INTEGRATED TRANSPORT PLANNING, THE DIGITAL CHALLENGE AND DECARBONIZATION OF TRANSPORT

Francisco Cardoso dos Reis, Head of International Affairs at IP. UIC Europe Chairman. UIC Rail System Forum Chairman

Introductory notes

These early years of the 21st century have brought unprecedented growth and development in human activity and society. This era has given rise to new challenges and demands, and the pandemic has added even more previously unseen phenomena.

To increase the transport sector's contribution to economic, social and environmental sustainability and respond to these demands, innovation must be at the service of the common good, as well as the environmental, health-related and functional challenges facing society as a result of climate change and all other emerging threats.

In keeping with our preferred line of reasoning, the key factors for the success of our sustainability and decarbonization ambitions are integrated transport planning, organization of transport with rail as the backbone, and a focus on public and digital transport.

To provide guidance and some initial considerations on structuring the transport system, we will underline some of our recommended principles and options.

- Regarding mobility:
  - Mobility that is safe, clean (without air and noise pollution), fluid, free from bottlenecks and accidents, and integrated into the landscape where it takes place;
  - Mobility that is energy efficient and environmentally friendly;
  - Mobility that is smart, shared, interconnected and user-centred;
- Regarding systems and technologies:
  - Connected and interconnected multimodal systems where the focus is on autonomous and automated driving modes and the widespread use of electrical propulsion and alternative, non-polluting fuels;
  - Implementation of efficient co-mobility supported by complementary, collaborative systems and technologies between modes of transport, from the heaviest (i.e. trains) to the lightest (i.e. pedestrians);
  - Use of digital technologies based on artificial intelligence, big data, cloud computing, the Internet of things, etc.;
- Regarding infrastructure:

- Widespread digitalization of infrastructure, and construction of more efficient and eco-friendly smart infrastructure;
- Implementation of more effective and more energy-efficient mechanisms in all areas of asset management;
- Renovation/construction of new multimodal stations as integrated spaces for mobility and the promotion of complementary transport activities;
- Digital overhaul and automation of logistics areas used for goods transport, especially through the use of automatic freight couplers for reception/training operations.

Transport system indicators and inefficiencies

This introductory section, which aimed to structure and clarify our thinking, will now be followed by a description of some key indicators and inefficiencies that characterize the transport system and help provide an insight into the complexity and scale of the problem at hand.

Some indicators and trends to consider are as follows:

- The world's population has grown 12-fold in three centuries, from 600 million people at the start of the 18th century to almost eight billion in the second decade of the 21st century. This is putting great pressure on the global and local economies, land use and transportation systems;
- After the Second World War, the human population trebled and there was a six-fold increase in the consumption of energy, most of which came from fossil fuels;
- The number of passenger cars in circulation grew from 40 million to one billion, with road transport leading the way and representing the biggest polluter (EU: 72%), way ahead of any other mode;
- Europe's railways (EU) carry 439 billion passenger-kilometres and 261 billion tonne-kilometres per year (2019), accounting for a market share of 7.8% and 18.7% of the total volume transported, respectively, and are a far cry from our decarbonization targets;
- Maritime transport is fundamental to the global freight transport system, but its relative carbon footprint is high, given that it accounts for around 4% of CO_2 emissions;
- Aviation is an essential, innovative sector for long-distance transport, but its carbon footprint is also very high, since it is responsible for around 14% of CO_2 emissions. New forms of mobility in this market segment are therefore crucial;
- The European transport sector is responsible for 25% of CO_2 emissions;
- The European road sector is responsible for around 26 million deaths per year, a figure that must be reduced considerably;
- Road infrastructure is currently used for 75% of the land transport of goods. It is vital that a significant portion of this be transferred to rail infrastructure;

- To achieve the objective of climate neutrality by 2050, as set out in the European Green Deal, transport emissions must be reduced by 90%;
- Today, more than three billion people in the world have a smartphone. Connected mobility therefore has plenty of potential for success.

We will now highlight the most significant transport system indicators and inefficiencies that must be addressed:

- Pollution and emissions produced by the transport system;
- The rate of road traffic accidents, the number of which is unacceptable and must be addressed;
- The high average cost of transport/passenger, according to the system's current structure, and which must be reduced;
- The low capacity of infrastructure used, given the intense use of individual transport and its low occupancy rate;
- The low energy efficiency of internal combustion engine vehicles, which have not significantly increased in the last hundred years;
- The system's inefficient global transport supply, given the modal rather than integrated approach;
- Excessive land use by the system, given the return generated, especially with respect to road infrastructure;
- The transport sector's heavy dependence on energy from fossil fuels.

We are very inefficient!

In light of the above observations, it is imperative that we change our practices and improve our performance by adopting a coherent overall vision and developing new policies to implement new solutions in terms of systems, equipment, infrastructure and transport operations.

We could keep on citing figures to illustrate the incredible growth in demand in recent years, the characteristics of the system and the transport sector's importance and its impact on our lives, but no additional arguments are required to describe the current situation.

Furthermore, in response to the purpose of this document, we must conclude which are **the most important challenges** involved in addressing citizens' **future mobility demands** in terms of infrastructure, equipment and range of services. Most importantly, we must take a holistic approach when designing and operating the transport system while keeping in mind that a digital mindset is key to designing a system that must be seamlessly implemented everywhere.

The digital challenge and decarbonisation

We will now address the issue of the digital challenge in the context of the revamped transport system we need.

Communication with transport network users has evolved from personal contact to digital "self-service", which requires more online services. An increasing number of services are currently available on user portals managed directly by transport companies, infrastructure managers or third parties in collaboration with the first two. The paradigm of the Internet and social networks has given rise to new ways to access services, which prompt leading transport providers to adapt to new channels so they can communicate with their customers.

In view of this reality, it is important to focus on investing in policies aimed at promoting cleaner, more efficient transport options to link smart regions and cities through smart modes of transport at high performance levels in terms of economic, social and environmental benefits.

To achieve this, it will be necessary to make investments and take certain measures, a list of which is provided below:

- Increasing heavy and light rail transport solutions for both passengers and freight by moving towards detection- and automation-based solutions, such as smart trains that run on smart infrastructure;
- Gradually building smart, connected road infrastructure with new materials to ensure perfect vehicle-infrastructure communication and offer additional features such as electrical charging solutions for moving vehicles;
- Making a firm commitment to the digitalization of maintenance processes, for both equipment and infrastructure in general, by optimizing their lifespan and maximizing the economic return on transport operations;
- Making a firm commitment to the renovation and construction of intermodal stations and transport coordination centres, including widespread use of digital systems;
- Streamlining and implementing integrated ticketing and payment solutions supported by digital operational and financial management systems, and potential solutions based on biometric control and contactless technology in general;
- Promoting user-friendly and barrier-free solutions for all system users, especially people with reduced mobility.

To describe our preferred approach in greater detail, we believe it is necessary to respond to the challenges mentioned by identifying specific system requirements in terms of infrastructure, transport equipment and range of services.

Requirements and characteristics of the FUTURE transport system

Regarding infrastructure, the following requirements and characteristics are key:

- Increased implementation of automatic traffic management systems and operational support systems;

- Widespread implementation of digital infrastructure protection systems and relevant equipment (safety and security);
- Promotion of greater energy efficiency in facilities and across all transport infrastructure management activity;
- Widespread implementation of infrastructure maintenance following a non-traditional approach based on a dense network of sensors installed mainly in infrastructure components, structures and equipment;
- Increased use of reliable new materials in infrastructure and equipment, such as materials with a regenerative capacity to minimize the risk of breakdowns and incidents;
- More widespread use of artificial intelligence, self-learning mechanisms and IoT in asset management;
- Renovation, construction and management of stations and secure interfaces to meet the needs of an increasingly complex, interconnected transport system based on contributions from different modes, which must also be adapted to respond to all kinds of crises, including those relating to health;
- Promotion of barrier-free access to stations, interfaces, trains, underground trains, trams, buses and other modes to guarantee reliable and fluid interconnections, while also promoting real-time public information on transport operations and direct and indirect commercial opportunities.

With respect to digital infrastructure management, we must focus on the following:

- **Communications**

  Next-generation services on public mobile networks create opportunities for powerful, engaging applications. Network coverage and standardization are also key factors for success in this area.

- **Navigation systems**

  Satellite navigation to ensure that positioning forms an integral part of all navigation systems. Deployment of Galileo and addressing integrity are crucial for transport management.

- **Analytics**

  As sensor and business data develops, big data and business intelligence tools can be used to transform data into accessible information. Forecasting and planning are the main areas of application.

- **Computing systems**

  Mobile computing has evolved to allow user applications to help deliver complex, IoT-based services and virtually unlimited applications through the use of inexpensive connected hardware.

In terms of equipment and the range of services, the following requirements and characteristics are key:

- Increasing the use of heavy and light smart trains, whose construction solutions, including infrastructure solutions, will be increasingly efficient, advanced and based on interconnected digital systems;
- As in the case of infrastructure, and in keeping with previous measures taken, increasing the use of systems and solutions for predictive maintenance of vehicles;
- Making significant developments in automation of transport operations;
- Ensuring the widespread use of 5G by improving the IoT and creating a more extensive commercial range of smarter transport options;
- Automating the processes associated with the movement of goods (automated robots, automatic coupling, etc.) with a particular focus on movements at logistics terminals and optimization of the costs associated with this type of transport;
- Ensuring the widespread use of digital systems supported by artificial intelligence for relationships with system users in service outsourcing, monitoring and implementation, and in the sale of products to complement transport services;
- Promoting integrated multimodal transport solutions for both passengers and goods based on digital systems and dedicated algorithms;
- Increasing shared mobility in each mode of transport and between modes while optimizing each mode's operational management systems.

Much more could be added, but we have already covered a long list of initiatives, areas of intervention and systems to be considered and adopted in each situation.

A Holistic Approach to Transport Policy

In addition to these measures for the promotion of a new transport policy, we firmly believe that only the holistic approach should be used for strategic planning of the future transport system.

In our opinion, integrated transport planning is therefore an essential requirement and a duty that will help address matters such as overall efficiency, functional optimization of the multimodal network, transport safety, and supply predictability and stability.

This type of holistic strategic planning will make it possible to optimize the investment programmes associated with it, thus maximizing performance and the benefits for the community.

In addition, it is necessary to provide a clear definition of system objectives, as well as in-depth knowledge of each modal network, a demand forecast and the contribution ideally made by each mode to the result, i.e. transportation of a person or a load from point A to point B under the best possible conditions of comfort, safety, price and time.

Finally, it should be noted that adopting a planning methodology for each mode of transport is an erroneous approach that squanders scarce and expensive resources. It should be replaced with our preferred method: a network-to-network approach that contributes to an optimized end result in terms of cost and service quality.

The Challenge of Cybersecurity

We will now focus on a subject that is becoming increasingly relevant in light of the growing digitalization of our systems: the issue of cybersecurity.

As we all know, cybersecurity represents a complex new challenge that must be tackled, given the increasing use of digital technology and resulting real and potential weaknesses. These weaknesses must be minimized by enhancing the efficiency of protection/prevention mechanisms.

To achieve this macro-objective, the items in the following non-exhaustive list of measures are essential:

- Protecting the interoperability and integrity of transport systems, which are complex, automated and interconnected – a growing concern, given the systems approach we advocate;
- Protecting security, operational and commercial information against external and internal attacks by strengthening network security, particularly in light of the relevance of systems and critical equipment and infrastructure;
- Designing the systems architecture to meet the challenges of cybersecurity (safety by design);
- Promoting and developing strategies based on cooperation and good practices between all entities – CSIRTs cooperate in a network;
- Implementing credible, certified solutions for all elements of the systems and moving towards effective standardization.

What Type of Cooperation is Required?

Finally, we would like to touch on the type of cooperation that should be promoted among us, the countries located in Southern Europe and North Africa.

Transport solutions are naturally linked to the landscape in which they take place and will therefore always have specific characteristics that set them apart. However, what sets them apart is far less important than what unites them.

Thus, the exchange of experiences and good practices and each country’s participation in standardization processes are key approaches and contributions in the construction of efficient, low-cost networks and systems.

With this cooperative vision, it will be important to promote specific discussions, especially concerning topics such as cooperation in joint innovation actions and joint projects.

Moreover, as a means of engaging in more in-depth technical discussions and sharing knowledge and good practices, an intervention within international associations such as UIC, UITP and PIARC, in particular, would be desirable to help generate an effective return.

Our coordinated action at political and technical level is a hugely important factor that must be expanded on and developed through more joint initiatives such as conferences, debate forums and projects.

It is up to us to respond positively to all these challenges presented by the new reality.