DIGITAL RAILWAY DEVELOPMENTS

INTERNATIONAL UNION
OF RAILWAYS

PROGRESS PAPER

VERSION 4

Making Rail Smarter

This paper, the third of a series that will describe the interactive approach towards rail digitalisation being led by the UIC Digital Platform, has taken into account the contents of the joint “Roadmap for digital railways” in Europe developed by CER, CIT, EIM and UIC and published end of April 2016.

Editor: UIC Communications Department

4th version: June 2017

Graphic Design: M. Grzanka/M. de Cossart

ISBN: 978-2-7461-2528-5

CONTENTS

What is UIC, the International Union of Railways?

UIC IS AN INTERNATIONAL ORGANISATION BRINGING TOGETHER RAILWAYS AND MAJOR RAIL-SECTOR STAKEHOLDERS FROM ACROSS THE WORLD.

SPECIFICALLY, UIC IS 200 MEMBERS FROM 100 COUNTRIES, REPRESENTING 1 MILLION ROUTE KILOMETRES AND 7 MILLION MEN AND WOMEN WORKING DAILY TO SERVE CUSTOMERS IN OPTIMUM COMFORT AND SAFETY.

UIC IS THE TOOL CREATED BY THE WORLD'S RAILWAYS TO ENABLE JOINT WORKING, THINKING, ACTION, AND PROGRESS.

A platform for technical cooperation and exchange

UIC is first and foremost a repository of railway expertise and a forum for sharing experience and seeking solutions whose aim is to bring about greater consistency between railways worldwide.

In particular, it is at UIC that current and future operating International Railway Solutions (IRS) are first developed. Taking the form of UIC-coordinated projects, this cooperation boosts railways' efficiency and attractiveness the world over. It also facilitates the development of international rail links, which benefit all rail users.

Future-proofing the railways

UIC's second major remit is to help the railways prepare for the future.

For each region of the world, UIC has drawn up a strategic vision offering a consistent framework for railway development.

One part of preparing for the future is investing in innovation, new technologies, and digitalisation. UIC is coordinating some 200 technical projects and is involved in studies featuring involvement from all sector stakeholders.

Lastly, UIC's educational and training programmes are preparing future generations of rail managers to meet the challenges of the market and society.

Speaking for the railways

The railways have appointed UIC as their global spokesperson.

This role is specifically recognised by the UN, where UIC represents the rail sector.

UIC is today the go-to contact partner for international and organisations of all types, whether, political, economic or financial, when they want to talk to the railways. UIC also has long-standing cooperation with a number of other bodies, and has concluded agreements to this effect.

Foreword

With the UIC being the technical platform for the rail operating community around the world, there is a significant challenge in helping the world's railway companies in facing the metamorphosis to the digital era.

The concept of the digital railway is not restricted to one or two areas but has an influence on the entire rail system. The challenge therefore needs to be collaboratively developed within the rail community and influenced not only by the successes already achieved in other sectors such as aviation but also by what the customer expects from the rail system of tomorrow.

The objective is to offer rail transport services to the customer that are better, safer, cheaper and therefore attractive, following the priority triptych: Productivity security services, through the development of IOT.

Digital might be the "in word" at the moment but this is not a flash in the pan phenomenon. Rail must evolve in order to keep pace with its competitors.

This means being responsive to societal needs (benefits for society), bringing more efficiency for the operators, at lower costs but at the same time more attractive services to the customer.

The UIC will support this through the preparation of IRS (International Railway Solutions that deal with the impact of digitalisation on the system.

Jean-Pierre LOUBINOUX

Director General of the International Union of Railways (UIC)

Introduction

Share Open Connect!

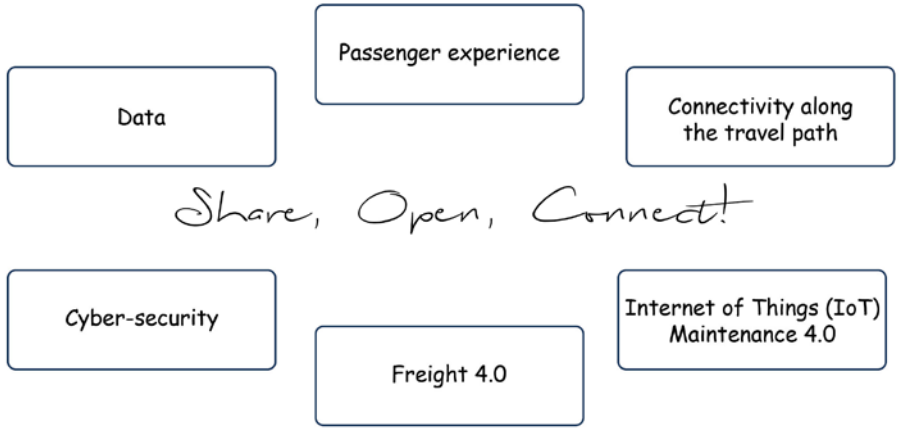
That would be the motto of the action led by the International Union of Railways, the international professional organisation grouping together 200 Members worldwide, on behalf of its Members in the Digital field. The interconnection of persons and objects through the Internet weaves a close connection between the real world and the digital world, causing structural changes in the relationship with our environment. The digital world brings with it new challenges in the company's relationship with its customers, its staff and its ecosystem.

Since the 19th century railways have been a cause and a consequence of the industrial revolution. And they have grown internationally at the service of society. Today in the 21st century they must be an actor and a vector of the digital revolution, with a world dimension. Railways can better share information, open services and connect people at the service of humanity.

It's important to highlight also the ongoing mobility revolution, with quantum leap evolutions in passenger experience (sharing economy, permanent connectivity, mobile first, …) and industry 4.0 (Internet of Things allowing predictive maintenance and transforming manufacturing processes, equipment of maintenance workers with mobile devices, …) by mentioning that railways have unevenly embraced this revolution.

Digital is a strategic issue. Objectives are to help share best practices amongst Members and help connect them with start-ups, where innovation actually happens. UIC method is openness. By setting up a dedicated worldwide platform in November 2015, the idea was to build also a community at the service of Railways, in order to "Make Rail smarter" in the coming years and decades.

This platform will foster innovation, help Members activate their projects and their contacts with the digital community. Based on their feedback, six priority topics will be cover first and foremost:



There is also a necessity to include digital in the value chain. Opportunities all along the value chain (internal and external) were mentioned – whilst allowing for the expected risks. In the "greater global digital context", UIC must prove itself able to meet its Members' needs, both now and particularly in the future, by furthering the leading-edge dimension of its research activities at global level and maintaining a vision and developing tools/actions/projects which allow UIC to continue supplying added value and global reach.

Mr Jean-Pierre Loubinoux, UIC Director General, highlights: "*We are opening a new era of creativity. Digital is at the service of everything. This platform has to be at the service of all the UIC Platforms, of all UIC Members, and ultimately at the service of society. We want to develop its activities with the motto "Share information, open data, source, innovation, services, connect people, objects" with an immediate link with security. We are becoming actors and vectors of our security. The future is outside, let's work with brains!*"

Digitalisation is the transition from a “modern” world to a “post-modern” world...

The railways must act (together) and quickly to create (imagine) their own space, behave proactively by taking into consideration the five fundamentals of the current revolution:

1. Transition from a deterministic world to a chaotic world – we can only make general predictions (mass scale) and no longer make deterministic predictions. The railway world is much more sensitive to the “butterfly effect” and “bifurcations”.

2. An industrial revolution of networks, the Internet, the Cloud, using technological opportunities for positive ecological development towards automatic operation and reducing production costs (3D printing).

3. An economic revolution, from a world of machines to a world of knowledge, the sudden arrival of new stakeholders (unknown until now – the rise of the platform economy), disruptive impact on the transport market

4. A managerial revolution, crushed pyramids and fast-growing interconnecting relations

5. A societal revolution, the transition from ownership to belonging

If Digital (numeric low-cost and big data) is:

- A threat to the current balance
- A revolution currently taking place which offers new possibilities, offering the possibility to turn problems into solutions, the collapse of previous silos –

(Example: the cohabitation of railway transport and cars to better share the public space, stations as hubs with cars connected via the Internet of Things…)

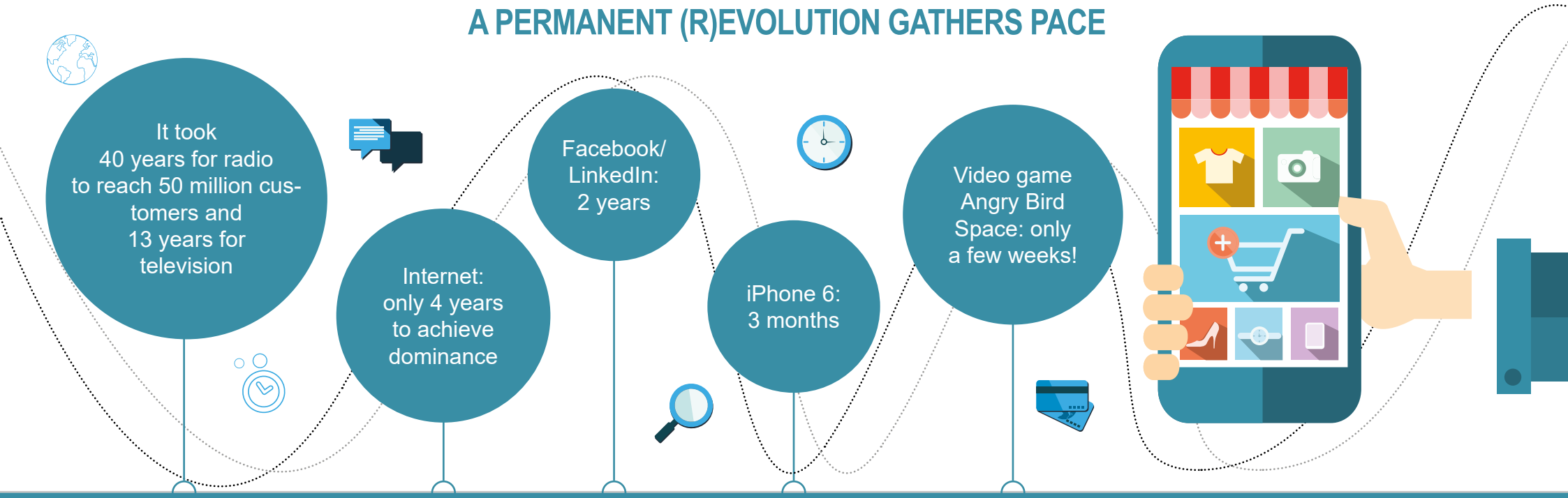
So... Tomorrow’s gold will be information (our information)

This is all the information that the railways have without knowing it; but careful – “too much information kills information”. Information needs to be processed in real time to get to the core of the matter and maintain a balance between cost, quality and performance of the rail system – artificial intelligence.

In addition to the conceptual revolution, we need to question our established frames of reference, look beyond the railway world, identify new entrants and contributors, and improve our agility (in time and space).

DIGITAL TECHNOLOGY: WHERE IS RAIL HEADED?

A PERMANENT (R)EVOLUTION GATHERS PACE



THE DIGITAL WORLD 2016-2025:

"RESISTANCE IS FUTILE, YOU WILL BE ASSIMILATED!"

PREPARE FOR GAME-CHANGING EVENTS IN THE "REAL" WORLD

New habits and behaviours (many initiated by "digital natives") are emerging all the time, causing a major rethink in the way companies and society at large operate.

Commercially speaking, consumers are becoming "consume-actors". They want to interact with brands, obtain products in real time, via any medium, thus demanding ever-greater responsiveness and flexibility from companies.

Welcome to the age of agility and Time-to-Market !

Alongside this, the digital revolution is seeing a new position emerge within more and more organisations.

DIGITAL TECHNOLOGY: WHERE IS RAIL HEADED?

No one can predict a paradigm shift!
There is no sign of a slowdown! Change is happening,
and will continue to accelerate.

Anticipation: our main weapon in facing the digital world of tomorrow

- How can we make the right technological and organisational choices when habits are evolving constantly and faster all the time?
- How can we prepare for future digital transformations when it is technological quantum shifts - which are by their nature unpredictable - which will have the greatest impact on our habits?

For example, it is interesting to think back 10 years and remember how we imagined 2015 to be: the term “cloud computing” did not even exist!

So, after years of digital (r) evolutions, what will the “digitalised world” of 2025 look like?

What role will be played by information systems and IT in the new paradigm?

What will the architecture of a typical information system look like in 2025, and what will be the associated business model?

The question remains open, and the answers may change in line with forthcoming innovations.

One thing is certain: the big hitters in IT are doing their utmost to be ready.
So let’s not miss the boat at UIC!

WHY DIGITAL TECHNOLOGY IN RAIL: WHAT ARE THE BENEFITS?

Opportunities all along the value chain (internal and external) - whilst allowing for the attendant risks

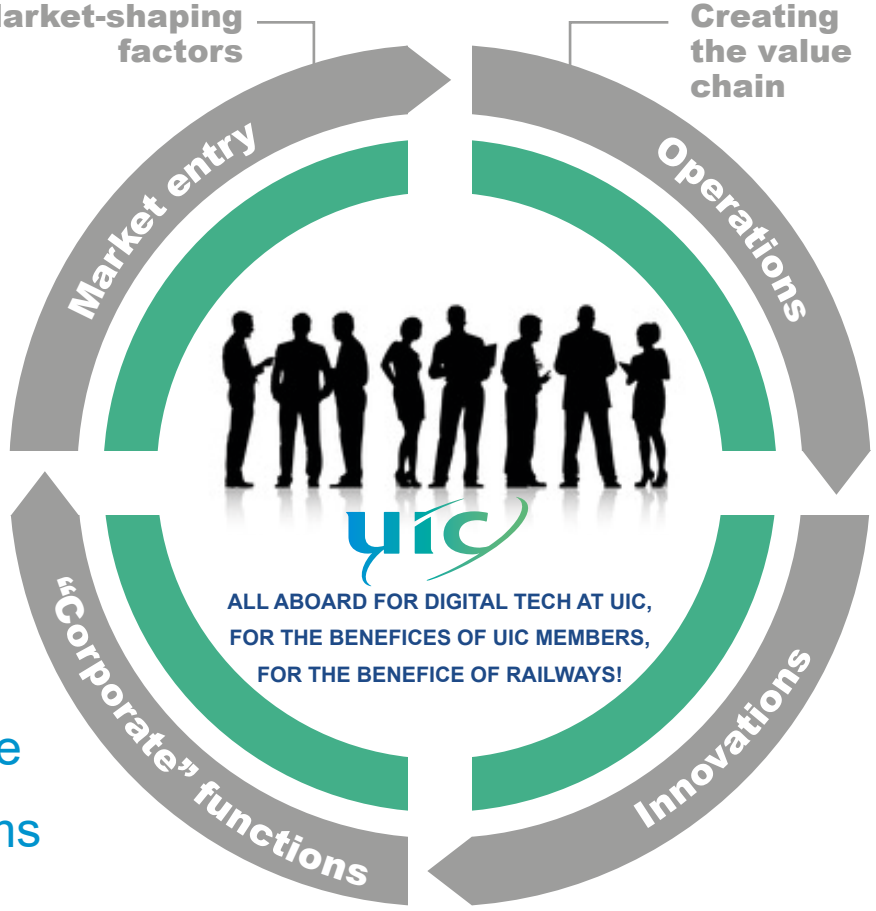
In the "greater global digital context", rail must embrace the challenges, both now and particularly in the future, by:

- furthering the leading-edge dimension of its research activities at global level and maintaining a vision
- developing tools/actions/projects which allow UIC to support the sector to continue supplying added value and global reach

International reach

Applicative example

- Preventive maintenance service



"Corporate" functions

- Electronic purchasing
- Fast transfer of knowledge
- Data management systems

Innovations

- Crowd-sourcing
- Co-development
- Innovative business models

Feedback from UIC Members

Results from an online survey made late 2015 and completed by 185 UIC Members worldwide delivered the key outcomes below:

Among the most relevant project themes

Most companies are aware of the digital impact that these technologies have created in our consumer habits

Digital is perceived as the way to innovate, create new habits and pattern – internally as well as for customers by using new connected technologies

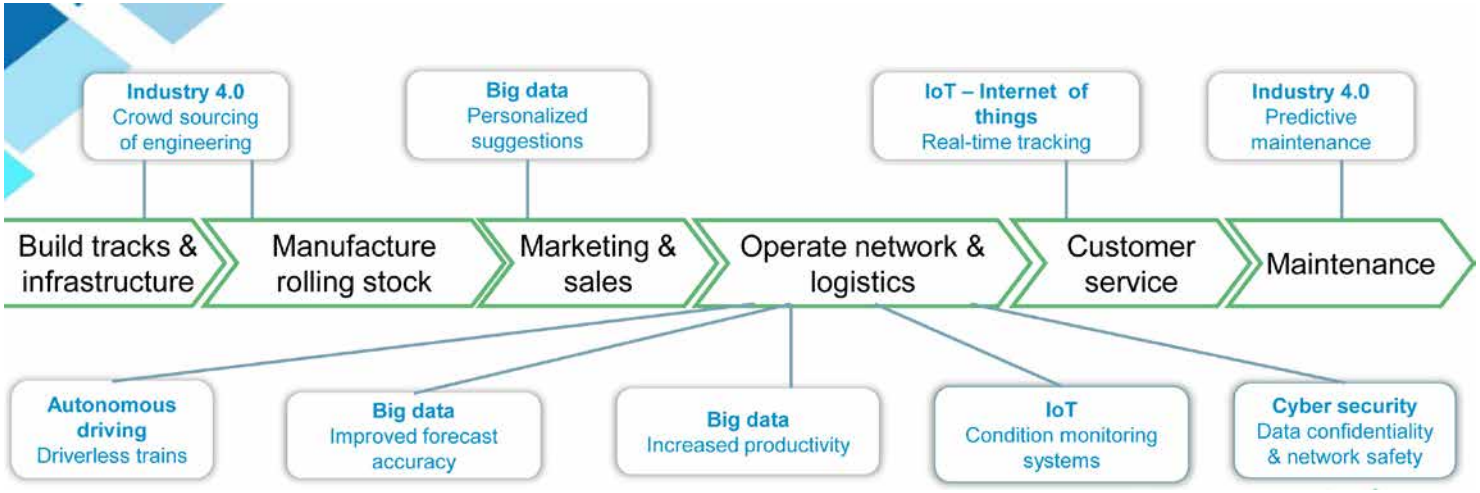
These technologies are identified as contributors to the new generation of R&D applied to the railway area

Are the two main developed digital supports

Beneficial impacts on the railways

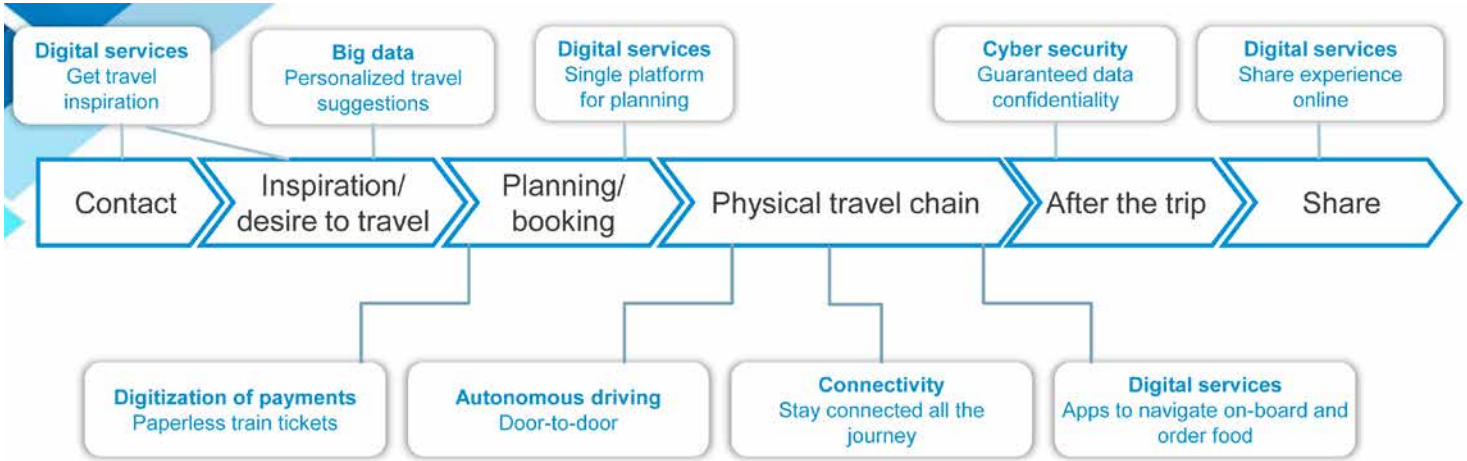
FOR BETTER QUALITY OF OPERATING SERVICES

Connected objects need to be "secure by design"
Act to educate users and invest in safety and security



FOR BETTER QUALITY OF CUSTOMER SERVICES

Digital with impacts across all services and customer value chain



The Digital train could be...

- Continuous communications, mobile and data services (each train will be a ‘gateway’ for all passenger, train control, train asset maintenance etc).
- Self learning and adaptive train control system to match ETCS/ATO needs, and ultimately ‘convoy’ and virtual coupling capability
- Rapid and automatic door open/close command/verification and operation
- Self diagnostics, fully integrated monitoring and status with continuous condition data for predictive maintenance

In service track geometry, OHL (overhead lines), and all track systems measurement for predictive maintenance

The key word is TIME

An organised approach: creation late 2015 of the UIC Worldwide Platform dedicated to Digital

Listing of the unmet needs and resources: 44% of companies have not yet introduced digital tool developments such as apps; one in two companies still do not use reliability equipment or a maintenance optimisation system. Digital skills need to be met through expert guidance. A collaborative digital platform for sharing ideas and prototyping would address this unmet need.

It is also important to realize how dynamic, fast moving and agile the digital space is. As a consequence, we need our platform "Share, Open, Connect" to act upon the digital world principles and rules.

To meet all these challenges, UIC created in 2015 a worldwide Digital Platform to support the organisation and its Members in the digital revolution by providing tools and resources. This Platform has the mission to provide courses of action (and benchmarks) which are then translated for some projects coordinated for the benefit of UIC Members.

What the UIC Digital platform is currently doing is:

- Create a community platform that is simple and efficient, leveraging existing tools, so we can share our concerns, our progress and our ideas
- Build a “marketplace” (better name to be found) to connect with state-of-the-art start-ups, to help us drive our agenda and our priorities
- Launch a “start up challenge” initiative, where the winners will be awarded with the right to perform POCs with some of ourselves

For this, the UIC Digital Railway Platform has planned to meet three times a year.

In early 2016, the platform has launched a start-up challenge which awarded 3 winning start-ups on 1st December 2016 in St Petersburg during the UIC General Assembly.

Digital: The UIC action in terms of Proofs of Concept

THE DIGITAL REVOLUTION IS NOT SO MUCH TECHNICAL AS IT IS FIRST HUMAN AND THEN INDUSTRIAL; IT IS ABOUT CONSIDERING HOW DIGITAL WITH VERY FEW INVESTMENTS IN TERMS OF MAN-DAY AND BUDGET CAN IMPROVE OUR INDUSTRIAL TOOLS, AND THEREBY PROCEDURES AND PROFESSIONS, BUT ALSO, IN PARTICULAR, MAN'S POSITION IN THIS PERPETUALLY EVOLVING WORLD.

Digital technology serves no purpose in and of itself. Digital technology for its own sake is not a way forward and a purely holistic approach has little chance of success.

This is particularly true for railway production; we are in transition from an organisation with a top-down management structure, where actors interact vertically with defined and assumed responsibilities, and which depends on deterministic processes to ensure production and safety in a closed world, to a system with a flat management structure, where actors interact holistically both internally and externally, with intentionally watered-down and transparent responsibilities in an increasingly open world.

UIC's role is to pre-empt, among other things, the organisational impacts, business models and safety and security aspects of these new possibilities by suggesting methods and approaches to "manage" this revolution, such as the Cybersecurity guidelines for railway undertakings. **The world of processes is swiftly developing concrete solutions.**

Several Proofs of Concept (POC) have already been carried out within UIC to adapt digital technology to the needs of railways:

- track circuit performance booster: to safeguard the performance of existing track circuits, even in very difficult conditions
- broken rail detection and localisation, which contains the use of machine learning
- use of artificial intelligence for the preventative maintenance of track equipment (switches, level crossings, insulated joints etc.)
- the formal language specifying the functional requirements of signalling systems and formal approval of safety features
- optimised management of track for two-way working and/or forks, with a targeted capacity gain of 50%

Some of these POCs may give rise to International Railway Solutions (IRS) and therefore assist in the opening of railways up to new value-creation drivers, whilst maintaining UIC's impartiality.

This has to be considered as an on-going activity of the Digital Platform in line with its core mission, delivering added value services to UIC members.

Everything depends on the actors and their cooperation

THE UIC DIGITAL PLATFORM COMPILES PRACTICES FROM AMONG ITS MEMBERS, COOPERATIVELY SUPPORTS THEM IN DEVELOPING NEW COOPERATIVE VENTURES AND PROMOTES THIS DIGITAL APPROACH FOR RAILWAYS WORLDWIDE.

"Digital technology opens the path to:

- *New Designs for railway business models.*
- *A Demonstration of digital's value for mobility.*
- *The Delivery of new specific solutions which benefit society as a whole."*

Proofs of Concepts

The POCs (Proof of Concepts) that have already been developed, are currently being developed or are yet to be developed at UIC!

- A PoC (Proof of Concept) brings together theoretical, practical and real-world components to answer the questions What, How and Why when creating new concepts or designing new applications
- A PoC is to be proactive; to wake up in order to break out of the circle
- A PoC is a bridge between the “awakened” railway community, and the “shining” world of academics and digital self-starting entrepreneurial sector
- A PoC is to be “thirsty” for knowledge, to be “mad” in order to imagine the unimaginable and to do it (“Whatever I invent, whatever I do, I will always fall short of the truth; a moment always comes when the creations of science overtake those of my imagination”, Jules Verne 1828-1905)

UIC has presented its first PoCs at various congresses, conferences and digital days:

- SATLOC – using satellite to save regional lines by making the most efficient use of their operation
- Detection and localisation of rail failure along large sections of track
- Surveillance and non-intrusive diagnosis of operating switches through artificial intelligence (neural networks)
- Non-intrusive diagnosis of operating track circuits with modern rail traffic, increased levels of safety and availability of these key components (track circuits)
- Non-intrusive diagnosis of individual isolation of insulated joints, increased availability of these key track circuit components track circuits)
- Definition of a modern track circuit without track installations, electric joints and insulators, to detect the presence and measure the speed of the rail traffic passing over it
- ClearStation – Assistive technology to help visually-impaired customers travel safely by rail – Establish conditions for the provision of permanent assistive digital technology for visually (and/or hearing impaired) customers, to help them in and around the railway stations of UIC members. This would particularly apply when there is disruption such as timetable or platform changes) as well as exceptional circumstances (attacks, crowd movements) [this will be the subject of a forthcoming physical PoC]

In short, the UIC POCs will result in:

- Defining novel concepts in order to meet the rail sector’s current and future needs – IRS (International Railway Solution)
- Providing the railway community with open hardware and software, the solutions already achieved, and follow-up of their development over time (community)

IRS INTERNATIONAL RAILWAY SOLUTION

Concrete fields of implementation

Among Railway topics concerned by the impact of digitalisation, there is **SECURITY**.

SECURITY IN A MORE AND MORE DIGITALISED WORLD

The growing digitalisation of our world or environment is considerably changing our information on what happened or happens, our modes of dissemination of that we know, our communication with the others on any personal or professional topic.

The notions of time and place are stepping aside when we become able to receive (and to transmit) any information at any time. Even when someone doesn't know where you are, you exchange with him permanently by electronic way.

No important event can remain unknown during a long time.

An element of security, beyond the various measures of prevention or deterrence is the information on real time 24/7 on what is happening enabling the relevant bodies to react and intervene in the best way.

Within this framework digitalisation is both a risk and an opportunity:

- A risk because the information is transmitted by various social networks quicker than by structured and hierarchic ways which are often used within our companies : that forces the crisis managers to react,- more than to act- faced to security events and to the media and political pressure that these events are creating.
- An opportunity if the digital tools are used to inform directly these crisis managers on real time.

The size of our networks makes that we cannot supervise them efficiently on 24/7. So the presence of clients and travelers has to be used as an important mode of information beyond the various technological modes: CCTV, markers …And more and more people are equipped with Ipad, Iphones, smartphones …

So the idea is to develop specific digital applications in order to enable the people to send easily with their smartphones or Iphones or ….the useful information to a dedicated analysis and crisis management centre. That lays down some technical questions, but also ethical and legal questions that have to be answered.

The role of UIC will be to define the framework, to make a benchmarking of the existing or in progress initiatives and to promote coherent solutions for its Members.

Digital acceleration in the rail sector

DISCOVER

Shape digital ambition, strategy, and business case based on insights

Sector-level insights
- Customer insights
- Industry developments
- Sources of disruption
- Do's and don'ts

Company-level bench marking
- Digital Opportunity Scan
- Digital Capabilities
- Best practice sharing

Inspiration for digital vision and strategy
- Best practice examples
- Chief Digital Officers' network
- CEO 'Go and see' tours
- e-Hackathons
- Aspiration workshops

DESIGN

Reinvent and prototype new capabilities and breakthrough journeys as part of a program

Core: Customer experience and E2E processes
- End-to-end process redesign
- Go to market approach

Foundations: Enterprise architecture
- Validated design principles
- Business-first approach
- Pragmatic road-mapping

New frontiers
- New business build plans
- Getting off the ground
- Manage core v non-core

Foundations: Digital-ready organisation
- Structure
- Talent
- Metrics / incentives
- Processes
- Culture

Advanced analytics
- End-to-end use cases
- Foundations

DELIVER

Activate an ecosystem to rapidly deliver at scale

Effective, tech-agnostic PMO
- Seasoned change managers
- Fully IT-agnostic
- Top talent deployment

Proven capability-building
- Capability-building centres
- On-site coaching
- "D-BOT" – Digital Build, Operate, Transfer
- Proof Of Concept (POC)

Global network of partnerships
- Platforms
- System Integrators
- Niche players

Deep internal capabilities
- Digital Labs
- Specialist acquisitions

Advanced Analytics
- Use case delivery

DE-RISK

Structure the change program, resources, and commercial models to reduce operational and financial risk

- Go for impact
- Thoughtful sequencing to enable self-financing
- Make successes visual

By end of 2017 UIC Digital Platform will have acknowledged 20-40 Digital Leaders, shared different priorities and challenges in detail, and disseminated UIC Digital Roadmap

DISCOVER

1. UIC Digital Academy

Silicon Valley go-and-see tour

- Tailored meetings with digital leaders
- Visits to 5-10 inspirational start-ups in the tech space
- Working sessions to collect and document impressions

Digital Masterclasses / e-Learning

- Class-room style learning sessions with leading digital experts from business and academia
- Break-outs and hands-on exercises on specific digital use cases and techniques

Executive Hackathons and e-Hackatons

- Executive level sessions to create prototype solutions to specific business problems

2. UIC Digital Maturity Benchmark

Assessment of UIC Digital Platform readiness for Digital

- Country-by-country and member-by-member benchmark survey
- What are UIC Digital Platform strengths and challenges? Who is leading the way, and how? What can we address together?
- Web survey followed by in depth interviews
- Create Rail digital eco-system on a worldwide basis with Labs, Universities, Research Centres

3. UIC Digital Roadmap

Updating UIC Digital Roadmap

- Break-out sessions, launch of working groups until Q4 2017
- What is the joint vision and initiatives to move forward? Which pilots will be run? How will be scale and stay at the forefront?
- Update and distribute UIC Progress Paper fed by UIC Members and their inputs

UIC Digital Leaders Acknowledgement - 2017 | **Digital Readiness Review - 2017** | **UIC Digital Roadmap - December 2017**

By end of 2018, UIC Digital Platform will have delivered 3-4 Digital Pilots and created a UIC Thinktank for delivering Digital

DISCOVER

4. UIC Digital Pilots

UIC Digital Pilots

- 3-4 pilot projects delivered in collaboration with members and Digital eco-system (e-rail, e-wag, e-ticketing, POCs…)
- Designs and prototypes to verify and test key opportunities in the way UIC Members operate with customers and partners, the way they use analytics and big data, and the way they implement automation and digitization across their operations.

UIC Digital Tech Crunch Ceremony June 2018

DESIGN

5. UIC Digital Thinktank

UIC Digital Thinktank

- Proven and standard "playbook" and proposed architectural standards for delivering Digital in Rail
- Based on industry methodologies (such as Agile, OpenSource, etc.), refined and tested through the pilot projects.
- Key purpose to enable interoperability and exchange of solutions and data between members

Digital Business Framework Launch December 2017

DELIVER

UIC Digital Platform deliverables

Updating our Digital Roadmap

- UIC Digital Transformation Tour
- UIC Digital workshops
- UIC Digital Days
- UIC Digital Conference
- e-Hackatons

INTERNATIONAL UNION
OF RAILWAYS