transfer Registers (PRTRs) are obliged to disseminate all relevant information that would help the public take measures to prevent or lessen harm in the event of an imminent threat to human health or the environment and ensure effective and inclusive public participation procedures.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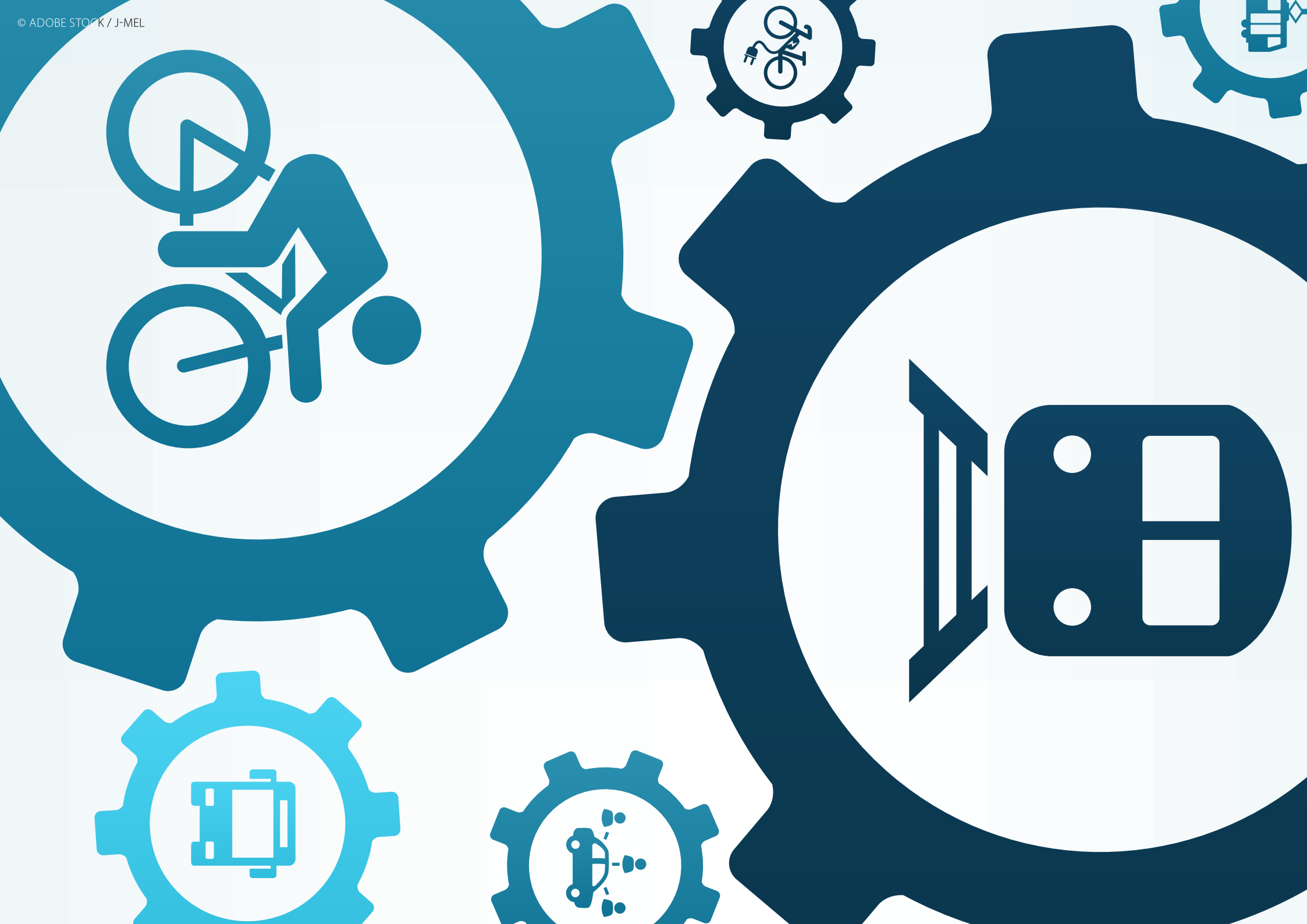

CONCLUSIONS AND RECOMMENDATIONS

The table in annex I provides a general summary of the topics provided in this document. The ECE region is globally well positioned on most of the topics and the UNECE tools and deliverables are well adapted to assist in achieving sustainable mobility and smart connectivity. Besides the individual activities in annex I, the following recommendations are proposed:

The UNECE should facilitate the take up of sustainable mobility and smart connectivity initiatives through:

- The continued support to member States to embrace economic, environmental and social sustainability whenever developing and implementing policies or projects in the region related to the nexus. To ensure that, member States are encouraged to use the UNECE's products (Conventions, regulations, recommendations, policy frameworks, guidance, guidelines and standards). This would also support member States in implementing several SDGs and leaving nobody behind.
- The collection of data enabling member States to better implement and use UNECE's products as well as collection of data to allow the UNECE to better tailor its products to the rich and varied reality of its member States.
- The continued convening role for the exchange of good practices and experiences in sustainable mobility and smart connectivity in its widest sense.

Specifically for Smart Connectivity, the UNECE should consider the following recommendations:

1. Its continued role as focal point for electronic business, helping governments, stakeholders and other UN bodies to satisfy their needs of electronic messaging.
2. Encourage the use of the UN/CEFACT semantic model of data for electronic business exchanges and encourage governments and stakeholders to contribute to its development and maintenance.
3. Consider a convention on the legal validity of electronic exchanges across borders.

Specifically for Sustainable Mobility, the UNECE should consider the following recommendations:

1. The continued development of a robust legal and regulatory framework for the inland transport sector as part of its role as the UN Platform for inland transport conventions. In this area work should focus on continuing efforts to harmonize transport solutions across borders.
2. The continued support for new technologies and innovations in inland transport by ensuring that its regulatory functions are keeping pace with cutting-edge technologies driving transport innovation thus improving traffic safety, environmental performance, energy efficiency, inland transport security and efficient service provision in the transport sector.
3. Its continued role as the UN Platform for regional, interregional, and global inland transport policy dialogue by providing a platform for policy dialogue to review emerging challenges in inland transport.
4. Its continued role as the UN Platform for sustainable regional, interregional, and global inland transport mobility in facilitating the development of intermodal, green transport solutions for freight and passengers across inland transport modes with the aim of minimising the environmental impact of transport and mobility.

ANNEX I

Challenges and Possible Role of UNECE

The following table summarizes the challenges identified within this paper and some of the proposed actions/role that UNECE can plan in response to these.

Area	Challenges	UNECE role/action
Electronic verification of Identities and authentication of trade documents	**Infrastructure:** Lack of alignment in the legal frameworks **Knowledge Management:** Lack of agreed standards/methods for authentication; Some entities still require paper-based documents and/or signatures **Collaboration:** Lack of multilateral cross-border recognition	Encourage uptake of UNECE recommendations Nos. 14 and 34. Further study the possibility of multilateral cross-border recognition.
Quality standards for traded products	**Infrastructure:** In some lower-income countries in the region, the physical infrastructure and trained staff needed for their implementation is missing **Knowledge Management:** More guidelines needed for their practical implementation, especially in lower-income countries **Collaboration:** The standards can be used as a barrier to trade	Enhance dissemination of existing standards. Encourage use of existing standards such as UN/LOCODE. Identify, through country studies, use of such standards as a barrier to trade.
Electronic exchange of information	**Infrastructure:** Lack of conventions (cross-border) agreements on the legal validity of electronic information **Knowledge Management:** Initial setup investments (time and money); need to interface with (or modify) existing legacy systems; requirements or modifications of unaligned semantic **Collaboration:** Lack of consensus on which standards to use in the face of a multitude of international and private standards	Reinforce existing electronic exchange standards, requesting more countries to participate and contribute to the development. Consider promoting a convention on legal validity of exchange of electronic information, eventually across borders. Gather best use-cases of transitioning from legacy systems to use of international standards.
National Trade Facilitation Bodies	**Collaboration:** Finance requirements to ensure long-term viability; Frameworks, guidelines and training to ensure adequate consideration of private sector views; requirement of having all entities to collaborate	Encourage uptake of UNECE recommendations Nos. 4 and 40. Enhance cooperation with UNCTAD and ITC on implementation guidance and assistance. Capacity building.

Area	Challenges	UNECE role/action
Single Window	**Infrastructure:** Funding; Legal agreements between the trade community and governments to exchange data **Knowledge Management:** Requirement for a clear roadmap, with continuous updating; lack of successful regional collaboration examples, single windows remain domestic operations. **Collaboration:** Requirements for leadership (in some cases, high-level political support); alignment across different regulatory authorities and for identification of benefits; in some cases, several "single window" platforms compete in the same country	Encourage uptake of UNECE recommendations Nos. 33, 34, 35 and 36. Gather best use cases of implementation as a guidance for countries. Consider promoting a convention on legal validity of exchange of electronic information, eventually across borders. Capacity building.
Electronic certificates	**Infrastructure:** The challenge of fraudulent certificates. **Knowledge Management:** For some certificates, a lack of internationally agreed standards **Collaboration:** Lack of end-to-end digitalisation	Encourage the exchange of certificates electronically between governments (in order to reduce fraud) Continue developing standards for certificates based on the UN/CEFACT CCL and harmonization process.
Natural Resources management	**Knowledge Management:** Standards for areas outside of fisheries and the transport of dangerous goods/waste **Collaboration:** Limited geographic utilisation	Encourage broader uptake of UN FLUX standard, UN/CEFACT's eCMR standard. Identify existing conventions within the UNECE that foresee electronic exchanges and coordinate with UN/CEFACT in order to create an official version of these messages.
Energy (electricity grid)	**Infrastructure:** Legacy infrastructure and financing for expensive upgrades to include renewable energy; in some cases, adequate legal frameworks for accommodating renewable energy **Knowledge Management:** New energy policies and practices are required **Collaboration:** Cooperation across energy suppliers (traditional and renewables)	Enhance UNECE work on energy policy; encourage broader uptake. Capacity building.
Electronic Invoicing	**Infrastructure:** Existence of more than one standard **Knowledge Management:** Lack of communication on standards **Collaboration:** In some cases, agreement between the private and public sectors on its use	Enhance dissemination of the UN/CEFACT eInvoice standard and encourage broader uptake. Encourage participation of stakeholders in the maintenance and further development of this standard.
Technological development	**Infrastructure:** Smart connectivity is limited to the weakest connected stakeholder	Encourage broader uptake of standards available from UNECE and its partners. Reinforce the convening role of UNECE to help all stakeholders adhere to base principles and standards.

Area	Challenges	UNECE role/action
eCommerce	**Collaboration:** The risk of the development of closed ecosystem (monopoly)	Encourage the use of freely available electronic standards and base principles. Continue to clearly define the term eCommerce and encourage member States to adhere to that definition.
Standard development	**Knowledge Management:** The majority of standards are developed unilaterally (by one organisation) or in a membership mode (where members have to pay a fee to participate); semantic standards are required to sustain the development of ever-growing connected systems.	Reinforce the convening role of UNECE to help all stakeholders to jointly develop standards which will be disseminated free of charge. Capacity building.
Efficiency – Road transport	Gaps in features and maintenance of E-roads	Continue regional platform role Facilitation projects such as EATL, TEM Capacity building Best practice exchange
Efficiency – Road transport	Implementation of the ITS roadmap	Continue regional and worldwide pivotal role with WP.29
Efficiency – Road transport	Use of digitalized transport documents only at its beginning or based on bilateral agreements	Encourage more signatories to parts of Conventions providing for e-documents Sustain wider use not requiring bi-lateral agreements Increase collaboration between Transport and UN/CEFACT experts on the creation of more standard digital documents
Efficiency – Road transport	Statistical information gaps	Request extended participation and coverage from AGR signatories
Efficiency – Rail transport	Infrastructure expanded in a coordinated manner and increase capacity	Continue regional platform role Facilitation projects such as EATL, TER Capacity building Best practice exchange
Efficiency – Rail transport	Interoperability of vehicles and systems and improvement of efficiency at functional breaks	Cross-border coordination
Efficiency – Rail transport	Statistical information gaps	Request extended participation and coverage from AGC and AGTC signatories Collect information on flows along corridors
Efficiency – Rail transport	Need for operators that deliver services efficiently and are financially stable	Best practice exchange
Efficiency – Rail transport	Simpler administrative procedures for cross-border transport	Continue regional platform role Continue work to develop and apply Unified Railway Law, aiming also beyond the ECE region
Efficiency – Inland waterway transport	Completion and maintenance of E-waterway network	Continue regional platform role Facilitation projects such as EATL, TER Capacity building Best practice exchange

Area	Challenges	UNECE role/action
Efficiency – Inland waterway transport	Promotion of inland waterways as part of multimodal transport chains	Support countries Best practice exchange
Efficiency – Inland waterway transport	Different organisation of inland waterway transport in different countries	Continue regional platform role
Efficiency – Inland waterway transport	Furthering automation and technological innovation Deployment of RIS	Continue regional platform role Take up also a role in the harmonisation of automation
Efficiency – Inland waterway transport	Fragmentation of the sector	Continue regional platform role
Efficiency – Inland waterway transport	Lack of new staff taking over from those who retire	Continue regional platform role Collaboration with CCNR and EDINNA on education of crews
Efficiency – Inland waterway transport	Statistical information gaps	Request extended participation and coverage from AGN signatories Collect information on flows along corridors/basins
Efficiency – urban transport	Promotion of efficient transport modes in urban areas	Continue and extend dissemination and facilitation role of THE PEP Foster integrated planning as per THE PEP Capacity building Best practice exchange
Efficiency – urban transport	Introduction of new technologies	
Efficiency – urban transport	Improvement of urban freight transport	
Efficiency – urban transport	Planning for efficient urban transport	
Affordability of transport for individuals and households	Clear understanding of transport affordability, quantification of its definition and understanding of how locations and families are affected	Becomes centre to develop the harmonization of transport affordability measurements
Affordability of transport for individuals and households	Deployment of methods to overcome issues with transport affordability and social exclusion	Support countries and cities through THE PEP initiatives such as the relay races Exchange of best practice Capacity building
Affordability for public authorities	Funding of transport services and effective involvement of private operators	Support use of robust prioritization methods
Affordability for public authorities	Choice of best way to fund infrastructure Appropriate ways to involve private operators where useful	Support use of robust prioritization methods Knowledge centre on PPP to extend its work in the transport area and its collaboration with other initiatives Capacity building Exchange of best practice

Area	Challenges	UNECE role/action
Safety – Road and urban transport	Road traffic rules in place and complied with	Continue role in harmonization of regulations Disseminate best practice Take up role in promoting implementation and enforcement Collect data on implementation and enforcement Support countries efforts to discourage drunk driving, use of mobiles while driving, speeding and other unsafe behaviours
Safety – Road and urban transport	Vehicles providing high safety level both for the occupants and for other road users	Continue role in harmonization of regulation
Safety – Road and urban transport	Road safety pursued within a suitable management system and following the safe system approach	Promote safe system approach Capacity building and pilot projects also as part of THE PEP
Safety – Road and urban transport	Attention to vulnerable road users such as pedestrians, cyclists, and motorcyclists	Promote safe system approach Capacity building and pilot projects also as part of THE PEP
Safety – Road and urban transport	Need that safety is given a prominent role in transport policy and planning	Capacity building and pilot projects also as part of THE PEP Promote the safe system in the education and training of transport professionals
Safety – Road and urban transport	Safe working conditions for professional drivers	Continue role in harmonization of regulation
Safety – Road and urban transport	Safe transport of dangerous goods	Continue role in harmonization of regulation
Safety – Rail transport	Harmonization of safety approaches across countries Introduction of safety targets	Continue role in harmonization of regulation Further use of safe system approach Foster agreements on safety targets, especially for countries lagging behind Promote rail safety regional initiatives Take up coordination role on rail safety at state and safety agency level
Safety – Rail transport	Improved rail safety statistics	Request extended participation and coverage from AGC and AGTC signatories Start initiative to collect data as suggested by Group of Experts on level crossings
Safety – Rail transport	Harmonization of safety systems	Continue role in harmonization of regulation Take up leading coordination role as for road vehicles
Safety – Inland waterway transport	Further harmonization of regulation	Explore the remaining needs and act as platform for further work

Area	Challenges	UNECE role/action
Safety – Inland waterway transport	Better waterway safety statistics	Develop and promote statistics standards Request extended participation and coverage from AGN signatories
Safety – Inland waterway transport	Lack of safety culture in the sector	Foster training of present crews Take up role in shaping content of education and training of new crews
Safety – Inland waterway transport	Development of automation only at the beginning	Take up role in automation safety standards as is currently the case for road vehicles Encourage further development of RIS
Safety – Intermodal transport	Comprehensive code of practice whose application is not mandatory	Collaborate with stakeholder to increase the status of the CTU code and ensure its application
Security	Dissemination and uptake of tried and tested methods across countries and modes	Collaboration with stakeholders from different modes and countries so above current collaboration efforts Provide platform for reference information and best practice exchange as for rail but in other sectors while continuing the work on rail
Security	Harmonization of cybersecurity standards	Lead the process with an approach similar to that followed for cybersecurity in the automotive sector.
Security	Lack of inter-governmental body on IWT security Lack of waterway transport security assessment	Take up role starting with assessment of needs/ promoting IWT security assessment
Environment – Road and urban transport	Need to decarbonize urban transport by promoting public transport and active modes	Support planning efforts with initiatives such as those by THE PEP (relay races), pilot applications and capacity building
Environment – Road and urban transport	Limited uptake/knowledge of eco-driving	Initiatives such as those by THE PEP (relay races), pilot applications and capacity building; Implementation of the UNECE LRTAP Convention
Environment – Road and urban transport	Need to encourage use of alternatively powered private vehicles and the use of renewables	Coordinate, harmonize and support actions such as energy and carbon labelling, taxation, financial aids so as to aim for common target and account for local conditions Support countries dealing with issues related to imported ageing fleets
Environment – Road and urban transport	Need to encourage use of alternatively powered vehicles and the use of renewables for fleets (e.g. public transport, garbage collection, other services)	Platform role, also to agree on targets Capacity building Exchange of best practices (e.g. concerning assessment of life cycle costs)
Environment – Rail transport	Electrification of rail should be extended Alternative fuel use not extensive	Support completion of E-rail network Support international agreement on energy use/ emissions form rail vehicles Best practice exchange

Area	Challenges	UNECE role/action
Environment – Rail transport	Limited uptake of eco-driving (only beginning)	Support international agreement on energy use/ emissions from rail vehicles Capacity building Best practice exchange Pilot exercises
Environment – Rail transport	Noise and vibrations from train movements. Impacts on environment of new networks and infrastructure	Capacity building Best practice exchange Promotion of internationally agreed standards Implementation of the UNECE protocol on SEA.
Environment – Inland waterway transport	Vessel currently powered by fossil fuels and limited prospects for change in the short run	Promote debate on coordinated incentives and targets Support eco-driving with capacity building and pilots as THE PEP does for road transport
Environment – Inland waterway transport	Limited resilience to climate change effects Use of natural resources	Support appropriate planning Best practice exchange Capacity building Participation in the UNECE Water Convention.

ANNEX II

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ANNEX III

Box 1: Digitalization of documents and progress towards e-CMR and e-TIR

Current technology allows transport documents to be digitalized. This may include only the transformation of a paper document into an electronic one or it may add features thanks to the possibilities for electronic processing of the data. Both approaches facilitate trade and improve safety and security. The UNECE identifies advantages from using electronic transport documents, including:

- Reductions in costs for document production, handling and storing.
- Reductions in time for document production.
- The ability to submit information independently of office opening times and with real time transmission.
- Better data flows with secure document exchange and no need for the manual, face-to-face hand over of papers.
- Better data quality with the possibility to re-using data without the need to re-enter them; including the ability to check data acceptability as they are entered.
- The ability to display data with captions and within forms in any language.
- The possibility to develop intermodal documents because e-transport documents focus on the data rather than documents themselves.
- Traceability.
- Improved safety due to the possibility of real-time sharing of data with emergency services.
- Increased security, due to the higher efficiency of controls based on electronic secure information.
- Possible integration with other services, such as Customs.

There are, at present, pilot projects to test the eCMR consignment notes which were developed in cooperation with UN/CEFACT. A test between France and Spain started in 2017 whereas in BENELUX there is an ongoing pilot for using eCMRs in transport between the three countries that is scheduled to last until 2020. DTLF (2016) reported the regular use of eCMR in Denmark with around 100 eCMRs used per day, but noted the existence of issues about the trustworthiness of the eCMR system and the interaction among parties. A further pilot started in early 2019 between Latvia and the Russian Federation.

The e-TIR builds on a system that already has several digital components, such as the procedure to manage the issuance and return of the TIR carnets. However, one issue for the actual implementation has been the development of an international, centralized platform to register the guarantees issued under the TIR convention and allow customs to securely exchange data. The platform will connect with the IT systems of customs, the guarantee chain and transport companies. A number of successful eTIR pilots have been undertaken in recent years paving the way for the introduction of the needed requirements in the TIR Convention.

Box 2: Euro-Asian intermodal rail freight transport: the EATL

There is an increasing interest in Euro-Asian rail connections for freight transport, especially for China-Europe traffic, which is predicted to grow and relies on routes already intensely used for national and international Asian rail transport.

In fact, rail transport offers much lower transit times between China and Europe and lower risk of damage or theft than maritime transport. At the same time rail services have become more reliable with fewer delays, however they remain more expensive than maritime transport.

From an interregional point of view, there is a need for coordinating and setting priorities to improve interregional transport links within Asia and between Asia and Europe. This work was carried out as part of the Euro-Asian Transport Links (EATL) project of UNECE and UNESCAP that included the development of an International Investment Plan based

on governments' proposals. The EATL is mentioned here with reference to rail transport but it had a much wider scope extending to road links and inland waterways. Completion of the EATL transport links would serve intra-Asian flows, benefitting landlocked countries as well as the growing volumes of China's exports to Europe. At the same time, the critical points in these planned transport links are the interfaces and connections between the systems. For instance, the terminals where specialized facilities are needed because containers must be transshipped due to different gauges - such as between Belarus and the European Union and between the Russian Federation or Mongolia and China.

International coordination work is also needed to ensure that recent technological developments facilitate trade. The EATL project also identified non-physical obstacles to transport in the region related to the management of transport infrastructure and border crossings and highlighted a number of best practices to reduce times at border crossings without compromising controls.

Box 3: River Information Services

The RIS provide for efficient and safe navigation by the transfer of electronic data to and among stakeholders including:

- Information on navigable fairways used by boat masters and fleet managers to plan, execute and monitor voyages, including geographical, hydro-meteo, and traffic related data. Electronic Navigational Charts (ENC) are available for several UNECE countries (Switzerland, Ukraine and the European Union member States). Updates are provided on the Internet and by email with the "Notices to Skippers" compiled according to an international standard that ensures usability by all parties.
- Vessel Tracking and Tracing. Information on vessel position (thanks to the Inland Automatic Identification System), along with other information -such as estimated times of arrival provided by boat masters- can be used by ports and terminals to plan their processes.
- Electronic Ship Reporting offers a simple way of reporting information about cruises and their loads, passengers and crew. It enables calamity abatement by using the information reported to provide the best immediate response in case of an accident, thus also ensuring environmental protection.
- Waterway charges and port dues: the travel data of a ship can be used to automatically calculate these charges and initiate invoicing procedures.
- Transport statistics.

Other data available to stakeholders includes information about vessels and their characteristics, waterways characteristics (infrastructures), crew and qualifications.

The characteristics and development of RIS are based on several UNECE resolutions and in the European Union are coordinated by a directive issued in 2005. These were built upon a foundation started in the late 1990s when several European countries were working on RIS systems and several European research projects began work on the harmonization of processes and the definition of RIS standards. After, many steps in technical regulation and international coordination were required to reach the current state of play. In 1998, PIANC (the World Association for Waterborne Transport Infrastructure) installed the first working group on RIS and in 2002 established the first edition of the RIS guidelines, updated since through stakeholders' debates at UNECE. In 2005, the European Union issued its RIS Framework Directive (2005/44/EC) which was followed by several other regulatory instruments to support the development of RIS. The current edition of the PIANC RIS guidelines, issued in 2018, includes Corridor Management and is intended for worldwide application rather than being focused on Europe.

Box 4: Promotion of cycling as an equal transport mode: the Pan-European Master Plan for cycling and the Eurovelo network

To foster the consideration of cycling as a transport mode THE PEP Partnership for Cycling Promotion has prepared a Pan-European Master Plan for cycling that will be considered for adoption by the Fifth High-level Meeting on Transport, Health and Environment.

The Masterplan provides objectives, indicators to measure progress, and a set of actions that governments in the ECE region should take to enhance cycling and realize its environmental, social and economic potential by reducing

congestion (and realizing the related economic benefits), reducing fuel consumption, GHG emissions, air pollutants and noise, and increasing physical inactivity.

The masterplan sets out 5 objectives to be achieved in each country:

(a) Double cycling in the region and increase it in every country;

(b) Develop and implement national cycling policies, supported by national cycling plans;

(c) Increase the safety of cyclists and halve the rate of fatalities and serious injuries;

(d) Integrate cycling into health policies;

(e) Integrate cycling, including cycling infrastructure, into land use, urban and regional planning.

The status and the uptake of cycling are very diverse across ECE countries and the Masterplan includes a catalogue of actions that can be adopted to foster a cycling culture. The following is a small selection from the actions suggested:

- Improve the regulatory framework for cycling promotion, taking a wide approach such as including standards for heavy goods vehicles (HGVs) to act on blind spots and improve pedestrian and cyclist safety.
- Provide sustainable investment and efficient funding mechanisms, also using suitable tools to assess investment decisions, such as the Health Economic Assessment Tool (HEAT).
- Promote cycling through incentives and mobility management including, for instance, subsidies for commuting by bicycle, and electric mobility funding schemes.
- Improving health and safety, by involving public health professionals in advocating for the inclusion of cycling in health policies and interventions.
- Promote cycling tourism, also with coordination centres and cycle-friendly service schemes.

The plan also emphasizes the importance of cycling related to capacity building, statistics, and innovation, for instance, by supporting innovative logistics based on cycling.

The implementation work for the Pan-European Master Plan for cycling will not be developed from scratch but will be based on existing international and local cycling infrastructure and coordination centres. The Eurovelo cycling network provides the backbone of both that infrastructure and coordination centres and is already the regional network around which national and sub-regional networks branch out (Figure 20). The 16 routes with a total length of over 70,000 km that make up the Eurovelo network are planned for completion in 2020. The routes are intended for cycle tourism as well as for daily journeys.

Figure 20: The Eurovelo cycling network

Source: www.eurovelo.org

UNECE NEXUS: Sustainable Mobility and Smart Connectivity

The 2030 Agenda and its Sustainable Development Goals (SDGs) provide an ambitious and comprehensive framework that opens new perspectives for policymaking and international cooperation. Its integrated character highlights the linkages and complementarities that exist between dierent goals and targets.

UNECE is supporting countries to address these key sustainable development challenges through an integrated, multisectoral approach leveraging UNECE norms, standards and conventions, and by building capacities and providing policy assistance. At the crossroads of all UNECE programmes and expertise, four high-impact "nexus" areas have been identied where multiple SDGs converge:

- Sustainable use of natural resources
- Sustainable and smart cities for all ages
- Sustainable mobility and smart connectivity
- Measuring and monitoring progress towards the SDGs.

The "Sustainable mobility and smart connectivity" publication reviews the challenges affecting mobility and connectivity within the ECE region. It highlights the vital importance that mobility and connectivity play in the operation of an economy and in moving goods and people within and across borders showing that the digitalization of many of these processes are key to improving efficiency and effectiveness. Addressing the challenges in these two areas is fundamental in assisting Member States in achieving the Sustainable Development Agenda. Each country has actions to pursue in relation to meeting these challenges and this publication highlights which are the main ones.

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