

UNIFE Vision Paper on Digitalisation

“Digital Trends in the Rail Sector”

15th April 2019

About UNIFE

Based in Brussels since 1992, UNIFE is the association representing Europe's rail supply industry at the European Union (EU) and international levels. UNIFE's members include more than 100 companies – from SMEs to major industrial champions– active in the design, engineering and manufacture of rolling stock (i.e. trains, metros, trams, freight wagons) as well as rail signalling and infrastructure equipment. UNIFE also brings together the national rail industry associations of 11 European countries.

Executive Summary

During the last few years, technological developments have been driving the transport sector towards major changes. Digital technologies are affecting the ways in which various players in the transport sector are dealing with user information, payments, integration and automation, and they are also influencing ongoing changes in mobility patterns and end-users' behaviour. We can reasonably expect that digital transformation will continue to advance, with the arrival of further improvements in areas such as asset management and operations, combined with the evolving expectations of transport users.

While the rail sector is sometimes perceived as being conservative, the truth is that rail transport has always been a frontier of technological progress, with the supply industry leading the way. With digitalisation, the pace of change in the sector has moved up a gear. Roles have been transformed and new companies as well as business models have emerged – such as Uber and Mobility-as-a-Service (MaaS). New concepts as well as new technologies create new possibilities, shortening the timeline of innovation and shaking-up the entire transport sector.

The most recent advances of rail in the digital arena have certainly shown that there is a strong level of interest and engagement by the whole sector – and in particular by the supply industry. However, when compared with other modes of transport, the deployment of digital and enabling technologies in rail is at an earlier stage. Therefore, it is vital for the whole sector to maintain its commitment to making digitalisation, not merely an objective in itself, but rather a means to achieving more ambitious and overriding goals.

In Spring 2016, the UNIFE Digitalisation Platform produced a Position Paper on 'Digitalisation of Railways'¹, identifying some key areas in which the rail sector was going to be confronted by disruptive trends. Nearly three years on, a new vision from the European rail supply industry – with new priorities and ambitions – is deemed necessary in order to include the latest and emerging digital concepts and trends.

Our industry is continuously adapting to the changing needs and expectations of end-users, in order to further enhance the attractiveness and competitiveness of rail transport. With this new Vision Paper, developed by its Digitalisation Platform, UNIFE aims to express its view on how digital transformations shall contribute to achieving the ambitions of Europe's rail sector and its supply industry – both in terms of enhancing the experience of rail passengers and also in terms of optimizing logistics and boosting capacity for carrying freight. In order to do this, five major focus areas have been identified:

- 1) Big Data
- 2) Cybersecurity
- 3) Artificial Intelligence (AI)
- 4) New Mobility Services
- 5) Digitalisation of Freight Logistics Services

¹ <http://unife.org/component/attachments/attachments.html?id=737&task=download>

For each of the aforementioned focus areas, the UNIFE Digitalisation Platform would present its position over the related state-of-play in the sector, the current hurdles and potential opportunities, expressing key-messages as well as recommendations to fully harvest those benefits in rail transport. These key-messages address primarily policy-makers both at EU and national level, but they also aim at bringing to the attention of fellow stakeholders in the rail sector – i.e. operators, infrastructure managers, etc. – the views and priorities of the rail supply industry.

Recognising that all products and services making use of digital technologies must be developed for the benefit of customers, economy and society, the purpose of this Vision Paper is therefore twofold: first, to bring the European rail supply industry's views and objectives into the centre of the digital debate; and secondly, to effectively engage in a fruitful dialogue with decision-makers and other key stakeholders – in the transport sector and more widely.

Introduction – The general European context

The European rail supply industry is confident that European Union (EU) legislation and regulations shall support and facilitate the process of digital transformation in transport and especially in the rail sector, whilst also providing the necessary tools to safeguard this process.

By adopting the “*Council conclusions on the digitalisation of transport*” in December 2017², the EU Member States formally recognised that fostering digital solutions in the mobility sector will bring significant benefits to the European economy and society. The Council also acknowledged that success of digitalisation in each of the transport modes depends on a close cooperation of all actors, including private and public entities at all levels, with the common aim of promoting and accelerating the deployment of digital solutions. In this regard, UNIFE reiterates its appeal to the European Commission to establish an overarching platform on digitalisation that would incorporate all railway stakeholders and relevant authorities.

With regard to funding, the European rail supply industry welcomes the Commission's proposal to allocate EUR 9,2 billion – of the Multi-Annual Financial Framework (MFF) 2021-2027 budget – for a new programme to develop and reinforce Europe's strategic digital capacities, called ‘Digital Europe’³. However, although transport has been formally identified as “area of public interest” to be prioritised under the proposed ‘Digital Europe’ programme, UNIFE believes that the role of mobility (and especially rail) should be given greater emphasis, while synergies with the Connecting Europe Facility (CEF) programme should also be strengthened.

The fundamental role played by research and innovation (R&I) in fostering the digitalisation of railways must also be highlighted. In its ‘Rail 2050 Vision’, the European Rail Research Advisory Council (ERRAC) outlines how transformative research and scientific advancement have the possibility to change technology dramatically⁴, and points out that the future of rail lies in its flexibility and ability to adapt to and incorporate future technological advances. It should be noted that digitalisation and automation are at the core of the vision being promoted by the Shift2Rail (S2R) Joint Undertaking, which by supporting numerous R&I projects will enable Europe's railway sector to develop various value-adding products and services.

By actively supporting the Shift2Rail Joint Undertaking, the whole of Europe's rail sector – including suppliers, infrastructure managers, operators and academia – has committed to investing together in R&I activities in order to reinforce the attractiveness of rail transport for both passengers and business by embracing

² Council conclusions on the digitalisation of transport; 5th December 2017;15431/17;
<http://data.consilium.europa.eu/doc/document/ST-15431-2017-INIT/en/pdf>

³ https://ec.europa.eu/isa2/news/european-commission-has-announced-investment-%E2%82%AC92-billion-align-next-long-term-eubudget-2021_en

⁴ <http://unife.org/component/attachments/?task=download&id=881>

innovations. Building on the success of Shift2Rail, a refocusing of collaborative rail-related research activities is needed for the post-2020 programming period. In particular, the increasing need for shared mobility, customer-focused, digital and intermodal transport tools – as well as the roll-out of new technologies – should be guiding principles for an extension of the Shift2Rail JU (or a ‘Shift2Rail 2’) which must be included in the forthcoming research and innovation Framework Programme Horizon Europe⁵ programme (2021-2027), in order to making rail the backbone of Europe’s future mobility.

Key Messages and Recommendations

- The ultimate benefit of the ‘final transport user’, namely the individual passenger or the freight customer, must remain at the heart of digital transformation within the rail sector.
- UNIFE strongly advocates an extension of the Shift2Rail Joint Undertaking within the forthcoming Horizon Europe Framework programme (2021-2027). ‘Shift2Rail 2 should become the crib of the most breakthrough innovation streams in the rail sector in the future.
- Given the special role of transport as a key socio-economic sector upon which all other sectors depend, the proposed Digital Europe programme must give priority to the digital transformation of mobility.
- As requested by the EU Member States in their Council Conclusions of 5 December 2017, the Commission must work with Member States and stakeholders to develop a comprehensive and multimodal digitalisation strategy for the transport sector without delay, accompanied by a roadmap with an indicative list of proposed actions and associated timeline.
- In this framework, a coordinated approach towards digital and technological development within the rail sector is necessary, and therefore a European platform on rail system digitalisation encompassing all rail relevant stakeholders should be created.

⁵ Proposal for a Regulation of the European Parliament and the Council establishing Horizon Europe– the Framework Programme for Research and Innovation;
<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1540387631519&uri=CELEX%3A52018PC0435>

Big Data

The Context

One of key drivers of digitalisation is the development of the internet, as the emergence and spread of web-based technologies has profoundly changed communication patterns between businesses, organizations, communities and individuals. In the era of the 'Internet of Things' (IoT), an ever-growing network of objects, data, processes and people connect with each other using devices such as computers, tablets and smartphones. As the IoT progressively becomes the 'Internet of everything', such continuous inter-connection produces a rapidly-expanding volume of created, transmitted and stored data.

The importance of collecting, managing and effectively processing data is increasingly being acknowledged by the rail supply industry, and promises to deeply transform the rail sector's business-as-usual. The volume of available data can be quite staggering: rail vehicles can today send between 1 and 4 billion data points per year, and rail infrastructure/signalling equipment can send several billions of messages per year within the system. Additionally, data related to operations control systems, advanced vehicle inspection and even the weather can also be collected and analysed for operational and technical purposes.

Accordingly, the challenges and the goals are, in principle, rather straightforward: to cope with and to manage this huge amount of data and to turn it into relevant information that can be used for targeted, effective decisions and actions. In other words, we wish to harvest and process this data in order to derive actionable insights that will enable us to improve rail business results.

The effective management and processing of data would give rail companies the business intelligence that can be used to enhance performance and optimise strategies; however, it would also expose massive quantities of sensitive and personal information to increased cyber threats. Understanding how 'Big Data' and cybersecurity interrelate can help the rail sector to assess how it can take full advantage of the available data, whilst also protecting that data effectively⁶.

UNIFE's view

The European rail supply industry has shown remarkable swiftness in recognising the potential value of Big Data and has proactively worked on solutions to harness it. Granted, UNIFE members understand that data-driven solutions can create added value for society, operators and public authorities. Accordingly, the effective use of digital data processing represents a breakthrough for the maintenance of railway infrastructure and rolling stock, as the reliability of the entire rail system can be improved.

In particular, maintenance needs could be predicted and based on the true condition of components – as data analytics can detect impending defects, ensuring that parts are replaced only when required and before a defect occurs. This would contribute to reducing the life-cycle cost of rail products, whilst also helping to prevent failures. Moreover, as data processing continues to evolve, overall energy consumption would be reduced, operational processes would be optimised and, eventually, the impact of problems on operations would be minimised – thereby increasing the overall safety of the system.

In addition, the collection and processing of data collected that refers to the usage of the network would allow transport operators to adapt and shape their service offer in order to better meet the actual transport demand. *(This will be further developed in the section on 'New Mobility Services').*

⁶ The subject of "Cybersecurity" will be dealt with in the next Chapter.

Following this further, UNIFE believes that, in order to fully harness the benefits of data-focused solutions, it is essential to remove barriers to information-sharing between operators (mainline and urban), infrastructure managers and suppliers. Last year's *Joint Rail Sector Declaration on Digitalisation of Railways* underlined the sector's common goal to make use of digital technologies in order to continue providing efficient and attractive transport solutions to their customers in a rapidly-changing environment⁷. In this regard, unlocking datasets would enable the rail supply industry to create more personalised and tailored services for its customers, thereby further boosting innovation in the sector. Data-sharing will therefore create opportunities to exchange ideas and devise new solutions, enabling the whole sector to develop new knowledge and expertise.

Nevertheless, although the integration of different sources of data would be necessary in order to fully exploit the increased possibilities of big data sets, there seems to be little appetite for openness and information-sharing among stakeholders in the rail sector. This should not come as a surprise, as there are several types of data which may be regarded as commercially sensitive by rail transport operators. Therefore, it may be necessary to clarify the ownership, access and usage of different types of data. Limited clarity over the ownership of data can be exacerbated even further by commercial relationships – because, for example, companies may sometimes refuse to share data with their competitors and other stakeholders.

Close cooperation between suppliers, operators – including public transport operators – and infrastructure managers will be vital in order to eradicate barriers to data sharing in the rail ecosystem. Therefore, an agreement involving all of the relevant parties, together with adequate rules for data sharing, would appear to be necessary.

Granted, digitalisation relies on communication and therefore a flexible and adaptable communication system is required in order to support emerging and future rail applications. This new system must overcome the current constraints and offer multi-radio technology support, being able to select, combine and aggregate bearers to deliver superior communication services in terms of higher throughput, lower latency, improved security and reliability. In this regard, we welcome the positive results of the UIC Project 'Future Railway Mobile Communication System (FRMCS)'⁸ and the technology demonstrator activities related to 'Adaptable Communication System for Railways (ACS)'⁹ – within the Shift2Rail Innovation Programme 2 '*Advanced Traffic Management and Communication System*'¹⁰. The outcomes of these will provide a sound technical basis for establishing a comprehensive and flexible communication system for railways that will satisfy the requirements of different operational services.

Key Messages and Recommendations

- It is necessary to clarify and increase transparency regarding the categorisation of data in the rail sector, which is necessary in order to promote a more collective view about which data may be shared among stakeholders.
- Adequate rules to provide a framework for data and information-sharing across the whole rail sector should be established, in order to fully harness the benefits of Big Data.
- Data exchange should be streamlined by developing and implementing an adaptable multi-radio multipath communication system, which would support higher data throughput, together with improved security and reliability.

⁷ Joint Rail Sector Declaration on Digitalisation of Railways; 9th November 2017; <http://unife.org/component/attachments/attachments.html?id=863&task=download>

⁸ <https://uic.org/frmcs>

⁹ Shift 2 Rail IP2 TD2.1 Adaptable Communication System (ACS); https://projects.shift2rail.org/s2r_ip2_n.aspx?p=X2RAIL-1

¹⁰ <https://shift2rail.org/research-development/ip2/>

Cybersecurity

The Context

Cybersecurity is intrinsically linked to Big Data and, in the latest years, it has been a subject at the centre of the European legislative process. Notably, the Network and Information Security (NIS) Directive (EU) 2016/1148¹¹ – adopted in August 2016 and whose implementation was due in Member States by 9th May 2018 – marks the first step towards a more coherent and harmonised cybersecurity management in Europe. Notably, the NIS Directive identifies transport, including rail transportation, as an “essential service”, imposing obligations on rail operators and infrastructure managers to implement risk management practices as well as to report cyber incidents.

The NIS Directive is just one of many initiatives being rolled-out at EU-level to improve cybersecurity across all sectors. In September 2017, the European Commission issued a package of legislative and other proposals, including a EU cybersecurity strategy through the Communication “*Resilience, Deterrence and Defence: Building Strong Cybersecurity for the EU*”¹². Part of the new strategy includes the establishment of a cybersecurity competence network with a European Cybersecurity Research and Competence Centre and increasing the powers of the European Network and Information Security Agency (ENISA) through a so-called ‘Cybersecurity Act’¹³.

Another landmark piece of EU legislation which affects cybersecurity is the General Data Protection Regulation (GDPR)¹⁴, which entered into force in May 2018, introducing strict rules on how private information may be collected and managed. The main purpose of the GDPR is to further strengthen data privacy, and its introduction has led to the development of new cybersecurity solutions. would have to be developed in compliance with the new protection levels for data.

As a matter of fact, we can say that the ongoing digital transformation and the increasing flow of big data are creating unprecedented opportunities for all sectors, including transport, to enhance overall operational and technical efficiency. At the same time, this technological progress completely redefines the security environment as systems become vulnerable to new types of threats.

Arguably, digitalisation can contribute to making rail transport safer, more efficient and more convenient for both passengers and freight, but it also exposes rail systems to cybersecurity risks. As rail harnesses the benefits of digitalisation and the internet of things (IoT), one can expect cyber-attacks to become ever-more sophisticated. Indeed, one must be aware that cyber threats are as versatile and dynamic as the digital world and its applications.

There are many different types of cyber-threats that could adversely affect the rail transport system. Some attacks may result into physical damage to crucial railway infrastructure – e.g. the signalling system while others might not even be focused specifically on the rail system (e.g. viruses and malware). Due to the complex landscape of potential threats, anticipatory measures are often difficult to develop and put in place.

¹¹ Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union; https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ.L:2016:194:TOC&uri=uriserv:OJ.L_2016.194.01.0001.01.ENG

¹² European Commission’s Communication “Resilience, Deterrence and Defence: Building strong cybersecurity for the EU”; JOIN/2017/0450 final

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1505294563214&uri=JOIN:2017:450:FIN>

¹³ Proposal for a Regulation of the European Parliament and if the Council on ENISA, the “EU Cybersecurity Agency”, and repealing Regulation (EU) 526/2013, and on Information and Communication Technology cybersecurity certification;

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1545126972662&uri=CELEX:52017PC0477>

¹⁴ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679>

UNIFE's view

Embracing the need for robust cybersecurity measures and being prepared to deal with cyber-attacks represent significant challenges for the rail sector, both now and in the future. The European rail supply industry fully recognises the fact that protection against cyber threats is a vital element of maintaining a safe and reliable railway, – with its complex interdependences and legacy infrastructure – ensuring the integrity of rail systems and maintaining operational continuity standards.

Through the Cybersecurity Working Group, UNIFE's Members have prepared a technical Position Paper, identifying the main cybersecurity-related challenges in terms of standards and technology, and providing a basis for further discussions with the EU institutions and the other rail stakeholders. This Position Paper identifies short-term and medium-term challenges to be addressed, specifically in relation to standardisation and R&I (Research and Innovation) activities, as well as the need for close cooperation within and between sectors, in the framework of an effective cybersecurity strategy.

UNIFE believes that the first step toward a holistic and cybersecurity chain depends on understanding the cyber-risks and their potential impacts on the rail system. This has to be done through developing targeted cybersecurity-related skills and knowledge, as well as increasing the cyber awareness regarding cyber threats within each company and organisation. Cybersecurity-related skills should be strengthened, especially regarding the detection of and response to cyber threats, in order to minimise the negative impacts of cybersecurity incidents and enable a swift recovery of systems and services following any such incident.

Furthermore, in addition to developing this critical expertise and filling any skills gaps, UNIFE strongly supports the strengthening of cooperation among all the relevant actors in the rail sector and beyond. In this regard, exchanging knowledge with other concerned businesses via existing networks, such as associations or governmental information systems, would help to enhance the capacity of rail stakeholders to develop and implement effective measures to protect their systems and services against cyber threats.

Security-by-design is another crucial element for an effective cybersecurity strategy. In practical terms, this means increasing the focus on security aspects during the design process of a product, giving them the required priority, and ensuring compliance with relevant regulations and standards at an early stage. As a positive consequence, products and systems that have been built with security in mind can help to spare time and resources, contributing to reducing the risk and avoiding the costs of an effective cyber-attack, avoiding the hectic and expensive replacement of a component.

An additional challenge relates to the design of maintainability strategies and the maintenance costs generated by cyber threats – especially when combined with safety risks. Notably, while safety systems are updated only when a safety issue is detected, such updates are accompanied by a complex validation process leading to a new certification of the safety system. However, cybersecurity risks are constantly evolving due to the development of new types of threats. Accordingly, the strategies and measures required to maintain the resilience of rail systems/sub-systems and to defend against the latest cybersecurity threats must be updated continuously and with a shorter time-cycle. Arguably, when problematics need to be addressed both from the cybersecurity and safety sides, the level of complexity – as well as the amount of work needed – to maintain the protection and safety of rail systems/sub-systems is raised considerably. As a consequence, this also leads to greater operational complexity and higher maintenance costs.

Looking at the EU policy landscape, UNIFE welcomes the entry into force of the NIS Directive in May 2018, whilst also recognising the need for additional measures to strengthen the European cyberspace and defend against cyber threats. We are concerned that the European cybersecurity landscape, both at institutional and at industry level, remains very fragmented and divided, with different strategies being developed often within

the same sector and/or in the same Member State. There is also a clear need for an EU-wide coordinated response management dealing with cyber-threats and incidents. In this regard, the agreement reached in December 2018 between the EU institutions on the 'Cybersecurity Act', which strengthens the mandate of the EU Agency for Network and Information Security (ENISA) turning it into a real 'EU Cybersecurity Agency', represents a positive step in the right direction.

In particular, the EU Cybersecurity Act¹⁵ also provides for the establishment of a new EU-wide framework for the certification of products and services. One can reasonably expect that certification will play an important role among all cybersecurity stakeholders' activities in the coming years. In this context, UNIFE sees the need for a harmonised, efficient certification scheme to be developed that takes into account the specific needs and safety requirements of the rail sector. We also share the European Commission's view that cybersecurity certification in the railway domain must remain voluntary and should not be imposed on all stakeholders as a legally enforceable requirement.

Moreover, UNIFE was pleased to see the positive outcomes of the first European Conference on Transport Cybersecurity, which was held in Lisbon in January 2019. On this occasion, all of the EU's Transport Agencies (ERA for railways, EASA for aviation and EMSA for maritime) pledged to strengthen cybersecurity synergies between different modes of transport, and to collaborate fully with ENISA and the European Commission (notably DG CNECT and DG MOVE).

Key Messages and Recommendations

- The European Commission should continue to develop a consistent and harmonised European legal framework and management system for detecting and addressing cybersecurity risks, covering all sectors and Member States, including the effective implementation of the NIS Directive.
- The development of a cybersecurity culture should be promoted, raising the awareness of risks and fostering the acquisition of cybersecurity skills – including in the rail sector.
- Cross-sectoral cooperation and exchanges of best practice should be strengthened across all transport modes, utilising and sharing knowledge as well as the acquired experience.
- UNIFE insists that any certification scheme to be developed by ENISA in the framework of the EU Cybersecurity Act must remain voluntary.
- The independence between safety application modules and network/operating systems should be ensured during the design of safety systems, in order to maximise protection against cyber threats and also to minimise the maintenance costs of rail systems and subsystems generated by cybersecurity.

Artificial Intelligence

The Context

Up until a few years ago, artificial intelligence (AI) was more about promise than reality, but today it is part of everyday life. AI has quietly evolved from being aspirational to commonplace, and now to being truly indispensable in a growing number of applications.

The term Artificial Intelligence (AI) is commonly used to refer to a range of technologies such as software, algorithms, processes, and robots that - contrary to machines only acting on human command - are able to acquire analytical capabilities and to perform tasks. In other terms, Artificial Intelligence is the next evolution of technology systems capabilities that mimics the way the human brain works because it understands, reasons

¹⁵ Also, in domestic legislative initiatives such as the IT-Sicherheitsgesetz 2.0 in Germany;
https://www.bsi.bund.de/DE/Themen/Industrie_KRITIS/KRITIS/IT-SiG/it_si_g_node.html

and learns, shifting technology's role from enabler to advisor and – notably – further unlocking the potential of the flow of Big Data.

Numerous sectors, including transport, are already making use of AI-driven applications (e.g. speech interpretation, facial recognition). There is enormous potential for AI technology, coupled with powerful processing capacity, to analyse huge amounts of data, recognise patterns and extract valuable information that would otherwise be hidden from human eyes.

At EU-level, 2019 and 2020 are crucial years during which the European Commission will try to define the EU's approach towards various AI-related trends. Arguably, governmental and institutional responses to the legal, societal and ethical challenges posed by AI have struggled to keep pace with the rapid evolution of AI technologies¹⁶. However, some significant actions have already been undertaken. In May 2018, the European Commission issued its first Communication on the subject – “*Artificial Intelligence for Europe*” - setting out a European approach to make the most of the opportunities offered by AI, whilst also preparing for socio-economic changes and ensuring an appropriate ethical and legal framework¹⁷. In its Communication, the EC pledges to invest EUR 1.5 billion in Artificial Intelligence during the period 2018-2020, and explicitly acknowledges that transport represents a key sector for the development of AI applications. The Commission has also proposed that EUR 2.5 billion should be channelled into Europe's AI capacities through the Digital Europe programme during the period 2021-2027.

In addition, the European Commission has established a High-Level Group on Artificial Intelligence, including 52 experts from academia, industry and civil society. This High-Level Group will support the implementation of the European strategy on AI¹⁸.

UNIFE's view

As the ongoing changes in land transport systems enter the next phase in their evolution, few emerging technologies offer as many possibilities and opportunities for the future of rail transport as Artificial Intelligence (AI) promises to do.

UNIFE acknowledges the significance of the initiatives undertaken by the European Commission in the area of Artificial Intelligence. The progress achieved in this field by Europe's economic competitors, such as China and the USA, necessitates urgent and coordinated action at EU-level. However, we note that the expected investments from the EU budget representing EUR 1,5 billion which can be combined with the EUR 2,5 billion through the Digital Europe programme –spread over a 10-year period (2018-2027) may only be “a drop in the ocean” when compared to the financial commitments undertaken by Europe's main competitors.

Furthermore, UNIFE welcomes the recognition of transport as a key sector for the development of AI applications, as identified by the European Commission in its Communication ‘*Artificial Intelligence for Europe*’. We strongly advocate for ‘rail’ to be expressly mentioned – in any future EU policy and/or strategy documents focussing on AI – as a priority area for strategic investments in Artificial Intelligence. Given that rail is the most efficient mode of land transport, capable of providing low-carbon mobility combined with high levels of energy efficiency, safety and capacity, we consider that rail transport offers unrivalled potential for realising the societal benefits of Artificial Intelligence. As the backbone of a clean and multimodal mobility paradigm, we see rail transport potentially becoming the perfect incubator to develop AI solutions.

European suppliers and manufacturers understand that AI-related applications can be developed and employed in a number of different segments of rail transport systems. First and foremost, there is enormous potential for AI-based technology to be applied in the area of train operations and autonomous driving.

¹⁶ “*European Artificial Intelligence (AI) leadership, the path for an integrated vision*”; Centre for Industrial Studies (CSIL); European Parliament's Committee on Industry, Research and Energy; September 2018

¹⁷ European Commission's Communication “*Artificial Intelligence for Europe*”; 25th April 2018; COM(2018) 237 final; <https://ec.europa.eu/digital-single-market/en/news/communication-artificial-intelligence-europe>

¹⁸ <https://ec.europa.eu/digital-single-market/en/high-level-expert-group-artificial-intelligence>

Moreover, AI can also play a major role in relation to mechanisation and robotisation – notably for construction, renewals and maintenance.

The implementation of AI solutions in the area of autonomous driving is of particular importance for the European rail supply industry. Autonomous trams, metros and trains (for regional, long-distance and freight transport) can contribute to significantly increasing the capacity of rail networks. This would lead to a better optimisation of rail transport systems tailored to the needs of customers and users – e.g. through more flexible and more frequent public transport services and adapted capacity.

In order to enable such developments in autonomous driving, two key elements are needed: dedicated investments in the field, together with assessable and certified AI technologies for safety-critical applications. Notably, this step would be carried out through new standardised certification processes and the possible creation of extensive open benchmark data sets, as well as the establishment of test fields/tracks for assisted and autonomous driving. It will also be necessary to produce highly detailed and accurate digital maps of public rail networks, containing standardised data and being accessible to all stakeholders.

Other domains where there is great potential for making use of AI technologies relate to data analysis methods. For example, predictive “intelligent” maintenance concepts can be developed by combining the monitoring of infrastructure using “travelling sensors” with augmented virtual reality support.

There is significant scope for further mechanisation and robotisation in the building and maintenance of rail infrastructure. AI-based technologies could be used during maintenance execution and eventually become an essential element in multi-purpose equipment. AI and machine learning technologies would enable the creation of collaborative robots – also called ‘cobots’ – capable of working safely alongside humans and carrying out several different tasks at the same time. Accordingly, Collaborative robots would share the workspace with humans, making automation easier and safer. Last but not least: robots with integrated AI will be able to monitor their own accuracy and performance, which will allow any weaknesses to be identified and addressed by human intervention if necessary.

Moreover, European suppliers and manufacturers are fully aware of the regulatory complexity linked to the deployment of AI applications. Currently, rail transport must meet strict safety regulations, rules and standards, which were written at a time when Artificial Intelligence was merely a concept. Therefore, in order to allow the commercial use of AI-based products in the transport market, many existing standards and regulations may have to be reviewed and modified. In this context, ensuring the highest possible levels of safety must be a fundamental objective.

As much as in the case of cybersecurity, we understand that close and transparent cooperation between suppliers, railway undertakings and infrastructure managers will be needed in order to maximise the contribution of AI-based technologies to the rail sector.

UNIFE is aware that the deployment of AI-based technologies may encounter concerns and/or reservations (a “trust” issue) from businesses and society. It goes without saying that AI decision-making processes, in the transport sector and beyond, are complex to grasp and may lead to a feeling of losing control of crucial operations or procedures. Therefore, UNIFE stresses the importance of rolling out AI-based solutions in a responsible and fully transparent manner. In this regard, the creation of a common legal and ethical framework for AI technologies at European level, including the respect of data privacy laws, would help to advance their usefulness vis-à-vis society and consumers and promote their uptake.

We acknowledge that the trust questions of confidence and “trust” regarding the use of AI technologies will affect the time-horizon for the marketability of AI-related products and applications, such that the time-to-market may be longer than for other digital technologies. UNIFE believes that the best way to maximise the positive contribution of AI to the rail sector will be through a transparent and trust-based cooperation between suppliers, rail service operators and infrastructure managers.

Key Messages and Recommendations

- The European Commission and EU Member States must scale up their ambitions and resources for AI, in order to develop the technologies that are necessary for Europe to compete with other leading players in the global economy.
- The European Commission should explicitly recognize rail transport as a strategic area for ambitious and ring-fenced investments in AI-based technologies.
- The European Commission and EU Member States should support the development of AI-based technologies for autonomous driving of railway vehicles, as well as the establishment of test fields/tracks for assisted, automated and autonomous driving.
- Standardised certification processes for AI technologies should be established in order to facilitate the deployment of AI-based solutions for safety-critical applications.
- All of the relevant standards and regulations should be carefully reviewed and revised as necessary, taking the emerging role of AI-based technologies into account whilst also ensuring the highest possible levels of safety.
- A common legal and ethical framework should be established at EU level in order to foster the deployment of AI technologies in the transport sector and beyond in a fully transparent and responsible manner, which will also contribute to building confidence and trust among businesses, consumers and society as a whole.

New Mobility Services

The Context

The rapid evolution of digital technologies is also triggering the creation of new business models and services in the transport sector, placing mainline and urban/regional rail transport within a broader multi-modal mobility chain. In fact, a new mobility market is emerging in which transport services are offered in an integrated way, beyond the “one single-mode” solution, covering many regions and countries simultaneously – for a fully seamless mobility experience. One of the most visible examples of such mobility business model is represented by MaaS (‘Mobility as a Service’), through an approach that builds on the complete integration of all available transport modes.

The impact of new mobility trends and services is most evident in cities and urban/suburban areas. As a matter of fact, urbanisation is one of the most notable megatrends throughout the world, with Europe being no exception. The share of Europe’s population living in urban and suburban areas is expected to reach 75% in 2020, climbing up to 84% by 2050¹⁹. Today’s cities face challenges in terms of traffic congestion, lack of space, population growth, air quality, noise, liveability, social inclusion and health, as well as economic development. In this context, the challenge facing the transport sector is to serve the evolving mobility needs of growing cities and increasingly populous suburban areas.

Once again, the “final” customer – either the passenger or the freight load – are at the centre of these radical changes in the mobility paradigm, as their expectations become ever more demanding. In this regard, digitalisation can help mobility providers to bring in a more diversified mobility offer. Accordingly, the increased availability of data on users’ travel patterns will allow transport authorities and service providers, across all modes, to better predict the demand and also understand their customers’ behaviour – driving targeted commercial and operational actions.

New mobility services fostered by digital technologies would be able to provide customers, for instance, with real-time travel information as well as personalised suggestions in the event of any possible disruption.

¹⁹ <https://population.un.org/wup/Download/>

Moreover, the digitisation of payment systems, based on the effective use and processing of the data available, would enable a smarter model of dynamic pricing – e.g. reducing prices at times when services are less busy and charging the users on the basis of their previous travel preferences – whilst also giving greater flexibility for users to define their own journeys.

The proactivity of the rail sector in positioning itself at the centre of changes in mobility models can be observed in the work being carried out within the Shift2Rail Joint Undertaking's Innovation Programme (IP) 4 '*IT Solutions for attractive railway services*'. The objective of Shift2Rail's IP4 is to build a digital mobility ecosystem combining different travel segments, in order to offer intermodal transport journeys customised to users' preferences²⁰ – and provide them with seamless access to all relevant services related to their journeys.

UNIFE's view

New mobility services and business models are aiming to meet the increasing demand for efficient, shared and sustainable transport solutions. Europe's rail supply industry is fully committed to driving a new mobility paradigm that embraces innovative transport services, capable of delivering high quality mobility solutions to people in their everyday lives – particularly, but not limited to, urban/suburban areas.

Digital technologies pave the way for new tools and services that can provide a seamless door-to-door mobility chain based on integrated multimodal transport systems. In this context, the role of rail assumes a particular significance. Rail transport solutions, especially in cities and urban/suburban areas (including metro tramways, tram-trains and suburban trains) already offer a number of assets in terms of capacity, CO2 emissions, land use and safety. Combining these traditional assets with the opportunities brought in by digital mobility trends – notably, through the effective collection and management of the data available – would enable rail to provide innovative, multimodal and customer's tailor-made tools based on flexibility, high performance and minimum environmental impact.

The European rail supply industry is strongly supportive of the activities that are being developed within Shift2Rail JU's Innovation Programme 4, which will contribute to building a digital ecosystem for MaaS ('Mobility as a Service'), encompassing all of the available transport modes – including "new modes" such as bike-, car- and ride-sharing services. Individual users will be able to access live traffic notifications based on predictive models fed by information received directly from the rail assets, and automatically receive suggestions of alternative solutions in the event of any disruption of transport services²¹.

Following this further, with a view to the continuation and/or follow-up of the Shift2Rail JU post-2020 period (in the framework of the Horizon Europe programme), UNIFE has developed a vision for the next wave of collaborative research and innovation (R&I) activities in the Joint Undertaking, based on nine pillars or "key-enablers". One of these key-enablers tackles the disruptive innovations for mobility pushed by digitally-based solutions under the name of "*Mobility as a seamless service*".

In UNIFE's view, the successor of Shift2Rail JU, through the framework set by the "*Mobility as a seamless service*" key-enabler, would foster innovation and technologies to accomplish the following objectives: first and foremost, provide rail customers (passengers and freight) with seamless, personalised, efficient and cost-effective end-to-end journeys – whatever the mode of transportation; secondly, to provide an intelligent and adaptive multi-modal traffic management system to mainline and public transport operators – always ensuring seamless door-to-door mobility to customers.

²⁰ <https://shift2rail.org/research-development/ip4/>

²¹ <https://shift2rail.org/news/mobility-as-a-service-one-ecosystem-to-book-them-all/>

Key Messages and Recommendations

- The individual customer shall be at the centre of new mobility services fostered by integrated and digital transport solutions. Rail, as the backbone of sustainable and multimodal transport, shall drive the development of a new mobility paradigm.
- UNIFE calls on the EU institutions and Member States to ensure the extension and/or follow-up of the Shift2Rail Joint Undertaking within the framework of the Horizon Europe programme (2021-2027). Through work-streams such as 'Mobility as a seamless service' new technologies will emerge, leading to the development of new business models. for suppliers, operators and customers.
- A new governance framework for the coordination of multimodal traffic management systems will have to be developed, giving priority to rail and other 'green' mobility modes.

Digitalisation of Freight Logistics Services

The Context

The traditional freight and logistics business is another area which is being deeply transformed by digital applications and new mobility services. The transition from paper to digital documentation, supported by the digital exchange of data, is the way forward to improve efficiency, reliability, simplification, and productivity, as well as reduced costs. The now rapidly progressing digital transformation demands new digital business models in order to retain customers and maintain market positions. Accordingly, digitalisation would enable logistics actors to maximise benefits from a digitised logistics process with intelligent services – e.g. end-to-end logistics planning & visibility; efficient sharing of information within the supply chain.

In order to retain their market competitiveness, customers and regulators increasingly require the logistics sector to provide customer-tailored end-to-end logistics services. Therefore, new factors have become increasingly critical, together with value-added services such as tracking and tracing, fleet management, and supply chain management benchmarking, alongside new technologies such as blockchain.

The European Commission has recognised that new technologies and big data have the potential to change the way the entire logistics chain is organised and managed. In this regard, the Digital Transport and Logistics Forum (DTLF) was created in 2017. The DTLF is an open and collaborative platform that brings together Member States, public entities and other organisations to exchange knowledge and develop policy and technical recommendations for the European Commission in the fields of transport and logistics digitalisation across all modes of transport²².

UNIFE has been a qualified party to the DTLF since the beginning of the Forum's activities, being involved in the initiatives related to the digitalisation of freight and logistics services and pushing for the acceptance of e-documents, as well as for the harmonised exchange of information and data within the logistics chain.

UNIFE's view

UNIFE appreciates that, in their Council Conclusions in December 2017, EU Member States have acknowledged that digitalisation – together with the sharing of pertinent data among relevant parties – offers the chance to better integrate rail into transport logistics chains, thereby enhancing the attractiveness and competitiveness of international rail freight transport²³. Indeed, the exchange of information is a critical success factor in supply chain management and freight logistics services.

The European rail supply industry is keen for rail freight to be seen as part of a global digital logistics ecosystem, reducing the complexity of operations while increasing their flexibility, leading to greater efficiency and lower

²² <http://www.dtlf.eu/about-us/presentation>

²³ Council's conclusions on the digitalisation of transport; 5th December 2017; 15431/17; <http://data.consilium.europa.eu/doc/document/ST-15431-2017-INIT/en/pdf>

costs. This transformation must be implemented very swiftly and be supported by the appropriate advanced technologies – in order to keep pace with the fast technological progress that is happening in the road freight sector. As described in the previous section on ‘New Mobility Services’, digitally-based solutions are paving the way for innovative mobility services and business models, offering new opportunities not only for passengers but also for logistics.

In this regard, UNIFE and its Members have developed the European Rail Industry Freight Agenda (ERIFA), highlighting the most important current and emerging technologies which could contribute to driving change in the rail freight and logistics business. More specifically, ERIFA is an open and living document in which 27 technologies have been identified, targeting five areas of potential improvement within the freight and logistics framework: energy efficiency, productivity and capacity, reliability, noise reduction, and the total cost of ownership. Officially presented to the European transport community in October 2018, the first version of the ERIFA document is due to be released by the first half of 2019.

We wish to highlight the important work that is being carried out within the Innovation Programme (IP) 5 of the Shift2Rail Joint Undertaking, “*Technologies for Sustainable & Attractive European Rail Freight*”, financed with EUR 83 million for the period 2014-2020. Accordingly, ERIFA is intended to support and complement the activities of Shift2Rail JU IP5. Moreover, through the ERIFA open and living document, the European rail supply industry would envisage to prospectively provide input to the preparation of the Shift2Rail 2 programme beyond 2020.

Key Messages and Recommendations

- The technological development of rail freight – as outlined in the European Rail Industry Freight Agenda (ERIFA) – should be supported by EU and national decision-makers, in order to make rail better integrated within the multimodal and digitalised freight logistics chain.
- A common legal framework is needed at European level to support the sharing of pertinent data and information among relevant parties in the logistics chain.
- UNIFE calls for the continuation and/or follow-up of the Shift2Rail Joint Undertaking in the framework of the Horizon Europe programme, in order to provide continued support for innovation in rail freight post-2020.

Summary of the Recommendations

Topic	Recommendations
<i>General Remarks</i>	<ul style="list-style-type: none"> ➤ The ultimate benefit of the “final transport user”, namely the individual passenger or the freight load, shall remain at the heart of every digital transformation within the rail sector. ➤ In order to ensure the continuation of EU support for collaborative research and innovation (R&I) activities related to rail transport, UNIFE calls for the extension of the Shift2Rail Joint Undertaking within the forthcoming Horizon Europe Framework Programme 2021-2027. ➤ The EU institutions should recognise the transport sector (and rail in particular) as being a key area for digital transformation to deliver economic, environmental and societal benefits, and also make it a priority within the Digital Europe programme. ➤ The European Commission should urgently prepare a comprehensive and multimodal digitalisation strategy for the transport sector, including a roadmap with an indicative list of proposed actions and associated timeline. ➤ It is necessary to establish a European platform on digitalisation in the rail sector, including representatives of all the relevant stakeholders, in order to ensure a balanced and coordinated approach to the development and deployment of digital technologies within the sector.
<i>Big Data</i>	<ul style="list-style-type: none"> ➤ It is necessary to clarify and increase the transparency regarding the way rail data is categorised, in order to promote a common understanding about which data should be shared between stakeholders. ➤ Adequate rules to provide a framework for data and information-sharing across the whole rail sector should be established. ➤ In order to streamline the exchange of data it will be necessary to develop and put in place a standardised communication system utilising several radio technologies.
<i>Cybersecurity</i>	<p>The European Commission should continue to develop a consistent and harmonised European legal framework and management system for detecting and addressing cybersecurity risks, covering all sectors and Member States, including the implementation of the NIS Directive.</p> <ul style="list-style-type: none"> ➤ The development of a cybersecurity culture, raising the awareness of risks should be fostered, together with the acquisition of cybersecurity skills – including in the rail sector. ➤ Cross-sectoral cooperation and exchanges of best practice should be strengthened across all transport modes, utilising and sharing knowledge as well as the acquired experience. ➤ Any European certification scheme to be developed by ENISA in the framework of the EU Cybersecurity Act must remain voluntary. ➤ The independence of safety application modules and network/operating systems should be ensured during the design of safety systems, to maximise protection against cyber threats and also to minimise the maintenance costs of rail systems and subsystems.
<i>Artificial Intelligence</i>	<ul style="list-style-type: none"> ➤ The European Commission and EU Member States must scale up their ambitions and resources for AI, in order to develop the technologies

	<p>that are necessary for Europe to compete with other leading players in the global economy.</p> <ul style="list-style-type: none"> ➤ The EU should explicitly recognize rail transport as a strategic area for ambitious and ring-fenced investments in AI-based technologies. ➤ The European Commission and EU Member States should support the development of AI-based technologies for autonomous driving of railway vehicles, as well as the establishment of test fields/tracks for assisted, automated and autonomous driving. ➤ Standardised certification processes for AI technologies should be established in order to facilitate the deployment of AI-based solutions for safety-critical applications. ➤ All of the relevant standards and regulations should be carefully reviewed and revised as necessary, taking the emerging role of AI-based technologies into account whilst also ensuring the highest possible levels of safety. ➤ A common legal and ethical framework should be established at EU level in order to foster the deployment of AI technologies in the transport sector and beyond in a fully transparent and responsible manner, which will also contribute to building confidence and trust among businesses, consumers and society as a whole.
<p><i>New Mobility Services</i></p>	<ul style="list-style-type: none"> ➤ The individual customer should be at the centre of the integrated and digital transport solutions fostered by new mobility services – in urban/suburban areas and beyond. Rail, as the backbone of sustainable and multimodal transport, shall drive the development of a new mobility paradigm. ➤ UNIFE calls on the EU institutions to ensure the extension and/or follow-up of the Shift2Rail JU within the framework of the Horizon Europe programme (2021-2027). Through work-streams such as ‘Mobility as a seamless service’ new technologies will emerge, leading to the development of new business models for suppliers, operators and customers. ➤ A new governance framework for the coordination of multimodal traffic management systems will have to be developed, giving priority to rail and other ‘green’ mobility modes.
<p><i>Digitalisation of Freight Logistics Services</i></p>	<ul style="list-style-type: none"> ➤ The technological development of rail freight should be supported by EU and national decision-makers, in order to make rail better integrated within the multimodal and digitalised freight logistics chain. ➤ A common legal framework is needed at European level to support the sharing of pertinent data and information among relevant parties in the logistics chain. ➤ UNIFE calls for the continuation and/or follow-up of the Shift2Rail JU in the framework of the Horizon Europe programme, in order to provide continued support for innovation in rail freight post-2020.

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