Plenary Session 3
Research and Development for Future Railways

Innovation for People and Technologies

Moderator: Prof. Roderick Smith
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This Plenary Session consisted of a panel discussion between six world leaders of railway research well known for their talent and strategic thinking, moderated by Roderick Smith (RS), Professor Emeritus of Imperial College London.

The members of the panel were:

- Dr. Norimichi Kumagai, (NK) President, RTRI, Japan
- Mr. François Davenne, (FD) Director General, UIC
- Ms. Luisa Moisio, (LM) Director of Research & Development, RSSB, UK
- Ms. Carole Desnost (CD), Chief Innovation Officer, SNCF, France
- Mr. Carlo Borghini (CB), Executive Director, Shift2Rail
- Dr. Zhou Li, (ZL) Chairman, CARS, China

The session was structured round two questions to which the panel responded in the order above, their replies identified by initials.

The first question posed was:

A key role of research is to identify and develop new and emerging technologies which will enhance and possibly transform the railways of the future.

What do you consider are the key technologies which should be investigated?

NK The main strengths of railways are safety, capacity and energy efficiency. The major challenge is to shift weakness into strengths. I see two major keys to achieving this switch. First, digital technology will become the driving force. Secondly, compared with the Automobile and IT industries where R&D budgets are around 6.7% of revenue, the railways industry spends only 1.2%. This figure needs to be increased.

FD Railways need to develop a system vision in line with the digital world we are living in. UIC is currently promoting tools to achieve this, in particular through the usage of conceptual models coming from the IT industry. Rail must become the backbone for low carbon mobility offering both:

- standardized internal interfaces allowing smart traffic management ;
- easy connection to other transport modes in order to make a reality of the concept of Mobility as a Service based on public transport services.

5G would be the main enabler to make it possible, UIC is working on its rail


Norimichi Kumagai
RTRI, Japan


François Davenne
UIC


Luisa Moisio
RSSB, UK


Carole Desnost
SNCF, France


Carlo Borghini
Shift2Rail, EU


Zhou Li
CARS, China

adaptation FRMCS (Future rail mobile communication system).

LM Identified the need to recognise and adopt/adapt emerging technologies, whilst recognising that the challenges were not nearly technological, but were about encouraging our workforce to embrace, not merely accept, changes made possible by new technologies, and this aim should influence our R&D thinking. Two tasks faced the railway: that of achieving greater automation, both in operations and maintenance, and making the railway easier to use for passengers, making their journeys more enjoyable and more productive.

CD Opined that mobility should be available and affordable to everyone and the experience of the passenger should be improved. Although demand for transport is always increasing, railways have in the past be slow to change. The top priorities should be competitiveness and decarbonisation. So, we are promoting innovation to reduce cost, to open new opportunities and to accelerate data exchange. The railway must rapidly become a smart system. Although railway already operate with a low carbon footprint, we can and must improve. SNCF will cease operating diesel trans by 2035, and we have already conducted research in hybrid, hydrogen and full battery operation, which will start being introduced as early as 2022/3. I conclude by stating that our efforts should encompass all stakeholders in railways and should be globally shared.

CB Asked I go back to the sentence you (RS) used to introduce this session? Research is what I do when I don't know what I am doing. In Shift to Rail we are running R&D to meet all the objectives discussed by the previous speakers. So competitiveness, decarbonisation automation and so on are certainly vital current topics. But at a meeting like this we have the opportunity to detach ourselves and ask about things we don't know. How will people want to travel in 10, 20, 30 years time? If we don't change our offerings for passengers and freight we will soon revert to a new legacy system and have the same problems. Collaboration is fundamental, we need to accelerate market uptake and

we need to direct the railway towards a service orientated culture.

ZL After RS congratulated China on building and operating nearly 30,000 km of high-speed line in the last 15 years, Zl responded to the first question as follows. He identified Intelligent and Green technology as the two major planks of railway research. He suggested that intelligent technology should cover the building phase (design, production and construction), the operations (from ease of use for passengers to the tracking of goods) and maintenance (making precise judgment on the condition of equipment and infrastructure, thereby reducing costs whilst ensuring safety). Green technology includes the use of new energy, new materials and modern information to reduce the impact of railway projects on the environment as much as possible, including the minimisation of land use. In the operation phase improvements will be made to train design to reduce energy, noise and emissions to make the railway even more sustainable.

The second question was then posed:

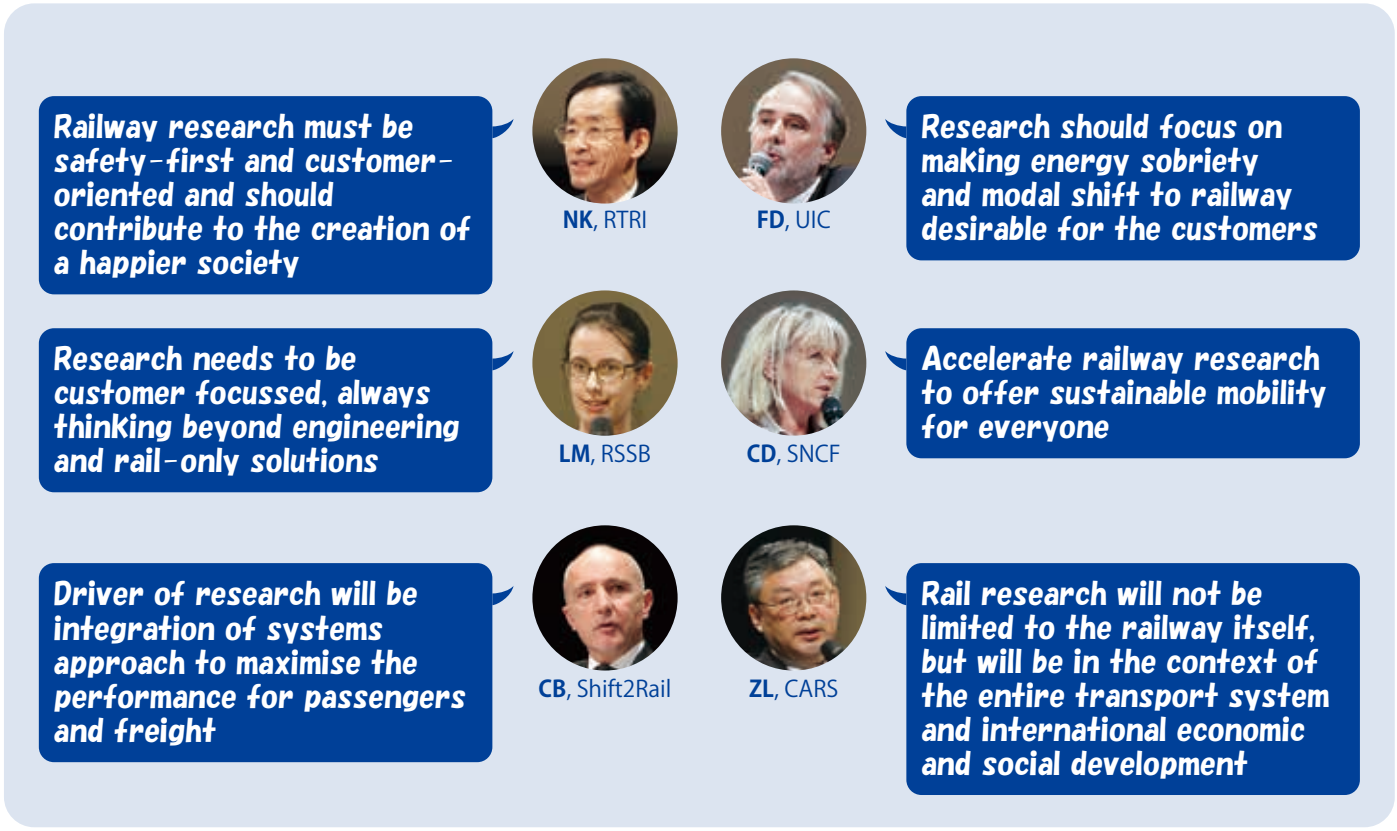
Railways own many aging and legacy assets. What research might be performed to manage these assets economically and effectively?

The Moderator reminded panelist that assets should properly include people.

NK Dealing with the deterioration of aging assets is prioritized by safety considerations. We are developing three approaches. First, is the increasing use of Condition Based Maintenance, which requires improved monitoring and intelligent analysis of data. Second, improving the performance of legacy assets, for which there are many technical challenges including cost effectiveness. Examples here include the rusting of bridges and the chemical deterioration of tunnel linings. Direct monitoring by commercial service trains is a priority, for

which AI techniques will be a key. Third, we are investigating the application of risk management techniques to asset management, again prioritized by safety. As far as human resources are concerned we are developing well planned training for R&D staff in cutting edge technologies and in field experience.

FD The long life cycle of many railway assets is good for sustainability: we are a frugal industry! At first sight, this seems to be an obstacle to innovation. On the contrary, at UIC we are convinced that a modular approach of innovation based on standardization is possible. It will pave the way to a savvy use of non-renewable resources. On this respect, I echo the comments of previous panelists : using digital thinking for designing the railway' s system architecture will allow to speed up innovation and promote modal shift. This future looking approach needs new thinking. We must communicate the desire of modernizing railways to young people that are committed to tackle climate change issues. We need their skills and enthusiasm to overcome the legacy/ innovation conflict.



LM Phasing out of legacy assets by gradual retirement comes at some cost and with possible increases in complexity, decisions are often incompletely informed. We need to think about agile implementation paths and system thinking to deal with both sides of interfaces. Much information of legacy assets is carried in the heads of retiring employees. This information needs to be retained: research on how to improve migrations paths is required.

CD Give an example of how automating the Paris Lyon operations could increase capacity by as much as 25%. The concepts of modular design and reinforced standardization could help to reduce the time cycle of innovation. There was agreement with many previously made points and a reiteration of the importance of attracting new people with new competences into the rail industry.

CB Agreed that complexity will increase, but it needs to be managed. The workforce is key, is rapidly aging and needs to be replaced. We need to adopt the concepts of the circular economy. Like airplane, we need to take as much of the system as possible onboard the vehicle. We need to develop resilience to climate change.

ZL China's railways have developed rapidly in the last 2 decades. A huge high-speed network has been built and building continues. The old meter gauge system is being developed as a tourist attraction. Freight and conventional lines have been upgraded and speeded up. Passenger demand has doubled and will grow more as the economy has developed. All countries face different issues, there is no common prescription.

The Moderator briefly attempted to summarise the panellists comments, before throwing a challenge to the panel. Could they summarise their view of the future of railway research in just one short sentence? Their responses provide a excellent, pithy, resume of the whole session (Above).

The Moderator concluded by thanking the panel members for their enthusiastic participation and for the thought they had given in the preparation of their excellent presentations, and apologised to the audience for having to truncate the discussion and having to omit questions from the floor because of time constraints. Enthusiastic applause indicted that the large audience has found the discussion both useful and stimulating.