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THE EUROPEAN RAIL INDUSTRY

UNIFE Vision Paper on Digitalisation
Second Chapter

"Rail fit for digital age"

July 2020

UNIFE – The European Rail Supply Industry Association

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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.

Introduction

Fostering digital transformation is an objective higher than ever on the EU's political agenda and it has been identified as key for unlocking future growth in Europe. All sectors are experiencing a fast-pace change in the business, products and services fostered by digital technologies. Transport is no exception, with the rail sector increasingly acknowledging its strengths and assets, as well as the importance of making a "digital leap".

In April 2019, UNIFE published its first Vision Paper on digitalisation, "Digital trends in the rail sector" [1], outlining the European rail supply industry's stances on some of the most discussed trends in the digital world and which ones' development in transport was accelerating significantly. Five were identified as potentially holding the most impact: 1) Big Data; 2) Cybersecurity; 3) Artificial Intelligence; 4) New Mobility Services; and 5) the Digitalisation of the freight logistics chain.

About one year later, an update/new version of that Vision Paper has become important for the following reasons:

I   Digitalisation changes rapidly. We are already witnessing technological evolutions in the focus areas tackled on the first Vision Paper, with new sectorial & cross-sectorial initiatives being carried out – for instance, the Digitizing Rail Round-Table led by DG CONNECT and DG MOVE.

II   Digitalisation is, together with the Green Deal, the other hallmark of the current European Commission. Vice-President Margrethe Vestager, responsible of the portfolio "Europe fit for digital age", and Commissioner Thierry Breton, responsible for "Internal Market and services", have launched their digital strategy and related initiatives – aiming to shape the European digital and technological framework for the years to come. It is therefore necessary that the European rail supply industry positions itself proactively with regard to such strategy and measures.

III During the latest months, more digital trends have become of great interests for the European rail supply industry – such as e.g. Blockchain or Digital Twins. The update/new version of the Vision Paper would offer the chance to convey the UNIFE's messages and views on those matters which were not examined in depth in the occasion of the first Paper.

IV   The update/new version of the Vision Paper is the opportunity, for UNIFE, to make a sort of "checklist" of our ambitions & goals. Namely, one year on the publication of our Vision, we would assess whether the objectives we had set in the Paper have been achieved, and whether the recommendations we pushed forth have been considered. On the basis of such "check", the European rail supply industry would be capable of, potentially, strengthening its strategy and, if necessary, readjusting its goals.

1.
http://unife.org/component/attachments/attachments.html?id=1011&task=download

In this context, as the pace of digital developments in transport and beyond has moved up a gear, a fresh, updated Vision Paper will stand as a dynamic, evolving document which allows the European rail supply industry to always look as a frontrunner in digitalisation. This second edition of the Vision Paper will be organised as follows according to the subjects being discussed.

1. Some of the key topics previously analysed in the first Paper – such as Big Data, Cybersecurity and Artificial Intelligence – will be revised and given an update as political and technological developments demand. Prospectively, new recommendations and key-messages from the European rail supply industry will be identified.

2. Furthermore, the second Vision Paper will present additional digital trends that present considerable relevance from rail suppliers and manufacturers. These notably include 5G, blockchain and digital twins. The footprints of the first Paper also proscribed recommendations and desired outcomes for each of those focus areas.

Executive Summary — Key Messages and Recommendations

Big Data

A Single Market for Data, as announced by the European Commission in its ''Data Strategy'', is a fundamental step to unlock the data sets in rail transport.

All modes of transport should be part of the scope of the ''Common European Data Space'' for mobility, in the context of the Commission's ''Data Strategy''

Coherence and coordination between the ''Common European Data Space'' and the Commissioner Vălean's "Sustainable and Smart Mobility" should be ensured.

The European Commission should involve upfront the rail supply industry in the review of the regulatory framework for data-sharing in rail transport.

A robust budget granted to the successor of Shift2Rail Joint Undertaking within Horizon Europe should be ensured, in order to support the breakthrough efforts of the rail sector in tackling the Big Data opportunities.

Cybersecurity

UNIFE's first technical Position Paper on Cybersecurity has been prepared by our ''Cybersecurity Working Group'' and published in April 2020.

The digital sovereignty of the European Union shall be at the heart of the forthcoming EU ''Cybersecurity strategy''.

The recommendations developed by the ''Cybersecurity workstream'' – within the ''Digitizing Rail Round-table'' initiative – should be presented to Commissioner Thierry Breton for the implementation of the ''Cybersecurity strategy''.

Harmonisation and consistent implementation of the NIS Directive 2016/1148/EU shall be fostered across Member States, while making sure to update the legislation to reflect the ever-evolving cyber-threats landscape.

Following the 2019-Cybersecurity Act, the cooperation between UNIFE and the ENISA Agency should be strengthened.

Within the framework set by the 2019-Cybersecurity Act, we support the harmonisation of certifications schemes, avoiding possible duplications.

The continuation of the Shift2Rail Joint Undertaking within Horizon Europe must be ensured with a strong budget, in order to ensure that rail's cybersecurity priorities are properly addressed.

Artificial Intelligence

The ''White Paper on Artificial Intelligence'' would be the starting point for UNIFE to enhance the role of rail in AI-related initiatives.

The concept of ''trustworthy'' AI should be rapidly defined and implemented, allowing the creation of a solid legal and ethical framework for the deployment these technologies across Europe.

Any future regulatory framework for AI should not be excessively prescriptive, in order not to create excessive burden for business and companies.

5G Connectivity

The European Commission should consider the rail sector's Strategic Deployment Agenda (SDA) when carrying out the masterplan for the rolling-out of 5G corridors for connected and automated mobility.

The rail supply industry should be fully involved in the preparation of the 5G deployment on railway corridors throughout 2021 and 2023.

The fulfilment of the 5G-deployment ambitions in transportation and rail systems require appropriate resources, to be ensured in particular through Horizon Europe, Connecting Europe Facility 2 and Digital Europe programmes.

A framework of common EU cybersecurity measures and coordination among Member States should be put in place to protect 5G networks against cyber-threats.

UNIFE will co-lead the Horizon 2020's project ''5Grail'' on the development of the 5G/FRMCS technology.

Blockchain

The European Commission should specify how Blockchain would be used to develop cutting-edge joint digital capacities, and the rail supply industry should be involved in any related initiatives.

Access to standardised digital information across the freight logistics chain is essential to build trust among the different parties involved in the commercial operation.

The promotion of energy-efficient mobility, such as electric rail transport, could be one of the tools to overcome the issue linked to the energy-use of Blockchain.

Digital Twins

The European Commission should advance specific initiatives and ring-fenced resources to foster the uptake of Digital twins in Europe, in the context of the ''Europe fit for digital age'' masterplan.

A robust budget for the successor of Shift2Rail Joint Undertaking within Horizon Europe should be ensured, in order to support the breakthrough efforts of the rail sector in developing the Digital Twins technology.

Data access and ownership remain open questions for the development of Digital Twins, which could be answered through the establishment of a EU-wide framework for data sharing in rail transport – including urban rail.

The general European context: Digitalisation and Green Deal

When she assumed the helm of the European Commission for the 2019-2024 mandate, President Ursula von der Leyen presented two major cornerstones for her tenure. Firstly, the Green Deal[2] which aims at setting the European Union on a path to holistic sustainability by 2050. Digitalisation, the other, is designed to make Europe ''fit for the digital age''.

Commission Vice-President Margrethe Vestager and Commissioner Thierry Breton were given, within their portfolio, the responsibility of crafting ''a digital Europe that reflects the best of Europe''. The digital path would define an ambitious approach towards digital technological development and set how technology will be used to meet our climate-neutrality objectives.

On 19 February 2020, the Commission unveiled its comprehensive digital masterplan, outlined by the Communication ''Shaping Europe's digital future[3]''. The document includes a prospective timeline with all expected actions. The first building blocks of the masterplan are the Data Strategy and the White Paper on Artificial Intelligence. Its main objectives – besides the already released initiatives on Data and Artificial Intelligence – notably target Cybersecurity, Gigabit Connectivity (i.e. 5G/6G), Digital Finance and the Digital Service Act. These measures aim to establish Europe's technological sovereignty , its global leadership, safeguard European values, and consolidate the EU Digital Single Market.

UNIFE strongly welcomes the publication of the European Digital Strategy, and the ambition therein enshrined. We fully agree with reducing Europe's over-reliance on digital solutions created elsewhere and simultaneously enabling Europe to catch up with global competitors on digital technologies. Moreover, we are particularly ready to commit to the deepening of a frictionless Data Single Market which we consider essential for a number of technologies, products and services to be presented to the market that will ensure an effective digital shift. When it comes to the promotion and safeguarding of European values – convincingly stressed by the European Commission – we firmly support the transition toward a ''trustworthy'' digital transformation which prioritises the end-user with its acquired Rights and Liberties.

Additionally, in regard to the Green Deal, it is undisputable that the twin challenges of green and digital transformations go hand-in-hand. The European Commission has made clear that the digital transformation needs also to be carried out in a way that contributes to a sustainable, climate-neutral and resource-efficient economy. In the digital masterplan, it is explicitly stressed that digital components will also be key in reaching the European Green Deal and Sustainable Development Goals' (SDGs)[4] ambitions. The European rail supply industry fully acknowledges that these digital tools can be powerful enablers of the transition towards an economic and social model based on whole sustainability and that they are essential to strengthening the sustainability-related assets of rail, namely energy efficiency, circularity and capacity.

While welcoming the European Commission's ambitious step and plans, UNIFE would need to raise some question regarding the way such ambitious will be financed in practice. Indeed, if it is unquestioned that Europe's digital leap is of major importance, its accomplishment would necessarily require substantial resources. In this regard, the European Commission indicates that the required investments will be channeled from the Digital Europe programme[5] (DEP), the Connecting Europe Facility 2[6] (CEF2) and Horizon Europe[7] (HEU). The exact amount of the resources for those instruments is linked to the negotiations on the revised proposal of the Multi-Annual Financial Framework (MFF) 2021-2027.

3.
https://ec.europa.eu/info/sites/info/files/
communication-shaping-europes-digital-
future-feb2020_en_4.pdf

4.
https://sustainabledevelopment.
un.org/?menu=1300

5.
https://ec.europa.eu/newsroom/dae/
document.cfm?doc_id=60502

6.
https://ec.europa.eu/newsroom/dae/
document.cfm?doc_id=63665

7.
https://ec.europa.eu/info/files/
horizon-europe-investing-shape-our-future_en

The general European context: COVID-19 global health crisis

At the time of this paper's publication, Europe has been severely impacted by the COVID-19 pandemic which has disrupted economies around the world as it has forced people's daily lives to a grinding halt. The coronavirus outbreak is presenting lasting ramifications on our individual behaviours and lifestyles, particularly on the way we work, consume and travel. In regard to the latter, transport and mobility are at the epicentre of the immediate and long-term challenges posed by the global health crisis. Nonetheless, even during such difficult times, transport's fundamental function of moving people and goods has remained imperative. The whole European rail sector, including its supply industry, has been working relentlessly to keep the inevitable economic impact as limited as possible while ensuring that international supply chains best continue to move seamlessly under these unprecedent circumstances.

UNIFE has strongly welcomed the response to the post COVID-19 economic and social consequences in the form of the Roadmap for Recovery ''Towards a more resilient, sustainable and fair Europe''[8], endorsed by Member States in April. The document includes a strong investment component that reassuringly confirms an upcoming "comprehensive recovery package with the EU budget at its heart" for a Marshall Plan-type investment effort. It also defines key areas for action, including investments in clean and digital technologies.

New digital applications offer public rail transport solutions that will help it navigate successfully through this storm. There exists a plethora of data-driven technologies that can be utilised by health and public transport authorities to facilitate and accelerate their decision-making. [Without entering into the details of the contingency measures related to the response against COVID-19] UNIFE observes that, for instance, locating and tracing passengers in real-time while communicating this information to users in real time is a feasible scenario due to the recent wave of data-driven innovations that mobility has been experiencing. In a sanitary emergency, such as the one that the world currently finds itself, a clear picture of how, when and where people move would allow authorities to reorganise public transport in an efficient and safe manner.

The European rail supply industry has been leading the way in acknowledging the importance of streamlined data collection and processing to devise actionable insights. European rail manufacturers have long called for multi-stakeholder collaborations within the sector. The a framework for data sharing processes across the mobility chain could be a reliable asset for public transport during the global health crisis. Collaborative research programmes, such as the Shift2Rail Joint Undertaking and its successor, would be crucial in the development of the enabling technologies.

As challenging negotiations unfold among European leaders around the 2021-2027 Multi-Annual Financial Framework (MFF), UNIFE calls for the right balance to be maintained between different policy areas, notably with regard to the safeguarding of sufficient resources for Research & Innovation through Horizon Europe and infrastructure investments through the Connecting Europe Facility.

Big Data

BACKGROUND

Data is at the centre of the ongoing digital transformation, being the backbone which enables the digitalisation of our economies and societies. Many rail assets – signalling, ticketing and trains, among others – already incorporate digital capabilities, while rail networks produce a staggering amount of digital information – yet only a fraction of that data is used to generate actionable insight. The importance of collecting, managing and effectively processing data has been fully acknowledged by the rail supply industry, and is already deeply transforming the rail sector's business-as-usual.

In our first Vision Paper on digitalisation[9], UNIFE analysed how the effective management and processing of data in rail can be used for targeted, effective decisions and actions. In particular, predicting the remaining useful life and extending the life of rail assets with data-driven maintenance; responding to disruption and re-scheduling rail traffic with dynamic traffic management – including the monitoring and anticipation of passenger flow demand for an adaptative transportation system – understanding rail infrastructure allowing greater service resilience, are some of the data-driven solutions which have been found to improve dramatically rail business's results.

One of the key-messages of UNIFE in relation to data in rail focused on the importance to remove barriers to data-sharing between operators (mainline and urban), infrastructure managers and suppliers. Indeed, unlocking data sets would enable to fully harness the benefits of data-focused solutions, create opportunities to exchange ideas and devise new solutions – enabling the whole sector to develop new knowledge and expertise. Faced to the little appetite for openness and information-sharing among stakeholders in rail transport, UNIFE has strongly called for clarification and increased transparency regarding the categorisation of rail data – in order to promote a more collective view about which data may be shared among stakeholders – as well as for adequate rules to set a framework for data & information-sharing across the whole rail sector.

STATE OF PLAY AND FUTURE DEVELOPMENTS

If "Europe fit for Digital Age" represents, with the Green Deal, the hallmark of the present European Commission, then "Data" is at the core. In its Communication "A European Strategy for Data"[10], Commissioner Thierry Breton presented the ambitious roadmap towards the creation of Single Market for data. Specifically, the aim is to create a single European data space, where personal, non-personal and sensitive business data are secured and can flow within and across sectors. Different aspects of "data" would be tackled by the Strategy: the availability, the interoperability ("shared compatible formats & protocols"), the governance ("organisational approaches and structures"), the infrastructures, skills and notably cybersecurity.

European rail manufacturers strongly welcome the "European Strategy for Data" Communication and fully support the designed path towards a data-sharing framework in the EU. This is a purpose which the European rail supply industry has been pursuing for a long time, therefore we are committed to work together with EU and national institutions to make the Single Market for Data in Europe a success.

9.
UNIFE's Vision Paper on digitalisation ;
"Digital trends in the rail sector" (p. 5-7);
15th April 2019;
https://www.unife.org/component/attachments/attachments.html?id=1011&task=download

10.
"A European strategy for data";
COM(2020) 66 final;
https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

Among the regulatory initiatives announced by the European Commission over the next couple of years, the so-called Data Act – incentivising horizontal data sharing across sectors, fostering business-to-government and business-to-business data sharing – and notably the establishment of a "Common European Data Space" for mobility are of major interest for the rail sector.

Mobility falls within the scope of the "high impact projects"[11] in strategic sectors [12] identified by the European data strategy. The creation of a EU-wide, common, interoperable data space in transport – would be achieved through the deployment of data-sharing tools and platforms, as well as the creation of data governance frameworks. The goal of the common mobility data space is to position Europe at the forefront of the development of an intelligent transport system, tackling all modes and fostering access, pooling, sharing of data from existing & future mobility databases.

Different measures are expected to contribute decisively to the setting up of the mobility data space, among which the review of the Directive on Intelligent Transport Systems (ITS) [13] in 2021 and the review of the regulatory framework for interoperable data-sharing in rail transport in 2022.

UNIFE considers the proposal to tackle the regulatory framework for data-sharing in rail transport a fundamental step to overcome decisively the insufficient openness and information-sharing among stakeholders in rail transport. UNIFE also shares the acknowledgment that the success of common data spaces – including in the rail sector – would depend on the fairness, clarity and practicality of the rules for data access and use, as much as on the trustworthiness of the data governance mechanisms.

Nonetheless, there is still a number of open questions around the "Common European Data Space" for mobility at stake. First and foremost – although formally the focus of the data space is on the whole transport system – the weight of the automotive sector vis-à-vis the others is considerable and UNIFE will be vigilant to avoid that most of the resources and regulatory instruments do not end up supporting tools for connected automated cars (CAVs) uniquely. Secondly, UNIFE stresses on the need to clarify the relation with and ensure consistency between the common mobility data space and the "Sustainable and Smart Mobility" strategy which Transport Commissioner Vălean is expected to present at the end of this year.

Following this further, since fixing the regulatory framework for data-sharing in rail transport would be a laborious and sensitive task, more information on how the European Commission plans to proceed – and how it plans to involve the rail sector – is necessary. More specifically, UNIFE points out the complexity in tackling the matter of rail's data-sharing globally, rather than focusing on the single data dimensions and applications – such as e.g. the "access", "collection" or "management" data issues, in e.g. the field of maintenance. Finally, the aspect the standardisation of data should be considered when working on the data-sharing framework in rail transport: rail stakeholders would benefit from a standardisation of data as they would be interoperable and accessible more rapidly.

Concurrently, the rail sector has not been "sitting and waiting" for the European Commission to take initiative, but has moved forward on the "Big Data" subject, especially in the context of Research & Innovation (R&I) and Shift2Rail Joint Undertaking [14]. Indeed, the significance of data permeates the whole partnership's scope, across all Innovation Programmes (IPs). The whole sector is now preparing the technical work for the successor of Shift2Rail within Horizon Europe, putting once again data at the centre of an integrated systematic approach, including decarbonisation, automation and digitalisation.

11.
The "High Impact Projects in European data spaces" will be co-financed by European Commission, Member States and Industry. The total funding expected is €4-6 billion (€2 billion by EC) drawing upon different spending programmes. The proposed amount, however, strictly depends on the outcome of the post-COVID-19 MFF 2021-2027 negotiations.

12.
Common European Data Spaces foreseen for the following focus-areas: 1) Industrial/manufacturing; 2) Green Deal; 3) Mobility; 4) Health; 5) Financial; 6) Energy; 7) Agriculture; 8) Public Administrations; 9) Skills

13.
Directive 2010/40/EU "On the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport"; https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0040&from=EN

14.
We also need to mention the activities of the UNIFE's TAF/TAP TSI Working Group, which has been in charge of the definition of the provisions for exchange of relevant information of passengers before, during, and after their journey – including ticketing information – and the definition of the provisions for handling and exchange of relevant information for freight and logistics.

UNIFE finally observes that Big Data also paves the ground to meaningful R&I collaboration [15], in the context of Horizon Europe, with other partnerships such as safe and automated road transport, High-Performance computing, air traffic management and aviation, ECSEL (Electronic Components and Systems for European Leadership) or Fuel Cell Hydrogen.

KEY MESSAGES AND RECOMMENDATIONS

- UNIFE is committed to working with EU and national institutions to make the Single Market for Data in Europe a success This is a fundamental step in unlocking rail transport data sets.

- The focus of the ''Common European Data Space'' for mobility should remain on all modes of transport, avoiding directing most resources and regulatory measures towards supporting tools for solely connected automated cars (CAVs).

- Coherence and coordination between the ''Common European Data Space'' and Commissioner Vălean's ''Sustainable and Smart Mobility'' should be ensured.

- The European Commission should provide further clarification on how they intend to proceed and their plan to involve the supply industry in the review of the regulatory framework for data-sharing in rail transport.

- A robust budget should be granted to Shift2Rail Joint Undertaking' successor programme within Horizon Europe as a means of supporting the rail sector's breakthrough efforts in the field of Big Data.

Cybersecurity

BACKGROUND

Cybersecurity represents one of the fastest-developing digital topics. As cyber-threats are redesigning the security environments of every industry and economic sector, building a solid, holistic cybersecurity strategy has become the essential step to successfully harness the benefits of digitalisation.

The European rail supply industry has recognised that the protection against cyber-threats is a vital element of maintaining a safe and reliable railway, – with its complex interdependences and legacy infrastructure. As a matter of fact, ensuring the integrity of rail systems and maintaining operational continuity standards is an objective which is shared by the whole rail sector.

In the 2019-Vision Paper on digitalisation [16] UNIFE had identified four main elements – among others – which would be crucial in devising a holistic and sound cybersecurity chain in the rail sector:

a. Dedicated Skills and knowledge, especially regarding the detection of cyber-threats and the response to them – in order to minimise the negative impacts of cybersecurity incidents and enable a swift recovery of systems and services following any such incident.

b. Sectorial and cross-sectorial cooperation, where the exchange of knowledge and the sharing of experiences with other concerned business would enhance the capacity of rail stakeholders to develop and implement effective measure to protect their systems and services.

c. Security-by-design, namely the increase of focus on security aspects during the design process of a product – thus giving them the required priority – and ensuring compliance with relevant regulations and standards at an early stage.

d. Research and Innovation (R&I), essential when it comes to new solutions which can improve the cyber-resilience of rail. In this regard, a refocussing of rail-related R&I activities is needed for the post-2020 period, this is why UNIFE strongly called for the continuation of Shift2Rail JU under the Horizon Europe Framework Programme – allowing the whole rail sector to develop various value-adding products and services in the field of cybersecurity.

Following this further, UNIFE had welcomed the entry into force of the 2018-Cybersecurity Act which has strengthened the mandate of the EU Agency for Network and Information Security (ENISA)[17]– turning it into a real "EU Cybersecurity Agency" –, as well as it has provided for the establishment of a new EU-wide framework for the certification of products and services. In this regard, UNIFE encouraged the European Commission to 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.

STATE OF PLAY

Cybersecurity has represented one of the most intense areas of work for UNIFE and its members in the latest months. In April 2020, UNIFE's Cybersecurity Working Group notably published its first technical Position Paper, which analyses the main challenges cybersecurity is bringing into the European rail system. Specifically, a comprehensive assessment of cybersecurity development in rail is given, from a short-term (1-3 years), medium-term (4-6 years) and long-term (7-9 years) perspectives, setting rail manufacturers' main priorities and targets. The Position Paper will be used as a basis for technical discussions and negotiations with the European Commission, ENISA, CEN-CENELEC and sectorial stakeholders. Finally, it is conceived as a living document to be updated regularly according to the new developments and needs identified periodically.

At EU-level, the European Commission acknowledged cybersecurity as one of the pillars of its Data Strategy and as pivotal to the EU digital sovereignty too. In particular, Commissioner Thierry Breton confirmed the presentation of a new "cybersecurity strategy" in the 2nd half of 2021 – also mentioned in the Communication "Shaping Europe's digital future". As the details of the strategy will be unveiled gradually, a key initiative would consist in the revision of the 2016-Network and Information Security (NIS) Directive 2016/1148/EU [18].

At sector-level, UNIFE was one of the major driving forces behind the "Digitising Rail Round-Table" initiative, launched by DG CONNECT and DG MOVE in September 2019. The European Commission's purpose was to gather the representative organisations of rail sector's stakeholders in the EU and streamline the different priorities in a number of carefully pre-identified topics. Three main "workstreams" were eventually selected – namely, "5G", "Cybersecurity" and "Blockchain & high-performance computing" –, with UNIFE co-chairing the "Cybersecurity" activities together with ER-ISAC [19]. Each workstream was tasked with preparing a "roadmap" containing a mapping of the diverse on-going initiatives, identifying gaps and crafting recommendations on how to overcome them.

The Cybersecurity workstream identified legislation, cooperation, standardisation, and legacy as the four grounds for recommendations to submit to the European Commission. Within the first ground, the rail sector called for the alignment of NIS Directive implementation in the different Member States. As far as the cooperation-level is concerned, the importance of synergies to tackle vulnerabilities within the sector and to build cross-stakeholders cyber-response was stressed. Regarding standardisation, the sector called for EU funding for the development of rail's functional & technical requirements for cybersecurity. Finally, the importance of supporting the adaptation of the rail's common eco-system was highlighted – the possibility of a rail-dedicated Call within the Digital Europe programme being investigated.

FUTURE DEVELOPMENTS

The activities carried out over the latest months represent an excellent basis in order to tackle the forthcoming measures by the European Commission. The review of the NIS Directive would represent a first area of work for the rail sector. While the NIS Directive has undoubtedly represented the first step towards the security of our digital society, the fact that it only requires minimum harmonisation implies that implementation could differ significantly across Member States. Secondly, for the NIS Directive was originally conceived back in 2013, we remark that certain provisions no longer reflect the current threat landscape – which today includes e.g. incremental usage and consequent criticality of cloud services.

Following this further, UNIFE considers that the forthcoming "Cybersecurity strategy" could also be the chance to strengthen further the 2019-Cybersecurity Act[20], notably regarding the harmonisation of the issuing of cybersecurity certificates at the EU level. UNIFE acknowledges that certifications have become important mechanisms to establish trust in cybersecurity, by establishing clarity of information – demonstrating that a product or service meets or exceeds minimum standards.

As much as we did in our previous Vision Paper, UNIFE would like to point out again the critical interaction between Cybersecurity and safety-critical applications. In fact, on the one hand, the "safety" and "security" fields are particularly close yet, on the other hand, their contexts and life-cycles differ in a sensible way. Where "safety" refers to the level of protection against system's malfunctions and is characterized by a long life-cycle, "'(cyber-)security" refers to the protection of the system against intentional attacks and – due to the fast-paced evolutions of the security environment – presents a short life-cycle. Therefore, in order to cope with such critical differences, a clear separation between the safety and (cyber-)security processes should be put in place – provided that a coordination framework is set up for the evaluation of the impact safety solutions have on (cyber-)security and vice-versa.

19.
European Rail Information Sharing and
Analysis Center.

20.
Regulation (EU) 2019/881 "On ENISA (the
European Union Agency for Cybersecurity) and
on information and communications
technology cybersecurity certification";
https://eur-lex.europa.eu/eli/reg/2019/881/oj

Finally, UNIFE would like to continue stressing the fundamental role played by Research & Innovation in the deployment of a cybersecurity strategy and culture in rail transport. In this regard, we strongly welcome the establishment of a European consortium to deliver the new Horizon 2020-funded Shift2Rail programme: 4SECURail [21]. The consortium will work to deliver a co-designed collaborative tools for the coordination of cyber-security response across European railways – called European Railway Computer Security Incident Response Team (CSIRT).

KEY MESSAGES AND RECOMMENDATIONS

- The forthcoming EU ''Cybersecurity strategy'' shall contribute to strengthening EU digital sovereignty. This will be essential to sheltering European rail networks from external, third countries' technological developments and threats.

- DG CONNECT and DG MOVE must ensure that the recommendations developed by the 'Digitising Rail Round-Table's' ''Cybersecurity workstream'' are taken into consideration by Commissioner Thierry Breton in the construction of the implementation of the forthcoming ''Cybersecurity strategy''.

- Harmonisation and consistent implementation of the NIS Directive 2016/1148/EU shall be fostered across Member States, while making sure to update the legislation to reflect the ever-evolving cyber-threats landscape.

- The ''EU Cybersecurity Agency'' ENISA is urged to consider rail transport in its cybersecurity strategy and to associate UNIFE with any development linked to the railway sector.

- Within the framework set by the 2019 Cybersecurity Act, harmonisation of certification schemes should be promoted while avoiding any duplication of existing ones.

- The continuation of the Shift2Rail Joint Undertaking within Horizon Europe and armed with a strong budget is highly recommended to ensure that rail's cybersecurity priorities are properly addressed.

Artificial Intelligence

BACKGROUND

The European rail supply industry wholly acknowledges that few emerging technologies offer as many possibilities and opportunities for the future of rail transport as Artificial Intelligence (AI) promises to do. By welcoming the recognition of transport as a key sector for the development of AI applications, as identified by the European Commission in its 2018-Communication ''Artificial Intelligence for Europe'' [22] , UNIFE had stressed that rail transport – the backbone of a clean and multimodal transport, capable of providing low-carbon mobility combined with high levels of energy efficiency, safety and capacity – could become one of the incubators to develop AI solutions, while fulfilling the economic and societal benefits of Artificial Intelligence.

21.
http://www.4securail.eu/

22.
'Artificial Intelligence for Europe''; COM(2018) 237 final ;
https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=51625

Notably, the area of autonomous driving as well as mechanisation and robotisation in the building and maintenance of rail infrastructure had been identified by UNIFE as key areas of development and implementation of AI-based applications in the rail sector [23]. Among the key-messages included in the Vision Paper, UNIFE called for the European Commission and the EU Member States to support the roll-out 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.

Furthermore, the complexities linked to the development of Artificial Intelligence in the rail systems were thoroughly investigated, from the technical, legal and ethical perspective. In particular, the importance of the revision of standards and regulations to take into account the emerging role of AI technologies was highlighted, while keeping the highest possible levels of safety. Moreover, a common legal and ethical framework to be established at EU level had been considered as instrumental to build trust among businesses and consumers as well as to accelerate the market's uptake of AI-based solutions.

STATE OF PLAY

Alongside the Data Strategy, the European Commission has made Artificial Intelligence (AI) one of the key priorities in its digital masterplan. First and foremost, AI is acknowledged as a crucial leverage to ensure the EU technological sovereignty against a background of fierce global competition. To this extent, in November 2019, Commissioner Thierry Breton presented the "White Paper on Artificial Intelligence"[24]. With such non-binding document, the Commission aims at setting the framework for promoting the uptake of AI in the EU – both accommodating technical progress through regulatory flexibility and providing legal certainty – while conversely addressing the risks associated with certain uses of AI-based applications.

The first objective would be pursued through the so-called "ecosystem of excellence", consisting on a number of soft-measures making use of existing instruments and built on previous work undertaken at EU and Member States-level. Among the soft policy options foreseen, the creation of AI testing centres that can combine European, national and private investments would be facilitated; specific AI-related competences would be developed through the "Advanced Skills" pillar of the Digital Europe Programme – making EU workforces fit for the AI-led transformation –; and a proposal for a public private partnership in AI and robotics will be made in the context of Horizon Europe.

Following this further, the potential risks brought by the deployment of AI-based technology would be addressed by the so-called "ecosystem of trust". The principle of "trustworthiness" of AI according to a risk-based approach, namely, by devising an adequate response for any potential risk which derives from the application of AI-based solutions. Eventually, deployment of AI in Europe in the respect of EU fundamental rights, such as privacy protection and non-discrimination must be ensured.

UNIFE welcomes the approach on AI undertaken by the European Commission in its White Paper, and we look forward to work together with EU and national institutions to enhance the role of rail in AI-related initiatives. In particular, we appreciate the predilection for soft-measures based on already-existing instruments, rather than heavy regulation. For no one-size-fits-all solutions can be envisaged for regulatory initiatives on AI, we agree that any future regulatory framework for AI should not be excessively prescriptive, in order not to create excessive burden for business and companies, especially SMEs.

23.
UNIFE's Vision Paper on digitalisation ; "Digital trends in the rail sector" (p. 10-13); 15th April 2019;
https://www.unife.org/component/attachments/attachments.html?id=1011&task=download

24.
White Paper "On Artificial Intelligence - A European approach to excellence and trust"; COM(2020) 65 final;
https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

Furthermore, UNIFE fully agrees with the importance of a ''trustworthy'' deployment of AI across Europe and industries. A solid legal and ethical framework would also be helpful for the rail sector when undertaking the review of rail standards & regulation written at a time when AI was merely an inspiration concept.

FUTURE DEVELOPMENTS

Granted, the European rail supply industry is keen to see rail transport being involved in the development of Artificial Intelligence in Europe. There are an increasing number of AI-related applications which can be developed and employed on several segments of rail transport systems. As we previously identified, there is enormous potential for AI-based technology to be applied in the area of train operations and autonomous driving, and AI can also play a major role in relation to mechanisation and robotisation.

Predictive maintenance is another breakthrough Big Data-based solution which requires the use of Artificial Intelligence. The collection of data from sensors and the combination of it with historical models is already being developed and implemented to anticipate the possible failure of assets. The use of AI-based technology is crucial to make predictive models more robust and adaptable to different scenarios and locations. This also applies for high-risk maintenance activities, where the use of AI-led robotic solutions could be deployed on works which are normally complex and/or costly when done by humans. Ultimately, predictive maintenance is an area where AI-based robotisation could become a great asset to support and facilitate human work.

Following this further, other areas for deployment of AI in rail transport could include multimodal route planning, digital stations and estimated time of arrival (ETA), all based on machine-learning and AI algorithms. Specifically, with regard to ETA, we acknowledge that predicting accurate estimated time of arrival is imperative to logistics providers and is regarded as key to improve the customers' [25] (incl. passengers) experience . By using the experiences of previous train journeys and delays from the past, and with more data assessed by forecast calculators taking algorithms into account, Artificial Intelligence can achieve a higher level of ETA accuracy.

Eventually, UNIFE sees the potential of Artificial Intelligence as technological ''glue'' linking the different components of a digitally-based mobility mix, with rail at its backbone. One of the most important applications in this regard is the Mobility-as-a-Service (MaaS), one of the priority areas for UNIFE to enhance the role of rail as sustainable system integrator of the transport system.

KEY MESSAGES AND RECOMMENDATIONS

- The European rail supply industry looks forward to work together with EU and national institutions to enhance the role of rail in AI-related initiatives, in the context of the ''White Paper on Artificial Intelligence'' and beyond.

- The concept of ''trustworthy'' Artificial Intelligence should be rapidly consolidated and implemented, allowing the creation of a solid legal and ethical framework for the deployment of AI-based technologies in Europe.

- Any future regulatory framework for AI should not be excessively prescriptive, as to prevent excessive burdens for businesses and companies.

25.
Important work has been carried out by the sector in the framework of the ELETA Project; http://www.uirr.com/en/component/downloads/downloads/1322.html

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5G Connectivity

THE CONTEXT

Fifth generation mobile telecoms technology, known as 5G, is expected to be a step-change in mobile networking for both consumers and industries across all sectors, offering users faster download speeds, lower latency [26] and data sharing in real time. What the mobile industry's operators and suppliers are promising, thanks to the 5G, is a new wave of technologies and applications based on a novel infrastructure for a number of beneficiaries: smart cities, advanced manufacturing, healthcare systems and also connected mobility.

Concretely, one of the features of 5G is to offer mobile and fixed Internet access at broadband speeds of the order of 10 Gbps, much faster than the current Long-term-evolution (LTE) technology – up to a hundred times. Through the access to this broadband speed, a much larger volume of data would be allowed to be transported quicker across a greater number of connected devices, exchanging information with each other in real time. Accordingly, the smooth uptake of Internet of Things (IoT) application is expected to benefit considerably.

The European Commission has acknowledged 5G technology as one of the most critical "building blocks" for the digital economy and society in the next decade, and as essential enabler to other digital technologies such as Artificial Intelligence. After establishing a EUR 700-million "5G infrastructure public-private partnership" [27] in 2013, a "5G Action Plan for Europe [28]" was adopted in 2016 setting a roadmap for public and private investment on 5G infrastructure in the EU and identifying key areas for actions such as a common EU timetable for the introduction of 5G, the availability of 5G spectrum and standardisation – among others.

In the recently-published "Shaping Europe's digital future" Communication, the European Commission has stressed again that Gigabit connectivity, powered with secure fibre and 5G infrastructures, is vital to foster Europe's digital growth and transformation. Landmark initiatives have been announced to fulfil Europe's 2025-gigabit connectivity's objectives – among which the revision of the Broad-Band Cost Reductions Directive 2014/61/EU as well as New Radio Spectrum Policy programme are already in the pipeline. Even more crucially, the European Commission has announced the roll-out of 5G corridors for connected and automated mobility from 2021 onwards. 5G Railway corridors are part of the strategy, planned for the biennial 2021-2023.

Member States have also given a strong signal on the fundamental relevance of 5G for European economy and society, enshrined in the Council's Conclusions of December 2019 [29], calling for a comprehensive and coordinated approach in the EU in view of a swift and secure roll-out of the 5G networks.

Despite the announced benefits and its potential acknowledged by several parties, the deployment of 5G technology does not make the unanimity. Three main concerns have been firmly raised, from different perspectives: sanitary, technological and also geopolitical.

From the sanitary angle, 5G has been put under strict scrutiny with regard to the potential effect on human bodies. The main concern points to the radiofrequency exposures 5G may have on people, higher than the one creates by the current wireless technologies in use today – i.e. 3G or 4G. Technologically, 5G may pose additional cybersecurity risks. This is mostly , but only uniquely, due to 5G being based on a distributed, software-defined network which is less suitable to inspections and controls than a centralised hardware-based network.

26.
Latency is a networking term to describe the total time it takes a data packet to travel from one node to another.

27.
https://5g-ppp.eu/

28.
"5G for Europe: An Action Plan";
COM(2016)588;
https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=17131

29.
"Council Conclusions on the significance of 5G to the European economy and the need to mitigate security risks linked to 5G";
https://www.consilium.europa.eu/media/41595/st14517-en19.pdf

Moreover, the prospective expansion of bandwidth that makes 5G possible creates additional avenues of attack. Finally, regarding the geopolitical concerns, the 5G future in the EU future is also dependent on wider goal trade relations, and the potential threats posed by states or state-backed actors – such as China's Huawei – have been taken very seriously.

While acknowledging the relevance of the health and geopolitical issues, this Paper focuses on the digital aspect of the subject matters being treated. UNIFE will only be examining the cybersecurity dilemma posed by this technology in this publication.

UNIFE'S VIEW: THE OPPORTUNITIES OF GIGABIT CONNECTIVITY

European rail manufacturers consider 5G not just a new technology on its own, but rather a key tool to enable the digital transformation rapidly and effectively in rail transport. In fact, a digital rail system would demand high-quality, high-availability and high-capacity Information and Communication (ICT) solutions for several applications: train operations, the control or signalling and infrastructure management – including predictive maintenance. On the contrary, the current communication systems – such as GSM-R (Global System for Mobile Communications-Railway) – are narrow-band technology and may not be fit to cope with the huge amounts of data such ICT solutions produce – hampering the efficient deployment of rail services. In this context, we see the potential of 5G to give rail systems the industrial, technical capabilities to drive a step change in data speed – while maintaining the high availability and low latency for the critical services like signalling and operational voice communication.

There are a number of areas where fifth-generation connectivity can enable significant progress for rail transport operations, among those we pinpoint real-time train's load rate, traffic forecast, video-surveillance, automatic train operations and signalling [30]. However, in particular, we acknowledge that 5G technology is the basis for developing the successor of GSM-R, namely FRMCS – the Future Railway Mobile Communication System [31]. FRMCS will be a game changer for the roll-out of the European Rail Traffic Management System (ERTMS) as well as Automatic Train Operations (ATO). In this regard, the European Commission has specified that most of the FRMCS functions will be implemented through 5G connectivity. UNIFE will notably work, together with UIC, on the implementation of the "5Grail" Project, under Horizon 2020- ICT-53.

The opportunities offered by gigabit technology for the digital transformation in rail transport have been well understood by the sector. The above-mentioned initiative "Digitizing Rail Round-Table" – launched by DG CONNECT and DG MOVE – identified 5G connectivity as one of the priorities for rail transport. Notably, the purpose of the workstream was to finalise the 5G & Spectrum "Strategic Deployment Agenda" (SDA) – a plan for the process of execution on the 5G strategy, supported by Horizon 2020, through the assessment of service criteria, cooperation models and regulatory aspects. Two key "requirements sets" have been defined: 1) the Smart Mobility 'focused on the "Gigabit train"; 2) Digital rail operations, on which UNIFE cooperated.

The SDA finalised by the sector should be taken into account by the European Commission when deploying 5G corridors for connected and automated mobility. In this regard, we welcome the purpose to rollout 5G railway corridors throughout 2021 and 2023, as announced by the European Commission, although more consistency should be given on how such initiative will be carried out on critical infrastructures such as the railways.

30.
Joint Rail Sector Declaration on Digitalisation of Railways; 9th November 2017;
http://unife.org/component/attachments/attachments.html?id=863&task=download

31.
UNITEL is UNIFE's Committee responsible for the development and implementation of the future interoperable railway communication system (FRMCS/Next Generation) as part of the future ERTMS. UNITEL brings together the major railway telecommunications products suppliers and companies that have significant experience in current GSM-R and future railway systems;
https://www.unife.org/about-us/committees/134-unitel-committee.html

The 5G uptake in transportation would necessarily require substantial dedicated resources. UNIFE considers important the proposal made by the Commission to allocate €3 billion – as part of the next Connecting Europe Facility Programme CEF2-Digital envelope – to support investment in digital connectivity infrastructure, of which part is proposed for large-scale deployment of 5G corridors including railways. Moreover, UNIFE reiterates the need for continuous support for Research & Innovation, especially for the new rail's institutionalised partnership within Horizon Europe. In this regard, through collaborative research, rail has the ambition to exploit the opportunities of new communication technologies such as 5G – enabling safe introduction of control, command and communication systems supporting greater automation of train operations, building on the benefits of ERTMS.

UNIFE'S VIEW: THE CHALLENGES OF GIGABIT CONNECTIVITY

5G technology, besides its undisputed potential, presents also some concerns, among which the one related to cybersecurity assumes a particular relevance. In fact, fifth-generation networks allow multiple IoT applications to communicate faster, creating an expanded sensors network which also exposes the connected devices to a multidimensional cyberattack vulnerability.

The 5G network infrastructure is different from the one of its predecessors, moving from a hardware-based and centralised architecture to a software-defined digital routing model. In a hardware-based network infrastructure – and possibly for all network activities – it would be possible to implement practices of "cyber-hygiene", through hardware "choke" pointes. On the contrary, in 5G software based networks, activities are pushed towards digital web routers which are spread across the entire network, making it very complex to allow the deployment of "choke" points to be used for security inspection and control.

It goes without saying that European rail manufacturers consider a priority to overcome the cybersecurity-related concerns linked to the deployment of 5G. Launching the 5G technology – in all economic sectors, including rail – would be a complete overhaul of other existing networks. This would bring in risks which may not be contained using the traditional security means and may require considerably investments from companies – a scenario which some SMEs may find challenging to tackle.

Following this further, for critical rail services, the use of 5G infrastructure provided by public Mobile Network Operators (MNO) would bring higher cybersecurity risks than relying on private network infrastructures – as it was the case for the GSM-R networks. In this regard, the European Commission should provide clarity to Member States on the authorisation, conditions and restrictions to use the 5G networks provided by MNO, especially when it comes to critical services like signalling and ATO.

UNIFE welcomes the European Commission's focus on cybersecurity of 5G networks. Since we support a EU-based solution's approach, the "EU Toolbox of risk mitigating measures"[32] launched by the Commission in January 2020 is a positive step. The toolbox aims to identify a common set of measures capable of mitigating 5G networks' main cybersecurity risks, as well as to provide guidance for selecting – among those measures – the ones to be prioritised in mitigation plans at national and EU-level. Prospectively, a robust framework of common measures would be able to adequately protect 5G networks across the EU through a coordinated approach among Member States.

Finally, UNIFE would like to highlight again the importance of allocating significant resources to Research & Innovation (R&), which can be key asset in developing solutions to counter 5G-related cyber threats. In this regard, the already-mentioned collaborative tool CSIRT, developed by the Shift2Rail-funded 4SECURail consortium, provides the ideal platform to tackle cybersecurity in the 5G networks.

KEY MESSAGES AND RECOMMENDATIONS

● The European Commission should consult the rail sector's Strategic Deployment Agenda (SDA) when carrying out the 5G corridor deployment masterplan intended to create connected and automated mobility.

● The Commission needs to fully involve the rail supply industry in the preparation of the 5G deployment on railway corridors between 2021 and 2023.

● Regarding the post-COVID-19 recovery plan, appropriate resources must be set aside for the fulfilment of 5G deployment ambitions in transportation and rail systems. These funds should be directed through Horizon Europe, Connecting Europe Facility 2 and Digital Europe programmes.

● In the context of the post-COVID-19 recovery plan, appropriate resources should be ensured for the fulfilment of the 5G-deployment ambitions in the transportation and rail systems – particularly through Horizon Europe, Connecting Europe Facility 2 and Digital Europe programmes.

● A framework of common EU cybersecurity measures and coordination among Member States should be put in place to protect 5G networks against cyber-threats. The EC is advised to provide clarity on the conditions related to the use of 5G networks provided by Mobile Network Operators.

Blockchain

THE CONTEXT

Since it had been initiated for the first time on the bitcoin crypto-currency platform, the blockchain technology has widely spread across various economic sectors as one of the most significant innovation of recent times. After being successfully tested in financial services primarily, it is now expected to become more operational and integrated into an increasing number of digital services in the coming years.

From the conceptual point of view, Blockchain is a digital ledger capable of recording transactions between two or more parties and storing data in immutable blocks across a distributed network. The technology's main feature is its ability to rely, for such transaction, on a peer-to-peer approach, without the support of a trusted "third party" – such as e.g. a bank. The verification and the validation steps in the transaction are done by the nodes – i.e. the "users" – of the distributed network [33]. Each transaction constitutes a "block" and the chain linking these blocks in a chronological order is called Blockchain.

The Blockchain technology appears to offer two relevant advantages for transactions between parties:

1. Reduction of costs: the technology eliminates the involvement of a third party in the transaction, eliminating the extra costs that would go to them.

2. Security: as the verification and validation of the transaction process are made by the nodes of the distributed network, the possibility of fraudulent transaction is considerably minimised – the transaction "blocks" are protected by the digital signatures.

33.
Each of the nodes-users is protected by a private key which is hidden from all other users in the network. Concurrently, a public key is assigned to each user and is visible as public identity. Each transaction is sent to the public key of the receiver, but it must be digitally signed by the sender using its own private key. The receiver verifies the digital signature of the sender, using its public key. After such verification – with no need for a central authority in charge of certifying the information – a transaction is allowed to form a group with other transactions that occur at the same time.

The European Commission took an important step towards supporting the deployment of Blockchain technology in Europe, by establishing in April 2018 a European Blockchain Partnership which was endorsed by all EU Member States through an official Declaration [34]. As part of this commitment, the Partnership is currently building a European Blockchain Services Infrastructure (EBSI) which aims to deliver EU-wide cross-border public services using blockchain technology. Through 2020, the EBSI is deploying a network of distributed blockchain nodes across Europe, supporting applications focused on selected use cases – with an investment of EUR 4 million. Finally, in its Communication ''Shaping Europe's digital future'' unveiling the European Commission's digital masterplan, Blockchain is one of the key areas on which Europe should strive to building and deploying cutting-edge joint digital capacities, but no indications have been given on how the Commission plans to work on the field.

UNIFE'S VIEW

The potential of the Blockchain technology applied to the rail sector stands on the opportunity to make business processes less error-prone, faster, more effective and more traceable, while reducing costs and reducing the risk of fraud. More specifically, UNIFE considers freight , one of the rail transport's segments on which the application of Blockchain technology seems to offer its best assets, improving considerably the reliability and efficiency of the whole, multimodal, supply chain – with rail at its core.

First and foremost, Blockchain would provide a single environment to exchange and check shipment-related documents more rapidly and safely. Secondly, Blockchain would allow a more precise and effective tracking of the movements of the different shipments. Arguably, this could be a game-changer for rail transport in the task of tracing and following the freight [35] consignments. Furthermore, Blockchain technology could be easily combined with IoT (''Internet-of-Things'') sensors fitted to freight wagons or containers monitoring real-time use of capacity, and sending this data to a Blockchain-based system: this would enable a more accurate billing reflecting the actual capacity used by a freight consignment.

In order to fully exploit the opportunities offered by Blockchain [36] , there are a number of requirements and challenges, related to the use of the technology, which need to be addressed. Indeed, the combined preconditions of ''trust'' and ''full participation'' of stakeholders must be met first. For Blockchain works on the basis of trust between participants, all parties must have ''trust'' in the accuracy and security of the data exchanged during the transaction – this is particularly important when it comes to commercial confidentiality. Moreover, collaboration across the different ''blocks'' needs to be in place and all parties in the shipment operation must be fully on board.

Following this further, there are three questions related to the application of Blockchain, attaining to data standardisation, (cyber-)security and energy consumption. When it comes to the first aspect, all parties in the commercial operation – i.e. freight operators, infrastructure managers, shippers, cargo owners and train builders – must have access to standardised digital information, recognised, adopted and accepted by each party across each stage. When mentioning the (cyber-)security aspect, UNIFE wished to stress that – even regarding soundly safe technologies such as Blockchain – attention needs to be given to avoid coding mistakes by developers or underlying flaw in the cryptography routines, as well as anti-malware scans must be run frequently to determine and prevent malicious attacks.

34.
Declaration ''Cooperation on a European Blockchain Partnership'';
https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=50954

35.
Rail freight is already the object of break-through developments such as the Digital Automatic Couplers (DAC). ''Digital Automatic Couplers'' is being currently developed by the UNIFE's Freight Committee. Therefore, this Paper would not go into the specificities of the matter at stake.

36.
Although this Paper, for the sake of conciseness, has focused on the freight aspect, the potential of Blockchain for rail passenger transport should not be overlooked either. In this regard, a Blockchain-based digital ticketing platform has been evoked as pivotal to overcome issues related to the current processes of procuring tickets (both paper and on-line).

However, it is with regard to energy consumption that Blockchain technology faces the biggest challenge. Indeed, the peer-to-peer transactions – with no central authority – involve a network of computers solving computationally-intensive cryptographic puzzles, and those operations are found to consume a huge amount of electricity [37]. This, needless to say, poses sensitive questions on the medium-term sustainability of the technology, especially if applied to a mode of transport such as rail which has been successfully striving to reduce its energy footprint. This would require prioritising a more energy-efficient blockchain procedure in which tens of thousands, rather than the current 20 or fewer, transactions are completed every second. Another way of overcoming this problem could be using blockchain to promote energy-efficient ways of getting around, such as electric rail transport. In this scenario, blockchain spurs people to adopt eco-friendly, environmentally conscious behaviours that help offset the energy used.

KEY MESSAGES AND RECOMMENDATIONS

- The European Commission should specify how Blockchain would be used to develop cutting-edge joint digital capacities, and the rail supply industry should be involved in any related initiatives.

- Access to standardised digital information across the freight logistics chain is essential to build trust among the different parties involved in the commercial operation.

- The promotion of energy-efficient mobility, such as electric rail transport, could be one of the ways to indirectly offsetting the energy used by Blockchain technology, improving the latter energy efficiency.

Digital Twins

THE CONTEXT

A digital twin is a highly detailed digital model which is counterpart (a "copy" or a "twin") of a physical asset, a process or a system. In other terms, a digital twin consists on the exact representation of that asset, process or system as digital data. Digital Twins should not be confused with Building Information Modelling (BIM), which is an important component of a digital twin, but the concept of the latter is much broader. BIM might nearly replicate the physical asset, while the digital twin connected to the BIM represents the interaction of the physical asset with its environment.

Companies have been using digital twin capabilities in a variety of ways. The most important field of application of digital twins has been the construction sector, in which their primary function and benefits have included tests of virtual construction sequencing and logistics scenarios to reduce construction and operating costs on site; collection and monitoring real-time data to optimise a building's operational performance and sustainability; and use of real-time tracking to improve safety on site.

When it comes to transport, in the automotive and aviation sectors, they are becoming essential tools for optimizing entire manufacturing value chains and innovating new products. In health care, cardiovascular researchers are creating highly accurate digital twins of the human heart for clinical diagnoses, education, and training. And in a remarkable feat of smart-city management, Singapore uses a detailed virtual model of itself in urban planning, maintenance, and disaster readiness projects.

37.
The current global power consumption for the servers that run bitcoin's software is a minimum of 2.55 gigawatts (GW), which amounts to energy consumption of 22 terawatt-hours (TWh) per year—almost the same as Ireland; https://www.economist.com/the-economist-explains/2018/07/09/why-bitcoin-uses-so-much-energy

Rapidly, Digital Twins have become one of the most talked about topics because of their promise to leverage innovation to improve design, visually enhance collaboration, and increase asset reliability and performance. Many other industries have opened their eyes towards the technology – including the rail industry.

At EU-level, the European Commission has explicitly stressed on the importance of Digital Twins in the framework of the Green Deal. With the objective of radically improving climate change mitigation and adaptation strategies as well as crisis management capabilities, the European Commission lists the setting of a "Digital Twin of the Earth", through sensors and satellite data, as an important area of application of its digital decarbonization plan.

UNIFE'S VIEW

European rail manufactures see Digital Twins as a great enabler of technological advancement for rail transport, interacting as much with Big Data as with Artificial Intelligence and also Blockchain – ideally closing the loop of our journey in rail digitalisation.

Granted, one of the true advantages of Digital Twins technology lies in its ability to anticipate key developments on rail systems and sub-systems, deriving insights about the future performance of the physical asset and eventually enabling test-driving solutions before taking on the actual applications [38].

Digital twins technology spans the entire assets lifecycle, and one of the major areas of potential is rail infrastructure and rolling stock, especially with regard to predictive maintenance. In fact, the use of digital twins through asset simulation can be very helpful for the prediction of and highlight of track's and vehicles' components at risk of failure – ensuring that the lessons learned contribute to design enhancement in line with operational requirements, and are applied to future products and systems. Furthermore, during the planning and construction of a new railway or rolling stock – as well as in the case of an upgrade or renewal – digital twins could contribute to the prediction of changes occurring in the project execution as well as the risks brought by non-conformant construction. Therefore, using digital twins can help drive maximum value from infrastructure and rolling stock investment, avoiding cost-increases and delays.

UNIFE points out that the digital twins' ecosystem can be much broader than the core rail-related systems and subsystems. In fact, if we consider large rail infrastructure projects – e.g. Cross-Rail [39] in the United Kingdom – such ecosystem can be extended towards the construction and civil work industries, as well as to infrastructure planners and real estate managers.

Following this further, digital twins technology allows the tracking of the rail's assets lifecycle from the design phase till the recycling stage, answering the demand for a higher sustainability of process and products. In this regard, the use of digital twins could enable rail to further comply with the circular economy-related requirements under the European Green Deal.

From the technological point of view, the strict relation between Digital Twins and Big Data should be looked at carefully. Digital Twins, indeed, tap into real information systems, producing and consuming large volumes of data, bringing in the issue of access and ownership of that huge amount of data. In particular, the issue of data ownership can be complicated due to the involvement of different rail stakeholders who participated in the generation, processing or analysis of that data. In this regard, UNIFE stresses again the importance of a framework for efficient data sharing in the rail sector – including urban rail – in order to overcome the questions on data access and ownership.

38.
Concretely, connected devices and sensors on the physical asset collect data that might relate to condition or performance that can be mapped onto the Digital Twin to understand how the physical asset is performing in the real world, but also, through analysis or simulation, how it might perform in the future or with a different set of parameters.

39.
https://www.crossrail.co.uk/

Moreover, for the successful implementation of Digital Twins' assets simulation, the trust in the security of the data-information system is essential – especially when Digital Twins are used in safety critical applications. To this extent, Blockchain technology would play an important role, by allowing protected archival and retrieval of data through advanced cryptography, while ensuring greater transparency and accountability [40].

Although in the ''A European Strategy for Data'' Communication, Digital Twins are recognised as part of the establishment of EU-wide common & interoperable data spaces, the indication of specific EU initiatives to be undertaken on the technology is missing. Notwithstanding, for what concerns the rail sector, work on Digital Twins has been already carried out in the framework of the Shift2Rail Joint Undertaking, with the purpose of facilitating sustained asset management monitoring on a life cycle basis, while allowing timely interpretation of data into meaningful information.

Arguably, the present and future role of Research & Innovation needs to be highlighted further. In the context of the preparation of rail's institutionalised partnership within Horizon Europe, ''Railway Digital Twin, Simulation and Virtualisation'' has been proposed as one ''transforming project''. Applied to several areas with high impact to business performance [41], the transforming project would tackle all modules of relevant sub-systems – i.e. vehicle, infrastructure, power supply, signalling – with their interfaces and interactions.

KEY MESSAGES AND RECOMMENDATIONS

- The European Commission should advance specific initiatives and ring-fenced resources to foster the uptake of Digital twins in Europe, in the context of the ''Europe fit for digital age'' masterplan.

- NIFE reiterates its call for a robust budget for the Shift2Rail Joint Undertaking' successor programmed within Horizon Europe, as a means of supporting the rail sector's breakthrough efforts in developing digital twins technology.

- The establishment of a EU-wide framework for efficient data sharing in the rail sector, – including urban rail – which would contribute to overcome the questions on data access and ownership, is a pre-requisite for a large scale deployment and market uptake of rail digital twins.

40.
C. Mandolla, A. M. Petruzzelli, G. Percoco, and A. Urbinati, ''Building a digital twin for additive manufacturing through the exploitation of blockchain''; Computers in Industry, vol. 109, pp. 134–152, 2019

41.
1) Management of assets during their whole life, with particular focus on interactions across the complete railway system; 2) Increased reliability, availability of assets and optimisation of their design; 3) Real-time and future oriented prediction of operational aspects; 4)
Reduction of lead-time and cost for design: design based on performance verification rather than specification, and improved models for virtual validation and certification.

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