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Consensus and dissent for rail visions of 2050: Insights from a Delphi study

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Abstract

This study was undertaken to determine if the rail stakeholders agreed with the Rail Vision 2050 document and agreed or dissented with the vision statements contained within the document. This was important as the next generation of this document is intended to be the basis of a Strategic Research and Innovation Agenda (SRIA) for Rail. A Delphi survey revealed the consensus and the dissent in relation to the statements. The methodology is presented along with the results. The impact of this paper is that it has been used to inform the European Rail Research Advisory Council (ERRAC) to formulate the research priorities for the EU rail sector and in particular the strategic rail agenda, the SRIA. The SRIA is a key document for the rail sector and the preparation of Shift2Rail's successor within Horizon Europe: "Europe's Rail Joint Undertaking".

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1. Introduction

Road-mapping is a powerful technique that has become integral to the creation and delivery of strategies and innovation in numerous sectors. Operational and organisational road-mapping are equally important: the determined operational goals can be delivered by the organisations that are most suited to deliver (Önsel Ekici et al., 2019; Phaal, 2004). The European Union facilitates and cooperates with European Technology Platforms (ETPs) to develop roadmaps and research agendas for key sectors. The work completed under SETRIS (Marigny et al., 2016; Palacín and Adtjandra, 2016; SETRIS, 2018) for the development of cross-modal roadmaps between ETPs for transport represents the broader context of rail road-mapping. These roadmaps can be combined with both the research capacity of different member states (Ulianov et al., 2012) and strategic research agendas and plans for action. On behalf of the rail sector the European Rail Research and Advisory Council has produced rail research visions and agendas since its'

formation in 2001. This road-mapping in the rail sector* is of primary importance and was contained within the Shift2Rail Multi Annual Action Plan (Shift2Rail, 2015), the ERRAC Strategic Rail R&I Agenda(s) (ERRAC, 2014), the subsequent RAIL VISION 2050 (Mazzino et al., 2017), as well as the ERRAC/ERTAC Integrated Urban Mobility Roadmap (ERTRAC et al., 2017), and the ALICE Roadmap to the Physical Internet (ALICE, 2020) among others. This work is an independent validation of the stated rail sector visions for 2050 free of organizational dynamics, politics, or culture.

2. Methodology

To achieve this validation, a methodology was developed and followed. The approach consisted of four steps: (a) compilation of key statements from the RAIL 2050 VISION (Mazzino et al., 2017); followed by (b) two online rounds of Delphi studies, (c) validation in a Word Café (Brown et al., 2005) event between the first and second rounds and (d) reported and discussed in four online webinars.

A Delphi survey is suited to quantitative and qualitative data. It is an appropriate approach for the collection, aggregation, and analysis of informed judgements from an expert group, or “panel” on future issues expressed as statements. The method is useful to collect group judgments while avoiding negative effects related to interpersonal biases, strong personalities, defensive attitudes, and unproductive disagreements (Islam et al., 2006).

The main goal of the Delphi methodology is to achieve consensus: Stuter contended that: ‘The Delphi Technique and consensus building are both founded on the same principle - the Hegelian dialectic of thesis, antithesis, and synthesis, with synthesis becoming the new thesis.’ (Stuter, 1998, p. 1). However, Saldanha and Gray nuance this, asserting that the result does not necessarily require consensus (Saldanha and Gray, 2002) and Hwang has stated that ‘consensus of opinion does not necessarily mean 100 per cent agreement among the participants in the panel’ (Hwang, 2004, p. 123).

To determine whether a consensus has been achieved, we adopted the Average Percent of Majority Opinion (APMO) and associated APMO Cut of Rate described in detail by Cottam et al. (Cottam et al., 2004). To offset any disbenefits in the methodology we used a World Café event and webinars to further inform our understanding. SurveyMonkey was used for this survey. The design was compliant with the EU GDPR directive, having a clear anonymity, and privacy policy.

2.1. Statement building Rounds One and Two

A Delphi survey poses statements to an anonymous panel and asks if they agree or disagree with them. If not, then dissenting statements can be made and these are taken to Round Two if no consensus has been reached in Round One for the original statement. The construction of statements for a Delphi survey is therefore key.

TER4RAIL had the advantage that the ERRAC RAIL 2050 VISION (Mazzino et al., 2017) document is essentially a series of statements, supported by text, that envision the future. This made the adoption of the key statements from the document the core body of statements for the process. This list was then reviewed by the TER4RAIL expert consortium, several of whom were authors of the VISION document. After 5 iterations an agreed list was finalised and the process of writing the survey could begin.

The statements on which there was no consensus in Round One (see Table 6 below) were reviewed. The dissenting comments from the panel were then used, along with the feedback from the London World Café event in June 2019, and the first webinar, to compile a new range of statements to ‘tease out’ the nuances of disagreement. This was often done by breaking the core statements from the ERRAC RAIL 2050 VISION (Mazzino et al., 2017), into smaller unique statements, often deliberately expressed negatively to engender response.

* An odd clash of concepts... road-mapping the rail-sector, which reveals more than the words themselves.

3. Round One & Two

Round One was launched 28th January 2019. The survey was closed on the 30th of May 2019. 126 responses had been received, of which 57 responses or 45.24% were valid, the invalid having not proceeded beyond the demographic profile if any response at all. These 57 people now formed the Delphi panel for this research. Round Two was launched 21st January 2020 and sent to those who responded in the previous round. The survey was closed on the 23rd of March 2020. 33 responses had been received, of which 27 responses or 81.8% were valid. These people, a subset of the original panel, now formed the Delphi panel for this second stage of the research.

3.1. The Panel

The panel was experienced and used to executive decision making, with 75.86%/81.48%[†] having 10 or more years of experience in the transport sector, whilst still including those newer to the sector at 17.24%/11.10%. Those with senior executive roles formed 44.83%/33.33% of the panel with 37.93%/44.44% having middle management roles, and 17.24%/14.81% with operational roles[‡].

The panel had high SME representation, with 45.45%/40.47% reporting that they worked for an organisation that had fewer than 250 employees and a turnover less than or equal to €50 million per annum or a balance sheet of less than €43 million, the EU definition of a medium sized enterprise[§].

The most prevalent organisational types represented in the panel were research organisations and consultancies (36.21%/37.04% and 18.97%/25.93% respectively). This may reflect the research led nature of the work, but also that experts gravitate to such organisations, and they may offer objective and independent viewpoints.

The panel had very high expertise on rail (89.66%) but also good coverage of all other modes, with road expertise reported as 48.28%. The panel had high expertise in the different transport activities: 75.86% reported expertise in rail as a single mode, 31.03% as expert in road as a single mode. The panel had a high representation of those with expertise in multimodal transport (51.72%), port and/or terminals (29.32%), and expertise in freight logistics with 44.83% of the panel.

3.2. Differences between Rounds and Panels

The subset of the panel that worked on Round Two was smaller, more influenced by UK based respondents, more middle management and with a higher proportion of research organisations and consultants. However, a Delphi Survey is intended to elicit experts and then work with them to develop synthesis. The panel may have been disproportionately composed of Europeans currently based in the UK, but as expert researchers and consultants to the European Rail Research Area, they were well qualified to help develop, critique and contribute to the second stage. The quality of the responses from this smaller group tends to bear this out.

3.3. Round One & Two Consensus and Stability Analysis

The overall APMO for Round One was calculated as follows:

$$\text{APMO} = \frac{\text{Aggregate of Majority Agreements}=827 + \text{Aggregate of Majority Disagreements}=0}{\text{Total Opinion Expressed}=1140} \times 100 = 72.54\% \quad (1)$$

Whilst there were some statements for which the panel was unstable and had not reached consensus according to the APMO of 72.54%, all had a simple majority of agreement. In a Delphi it possible for a majority to agree or disagree with a statement, but until it has been defined as achieving stability, it is not resolved.

[†] Round One/Two, a format we adopt for this section for panel demographics

[‡] Or had had, in the possible case of retirees.

[§] https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

The overall APMO for Round Two was calculated as follows:

$$\text{APMO} = \frac{\text{Aggregate of Majority Agreements}=245 + \text{Aggregate of Majority Disagreements}=32}{\text{Total Opinion Expressed}=405} \times 100 = 68.40\% \quad (2)$$

Whilst there were some statements for which the panel was unstable and had not reached consensus according to the APMO of 69.40%, all had a simple majority of agreement or disagreement. In a Delphi it possible for a majority to agree or disagree with a statement, but until it has been defined as achieving stability, it is not resolved.

3.4. Statistical Analysis of Results.

It was hypothesised that different groups may have had a tendency, for reasons unknown, to tend to favour the statements from the visioning. To test that the data was recorded and imported into SPSS for analysis. A Kruskal-Wallis test showed that there was no significant difference in the responses for agreement or dissension from the Rail 2050 Vision by Organisation Type There was no significant difference in the responses for agreement or dissension from the Rail 2050 Vision by Level of Management.

There was significant difference between the level of dissension when analysed by Years of Experience. This difference was between those with 1-5 years of experience and those with 10+ years of experience, with those with longer experience showing more dissent. There was a significant difference in agreement and dissension between SMEs and Non-SMEs, with SMEs agreeing less and dissenting more.

4. Insights and Findings

4.1. Summary of agreed statements

In order of % agreement the statements that the Delphi Study had stable consensus on were, by round**:

4.1.1. Round One stable statements ranked by agreement

- Rail Freight transport units in 2050 in Europe can communicate with one another as well as with infrastructure and operational facilities, minimising downtime.
- Passengers across Europe are able in 2050 to access real time personal communication and new services for work or leisure continuously, before, throughout and after the journey.
- Rail in Europe in 2050 is the backbone of urban mobility, with intelligent stations at the heart of smart cities, being life-centric places to work, meet and communicate.
- The rail sector of 2050 manages a growing volume of data in Europe contributing to the data economy. Collection, analysis interpretation and prediction are automated to provide consistent up-to-date information, supporting fast, well-informed decisions and business benefits.
- By 2050 rail has maintained its place as the safest transport mode and this is recognised and valued by European citizens. Zero casualties per year is the current status of the rail sector at urban, regional and inter-city level.
- In 2050, rail transport in Europe is the backbone of an intermodal Mobility as a Service for passengers within cities and beyond, meeting the needs of customers, EU citizens and society.
- By 2050 innovative logistics services in Europe are driven by customer demand. Shipments are moved effectively, efficiently, safely and securely through the “Physical Internet”. [https://en.wikipedia.org/wiki/Physical_Internet]
- Manned and unmanned autonomous intelligent vehicles operate safely on the same European railway network of 2050, controlled by artificial-intelligence based traffic management systems.
- By 2050 European railways are a core part of any smart city planning, mobility management systems, and city

** Since the panel sizes were different between rounds it is not appropriate to mix the ranking between rounds.

fulfilment and delivery services, promoting interconnection by freeing up land which was previously needed by private road vehicles and minimizing pollution and congestion

- By 2050 new energy-efficient station designs in Europe provide easy access and seamless interchange across all transport modes, enabling railways to manage growing passenger volumes and mobility demands
- The European rail system of 2050 is fully integrated with the automated multimodal logistic chain forming the backbone infrastructure, comprising new intelligent, automated cross-modal shipment transfer nodes.

4.1.2. Round Two stable statements ranked by agreement

- By 2050 the rail freight sector will have to have addressed some fundamental issues around cost, asset utilization and customer facing connectivity.
- Rail is more of a mass transit solution. Tailor-made autonomous journeys will not be the solution. By 2050 as a backbone, rail in Europe will provide journeys on a regular time table so other "light" transport modes can offer autonomous trips.
- In 2050, by obliging access to data from all providers for all modes and all asset and service providers, relevant information is shared across the European rail stakeholders as a part of the data economy.
- A majority of native speakers in urban areas across Europe will have easy tailored access to mobility services by 2050.
- Only if the rail sector is financially supported through capital investment, large amounts of which are needed now, can the European rail system in 2050 be able to detect, understand and respond to individual and collective European citizens mobility needs, delivering tailored, on demand, integrated end-to-end mobility solutions.
- In 2019, Europe is still a leader in the railway products and services. But by 2050, companies from Japan, South-Korea and China would probably be the new leaders.
- People in cities feel safe and secure using European rail services in 2050 thanks to non-blocking security systems.

These statements offer clear insights into the consensus view of the expert panel that can be used to critique, support, or amend the future roadmaps, especially the next Strategic Rail Research Agenda (SRRIA) currently under development as of November 2020.

4.2. Dissent, Doubt and Uncertainty

One of the major objectives of applying a Delphi study is to achieve consensus on some previous issues through the “Hegelian dialectic of thesis, antithesis, and synthesis (Stuter, 1998). However, it became clear that in this work the search for consensus was just one part of the process and that it was often be the dissenting voices and the non – consensus statements that also yielded value.

The statements that remained unstable and unresolved at the end of Round Two, and therefore in need of further research and examination for the future of the sector were:

- By 2050 the European rail sector will remain largely technically led with service and user aspects not well recognised.
- By 2050 rail will not be the backbone of an intermodal Mobility as a Service for freight.
- Only some European smart vehicles on rail on low usage lines are aware of themselves by 2050 and have operational autonomy.
- Right now, national rail services do not integrate seamlessly with rail services available in neighbouring countries. So integrating seamlessly with all other available transport modes seems a very distant prospect indeed, not by 2050.
- In the year 2050 information that is shared across the European rail stakeholders as a part of the data economy is exploited by large businesses and threatens personal data privacy.
- The fragmenting political structures across Europe is unlikely to facilitate mobility services tailored regardless of demographics, culture, language, location, or technical proficiency by 2050
- Only in urban mixed traffic environments shall the rail system of 2050 deploy fully-smart vehicles that may be

self-regulating by 2050 in traffic, negotiating vehicle-to-vehicle and vehicle-to-X to determine movement priority and resolve potential conflicts at junctions in the network and reacting to unexpected situations.

- European rail systems in 2050 will continue to be very vulnerable to terrorism.

4.3. Common Themes

We concentrated on the comments of the panels, both on the stable and unstable results and found common denominators in the varieties of the replies. Some of them were contrasting, so that on the same statement comments both partially reinforced and were totally in disagreement. This indicates that actions need to be taken but the panel did not have a clear idea on how the shortcomings would be solved. We have identified 12 of these common denominators which repeat themselves although using different expressions.

- Market orientation.
- Cost, competition and efficiency.
- Leadership, political issues, lobbying, government intervention for good or ill.
- Lack of seamlessness for many reasons.
- Inadequate speed of reaction/investments compared to Asian competitors.
- Lacking technical/technological innovations and skills.
- Language barriers.
- Different regulations barriers in EU rail space.
- Info, data availability sharing and management.
- Safety and security issues.
- Accessibility and capacity.
- A limiting of scope from universal visions to
 - Urban,
 - Native,
 - Backbone.

5. Conclusions

We have used both the areas of consensus and of dissent to inform a narrative to inform the future road-mapping of the EU rail sector and in particular the strategic rail agenda, the SRIA.

There are issues with rail freight, to increase the use of rail freight and for rail to become the backbone for freight it is imperative that it addresses some fundamental issues; namely cost competitive, asset utilization and customer facing connectivity. These service user aspects are the important challenges that need to be addressed for rail freight to raise expectations and to enable the shift of freight from road to rail. An important aspect that has been highlighted, it is expected that rail freight transport units will be able to communicate with each other as well as with the infrastructure and operations. This expectation will not become a reality without significant investment and development of the appropriate communication standards towards the intelligent freight train which will communicate over the next generation communication system.

One very challenging target requiring significant support is to move from competitive rail freight to rail taking the lead and becoming the backbone of an intermodal Mobility as a Service for freight. The freight business has not yet been consolidated but there are opportunities with sea transports that lead to success for rail. Intermodal transport with a rail backbone is the segment with a great potential. To achieve this potential there must be investment in terms of capital but also essential research. One way of improving intermodal mobility is to improve rail provisions in terminals and close to ports.

With respect to passengers there is a clarity that rail and public transport are the solution to provide mobility for passengers. This belief builds on rail's existing credentials and credibility as the most environmentally friendly form of mass land transport with an excellent safety record. In 2050 rail will still the safest mode with zero casualties and this is recognised and valued by European citizens. This opportunity is enhanced by the fact that passengers across Europe are to access real time personal communication continuously, before, throughout and after the journey. This

situation will only improve as passengers demand connectivity and entertainment through their mobile devices.

One issue that will hold back seamless services is that national rail services do not integrate seamlessly with rail services available in neighbouring countries. This situation must be addressed by research into standards and data sharing without serious consideration of this aspect integrating seamlessly with all other available transport modes would seem unrealistic.

The flagship for passenger services is rail at the backbone of urban mobility with rail considered the mass transit solution, with large numbers comes the responsibility for protection and improvement of service but also the revenue to provide intelligent stations at the heart of smart cities, being life-centric places to work, meet and communicate. This improvement is considered as a given and it is believed that the expected innovation in mass transit will lead to rail being fully intelligent, operating autonomous vehicles operating in cities with the offer further from the city centre being less focused on mass transit with the innovation such as pods being researched and developed for the final stages of the journey. These pods or fully smart vehicles may be self-regulating by 2050 in traffic, negotiating vehicle-to-vehicle and vehicle-to-X to determine movement priority and resolve potential conflicts at junctions in the network and reacting to unexpected situations.

Especially in cities there will be new energy-efficient station designs in Europe provide easy access and seamless interchange across all transport modes, enabling railways to manage growing passenger volumes and mobility demands funded by the secondary spend in stations.

There is one basic assumption that must become a reality for the strategic development of the rail system. Free access to data from all providers for all modes and all asset and service providers, relevant information must be shared across the European rail stakeholders as a part of the data economy. An additional challenge is to have a harmonised system architecture and data organisation able to support the challenges listed above in an open, interoperable way whilst preserving the requirements of some of the parties' privacy in terms of data confidentiality. A commitment needs to be made to managing the growing volume of data in Europe contributing to the data economy. Tools will need to be jointly developed for the collection, analysis interpretation and prediction of passenger flows. Passenger information needs to be automated to provide consistent up-to-date information, supporting fast, well-informed travel choices and aiding decisions. This will all benefit rail as a business.

Europe has several languages and native speakers in urban areas across Europe will have easy tailored access to mobility services. The same is not true for non-native speakers and therefore research should be conducted into the use of smart systems to assist non-native speakers.

The common themes elaborate areas of focus for the sector and future research. The statements showing dissent and instability merit further investigation and either research and action to mitigate the concerns, or an acceptance that the vision needs reconsidering considering expert opinion.

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