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This project has received funding from the Shift2Rail Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 826055 (TER4RAIL)

TER4RAIL DELPHI STUDY WEBINAR

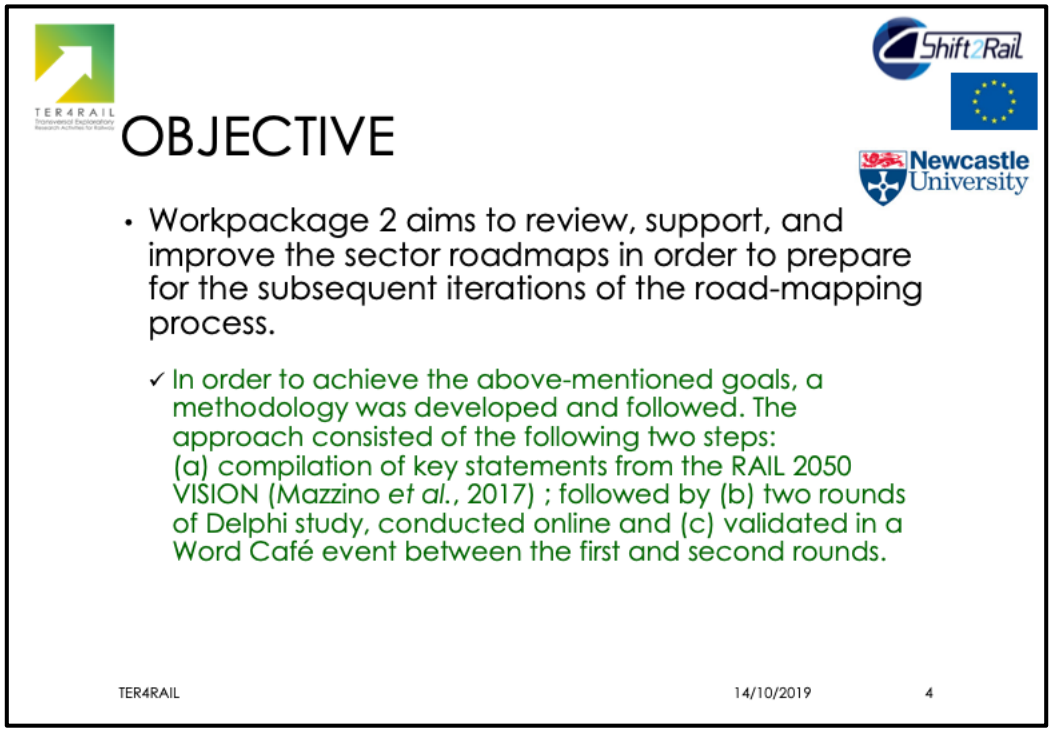
Round One Results

GoToMeeting, Monday, October 14, 2019 from 11:00 AM to 12:00 PM (CEST);
Please join my meeting from your computer, tablet or smartphone.
https://global.gotomeeting.com/join/522273653

Thomas H Zunder, Newcastle University

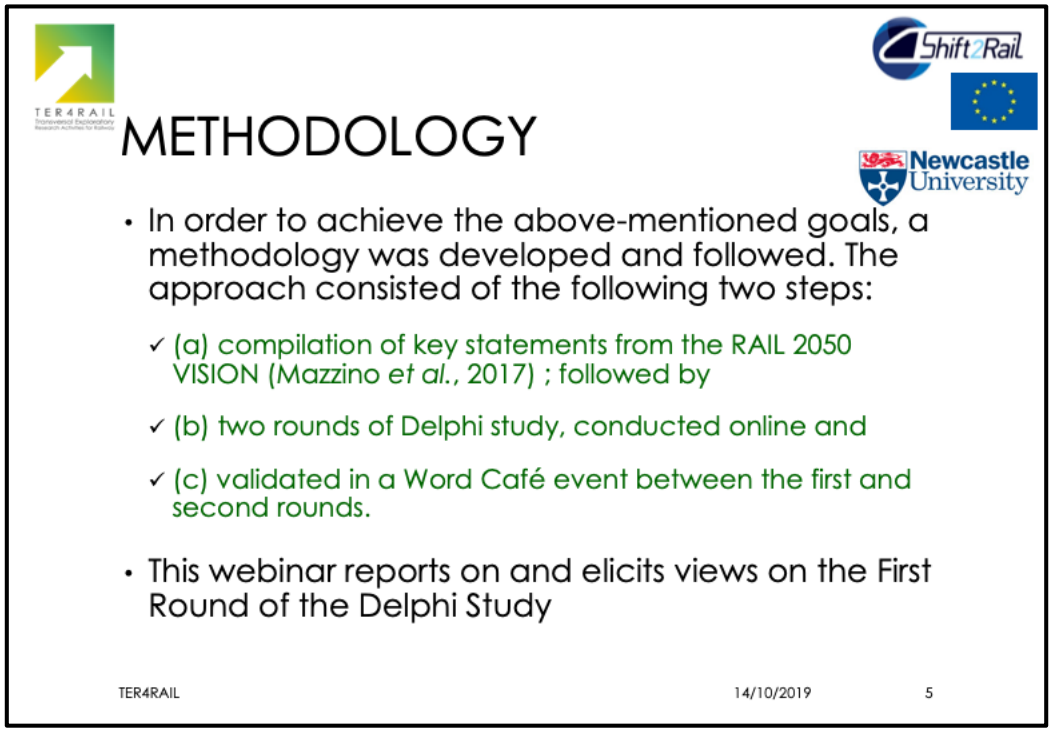
OVERVIEW

- Objective
- Methodology
  - ✓ Consensus
  - ✓ Advantages/Disadvantages
- Statement Building
- Online Survey
- Consensus and Stability
- Your Role
- Results



Workpackage 2 aims to review, support, and improve the sector roadmaps in order to prepare for the subsequent iterations of the road-mapping process.

Road-mapping in the rail sector can be considered to be primarily contained in the Shift2Rail Multi Annual Action Plan, the ERRAC Strategic Rail R&I Agenda(s), the subsequent RAIL VISION 2050 document, as well as the ERRAC/ERTAC Integrated Urban Mobility Roadmap, among others. Additionally, the work completed under SETRIS for the development of cross-modal roadmaps between the ETPs for transport represents the broader context of rail road-mapping.
Task 2.2 comprises of work as follows:
"A Delphi Study will be conducted in 2–3 rounds over 18 months to utilise expert knowledge acr oss the EU and beyond, to identify challenges and explore the rail and intermodal roadmaps, the assumptions underlying them, including the actions required to achieve them on time. This will be accomplished with online tools, and each stage will be reported at appropriate workshops in the project. The Delphi Study will for a written paper which will comprise a deliverable project and will be submitted to a peer-reviewed academic article."

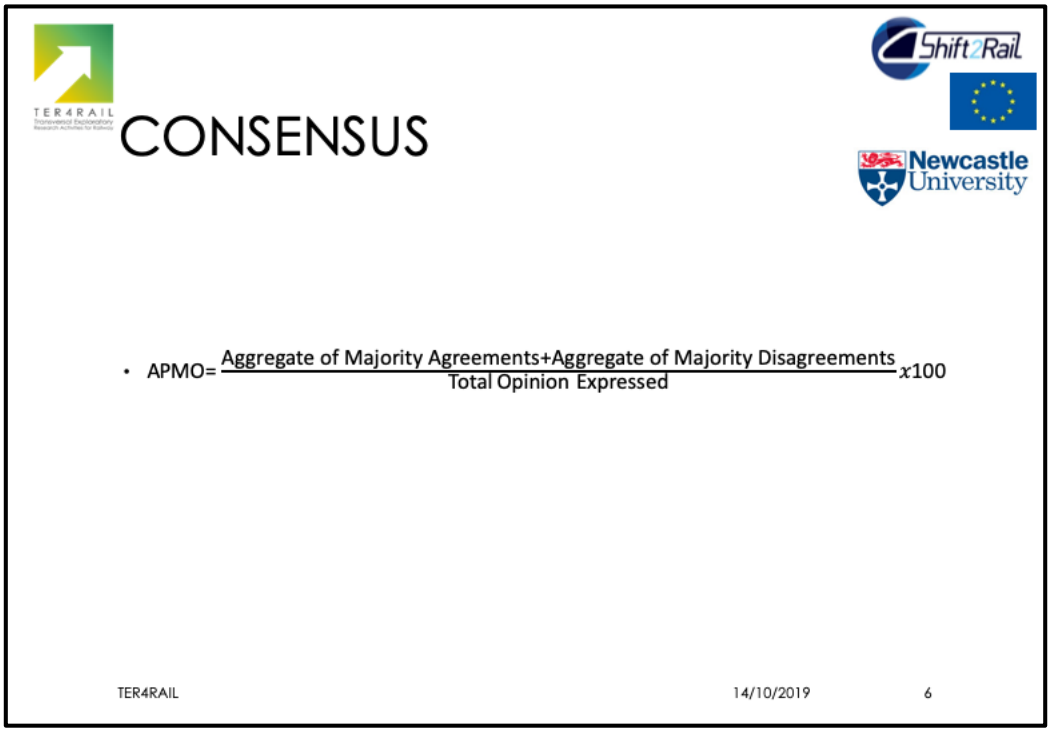


The Delphi technique can be used for both quantitative and qualitative data and is an appropriate technique for collecting, aggregating and analysing the informed judgements of a group or panel of experts on previously identified issues. The technique provides unbiased input, as the researcher and experts never meet face to face, preventing the negative effects of group dynamics and peer pressure (Saldanha and Gray, 2002; Islam, Dinwoodie and Roe, 2006). The Delphi results were then validated with expert group workshops using facilitated discussions, break out groups and mutual brainstorming.

A Delphi study starts with in-depth desktop research to identify the issues and problems in the field and a preliminary questionnaire is developed. Generally, a broad range of topics is examined in the first round and open-ended statements are included in the questionnaire (Wellington, 2015). More than one round is carried out and, in each round, a questionnaire is used. The number of rounds can vary from two to ten (Clark and Friedman, 1982; Green, Hunter and Moore, 1990), although most use two iterations (see next section). In the later rounds, a limited range of

issues is explored in a more structured way (Wellington, 2015). However, iteration is usually determined according to the achievement of consensus by the panel. Even though iteration results in a certain level of improvement or refinement, in most Delphi studies the main improvements usually occur between the first and the second rounds (Dalkey, 1969; Bardecki, 1984; Nelms and Porter, 1985).

One of the major objectives of applying a Delphi study is to achieve consensus on some previous issues. On consensus, Stuter (1998) contends that: 'The Delphi Technique and consensus building are both founded in the same principle - the Hegelian dialectic of thesis, antithesis, and synthesis, with synthesis becoming the new thesis.



Thus the overall aim of the study is to achieve a consensus among the participants. To determine whether or not a consensus has been achieved, any arbitrary figure could be used, although some justification should be made for it (Abdel-Fattah, 1997; Abdel-Fattah, Gray and Cullinane, 1999). Abdel-Fatthah (1997), Saldanha and Gray (2002), Hwang (2004) and Islam et al. (2006) used the following formula of Average Percent of Majority Opinion (APMO), which will also be used in the present research, to find out the cut-off point for a consensus:

- APMO=Aggregate of Majority Agreements+Aggregate of Majority Disagreements
- Total Opinion Expressed

If neither agreement nor disagreement has a majority amongst the panel, then no score is carried to the APMO, reducing it accordingly and representing the lack of stability. Consensus, which can be either agreement or disagreement with a statement, is defined as a percentage higher than the average percentage of majority opinion. The statements that do not reach consensus are included in the next round for re- evaluation

Advantages

- It elicits the views of panels of experts.
- It employs an iterative process of summarising, averaging and recycling panel members' views to encourage convergence on a consensus view.
- Panellists are given the opportunity to revise earlier answers in the light of the general opinions expressed by the panel as a whole.
- Information is collected by questionnaire and does not involve interviews or discussion.
- Members of the panel are guaranteed anonymity.

Disadvantages

- Delphi study can

exaggerate the concept of expertise.

- The composition of the panel is seldom random, reflects the personal biases of the researchers and is not necessarily representative of specialist knowledge in the field.
- Anonymity relieves panel members of accountability and hence can lead to careless responses.
- By seeking consensus, Delphi surveys promote a conservative view of the future, discourage original thinking and suppress radical views.
- It can have the effect of reinforcing existing paradigms.
- It offers little insight into the reasoning underlying the panel members' responses and gives no opportunity for their arguments to be tested in face-to-face discussion

.

A Delphi survey poses statements to an anonymous panel, and asks if they agree or disagree with it. If not then dissenting statements can be made and these are taken to round 2 if no consensus has been reached in round 1 for the original statement.

The construction of statements for a Delphi survey is therefore key.

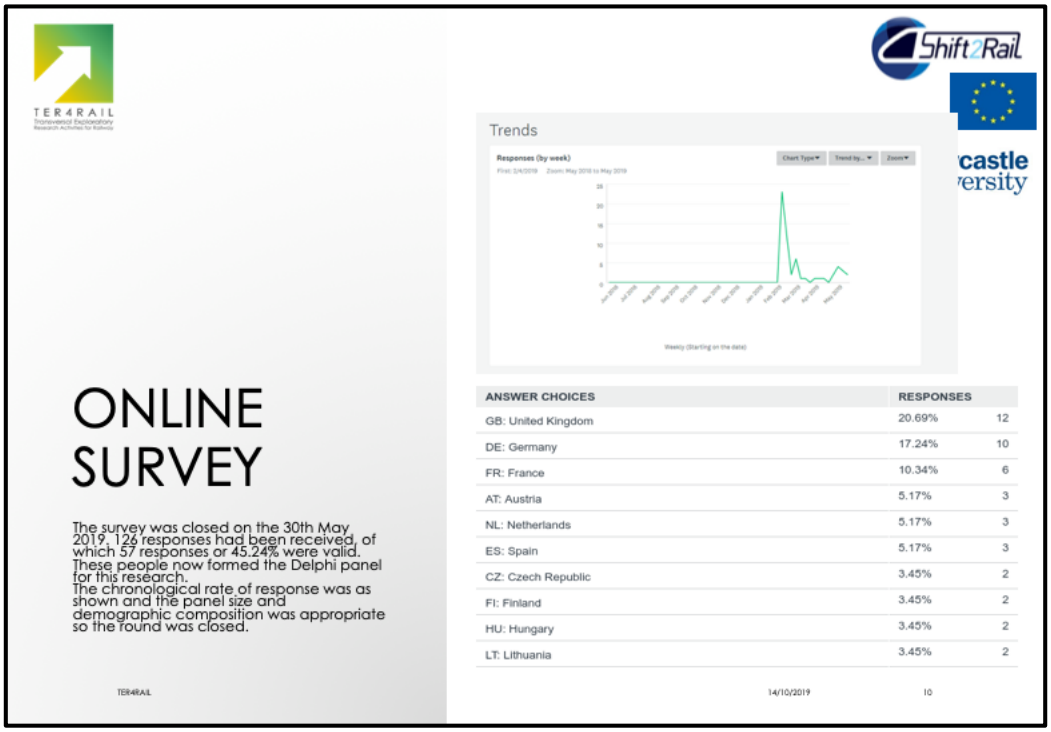
TER4RAIL had the advantage that the ERRAC RAIL 2050 VISION (Mazzino *et al.*, 2017) document is essentially a series of statements, supported by text, that envision the future. This made the adoption of the key statements from the document the core body of statements for the process.

This list was then reviewed by the TER4RAIL expert consortium, several of

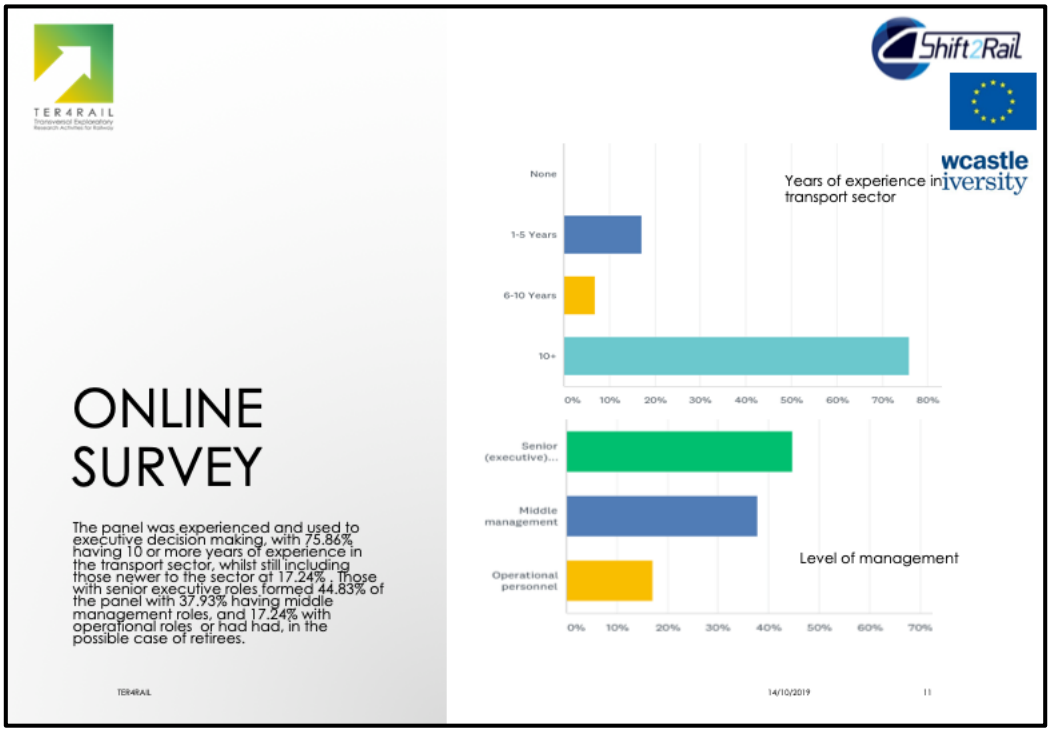
whom were authors of the VISION document. After 5 iterations an agreed list was settled upon and the process of writing the survey could begin.

STATEMENTS FOR DELPHI ROUND 1

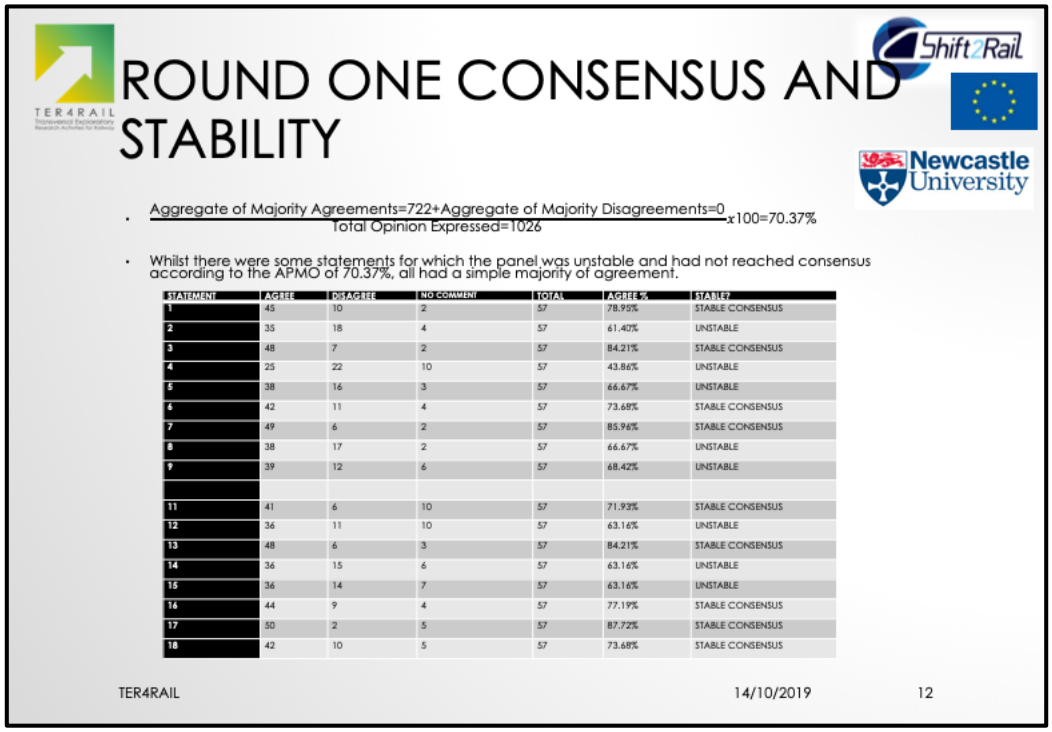
- In 2050, rail transport in Europe is the backbone of an intermodal mobility as a Service within cities and beyond, for both passengers and goods, meeting the needs of customers, EU citizens and society.
- The suppliers, operators and other service organisations of the European rail industry in 2050 are recognised as the world's thought leaders for railway products and services.
- The European rail system in 2050 is able to detect, understand and respond to individual and collective European citizens mobility needs, delivering tailored, on demand, integrated end-to-end mobility solutions to which the rail system is a prime contributor, integrating seamlessly with all other available transport modes in an easy and friendly way
- Rail in Europe is the backbone of urban mobility, with intelligent stations at the heart of smart cities, being life-centric places to work, meet and communicate.
- European railways are a core part of any smart city planning, mobility management systems, and city 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
- Passengers across Europe are able to access real time personal communication and new services for work or leisure continuously, before, throughout and after the journey.
- Every individual across Europe has easy tailored access to mobility services regardless of demographics, culture, language, location, or technical proficiency
- Taking into account data privacy management, relevant information is shared across the European rail stakeholders as a part of the data economy, enabling new services and applications for the benefit of the railway and its customers;
- Rail 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;
- European smart vehicles on rail are aware of themselves, their passengers/loads and their surroundings, know where they need to be and when and can adjust journeys automatically to meet demand.
- A European rail network of fully-smart vehicles that may be self-regulating 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.
- 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
- Manned and unmanned autonomous intelligent vehicles operate safely on the same European railway network, controlled by artificial-intelligence based traffic management systems.
- People feel safe and secure using European rail services thanks to non-blocking security systems. Precautions against external threats, aggression and vandalism, supported by technologies are in place.
- The European rail sector has a long-established collaboration with all other sectors to handle cyber security. New forms of cyber-attacks are therefore recognised at an early stage and are dealt with through joint cross-sectoral effort.
- 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]
- 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
- Rail Freight transport units in 2050 in Europe can communicate with one another as well as with infrastructure and operational facilities, minimising downtime.



There are a number of online survey tools including Survey Monkey and Bristol Online Surveys (BOS). Comparing the functionality and other suitability, SurveyMonkey was used for this survey.
The design was compliant with the GDPR directive, having a clear privacy policy and statement as to the use of the data. The full survey was launched 28th January 2019.
The survey was closed on the 30th May 2019. 126 responses had been received, of which 57 responses or 45.24% were valid. These people now formed the Delphi panel for this research.
The chronological rate of response was as shown and the panel size and demographic composition was appropriate so the round was closed.



The panel was experienced and used to executive decision making, with 75.86% having 10 or more years of experience in the transport sector, whilst still including those newer to the sector at 17.24% . Those with senior executive roles formed 44.83% of the panel with 37.93% having middle management roles, and 17.24% with operational roles or had had, in the possible case of retirees.



ROUND ONE CONSENSUS AND STABILITY

- $\frac{\text{Aggregate of Majority Agreements=722+Aggregate of Majority Disagreements=0}}{\text{Total Opinion Expressed=1026}} \times 100 = 70.37\%$
- Whilst there were some statements for which the panel was unstable and had not reached consensus according to the APMO of 70.37%, all had a simple majority of agreement.

STATEMENT	AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
1	45	10	2	57	78.95%	STABLE CONSENSUS
2	35	18	4	57	61.40%	UNSTABLE
3	48	7	2	57	84.21%	STABLE CONSENSUS
4	25	22	10	57	43.86%	UNSTABLE
5	38	16	3	57	66.67%	UNSTABLE
6	42	11	4	57	73.68%	STABLE CONSENSUS
7	49	6	2	57	85.96%	STABLE CONSENSUS
8	38	17	2	57	66.67%	UNSTABLE
9	39	12	6	57	68.42%	UNSTABLE
11	41	6	10	57	71.93%	STABLE CONSENSUS
12	36	11	10	57	63.16%	UNSTABLE
13	48	6	3	57	84.21%	STABLE CONSENSUS
14	36	15	6	57	63.16%	UNSTABLE
15	36	14	7	57	63.16%	UNSTABLE
16	44	9	4	57	77.19%	STABLE CONSENSUS
17	50	2	5	57	87.72%	STABLE CONSENSUS
18	42	10	5	57	73.68%	STABLE CONSENSUS

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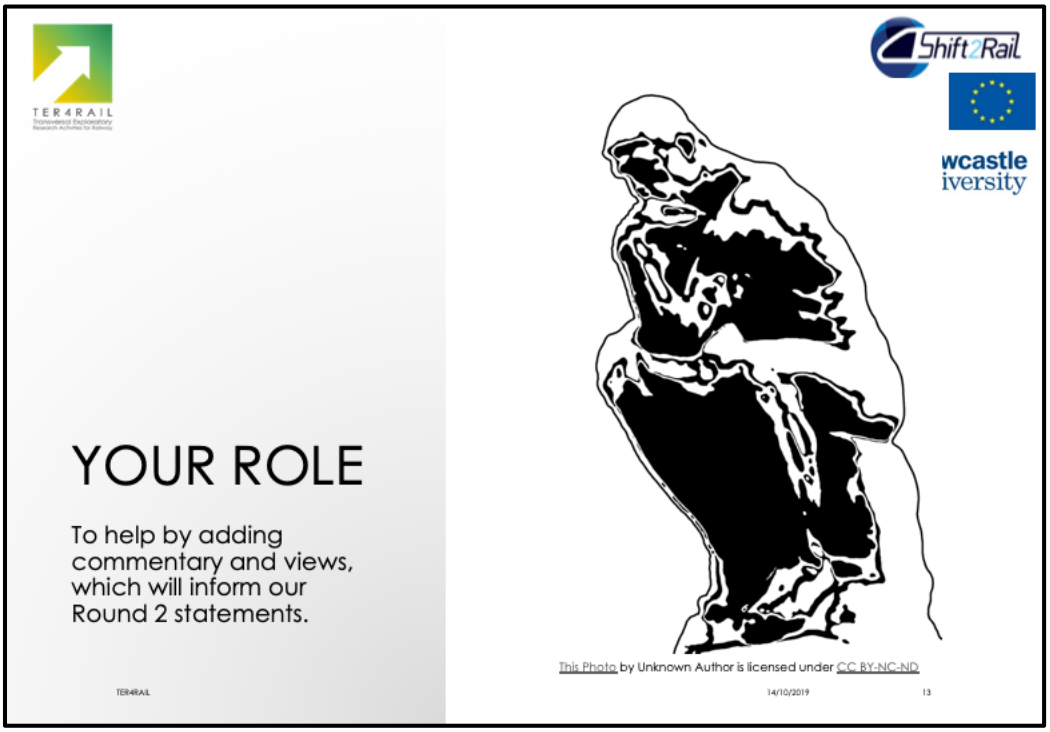
Using the methodology detailed in Section 5.1 above the overall APMO was calculated as follows:

$$\frac{\text{Aggregate of Majority Agreements=722+Aggrega}}{\text{Total Opinion Expressed=}}$$

Whilst there were some statements for which the panel was unstable and had not reached consensus according to the APMO of 70.37%, all had a simple majority of agreement. This is detailed in Table below.

Accordingly, the panel did not achieve a stable consensus on statements 2, 4, 5, 8, 9, 12, 14 and 15; these will be analysed to develop further statements for a second round.



Please comment, it is not necessary to dispute the comments, it is better to view them as talking points to elaborate new views that will help build new statements for Round 2
Subtlety is better than outrage!

2: 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.

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
35	18	4	57	61.40%	UNSTABLE

This should be the case. The rail sector will have to address some fundamental issues around cost, asset utilization and customer facing connectivity if is is to achieve this amongst other things
Current political decisions are not giving enough support to railways. For economic reasons the RUs are focusing on freight corridors and transport of complete trains from A to B, neglecting smaller clients. Continuing the political hype for autonomous driving will push this sector, which could take over a great part of the freight business.
This will only happen if the existing infrastructure is well maintained, if harmonisation follows suit, and if there are enough governments or companies to prioritise the matter. None of this seems to be the case now. Even worse, freight does not seem to be a priority in many countries.
The rail sector would have to become freight customer-oriented and more internationally-minded than it is now for this to happen. This is far from being the case today in some countries.
I would like to agree, but I doubt that with current politicians and road lobbyists this vision would be reached.
Freight by rail is relevant for high volumes, high weight, high frequency and long distances (but this last criterion is not a must). So, rail freight should be the backbone of transport between big Origins/Destinations but not within the cities where tailor-made transport solutions should be proposed
Disagree for non-bulk commodities and freight within cities.
But the last mile problem must be solved
Rail has a key role but, again, as part of an integrated system as rail freight is not always the most efficient or cost-effective solution.
No way the road lobby would give up pushing themselves further on motorways and roads.
Within cities the rail freight has many issues. I foresee more chance in as a feeder mode for city logistics. For long distance freight I fully agree.
Insufficient infrastructure to meet projected needs. Unable to demolish city centres to improve infrastructure.

4 The European rail system in 2050 is able to detect, understand and respond to individual and collective European citizens mobility needs, delivering tailored, on demand, integrated end-to-end mobility solutions to which the rail system is a prime contributor, integrating seamlessly with all other available transport modes in an easy and friendly way

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
25	22	10	57	43.86%	UNSTABLE

The rail sector and other modes still largely think and operate in silos. Connectivity fails consequently.
While there are lots of endeavours in the area of mobility as a service, rail plays a rather small role in them.
There is a field of improvement in going from technical skills to market-oriented behaviour
Right now, national rail services do not even 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 before 2050.
Only if the rail sector is financially supported through capital investment, large amounts of which are needed now.
Some European stakeholders are already assessing these topics. But in 2050, will the European Rail System be homogeneous? I have some doubts.
Depends a lot on leadership and political support. Further it is essential to harmonise safety regulation for all modes (level-playing field). Self-driving cars/trucks and trains/trams/metro should use the same communication and safety systems. Eventually this will even provide the option to blend the modes into one system and network (note that I expect that some rail infra for less dense routes will have available capacity for this "plan B"). This again is a big challenge. I hope it succeeds
A good aspiration, but this must also be affordable.
This is aspirational and does not seem to synchronise with the competences of the current rail sector and its political masters
Essential the Channel Tunnel, Great Belt crossing (Germany-Denmark), Rail Baltica & other rail infrastructure improvements are delivered & fully exploited.
We still cannot get all modes operating together and it is unlikely this will change as competitive pressure will remain.

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5: By 2050 European railways are a core part of any smart city planning, mobility management systems, and city fulfilment and delivery services, promoting interconnection by freeing up land which was previously needed by private road vehicles and minimizing pollution and congestion

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
38	16	3	57	66.67%	UNSTABLE

wcastle
niversity

I doubt much road infrastructure will be surrendered
Rail transport must be the defining element of logistics and transport of people within cities. It is the only mode of transport that frees space from the surface of cities, has no traffic jams and has regularity that must be expanded. It must also offer the necessary services to be considered a viable alternative to private vehicles.
Current mobility as a service endeavours tend to focus much more on car sharing options than rail.
I would like to agree, but I doubt that with current politicians and road lobbyists this vision would be reached.
The problem of "capillary connections" is not resolved with rail alone, and the current trends (whether good or bad is an open question) are to further close small lines and stations. In other words: what's the threshold size for a "smart city"? Is it sensible to push for more concentration just to make rail relevant?
I agree, but technology will enable road to deliver some of these services, so rail needs to focus on areas where it can offer real benefit.
Essential robust land use & transport planning go hand-in-hand. New town & garden village developments to be rail-served

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Shift2Rail

8: Every individual across Europe has easy tailored access to mobility services regardless of demographics, culture, language, location, or technical proficiency by 2050

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
38	17	2	57	66.67%	UNSTABLE

wcastle iversity

Aspirational. How will success be measured.
Please determine "easy" compare to the target group that has access to the system. There will always be disadvantaged areas that are not included in the business case or service
Mobility as a service options would need to improve a lot not just in the development of apps but their back link to payment systems beyond country boundaries, and in language support beyond the dominant language(s) of any given country. Apps are becoming more user-friendly but there is also a trend towards non-smart phones for the elderly, for example.
Technical proficiency might be a problem: this will depend on how well educational systems adapt to the digital revolution and make sure that all schoolchildren acquire digital skills
Much work is ahead though to achieve this objective, especially for dissemination, digitalisation, common ontology and vocabularies, and automation subjects
Agree, but only when the appropriate measures are taken now.
Ensuring access for everyone regardless of location, income and technical proficiency is again a challenge
Every individual - too strong expression
The fragmenting political structure across Europe is unlikely to facilitate this. I am not sure about the rural areas without proper connections to rail.
30 years just are not enough for developing everywhere
Aspirational
So many languages to produce information in, likely a reduced amount of data will be available to non-indigenous travellers
Inequality will continue to exist

9: Taking into account data privacy management, in the year 2050 relevant information is shared across the European rail stakeholders as a part of the data economy, enabling new services and applications for the benefit of the railway and its customers

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
39	12	6	57	68.42%	UNSTABLE

Doesn't feel like a 2050 goal but something that should be close to reality
Currently no commitment to be expected for the sharing of relevant data
I believe that in times of accelerating digitisation this aspect is on one hand a big challenge for the stakeholders, but on the other hand sharing necessary to provide the adequate customer solutions.
We wished. This has been on the agenda for so long, why would it now miraculously happen?
By 2050, more information will be shared. Is this information relevant? that is another question. The stakeholders will probably use this information for business purposes. If it benefits to the whole community, then it is good. But not sure it is the first goal.
Agree, but providing access to data should be obliged for all providers to get this running. For all modes and all asset and service providers, by the way.
How is this to be achieved, given that rail stakeholders are often competitors?
Hopefully not ... I am deeply again of this "lets collect and share every information about people" thing
Not clear what is the novelty exactly. Political difference will prevent this

12: People feel safe and secure using European rail services in 2050 thanks to non-blocking security systems. Precautions against external threats, aggression and vandalism, supported by technologies are in place

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
36	11	10	57	63.16%	UNSTABLE

Rail is assumed to be safe and secure. Not sure what a non-blocking security system entails.

General situation in the world with security is unpredictable

1:) Clarify "non-blocking"; 2) safety and security come at a price, and the question is what price the users and non-users (e.g. taxpayers) are willing to pay. We know (from experience) that willingness to pay varies with time, transport mode, and location. While the trend was upwards in an increasingly risk-averse society, forecasting is difficult. Security systems are only creating problems and are expensive. Passenger are already safe enough.

Rail system is and will probably continue being very vulnerable to terrorism

This would be good and welcome, but we know that the most intelligent brains often are used also by the attackers.

For smaller cities and villages this statement is false.

This should be a key given/selling point.

People will not feel safer thanks to non-blocking security systems. Depending on the threat

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14: The European smart vehicles on rail are aware of themselves by 2050, their passengers/loads and their surroundings, know where they need to be and when and can adjust journeys automatically to meet demand.

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
36	15	6	57	63.16%	UNSTABLE

stle sity

Agree, but I don't see the development of the necessary equipment currently
Last part is dubious; there are trade-offs between capacity and adaptation to demand (esp. time). Mass transport is still (technically and economically) desirable for rail.
Agreed, these will probably also be a massive support to more rural locations ensuring that rail services there have a critical mass in order to remain in operation.
Rail is more a mass transit solution. Tailor-made journeys may not be the solution. As a backbone, rail may provide journeys on a regular time table so that passengers, and other "light" transport modes can lean on.
I am not clear how a mixed traffic rail system could work entirely with vehicles adjust journeys to demand.
Much of this I agree with, but I believe that there will still be many/mostly fixed timetable 'heavy rail' services as it is hard to adjust what the vehicles do 'real time' when they have a range of passengers with different destinations and expectations about arrival times.
I disagree because rail have restraint in access and capacity
Freight & passenger.
Not sure this will meet commercial needs.
Bit completely. Different rates of funding and enthusiasm will apply.

15: A European rail network of 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.

AGREE	DISAGREE	NO COMMENT	TOTAL	AGREE %	STABLE?
36	14	7	57	63.16%	UNSTABLE

Agree, but V2X must not be necessarily IEEE 802.11p
Only on the unexpected predictable situations, how can we prepare for the unexpected event
Agree, but I don't see the development of the necessary equipment currently
Technically this may be possible, the question of ethics in such decisions needs to be sorted out, though.
Again, this is not road transport; as vehicles (assuming they are small: a car body for instance) should often travel as a single convoy, they become a bit dumber, for the benefit of overall efficiency.
Perhaps not by 2050 but this will most likely happen.
Again this seems to me to be over ambitious
Essential
Not sure that this is achievable.

This project has received funding from the Shift2Rail Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 826055 (TER4RAIL)

THANK YOU!
QUESTIONS?
COMMENTS?

Thank you for your kind attention!

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