PREPARING RAILWAY STAFF FOR CULTURAL CHANGES LINKED TO DIGITAL AND TECHNICAL INNOVATIONS

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Background

The main challenges for Railways, by 2030

The evolution of the rail system in its structures, its interfaces, in the distribution of the roles of its major players by 2030 raises many questions, direct or ancillary to this theme, specific or not to the railway sector.

Technological developments are often guaranteeing of considerable gains in performance, reliability, and safety. This substantial improvement comes at the cost of systemic, legal, and regulatory complexity as well as a redistribution of roles and responsibilities that generate other vulnerabilities, uncertainties, and exciting debates.

A very important consequence of systemic complexity is that increasingly secure systems under normal conditions, will become completely unpredictable under exceptional conditions, which can lead to disasters.

There are the questions of massive data traffic, which inexorably involves very high-speed data exchange (5G), data quality and qualification, also the certifiability of artificial intelligence (AI). What is the safety demonstration for these systems? We are not able to understand their function (will it ever be?), to demonstrate their safety, for which there is no reference or specific regulation.

If aviation has launched standard-setting work on artificial intelligence, in the more fragmented railway sector, it is still difficult. However, the operational standardization that UIC is doing through the International Railway Solutions (IRS), an important project launched in 2020, must be highlighted. Considerable work on standardization remains to be done, however without locking in innovation, thanks to the development of « AMoC » concept (Acceptable Mean of Compliance), which is a good solution for allowing standardisation and/thanks to technological innovations.

A huge effort must be made in the modelling activity of the railway system, its architecture, and its operations, to obtain a clear idea of what software, based on artificial intelligence and/or any other technology, can achieve. It is also essential that the supervisory authorities and the lawmaker are involved in the debates in the rail sector, to move forward together and define the best possible framework for these new technologies.

Transforming and maintaining skills is also a key issue for the near future. The digital skills gap is a reality, also for the supervisory authorities. How to certify, control a software that we do not understand? On the other hand, the personnel who manipulates the data and algorithms do not have a clear vision or detailed knowledge of the reality on the ground and/or the objects they are talking about and dealing with.

It can be important, even if they are helped by sensors and databases, etc., to keep operators trained in observation and capable of diagnosis, even outside their strict field of tasks. How to maintain these useful skills if we go back to manual mode, how to develop skills that will only be used in exceptional situations? The balance to be maintained between digital skills and more traditional skills is a real future challenge.

What logic will be adopted in terms of autonomous driving/operating technologies? Are we going to substitute operators in real time, with a constant system led by technology, or are we going to rethink the system, to redesign it, to optimize the use of artificial intelligence? The strategic choice that will be made will have strong impacts on an ancillary but crucial theme, that of responsibility.

Of course, the legislator tries to define a framework but, depending on the option taken between an intelligent automatic driver as "google" may conceive it, and an intelligence distributed in the system, the framework is not the same! An atomization of responsibilities is emerging, between the one who designs the algorithm, the one who collects it and integrates it into a train, the one who operates it and ensures the interfaces are managed and monitored.

The legislator will have an important job in defragmenting responsibilities and defining the framework, especially for the necessary reflection that must adapt to the problem posed, to the legislative framework, to what experts, society and users say.

To reconcile innovation, regulation, and safety, creating transitional physical and regulatory innovation "bubbles" is a path that must be proposed. On the one hand, it is a question of opening in certain places, where it is justified, spaces to develop the autonomous train or systems, spaces both isolated from the external environment to limit hazards, and at least temporarily separated from the old network, renouncing immediate interoperability with conventional technologies. It is also necessary, at the same time, to open provisional regulatory areas dedicated to « free » the sector from the long delays of the law. Technology can move forward; regulation must follow in a curative way and must accompany it. With the state of the scientific art and the state of actual regulation, this remains a problem of use with a jurisprudence that runs in small successive steps.

A solution may therefore lie in simplification, by confining autonomous technology to limited physical and regulatory spaces, disconnected from the rest of the network and general regulations to allow both innovations, in safety, and the allocation of significant resources on the historical network to modernize it.

Another main topic is the ability to react to modulations to modify manufacturing plans or even reorganize processes to suit situations and optimize transportation. The performance of the information system and processes for exchanging and accessing stored data is paramount for the manufacturers and delivery of products or services to customers.

Thus, railways need to transform the industrial model into a business oriented and customer-oriented system, thanks to an (ultra-better) automated model, with new

technologies (robotics, augmented reality, 3D printing, digital simulation, industrial Internet, etc.), thanks to the upcoming 4th technological revolution.

This rupture requires a rethinking on the way an industrial strategy is settled and viewed, especially from the IM and Stations/hubs managers points of view, regarding their organization through silos/jobs.

It is true to say that today, the majority of the proposed mathematical optimization models become impractical when trying to solve the timetabling problem for large geographical areas and many trains. However, since the advent of computers, people have started to think about ways to automatize/optimize these processes.

Safety, where innovations must keep leading on standardisation

Since the digitalization and innovations in railways, the development of "Acceptable Means of Compliance" is one of the preferable means to make the regulatory framework evolving at the same time as the standardisation processes.

For the further steps related with AI (artificial intelligence), DL (deep learning), ML (machine learning), etc., with new algorithm processes and methods, "safety" requires the development of methods, using a global and systemic approach (especially including cyber-security), achieving with internationalization of certifications and homologations, and reshaping the relationship between stakeholders.

Safety must from now be considered and defined **as safety as a service (SaaS),** considering the globality and the completeness of the system, **in terms of Performance**, **Reliability, Availability, Maintenance, (Health&) Safety and (cyber) Security (PRAMSS)**

Agreeing on the set and principles for PRAMSS objectives and rules on international level, from existing to target ones, will be a prerequisite for the harmonisation of operational processes and the system of systems architecture, classified per system and components. Common safety methods, generic safety cases which reduce the effort for specific applications, and "modular safety certification" strategies that reduce integration cost or increase the compatibility of different products, shall be developed.

The advent of integrated safety – technologies that connect and/or combine safety and standard control systems – has opened new doors to productivity. Integrated safety helps ensure your system has a far lower impact on productivity by improving machinery availability, reducing mean time to repair (MTTR), and streamlining maintenance.

Operations scope encompasses all the processes and responsibilities required to operate a train with passengers or freight, from "service design" to "return of experience", with a complete view of system interactions, considering all structural and operational interfaces, most notably rolling stock, infrastructure, CCS and energy, and external interfaces.

Operations must include a systemic approach, and the safety is both at the core of operations and at the service of operational excellence and performance. Operations need to display customer-oriented, competitive, agile-forward, sustainable, and interoperable values.

To reach the goal of harmonisation and optimization of operational processes, which are the foundational requirements towards an intricated CCS and railway System architectures, the enablers that will be triggered are:

- **Innovative solutions developed.**

- **New homologation and safety methodologies for placing on the market:**
  - For the further steps related with AI (artificial intelligence), DL (deep learning), ML (machine learning), etc., with new algorithm processes and methods, "safety" requires the development of methods, using a global and systemic approach (especially including cyber- security).

- **Necessary cultural and organisational changes within the railway sector:**
  - Solidify the role of operational staff in knowledge management through the involvement of managers.
  - Certify acquired knowledge and in particular technical knowledge: "establishing a certification system also enables company employees to adopt a culture of competition"
  - Engage senior managers in training.

- **New means for talents and skills management:**
  - Autonomy: promote the autonomy of employees through a simplified organisation (organisational lever).
  - Social: building new relationships based on trust, commitment and transparency between employees, customers, and business partners.

- **From a managerial point of view,** new management styles (less vertical and hierarchical) may be relevant, as well as new skills for managers. In addition, decision-making, leadership, communication, and soft skills such as innovation and creative thinking will be essential if cultural change is to take place.

The successful industrial partnerships with Operations & Safety

It is therefore key to establish successful partnerships for the:

- ❖ Architecture of the railway system and the design and the organisation of Railway Operations and Traffic Control Centres,

- ❖ Automated systems such as autonomous train driving / operations, including remote long haul driven or autonomous trains, also freight in terminals and yards (AI, augmented reality, ATO/ATC/ATS, big data, block chain, cybersecurity)

- ❖ Digital Capacity Management, with standardized transparent and international planning tools (slots, maintenance, etc, this automatization process to be a game changer in the timetables and capacity management)

- ❖ Digital platforms for safety/interoperability of data operations and exchanges, across countries and companies, to enable seamless competitive products, ease

the sharing of information, wherever these are available, to speed-up the decision-makings, and allow for the continuous improvement through industrialization processes.

Preparing railway staff for cultural changes linked to digital and technical innovations

Digital and technical innovations, even AI is already here or will soon be in the railway landscape. Railway compagnies will increasingly have to integrate digital technologies into their safety management and other activities.

Indeed, digital technologies and innovations will force railway compagnies to rethink their operating and management methods. As Human play a key role in this process of change, it is important that digital and technical innovations are accompanied by a cultural change to better prepare staff, managers, leaders, and decision-makers.

Objectives

The purpose of this paper is to launch soon a study in railway sector to achieve " a change in the mentality and cultural practices that dominate and guide the mode of training and apprenticeship of employees" and to "a conception which would make the workplace as the place for learning par excellence".

Method

To achieve this necessary change of mentality and using a participatory and human-centre approach, a learning/analysis laboratory for cultural change will be set up. This lab will be a valuable aid in identifying the elements of employee motivation and their needs in terms of new technologies: in particular, the maturity assessment and the anticipation of employee resistance (emotional needs, design of workstation, remuneration, promotion, recognition, the relationship with the line manager, etc.).

This would be complemented by exchanges of experience and good practice between members, on the theme of new leading cultural practices used in the railway world and in other fields.

Three actions would be able to effect such a cultural change:

• Strengthening the role of operational staff in knowledge management by involving managers.

- Certifying acquired knowledge and in particular technical knowledge: "establishing a certification system also enables the company's employees to adopt a culture of competition».

- Involving and engaging senior managers in training.

The second issue in managing such a major change is employee motivation. It is recommended that a maturity assessment be carried out prior to deployment to consider what incentive measures should be put in place and to anticipate employee resistance. Commonly encountered resistance is related to emotional and psychological needs on the one hand, and the workstation design on the other. "Factors such as remuneration, promotion, recognition, and relationship with the hierarchical superior […], affect personal and emotional needs, and therefore condition they support for any new initiative".

The third issue in leading such a change evolves around the technological competence of employees. It is recommended that, prior to deployment, the actions to be implemented, if necessary, to provide the necessary prerequisites should be defined.

- Autonomy: foster employee autonomy through a less hierarchical organization (organizational leverage).

- Social: establishing new relationships based on trust, commitment and transparency between employees, customers, and business partners.

The planned deliverables and results are as below

Name of deliverable	Estimated date of delivery	Type of deliverable
Learning lab for cultural changes	December 2023	Interactive and evolutive Learning/analysis lab for cultural change to identify barriers and issues
Toolbox/guidelines of recommendations and best practices	December 2024	Toolbox or guidelines gathering presenting a list of recommendations of key levers on how to engage staff at all levels of the organization.
Cultural changes event	December 2025	- Dissemination event - Add an item on cultural changes in RAIL HOF Digital Platform in which will be included: best practices, solutions, recommendations, etc.

Some potential results that could emerge from the leaning lab for cultural changes:

> ➢ One of the basic requirements for transport employees will remain "soft skills". Transport companies do not only need technological skills, but also **soft skills, psychological skills, communication skills**. All of these are important if companies want their employees to have good working conditions.

> ➢ In addition, in times when technologies used in the transport sector are rapidly changing, it is important to consider that each person has certain biological, physical, and psychological capacities to adapt to changing circumstances, and these changing circumstances are not only relevant to the labour market. It is therefore essential to look more closely at soft skills. **Psychological skills, resiliency to stress, skills for coping to change** need to be addressed not only in employee on-the-job training, but already start in school. Soft skills should be developed earlier to allow people to have a higher level of adaptability.

Conclusion

UIC will therefore work to identify the key levers that will enable employees to be engaged in a change of culture, through a dedicated strategic project organized as below

> **Work Package 1: Create a learning/analysis lab for cultural change, to achieve with a consistent path toward mindset change.**
> - Identify the main levers and barriers to cultural changes
> - Identify best practices for operational cultural change

> **Work Package 2: Set up operational recommendations on how to engage and support employees, middle management and moreover the top management in this process**

> **Work Package 3: Dissemination and communication**
> - capitalize all data, recommendations, and best practices, hosted in the "RAIL HOF Digital Platform"
> - organize dissemination events

This project "Preparing railway staff for cultural changes linked to digital and technical innovations" will link with other projects, non-exhaustively, such as EU project HUMAN CAPITAL, whose objective is to implement an HOF approach that will serve as a reference from a human capital perspective for the LinX4Rail project, such as the EU project WE TRANSFORM, whose objective is to create a policy agenda to prepare the transition to automation and workforce transformation in the transport sector and more specifically in the railway sector for the UIC.

Keywords: cultural change, mindset, railway safety, regulation, innovations