

# SMART MAINTENANCE AND THE RAIL TRAVELLER EXPERIENCE

## Deliverable 3.4/The Smart Journey Vision

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## EXECUTIVE SUMMARY

This deliverable is produced as part of Work Package 3 (WP3) of the SMARTE project, funded by the Shift2Rail consortium. It reports on the final evidence gathering undertaken in Task 3.4 and describes how this evidence is synthesised with the outputs from the other tasks in WP3 to produce the final “Railmap” of recommendations for the SMARTE Journey Vision for an improved rail passenger experience.

The objective of Task 3.4 was to seek expert opinion on improving the rail passenger journey experience by firstly providing selected information from the outputs of tasks 3.1-3.3 namely: 1) a high-level survey of demographic and societal factors affecting transport users at different journey stages; 2) a Passenger Experience Map from Task 3.2; and 3) selected results from a large survey of rail users and non-users; and secondly adding expert opinion and reflection to synthesise an industry and policy-facing “Smart Journey” vision, with a “Railmap” of recommendations for the industry aimed at simplifying the end-user experience of planning and undertaking a trip that includes a rail journey.

The outcome of this task provides a clear overview of the key factors influencing the rail passenger experience which could be addressed in order to best influence travel choices to maintain and increase passenger rail journeys and how the prioritisation of effort might be affected by different future conditions.

The research exercise for Task 3.4 represents the final part of WP3 and was constructed as a Delphi survey of experts.

The Delphi Survey expert participants were recruited from the participants in the Stakeholder Workshops conducted in Task 3.2, and from the networks of the Institute for Transport Studies (UNIVLEEDS) and project partner, UITP. Through these strategies, Round One of the Delphi Survey was distributed directly to 48 recipients. 9 responses were received as a result, following two rounds of reminder emails, representing a response rate of 19%. The responses that were received were collated and synthesised to produce the materials for Round Two. In Round Two, the questionnaire was sent to all those who had responded to Round One, and also sent with a renewed invitation, to recipients who had expressed an interest but not been able to participate in Round One for some reason (for example, the first exercise coincided with the summer holiday period and the second with the start of the academic year). From a distribution of 26, a total of nine responses were received from Round Two, a response rate of 35%. Overall, ten individual respondents participated in ways that inform this analysis.

A prioritised list of thirteen recommended actions was one key output from the Delphi Survey.

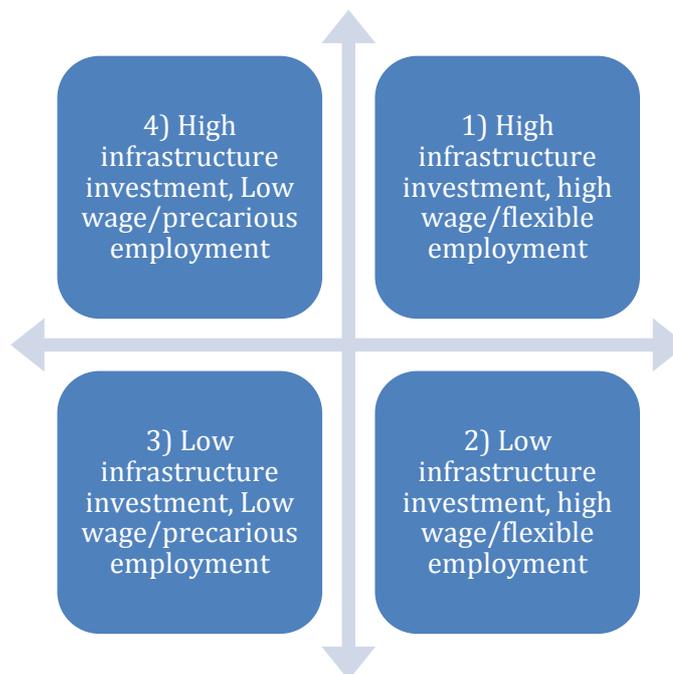
### **Rank Recommended action for improving rail passenger experience**

- 1 Improve service reliability and availability (more lines, more frequency)
- 2 Improve first and last mile travel experience around stations
- 3 Improve affordability and ticket flexibility
- 4 Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (front end)
- 5 Utilise digital tools to improve coordination between operators and across modes to create a ‘whole mobility experience’ (back end)

- 6 Designing for the needs of the elderly and disabled
- 7 Develop better mechanisms for listening and responding to customer needs
- 8 Strengthening regulation to increase rail operator focus on responding to customer experience
- 9 Better tools to plan trips and for accessing travel information through online systems
- 10 Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort)
- 11 Simplified ticket buying processes
- 12 Ensure that the terms of market opening embed improvements to customer experience
- 13 More should be done to involve passengers in designing solutions

The outcome of the Delphi Survey was then synthesised with the evidence gathered in the earlier tasks in the work package.

In order to develop the 'Railmap' for the Smart Journey Vision, the key drivers from the PESTLE analysis and Porter's Five Forces exercise were synthesised, and where necessary supplemented with findings from the other three tasks in the Work Package. The axes for the scenarios (level of investment in rail and wage/employment environment) are derived from the Delphi survey PESTLE analysis findings. This generated a 'best future' scenario, in which the identified priorities for the actions apply. The other three scenarios were less advantageous for the rail sector in clearly defined ways.



This scenario structure was then used to develop the Smart Journey Vision by narrating how each scenario would shape the experiences of the personas from the Experience Map. Whilst all these scenarios are plausible<sup>1</sup>, they are not all equally preferable<sup>2</sup>. Scenario One is the most advantageous for the rail passenger industry, and for society generally, if environmental

<sup>1</sup> <http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/scenario/>

<sup>2</sup> <https://www.nesta.org.uk/blog/speculative-design-a-design-niche-or-a-new-tool-for-government-innovation/>

issues are being addressed as part of the High Infrastructure Investment. No assumptions or prescriptions are made as to who should make the investments. However, the following paragraphs elaborate how the prioritisations of our experts, which remain true under Scenario One would be modified by a consideration of implementation costs under Scenarios Two, Three and Four. In summary, the conclusion is that the most favourable Scenario for the rail sector is Scenario One, the reference case, in which there is no reason why all the identified priority actions shouldn't be implemented.

In all Scenarios, highly predictable commute travel in a clearly defined peak period is likely to continue reducing overall, and this should make it easier to provide a more regular service frequency with greater service provision in evenings and early mornings to accommodate shift workers and leisure trips, without incurring a lot of extra cost.

In focusing on the key actions to take forward we consider cost implications, applicability across the scenarios and also take into account where we have support for the actions from multiple sources of evidence from earlier tasks.

The outcome of this task provides a clear prioritisation to focus on the most significant factors influencing the rail passenger experience in order to best influence travel choices to maintain and increase passenger rail journeys and how the prioritisation of effort might be affected by different future conditions.

The conclusion is that the most favourable Scenario for the rail sector is Scenario One, the reference case, high wage/high investment in which there is no reason why all the identified priority actions shouldn't be implemented.

Where prioritisation is required we particularly favoured actions to Improve affordability and ticket flexibility, improve safety and security and facilities around stations, improve comfort in rolling stock, and the development of trip planning tools. More costly recommended actions involved Improving service reliability and frequency and first and last mile travel experience around stations.

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## 1. INTRODUCTION

This deliverable is produced as part of Work Package 3 (WP3) of the SMaRTE project, funded by the Shift2Rail consortium. It reports on the final evidence gathering undertaken in Task 3.4 and describes how this evidence is synthesised with the outputs from the other tasks in WP3 to produce the final “Railmap” of recommendations and the Smart Journey Vision for an improved rail passenger experience.

The purpose of this task is to integrate the outcomes of Tasks 3.1-3.3 into a vision and ‘railmap’ of measures to simplify the end-user experience of planning and undertaking a trip that includes a rail journey. A key challenge is that of integrating rail into end-to-end Mobility Service ICT infrastructure, distinguishing between front-end and back-end measures. The focus of this task is on making definite recommendations for how to decrease the cognitive effort for individuals using rail services, through planning, booking tickets, integrating the rail journey with complementary activities including trip-purpose chaining (e.g. incorporating shopping or picking up of purchases ordered online), access to the station and onward mobility at the destination (the ‘first and last kilometre’). Each of these elements needs to be considered in different contexts (e.g. information and service purchase for bus, cycle or car, and for different journey types – commuting, leisure and business trips of different distances/journey times, with and without the crossing of international borders). The premise is that reducing cognitive effort should increase the attractiveness of rail travel, thus increasing rail use relative to competing modes.

The outcome of this task provides a clear overview of, and conclusions about, prioritising effort to focus on the most significant factors influencing the rail passenger experience in order to best influence travel choices to maintain and increase passenger rail journeys. This overview is synthesised with the other strands of work in WP3 which look at different aspects of the topic through the eyes of different stakeholders, with each step informing the focus of the next. Figure 1 demonstrates the workflow visually.

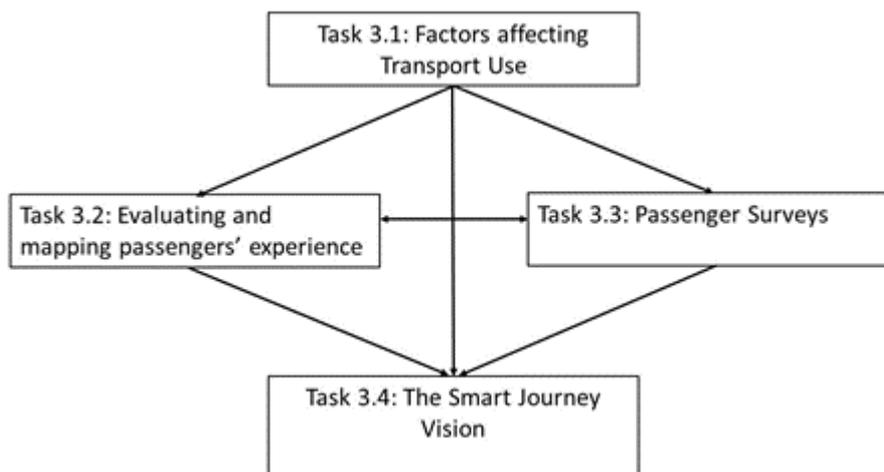


Figure 1 Work Package 3 workflow diagram showing information flow through individual tasks

Table 1 Work Package 3: Task Descriptions (reproduced from D3.2)

Task unit	Subtask
T3.1	<ul style="list-style-type: none"> <li>Review of demographic and societal factors affecting rail transport use at each step of journey, by including modes of transport interconnected or alternative to train.</li> </ul>
T3.2	<ul style="list-style-type: none"> <li>T3.2.1 – Plan: Creation of a research protocol starting by results of Task 3.1 review and recruitment of relevant stakeholders (representative passengers and rail sector stakeholders across Rome, Leeds and Brussels).</li> <li>T3.2.2 – Investigate: Planning and scheduling of three workshops with key stakeholders for building the travel process and defining gaps existing between the offered service and passengers’ mental model will be organised.</li> <li>T3.2.3 – Illustrate: Implementation of the “Experience Map”, which will simulate possible train trip experiences by taking into account the result from workshops with stakeholders and passengers groups.</li> </ul>
T3.3	<ul style="list-style-type: none"> <li>T3.3.1 – Methodology definition: Definition of the methodological framework for the survey by identifying attrition factors for each activity in the journey.</li> <li>T3.3.2 – Survey: Devise of the survey and translation of survey items in three local languages. Then, submission to the panel of 400 users/passengers via market research provider(s).</li> <li>T3.3.3 – Analysis of survey results: Identification of the physical and planning factors and their relative importance in the journey to enlighten the resistance at each step of the journey, according to the quantitative results of the survey.</li> </ul>
T3.4	<ul style="list-style-type: none"> <li>T3.4.1 – Scenario framing: Define scenarios of the Vision and revise the “Experience Map” preliminary version in the light of the survey’s quantitative outcome, in order to make it an element of the Vision.</li> <li>T3.4.2 – Scenario scanning: Validation of scenarios of the Vision through a Delphi study.</li> <li>T3.4.3 – Scenario forecasting and delivery of the Final Smart Journey Vision: Integration of findings of the previous subtasks to refine the scenario set, crafting and presentation of the “Smart Journey Vision” and of the ‘railmap’ in its final version.</li> </ul>

The document is structured as follows. Section 2 sets out the Delphi survey methodology. Section 3 describes the materials used with expert participants. Section 4 describes the results, analysis and limitations. Section 5 is a discussion of the findings that informs the final section, the Conclusion, in which we set out the “Railmap” for our Smart Journey Vision.

## 2. METHODOLOGY

The research exercise for the final part of WP3 was constructed as a Delphi survey of experts. The objective of the task was to seek expert opinion on improving the rail passenger journey experience by firstly providing selected information from the outputs of tasks 3.1-3.3 namely: 1) a high-level survey of demographic and societal factors affecting transport users at different journey stages; 2) a Passenger Experience Map from Task 3.2; and 3) selected results from a large

survey of rail users and non-users; and secondly adding expert opinion and reflection to synthesise an industry and policy-facing “Smart Journey” vision, with a “Railmap” of recommendations for the industry aimed at simplifying the end-user experience of planning and undertaking a trip that includes a rail journey.

Our main focus in relation to ‘simplifying the end-user experience’ is on decreasing the cognitive and physical effort that individuals have to make to plan, book, access the rail system and complete their onward journey.

## 2.1 THE DELPHI SURVEY DESIGN

A Delphi survey is a structured communication technique or method, originally developed as a systematic, interactive forecasting tool which relies on a panel of experts. It consolidates expert opinion through a series of iterative questionnaires, with a goal of coming to a group consensus. We have used it to estimate the likelihood that specific driving forces external and internal to the rail passenger industry will arise, and synthesising expert opinion about how these driving forces will impact on the rail passenger experience.

*Table 2 Matrix describing the Delphi Survey Scenario Scanning Exercise*

Scenario Scanning Exercise: Delphi Survey		
Who?	Round 1	Round 2
<b>Expert participants</b>	PESTLE analysis (for experts from transport authorities/interest groups and academia)	Indicate level of agreement with synthesised PESTLE analysis Prioritise the list of recommendations
<b>Consortium</b>	Synthesis of responses, draft priority list of recommendations based on SMARTE persona/scenarios	Final synthesis

Participants from the rail industry stakeholders’ workshops held earlier in the SMARTE project (see D3.2) were invited to participate in this Delphi survey, along with several additional experts from transport authorities, interest groups and academia. The exercise had two consultative rounds and two analysis phases.

In round one each participant was given the same information about the SMARTE project and its objectives and a summary of the findings from Tasks 3.1, 3.2 and 3.3. Participants were then asked a series of questions organised in the form of either a PESTLE exercise (Appendix 1) or a Porter’s Five Forces exercise (Appendix 2). Each approach is explained below. Each expert participated independently, and their knowledge, opinions and assumptions were synthesised anonymously by the University of Leeds team for task 3.4, and a summary was produced.

In round two participants received the summary report with a set of questions (Appendix 3). They were asked to indicate their level of agreement using a small number of Likert scale questions and asked to prioritise identified actions to improve customer experience. Some Delphi exercises continue until a consensus is achieved. However, the need to keep participant burden to a

minimum restricted the exercise to two rounds only. Participants were also asked to give their informed consent (an example of the consent form is contained in Appendix 4), and the exercise was granted ethical approval by the Ethics Committee for the Faculty of Environment, University of Leeds, reference number LTTRAN-108 (see Appendix 4).

## 2.2 THE DELPHI SURVEY PARTICIPANTS

The Delphi Survey expert participants were recruited from the participants in the Stakeholder Workshops conducted in Task 3.2, and from the networks of the Institute for Transport Studies (UNIVLEEDS) and project partner, UITP<sup>3</sup>. Through these strategies, Round One of the Delphi Survey was distributed directly to 48 recipients. 9 responses were received as a result, following two rounds of reminder emails, representing a response rate of 19%. The responses that were received were collated and synthesised to produce the materials for Round Two. In Round Two, the questionnaire was sent to all those who had responded to Round One, and also sent with a renewed invitation, to recipients who had expressed an interest but not been able to participate in Round One for some reason (for example, the first exercise coincided with the summer holiday period and the second with the start of the academic year). From a distribution of 26, a total of nine responses were received from Round Two, a response rate of 35%. Overall, the number of distinct respondents received that inform this analysis is 10. The areas of expertise of the final participants are summarised in Table 1 below:

*Table 3 Distribution of expert participant types*

		Rail operators	Rail bodies	Academic	Consultancy	Passenger group	Total
Round 1	P5F	2	1				3
Round 1	PESTLE			3		1	4
Round 2		1	1	4	1	2	9
<b>Distinct responses</b>							<b>10</b>

## 3. THE DELPHI SURVEY MATERIALS

The materials for the PESTLE analysis and the Porter's Five Forces template were developed through internal project collaboration building on the outputs and learnings from the sequence of tasks comprising the work package. UNIVLEEDS developed and shared the proposed approach with task partners. Through two rounds of feedback on the materials, the materials to be sent to potential participants were finalised (see Appendix 3).

In Round One Expert participants from transport authorities, interest groups and academia were asked to complete the PESTLE analysis (section 3.1). Expert participants from the rail industry were asked to complete the Porter's Five Forces analysis (section 3.2). In Round Two, the results from Round One were combined into a questionnaire and ranking exercise, and no distinction was made between type of expert participant. Round Two is described in section 3.3 below.

<sup>3</sup> The invite to participate in the survey was also sent out to mail groups hosted by UITP and including key rail stakeholders but yielded no further responses

### 3.1 PESTLE ANALYSIS

PESTLE analysis is a framework for surveying and understanding the external driving forces affecting an organisation, industry or sector. The acronym PESTLE is a mnemonic for the factors: Political, Economic, Societal, Technological, Environmental and Legal/Regulatory. The full set of materials for the PESTLE analysis survey is in Appendix 1.

### 3.2 PORTER'S FIVE FORCES

Porter's Five Forces is a tool for understanding competitiveness in a business or sector. We modified the original framework to focus on how the competitive environment in rail and with other substitute or alternative modes impacts on the customer experience. The full set of materials for the Porter's Five Forces analysis is in Appendix 2. We adapted the original framework to focus it on our specific area of interest.

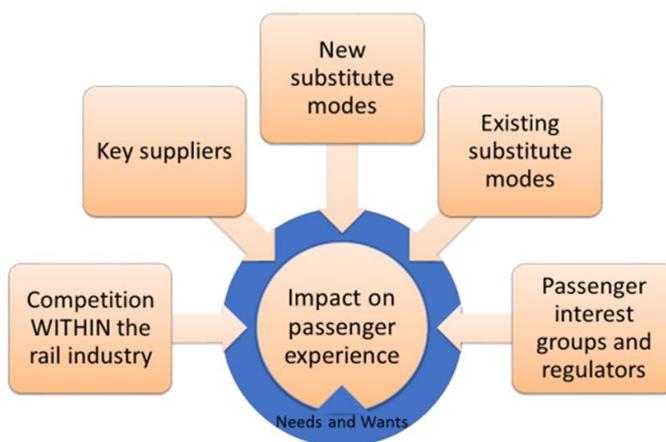


Figure 2 Porter's Five Forces adapted for SMARTE (modified from original framework, Porter 1979)

### 3.3 SYNTHESIS ROUND

For the final round, participants were sent a synthesised summary of the PESTLE analysis and the Porter's Five Forces exercise, with a set of scale questions to indicate the strength of their agreement with the statements. They were then asked to rank their top five recommended focus actions for the rail industry to improve the rail passenger experience. The materials are in Appendix 3.

## 4. THE DELPHI SURVEY RESULTS

The results based on the synthesis round are reported first. For each driving force in the PESTLE analysis asked a set of questions. The synthesis round summarised the answers to each question for each driving force and asked participants to indicate how much they agreed with the identified driving forces using a scale. The same process was followed for the Porter's Five Forces exercise. Participants were given the option not to answer a question and provided space for their own comments. Finally, a list of fifteen potential recommended actions for improving the customer experience was presented, based on the task team interpretation of the first round of the Delphi exercise, and the findings from the Tasks 3.1-3.3 of Work Package 3. The results of each exercise are presented in turn. Section 5 (Discussion) describes how plausible future

scenarios are built from the PESTLE analysis and highlight how each of the prioritised actions would fit with each scenario.

## 4.1 AGREEMENT WITH PESTLE ANALYSIS

For each driving force in the PESTLE analysis participants were asked a set of questions as described above. For the next round of the Delphi Survey, participants were presented with a set of statements expressing the strongest driving forces that emerged from Round One (drawn from the summarised answers to each question for each driving force). Participants were asked to indicate how much they agreed with these driving forces using a scale ranging from Strongly Disagree to Strongly agree. Participants had the option not to answer a question and were provided with space for their own comments.

### 4.1.1 POLITICAL DRIVING FORCES

*Table 4 Participant agreement regarding political driving forces affecting the development of passenger rail in Europe over the next 20 years*

Political driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<u>Environmental concerns</u> : high environmental cost of road traffic raises political profile of rail.	-	-	3	6	-
<u>Immigration</u> : increasing political concerns may create less seamless/more surveilled travel.	1	-	2	5	1
<u>Nationalisation</u> : political calls for nationalisation in some countries may increase the emphasis on political control, swallow up funding and move the focus away from service improvement	1	5	2	1	
<u>Privatisation</u> : continued impetus to privatise rail in some countries might increase investment and put more focus on customer experience	1	-	7	1	
<u>Public policy</u> : level of rail usage is highly dependent on government investment and high employment			7	2	
<u>Devolution</u> : devolving powers over transport including rail to regional/sub-national level brings decision-making to people affected, which is a positive effect		2	3	4	
<u>Devolution</u> : devolving of powers over transport could lead to disruption or significant differences between areas, suggesting that strong national frameworks are needed	1	3	3	2	-

It can be seen from Table 4 that all participants either strongly or somewhat agreed that environmental concerns will raise the political profile of rail (mostly strongly agreeing), and almost

all strongly agreed that future political sensitivities concerning migration would lead to a reduction in seamlessness or great surveillance of rail travel (one strongly disagreed and another chose not to express a view).

Two thirds disagreed that funding would be diverted in ways that would reduce focus on service improvements where there was a political drive to nationalise rail services. Conversely most participants agreed that a continued political drive to privatise rail would tend to increase investment and put more focus on the customer experience.

All participants agreed that the level of rail usage is strongly dependent on government investment in rail services and high employment. These two factors would therefore be important differentiators between different future scenarios (see Section 6 below).

In relation to the governance level at which powers over rail are settled, two thirds of participants agreed that bringing decision-making closer to the people affected by locating powers over rail at sub-national levels has a positive benefit, whereas fewer (slightly more than half of participants) agreed that this could lead to disruption or significant differences between areas that would require strong national frameworks to be in place. One participant strongly disagreed with this notion.

Two substantive comments were made relating to the participants' interpretation of the summarise driving forces.

- 1) *"Framing the questions as 'in Europe' involves some educated guessing, as most people will only have knowledge in depth about transport in one country."*
- 2) *"On public policy I agree that government investment is important for rail usage. Does it though refer to a) investment in the rail investment or b) global government investment?"*

3)

## 4.1.2 ECONOMIC DRIVING FORCES

Table 5 Participant agreement with economic driving forces impacting on passenger railways in Europe in the near or medium future

Economic driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<u>Energy</u> : drive to diversity rail's energy mix will be costly, and create difficulties in upgrading services, suppressing customer service improvements.	-	4	4	-	1
<u>Growth</u> : A sluggish European economy and Brexit will depress rail travel demand as employment and household income are affected.	-	3	5	1	-
<u>Economic policies</u> : to revive the high street/counter out of town sprawl/internet shopping strengthen city centres as destinations accessible by rail.	-	2	5	2	-
<u>Environmental constraints</u> on economic growth affect the business case for rail improvements	-	4	3	-	2
<u>Maintenance and infrastructure investment</u> increasing impact on government budget	-	2	6	-	1

It can be seen from Table 5 that the participants were split about whether or not the necessary investment in energy diversity would suppress customer service improvements. There was slightly less of a split regarding growth prospects, but slightly more than half felt that sluggish economic conditions would constrain individual budgets and hence affect rail passenger demand.

More than two-thirds of participants agreed that there would be a policy emphasis on reviving city centres and reversing out of town sprawl and to counter a further uncontrolled rise in internet shopping. They agreed that this would favour rail.

It was agreed by about half of the participants that environmental constraints on economic growth would be likely to strengthen the case for investing in rail rather than road.

About two-thirds of participants agreed that maintaining existing infrastructure and investing in new projects would have an increasing impact on government budgets.

Two detailed comments were made relating to the participants' interpretation of the driving forces.

- 1) *"Environmental constraints on economic growth are assumed but may not be the case. Environmental issues might stimulate economic growth in some ways, and are also likely to favour rail over road."*

- 2) *“Energy/Environment-related investments need not detract from, and in fact can demonstrably contribute to, rail and customer experience improvements: not a zero-sum game. Environmental constraints on economic growth may 'affect' rail improvements, but environmental policies need not constrain economic growth: they can in fact spur growth in various sectors including particularly rail mobility. Maintenance and Infrastructure need not increase impact on government budget. Research and Innovation is needed to challenge and change the underlying assumptions of the statements.”*

### 4.1.3 ECONOMIC PUSH FACTORS

Participants were also asked about economic push factors that could drive potential rail passengers to alternative modes.

*Table 6 Participant agreement with economic forces pushing potential passengers to alternatives to rail*

<b>Economic push factors</b>	<b>Strongly disagree</b>	<b>Somewhat disagree</b>	<b>Somewhat agree</b>	<b>Strongly agree</b>	<b>N/A</b>
<b>Perceived cost:</b> passengers who have cars will perceive rail costs differently to those without cars (i.e. car owners tend to discount the costs of vehicle ownership).	-	1	3	3	2
<b>Value of time:</b> if worthwhileness of time, especially for business travellers, is not enhanced on rail, passengers will use other modes.	-	1	8	-	-

It can be seen in Table 6 that about two-thirds of participants agreed that car owners tend to underestimate the cost of car ownership and thus have negative perceptions of the cost of individual and season tickets compared to the cost of vehicle fuel for a journey of equivalent distance.

Most participants agreed that failing to enhance the worthwhileness of time on train journeys would push passengers to use other modes, particularly business travellers.

There were some comments relating to the perception of the cost of travelling by rail and whether car owners versus non car owners perceive this in a different way.

There were two comments about the value of time. One comment suggests that it is now expected that in addition to a seat, a table and WiFi are expected, presumably by business travellers. This participant therefore was considering that the worthwhileness of time for prospective rail passengers now needs to go beyond these factors (*“I assume the question refers to services beyond these”*). The other comment related to the contrasts between modes as to what is possible during the journey, i.e. the obvious inference that cycling, driving or travelling by bus are less conducive to being able to work.

## 4.1.4 SOCIETAL DRIVING FORCES

Table 7 Participant agreement with societal driving forces influencing rail and the market that it targets

Societal driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Ageing population:</b> Where service providers face economic constraints, it will be difficult to upgrade services to better serve the needs of ageing customers.	-	2	6	-	-
<b>Ageing population:</b> old people (>65 yrs) will tend to travel less than the current equivalent cohort.	1	6	2	-	-
<b>Young people:</b> Young people will use rail more often, due to delaying/not getting a driving licence.	-	1	5	3	-
<b>Technology:</b> working from home becomes easier and more common, reducing rail commuting.	-	1	8	-	-
<b>Inclusion:</b> greater emphasis will be placed on addressing inclusion and rail accessibility for disabled people.	-	-	8	1	-
<b>Environmental awareness:</b> greater awareness of environmental impacts will encourage more rail travel.	-	1	6	2	-
<b>Car parking:</b> some people remain dependent on using cars to access rail (e.g. rural residents). Constraints on car parking around rail stations will limit their mobility options.	-	-	7	1	1

About two thirds of participants agreed that cost could be an issue in upgrading provision to meet the needs of an ageing population. A similar number of participants disagreed that older people would travel less than the current equivalent cohort of older people.

There was substantial agreement that young people will use rail more often, due to a continuation of the trend of delaying driving licence acquisition, or not getting one altogether.

Most participants somewhat agreed that working from home would become easier and more common, and that this would reduce rail commuting.

Most participants somewhat agreed that there would be more emphasis on addressing inclusion and accessibility for disabled people.

About two-thirds of participants somewhat agreed that greater public awareness of environmental impacts would encourage more rail travel through modal shift.

Most participants agreed that some people (such as rural residents) would remain dependent on cars in the near future. Therefore, constricting parking availability at rail stations would limit their mobility choices and further reproduce car dependence.

Several comments were made relating to the participants' interpretation of the summarised driving forces or reflecting on different possible paths arising from the same driving forces:

- 1) *"Most of these questions assume rail is an option. In more geographically challenging areas ... or where settlements are relatively small and scattered ... rail may not be an option."*
- 2) *Ageing: "It depends on what the upgrades are. With 45% of those aged 65 or over having a disability or health condition, and the population ageing, one could argue that better serving the needs of older people could bring more rail patronage; Workforce is [also] likely to age I suspect. ..."*
- 3) *Inclusion: "especially going beyond providing for people with physical and sensory difficulties, with greater emphasis on reducing anxiety/increasing travel confidence (I like to think...)."*
- 4) *Constrained rail parking: one participant suggested that restricted parking around stations does not 'limit mobility' but discourages multimodality (i.e. pushes people to use their car for the whole journey. A second participant implied that constraints on rail parking would only be an issue in the medium term, being amenable to resolution through the use of shared autonomous shuttles.*

#### 4.1.5 TECHNOLOGICAL DRIVING FORCES

*Table 8 Participant agreement with technological driving forces that are going to be applied to passenger rail networks and that will directly impact on rail passenger experience*

Technological driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Automation:</b> digital railway innovations make higher frequency services easier.	-	-	6	3	-
<b>Automation:</b> brings greater surveillance and reliance on technology accompanied by less visibility of staff.	-	1	8	-	-
<b>Automation:</b> Automation in road transport will make people shift away from rail.	-	5	4	-	-
<b>Integration:</b> continued progress with integrated ticketing and journey planning services improves passenger experience.	-	-	4	5	-
<b>Digital technology:</b> 5G reduces pressure to provide free WiFi on trains (but excludes passengers who cannot afford mobile data)	-	2	5	1	1

Most participants agreed that automation would have the effect of increasing service frequency but would also reduce visible staff presence and an increase in the use of surveillance technology.

The participants were split on whether automation in road transport would make people shift away from rail and towards the newly automated road vehicles.

Most participants agreed that continued progress with integrated ticketing and holistic journey planning services improves passenger experience.

Slightly more than half of participants agreed that 5G technology might reduce the need to have free WiFi on trains, but that this could also be exclusionary for people who cannot afford large mobile data allowances. Three comments were made relating to participants' interpretation of the summarised driving forces.

- 1) *"It is too early to judge 5G".*
- 2) *"More surveillance technology will reduce visibility of surveillance staff but will allow more visibility/access of staff dedicated to 'experience' services. True 'integrated ticketing' is no ticketing (as we know it). Passengers should not need a 'ticket' (as we know it) for seamless multimodal travel any more than they need it to make roaming phone calls. The ultimate goal of Integration is to eliminate 'ticketing' (as we know it) from the process and therefore the experience. The technology is available now."*
- 3) *"Impact of integration: Depends on what is done"*

#### 4.1.6 ENVIRONMENTAL DRIVING FORCES

Table 9 Participant agreement with environmental driving forces impacting on the rail passenger experience

Environmental driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Air quality:</b> mitigation of air pollution from rail may lead to improvement of passenger experience in and around stations.	-	-	7	1	1
<b>Pollution:</b> Pollutants damage infrastructure. Existing environmental laws and regulations are important generally to protect infrastructure from the detrimental effects of pollution, and emissions standards for diesel trains have improved air quality. Efforts need to continue.	-	-	6	2	-
<b>Natural disasters or extreme weather events:</b> cause delays and cancellations. Between now and 2040 extreme weather events will increase in severity and frequency. Infrastructure and passenger vulnerabilities will need to be reassessed.	-	-	4	5	-
<b>Energy:</b> Changes are already underway to electrify the rail network, and hydrogen is being explored as an energy source. However, by 2040 power shortages will put pressure on the rail network leading to negative customer experiences from reliability and service level impacts.	-	3	2	1	2
Future regulation will make in-vehicle passenger experience more pleasant due to the shift from diesel to electricity (or hydrogen) – quieter and cleaner.	-	1	5	2	-
If regulation were to phase out the use of diesel, there will be difficulties and significant cost for rail which could be passed on to customers.	-	2	4	1	1

Most participants agreed that mitigating air pollution around stations would improve passenger waiting experience.

Most participants agreed that environmental laws and regulations have been effective in driving down pollution from rail, and that efforts needed to continue. They also agreed that pollution is (chemically) damaging to infrastructure.

Most participants agreed that climate change was affecting the frequency and severity of storms and natural events that impact on rail reliability in ways that necessitate greater focus on understanding and addressing passenger vulnerabilities.

Participants were split on whether future energy shortages would put pressure on the rail network and negatively impact passenger experience.

Most participants agreed that a shift away from diesel would improve passenger experience during journeys as cleaner and quieter.

Slightly more than half agreed that if diesel was phased out by regulation, costs of transition would be significant for rail and this would be passed on to customers (increasing fares).

Three comments were made relating to the participants' interpretation of the summarised driving forces.

- 1) *“How energy driving force develops depends on (1) what power generation choices are made by government[s] and (2) technological improvements in power storage”*
- 2) *“It is difficult to find an economic alternative to diesel for lightly trafficked long rural routes. The emissions from such services are trivial.”*
- 3) *“Air quality in and around stations: not sure it would be noticeable in most cases; Environment DF: These questions seem a lot more specific and informed than the previous sets”.*

## 4.1.7 LEGAL/REGULATORY DRIVING FORCES

Table 10 Participant agreement with regulation/law changes to support innovation in customer services in rail passenger services

Regulatory driving force statements	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
New laws to place a duty on bodies with authority over transport to provide better mode integration would be useful.	-	-	5	4	-
Devolving franchising to appropriate regional bodies would support regional integration of transport modes which would improve the customer offer and in turn the customer experience.	-	1	4	3	1

It can be seen in Table 10 above that most participants agreed that it would be useful to place legal duties on transport authorities to provide more mode integration. Most participants also agreed that regional bodies with authority over franchising would support better integration between modes at the regional level which would improve the customer offer and experience.

A number of comments were made relating to the participants' interpretation of the summarised driving forces.

1. *"The problem is the financial interests of private operators. Franchising authorities need authority to require them [operators] to cooperate with appropriate financial arrangements"*
2. *"Regulatory/legal rights and obligations of passengers, operators and other travel service providers are different and incompatible across modes, and historically not designed for seamless multimodality. "Bodies" should concentrate on measures that provide balanced/harmonized such rules."*

## 4.2 AGREEMENT WITH PORTER'S FIVE FORCES

Following the PESTLE analysis agreement exercise, participants were presented with a set of potentially important factors for each of the five forces headings. These factors were derived from the first round of the Delphi Survey. Under each heading of the adapted Porter's five forces analysis participants were given a set of premises and asked to indicate how much they agreed or disagreed with the premises, using a scale ranging from Strongly Disagree to Strongly Agree. N/A indicates either that the participant selected that box or did not answer the question at all. Participants were also given space for their own comments.

## 4.2.1 COMPETITION WITHIN THE RAIL INDUSTRY

Table 11 Participant agreement regarding competition between different passenger rail types or between operators, and how this impacts on passenger experience

Competition among different passenger rail types or between operators, and how this impacts on passenger experience	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
On the whole, light rail services are not competing with heavy rail.	-	-	5	1	3
Where there is competition it tends to be based on price rather than passenger experience.	-	4	3	-	2

It can be seen from Table 11 that about two thirds of participants agreed that light rail services are mostly complementary to heavy rail rather than competing with it.

Participants were split as to whether competition within rail sector is based on price rather than passenger experience. One participant commented that the knowledge bases suggest that there is a mixed picture with price and quality both being used as parameters in the competition between rail operators.

## 4.2.2 KEY SUPPLIERS

Table 12 Participant agreement with identified effects of key suppliers on rail passenger experience

Effect of key suppliers on rail passenger experience	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Suppliers of physical infrastructure and facilities have less direct ability to address passenger experience factors than train operators.	-	4	4	1	-
Suppliers of customer-facing technologies can improve rail passenger experience by providing easy and fast service, especially for trip payment. For example, trusted digital identity and innovative payment services.	-	-	8	1	-

It can be seen from Table 12 above that participants were split about the direct effect on passenger experience from the actions of physical infrastructure suppliers and facilities. See comment (1) for one situation where infrastructure quality directly impacts customer experience.

All participants agreed that the suppliers of customer-facing technologies have a significant capacity to improve the rail passenger experience at key journey phases by providing fast and easy service. It was noted in comment (2) that the cost of innovative payment technologies is rather high in comparison to the impact that it might have on overall experience.

Comments include:

1. Q1: “much of the negative CX [customer experience] comes from signalling problems – hence why I disagree. I also think that stations as destinations can make a large difference (e.g. St Pancras)”
2. Q2: “payment is only a small part of the overall experience and costs are often pretty high.”

### 4.2.3 NEW SUBSTITUTE MODES

Table 13 Participant agreement regarding current threats to rail from new substitute or alternative modes

Current threat to rail from new substitute modes	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
New modes take a long time to become established before threatening rail’s role in facilitating mass-transit.	1	3	5	-	-
New modes should be viewed as a necessary complement to rail in the provision of sustainable mobility for citizens.	-	1	6	2	-
The transfer of activities to the internet as an alternative to travel is not a specific threat to rail, as will affect the whole transport system.	-	-	7	2	-
Rail will need to respond and adapt to the threat posed by autonomous road vehicles.	-	1	6	2	-

It can be seen from Table 13 above that participants were split on the speed with which new modes can become established enough to pose a threat to rail.

Nearly all participants agreed that new modes should be conceptualised as necessary and complementary to rail in the drive to provide sustainable mobility opportunities for all citizens.

All participants agreed that transfer of certain activities to the internet as an alternative to travel (e.g. streaming films, shopping, accessing government services, ordering takeaway food) would affect the whole transport system but were not a specific threat to rail.

Most participants agreed that rail needs to respond and adapt to threats arising from autonomous road vehicles.

There were no comments on this factor.

## 4.2.4 EXISTING SUBSTITUTE MODES

Table 14 Participant agreement regarding existing substitutes affecting the current provision of passenger rail

Existing Substitutes affecting the current provision of passenger rail	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Rail should be able to attract new users from a generalized cost perspective (as the main driver for substitution is cost).	-	1	8	-	-
Passenger experience factors play a critical role in switching to other modes for up to half of those who switch.	-	-	6	1	2
In many European countries, rail now faces increased competition from low-cost coach services, especially on long range trips	-	-	7	-	2

It can be seen from Table 14 above that most participants agreed that the generalised cost advantage of rail should enable it to attract new users.

Most participants agreed that passenger experience factors play an important role in driving users to other modes for about 50% of switchers.

Most participants agreed that rail is facing competition from low-cost long-distance coach services.

One participant commented about passenger experience factors in switching to other modes, questioning whether there are always viable alternatives for customers to switch to. The inference here is that if there is a captive market, a negative passenger experience is not always translated into switching to other modes, which could reduce the incentive for providers to address the issues.

## 4.2.5 PASSENGER INTEREST GROUPS AND REGULATORS

Table 15 Participant agreement regarding the degree of influence that passenger interest groups have on rail passenger experience

Influence of passenger interest groups on rail passenger experience	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Passenger interest groups are effective at using direct negotiations and expressions of their opinions on social media to put forward rail passenger concerns	2	4	1	2	-
Passenger interest groups formally participate in consultation on new regulations at national and European level	-	-	3	1	5
Individual passengers have less influence and cannot always express what is really important for them and	-	2	4	2	1

It can be seen from Table 15 above that participants were divided about the effectiveness of passenger interest groups. Participants were not very knowledgeable about the formal participation of passenger interest groups in national and European consultation.

About two-thirds of participants agreed that individually passengers lack influence, and may even find it hard to express their real priorities (but see the comment).

Comments:

1. *“I agree [passengers] may have less influence as individuals but with social media there are no individuals anymore - the collective digital voice must be having a pretty strong impact. I strongly disagree that they cannot express what is important to them (for the same reason and because it is now much easier to ping a message to a TOC than it used to be)”*.

Table 16 Participant agreement regarding the influence regulators/regulation have on current rail passenger experience

Influence of regulators/regulation on current rail passenger experience	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Regulators/regulations influence current rail passenger experience a lot by setting the service standard without being informed by what customers want.	3	5	-	1	-
Regulations are constantly “behind the curve” of technology and business model innovation which slows down the adoption of improvements.	-	3	5	1	-

It can be seen from Table 16 above that most participants disagreed that existing regulations are uninformed by customer priorities.

Slightly more than half of participants agreed that regulations tend to be behind the curve of innovation, which creates inertia.

Comments

1. *“I agree [regulators] do influence rail passenger experience. However, I'd like to see a stronger focus on this - including more of a focus on partnering with other sectors to provide seamless travel. I don't agree that they are not informed by what customers want because e.g the NRPS gives plenty of data to them.”*
2. *“The extent to which regulations are constantly ‘behind the curve’ depends critically on the general regulatory framework, whether regulations providing incentives for innovations or not and whether regulations are prescriptive or high-level.”*

#### 4.2.6 SUMMARY OF KEY FACTORS FOR EACH FORCE

Figure 3 below represents a summary of the five key forces that participants agree are impacting on rail passenger experience now and in the future. The summary is constructed from the participants' strength of agreement with the statements and the comments shown in the tables above under each factor heading and applied to the diagram in Figure 2 above.

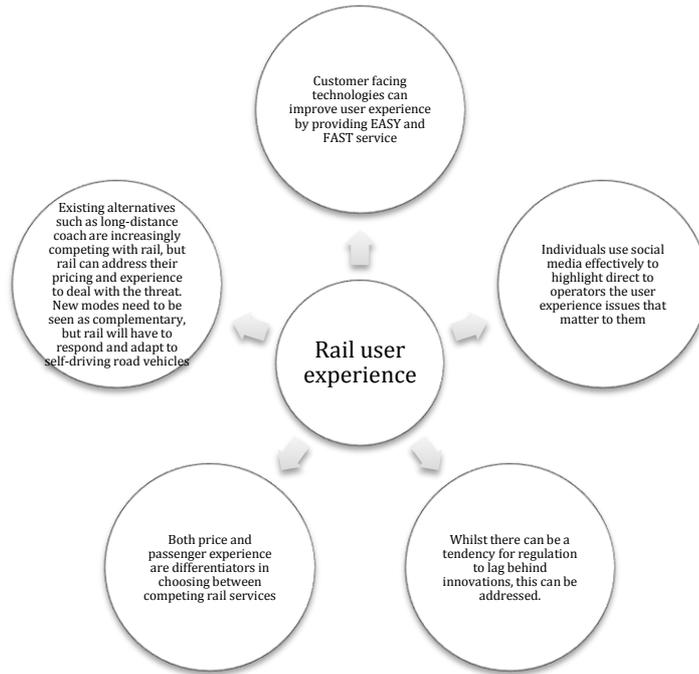


Figure 3 Summary of the identified Five Forces impacting on rail user experience



## 4.3 PRIORITISATION OF RECOMMENDED ACTIONS

Participants were asked to give their top five rankings for prioritising recommended actions which were inferred from the first round of the Delphi exercise. Table 17 shows the number of expert participants who prioritised each statement within their top five, i.e. for statement number 1, it can be seen that one participant ranked it third and three participants ranked it as fifth, whereas for statement number 2, two participants ranked it at fourth place and one ranked it in fifth place.

*Table 17 Summary of participants' top five ranked recommended actions (shaded rows received no prioritisations)*

Statement ID number	Top Five Ranking (1 is highest)	1	2	3	4	5
	Recommended action					
1	Better tools to plan trips and for accessing travel information through online systems	0	0	1	0	3
2	Simplified ticket buying processes	0	0	0	2	1
3	Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort)	0	0	1	1	0
4	Improve services provided on board trains	0	0	0	0	0
5	Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package	3	0	0	0	0
6	Develop better mechanisms for listening and responding to customer needs	0	1	0	1	1
7	Strengthening regulation to increase rail operator focus on responding to customer experience	0	1	0	1	0
8	Improve service reliability and availability (more lines, more frequency)	4	1	0	0	0
9	Ensure that the terms of market opening embed improvements to customer experience	0	0	0	1	0
10	Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience'	0	2	2	0	1
11	Improve affordability and ticket flexibility	0	1	4	1	1
12	Replace season tickets and travel cards with multi-journey carnet tickets	0	0	0	0	0
13	Designing for the needs of the elderly and disabled	1	0	1	0	0
14	Improve first and last mile travel experience around stations	1	3	0	2	0
15	More should be done to Involve passengers in designing solutions	0	0	0	0	2
	Weights	5	4	3	2	1

Across the responses received, the level of inter-rater agreement was measured using Krippendorff's alpha ( $\alpha$ ). This test returns a figure between zero (indicating complete disagreement) and one (indicating complete agreement). Amongst our participants we achieved a  $\alpha$  of 0.35, indicating that the results fall just short of a low level of "moderate agreement" as to the relative importance of different priority actions for those that were selected by at least two experts (actions receiving no priority between 1 and 5 or only one priority between 1 and 5 were eliminated from the  $\alpha$  test, i.e. action numbers 4, 9 and 12).

However, we can say that there was complete agreement regarding those suggested actions that were not selected as a top five priority by any respondent. Two of the suggested actions identified from the Delphi responses, stakeholder workshops and passenger survey were eliminated from the ranking as a result (#4 Improve services provided on board trains; and #12 Replace season tickets and travel cards with multi-journey carnet tickets). These are indicated in the table with a grey shading.

Of those that were selected by at least one respondent, we did a simple weighted ranking to order the recommended actions by overall priority (see the bottom row of Table 17 for the weights). Where the weighted ranking method scored two actions the same, we ordered them by manually checking which had the highest ranks from participants. For example, "Simplified ticket buying processes" and "Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort)" both had a weighted score of 5. However, the latter had one score of 3 and one of 4, whereas the former had two of 4 and one of 5. As one participant had essentially placed comfort at third place, we ranked this above simplified ticket buying processes, which whilst it had been ranked by three participants had no rank higher than fourth place.

*Table 18 Ranking of recommended action for improving rail passenger experience using weighted scoring system*

Rank	Weighted Score	Recommended action for improving rail passenger experience
1	24	Improve service reliability and availability (more lines, more frequency)
2	21	Improve first and last mile travel experience around stations
3	15	Improve affordability and ticket flexibility
4	15	Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (front end)
5	19	Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience' (back end)
6	7	Designing for the needs of the elderly and disabled
7	6	Develop better mechanisms for listening and responding to customer needs
8	6	Strengthening regulation to increase rail operator focus on responding to customer experience
9	5	Better tools to plan trips and for accessing travel information through online systems
10	8	Accessible and comfortable rolling stock to improve in-vehicle service quality
11	5	Simplified ticket buying processes
12	2	Ensure that the terms of market opening embed improvements to customer experience
13	2	More should be done to involve passengers in designing solutions

Two statements are excluded from this table, as they received a weighting of zero: ID#4 Improve services provided on board trains and ID#12 Replace season tickets and travel cards with multi-journey carnet tickets.

From this point forward statements are referred to using their rank number rather than their ID number.

## 4.4 LIMITATIONS

A Delphi Survey is a qualitative method of building a consensus opinion about future prospects where there are widely divergent opinions, or many experts coming from different perspectives on an issue, in this case driving forces that will influence how passenger rail develops, and how this will impact on the rail passenger experience. In order to develop the Smart Journey Vision, these insights are combined with findings from Deliverable 3.1 as well as the stakeholder workshops (reported in Deliverable 3.2) and the passenger survey (reported in Deliverable 3.3) to develop a list of recommended actions for improving the rail passenger experience that guides the vision. The expert participants were asked to rank their top five of these potential actions. However, the overall number of experts who agreed to participate in the Delphi survey did not reach the expected target, despite considerable efforts to encourage greater engagement. Confidence in the findings is mediated by this. Nevertheless, it should be noted that the number of participating experts is equivalent to a typical stakeholder workshop, and therefore has sufficient validity, when taken with the findings of the other tasks in the Work Package. In order to triangulate the Delphi Survey results and prioritisation, the final analysis draws on the findings from the other tasks, along with the results of the Delphi survey in the Discussion section below.

## 5. MAPPING RECOMMENDATIONS TO JOURNEY PHASE AND PASSENGER TYPE

The academic literature survey reviewed the underlying factors in the use of rail. In focusing on how to improve the rail journey for passengers there are a number of clear findings:

- There should be a focus on the full journey not just the rail aspect;
- The convenience of the rail journey should aim to match that of a car journey;
- Whilst improvements in hard factors such as journey time and frequency changes would help, in terms of cost effectiveness, addressing informational and accessibility improvements may be more achievable;
- There is an ongoing need to try and address reliance on and attitudes towards cars;
- Certain groups are not being fully catered for in terms of accessibility and information provision such as the elderly and people with disabilities;
- One size does not fit all - different traveller groups have different requirements reflected the aspects of the journey they deem important and are satisfied with.

We consider that these insights represent a preferable future state for the rail passenger sector. This preferable future state therefore guides the development of the Smart Journey Vision, through the lenses of journey phases, passenger groups, illustrative persona and finally four

scenarios representing different levels of public investment and individual prosperity. The four scenarios represent different challenges for achieving the desirable future state.

This section synthesises and discusses the findings from the Delphi Survey in relation to the findings of the other work packages, guided by the key clear findings from the academic literature survey as summarised above (but see also D3.1). More specifically the section sets out the steps towards the “Smart Journey Vision” surveyed on two different, but interrelated, levels, with the recommendations identified and prioritised during T3.4 activities:

- The journey phases level (see section 5.1).
- The rail passenger groups level (see section 5.2).

These recommendations, linked to each of the main phases of the journey and to the different passenger group profiles, will guide the identification of concrete actions to be taken to improve traveller experience by setting out how the strategic significance of the recommendations will vary according to the prevailing economic conditions, in four scenarios extrapolated from the PESTLE and Porter’s Five Forces exercises, when pursuing the desirable future state for a positive rail passenger experience described above.

## 5.1 JOURNEY PHASES

These phases were identified through literature review and stakeholders’ workshop outcomes (see D3.2). Each phase identifies a precise moment of the journey that, depending on the type of passenger, can be experienced in a different way. In order to facilitate the interpretation of the following outcomes, a description of each phase is provided below.

### 5.1.1 PLANNING

In relation to the **literature review** insights, planning can be regarded as the process by which a potential rail passenger concludes whether or not the choice of rail as the main mode for their journey will satisfy the required convenience within a whole trip, that it will meet the demands of their schedule and cost constraints, that the necessary elements of the trip (access to station, waiting at the station, boarding and travelling on the train, the destination station and onward journey) are accessible to them individually and that they have sufficient information about all necessary aspects of the journey in a form that they can understand. Recent developments in integrated booking/payment, e-ticketing and journey planning information via the internet have the potential to greatly improve the passenger experience. Co-ordination of fragmented data sources from different operators particularly in de-regulated environments remain problematic for this.

“Planning the journey” step was described to participants as the phase when people plan and choose how to go from A to B, what means of transport they have to take, how much time the journey will take and how much it will cost. The planning element of a journey that will include rail involves some implicit or explicit consideration of rail against other modes, principally car. These comparisons would likely to be more explicit and important for non-frequent journeys. For example, a survey of over 2,000 recent rail passengers carried out for ORR (2014) finds that whilst a minority of leisure/business rail passengers compare rail with other modes, the proportion is lower for commuters and comparisons usually involve car rather than any other mode.

The **Stakeholder Workshops** were reported in D3.2 and fed into the **Experience Map**, but the elements most strongly aligned with the Delphi Survey outcomes are reiterated here. There are three main points to note under planning:

1. stakeholders noted that apps have to provide specific information and that sometimes they might objectively or subjectively be perceived as not focused on the user interest but on the interests of a particular provider.
2. Rail has an implicit informational advantage for journey planning in that journey times are perceived as more reliable and consistent than estimates for other modes of transport.
3. Rail has a disadvantage for potential users planning weekend and night time journeys due to the typically lower service levels.

The **Experience Map** presents planning as an unambiguously separate element to other journey phases (see D3.2), as this aids the analysis. However, in reality this step is very often unconscious or blended with booking/paying, particularly now that this is possible online.

From the **passenger survey** the ability to use one or more tools to plan the journey was found to be important, i.e. in the Top Ten considerations necessary for undertaking a rail journey. Other factors associated with this journey phase (eg accessibility information) were not seen as important. In terms of necessary improvements to encourage non users to switch to rail no particular planning factor emerged.

## RECOMMENDATIONS

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In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), the recommended actions prioritised in the Delphi Survey that would contribute to this journey phase are (the ranking numbers refer to Table 18):

- Improve service reliability and availability (more lines, more frequency) - Rank #1
- Make more use of digitalization to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package – Rank #4
- Improve affordability and ticket flexibility - Rank #3
- Better tools to plan trips and for accessing travel information through online systems - Rank #9
- Designing for the needs of the elderly and disabled - Rank #6

Indirectly, it is suggested that More should be done to involve passengers in designing solutions (Rank #13)

Furthermore, according to D3.2, it is possible to identify that within making more use of digitalization and providing better tools for planning and information, there are specific opportunities for rail sector to improve traveller experience at this stage to support people in creating personalized travel solution that are customized on their individual needs and preferences that are not only based on time and cost.

## 5.1.2 BOOKING AND PAYING

From the **literature review** it was found that rail may actually be cheaper than car but understanding is lost in complex fare structures and also the hidden costs of car travel. Cost is a key factor, particularly for leisure/business travellers. It was also established that the internet is key for ticket purchasing amongst these groups, many of whom buy before travel. There were higher levels of satisfaction for ease of ticket purchase for frequent users.

“Booking/Purchasing the ticket” step was described to participants as the phase when people book or purchase the ticket/s for one or more means of transport they will need for the journey. It is important to remember that in reality, this step can merge with planning.

From the **Stakeholder Workshops** there were three main points to reiterate:

- Frequent travelers may be disadvantaged by current fare structures, and there is a perceived or actual lack of flexibility in ticketing solutions and offers for non-frequent travelers.
- User experience is a central element of mobile payment/ticketing. The core element is ease of use, but there are still some back-end barriers, for example whilst it is generally possible to use a credit card, there are still some barriers to using debit cards, put up either by the payment service or by the cardholder or ticket merchant’s bank. However, there are also some rail users in the retired group who like to go to buy tickets in person some days ahead of travel.
- There is a perception that some apps are non-neutral by favouring particular services or operators. This may not be transparent to the end user.

From the **passenger survey** cost was found to be the key element to any journey. Additionally, ability to book in advance was also in the Top Ten considerations necessary for undertaking a rail journey, and a particular consideration for longer rail journeys. Other factors associated with this journey phase (e.g. integrated ticketing) were not seen as important, though we did find cost to be a factor with the highest level of dissatisfaction. Cost was also the only particular factor that emerged as necessary to encourage non-rail users to switch to rail.

## RECOMMENDATIONS

In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), the recommended actions that would contribute to this journey phase, according to Delphi Survey participants’ prioritisation exercise, are (referring to the ranking numbers in Table 18):

- Simplified ticket buying processes (Ranked #11)
- Making more use of digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Utilise digital tools to improve coordination between operators and across modes to create a ‘whole mobility experience’ (back end) (ranked #5)

- Improve affordability and ticket flexibility (ranked #3)
- More should be done to involve passengers in designing solutions (ranked #13)

Furthermore, according to D3.2, it is possible to identify specific opportunities within this priority actions for rail sector to intervene to improve traveller experience at this stage:

- Design usable online and offline planning and purchasing paths, reducing the gap (of accessibility to information and services) between the different segments of the population (this suggests that Designing for the needs of the elderly and disabled (ranked #10) is indirectly relevant here);
- Provide people with more reliable and update information about the different travel solutions and conditions, making them available in a simple, accessible and aggregated way, suggesting that Better tools for planning and accessing travel information (ranked #9) are also indirectly relevant.

### 5.1.3 ARRIVING AT A DEPARTURE STATION

The **literature review** emphasised the lack of competitiveness with car here. This is a very important aspect, with almost half of UK rail journeys (for example) using auxiliary modes for station access, requiring good integration between modes (in terms of ticketing, co-ordinated connections between public transport and rail, information, car parking and cycle provision) to imitate the more seamless experience of car travel. Improved interchange is a relatively cost-effective measure to address compared to improving rail speeds and frequencies for example. These issues are particularly acute for infrequent travellers.

From the **Stakeholder workshops** two key points should be highlighted:

1. Rail has an advantage over car where it delivers users direct to urban centres, but this can be undermined if the origin station is poorly connected to other modes, or not accessible to disabled users. It also loses its advantage if information about service punctuality or disruptions is inaccurate.
2. There needs to be a stronger commitment from operators and infrastructure managers to go beyond just providing passenger transport to more holistic perspective, such as providing good information and communication, as well as to providing what customers want, eg charging stations for e-mobility, or bike parking/bike sharing facilities.

In the **passenger survey**, “Arrive at the departure station” step was described to participants as the phase when people leave their houses and take one or more means of transport to reach the departure station. This is sometimes referred to as the ‘first mile’. In relation to the journey to the station only access journey time was in the Top Ten considerations necessary for undertaking a short rail journey. However, car parking cost and availability were found to be key factors which passengers expressed dissatisfaction with (both in the top three). All three aforementioned factors were considered as in the Top Ten necessary improvements required to consider use of train in future.

## RECOMMENDATIONS

In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), and referring to the rankings in Table 18 the recommended actions that would contribute to this journey phase, according to Delphi Survey participants' prioritisation exercise, are (again, rankings come from Table 18:

- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience' (ranked #5)
- Designing for the needs of the elderly and disabled (ranked #6)
- Improve first and last mile travel experience around stations (ranked #2)
- More should be done to involve passengers in designing solutions (ranked #13).

Furthermore, according to D3.2, it is possible to identify also more specific opportunities for rail sector under these actions to intervene to improve traveller experience at this stage:

- Provide users with infrastructures, utilities and services so that people can continue their lives and activities in stations and during the journey, rather than interrupting them because of the journey; This item was included in the Delphi exercise, but not ranked by the participants.
- Improve the integration between first/last mile services and the longer distance ones, by developing better connections between access modes and rail stations, and between rail stations and airports; This item is aligned with Improve first and last mile travel experience around stations, ranked #2 by participants.

### 5.1.4 WAITING AT STATION

From the **literature review** it was found that the quality of the waiting environment, informational and safety aspects were also highlighted as important, reflected in higher values of time for waiting time. As with arriving at departure station, improved waiting experience could be implemented through more cost-effective measures. There were risks of exclusion for older and mobility impaired travellers through the reduction in staff at stations, particularly with changing demographics meaning that there is likely to be more travellers with these characteristics.

"Waiting at the departure station" step was described to participants as the phase when people wait at the station for the arrival of the rail vehicle to travel in.

From the **Stakeholder Workshops** the main points related to accessibility to and within the station, trained staff to help people board and exit trains, and aspects of security. For example, there is still a perception amongst some stakeholders that a human presence in a ticket office

provides security, especially at less busy stations or after dark. At present these are contexts in which a ticket office is more likely to be closed for economic reasons. There was a clear finding that there should be more investment in accessibility and security.

From the **passenger survey**, in terms of waiting at the station only security and safety were found to be in the Top Ten considerations necessary for undertaking a rail journey. Provision of waiting facilities, cleanliness and maintenance of stations, wi-fi and power connectivity all to be in the Top Ten key factors with which passengers expressed dissatisfaction. For non-rail users security and safety were in the Top Ten necessary improvements required for them to consider use of train in future.

## RECOMMENDATIONS

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In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), the recommended actions that would contribute to this journey phase, according to Delphi Survey participants' prioritisation exercise, are:

- Designing for the needs of the elderly and disabled (ranked #6)
- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- More should be done to involve passengers in designing solutions (ranked #13)

Indirectly:

- Develop better mechanisms for listening and responding to customer needs (ranked #7)
- Ensure that the terms of market opening embed improvements to customer experience (ranked #12)
- Strengthening regulation to increase rail operator focus on responding to customer experience (ranked #8)

Furthermore, according to D3.2, it is possible to identify specific activities within the above recommended actions for rail sector to intervene to improve traveller experience at this stage:

- Undertake public service campaigns to improve social norms of respecting common spaces to prevent damage and keep them clean (e.g. toilets, waiting areas, platforms) in order to preserve them and improve the ambience;
- Provide users with secure and safe infrastructures, utilities and services so that people can continue their lives and activities in stations and during the journey, rather than interrupting them because of the journey;

### 5.1.5 DURING THE JOURNEY

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The **literature review** highlighted longer journey times for rail than car as representing a particular barrier for mode shift and more difficult to address through implement cost-effective solutions. Whilst innovations on disruption are being developed, the literature review found poor satisfaction with information on delays during the journey currently in the UK. From importance

analysis, travel comfort emerged as a key dimension to the rail journey. Interchanges during the journey are particularly inconvenient due to additional travel time, stress and inconvenience, reflected in high interchange penalties in demand models.

“Rail journey” step was described to participants as the phase when people are physically on the vehicle.

From the **Stakeholder Workshops** the main elements of the on-board experience that were perceived as significant were punctuality; ride comfort; cleanliness and security.

From the **passenger survey**, in terms of the on-board experience we found security and safety, ability to find a seat, rail journey time and cleanliness and maintenance of the vehicles all to be in the Top Ten considerations necessary for undertaking a rail journey. We found connectivity in the vehicles and cleanliness and maintenance to be Top Ten key factors with which passengers expressed dissatisfaction with. For non-rail users, the ability to find a seat and on-board security and safety were in the Top Ten necessary improvements required to consider use of train in future.

## RECOMMENDATIONS

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In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), the recommended actions that would contribute to this journey phase, according to Delphi Survey participants’ prioritisation exercise, are:

- Designing for the needs of the elderly and disabled (ranked #10)
- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort) (ranked #10)
- Improve service reliability and availability (more lines, more frequency) (ranked #1)

Indirectly, there are four other recommended actions that would indirectly contribute to this journey phase:

- Strengthening regulation to increase rail operator focus on responding to customer needs (ranked #8)
- Ensure that the terms of market opening embed improvements to customer experience (ranked #12)
- More should be done to involve passengers in designing solutions (ranked #13)

In accordance with D3.2 and D3.3, actions should be taken to improve on-board cleanliness and security.

Furthermore, according to D3.2, it is possible to identify also other opportunities for rail sector to intervene to improve traveller experience at this stage:

- The quality of the journey with high-speed trains generally considered higher than that with ordinary trains. Therefore, it could be useful to explore whether suburban and regional trains could take design cues from the strengths of high-speed trains in order to improve their desirability compared to other modes of transport. This proposition aligns with several recommended actions above (particularly those ranked #10 and #13)
- Addressing overcrowding in particular on peak hours, by intervening on multiple factors:
  - Motivate non-captive travellers and those with more flexibility to travel outside the peak hours (e.g. with offers, lower fares on services with fewer users). This could be achieved through design aspects of items #4 and #5;
  - increase of the number of rides available and their frequency (which was ranked #1);
  - provision of reliable and up-to-date information (e.g. about level of people concentrations on next trains, alternative mobility solutions to reach a certain destination), which links to most journey phases, from planning onwards, and is strongly related to recommended actions relating to the use of digitalisation that are ranked #5 (front end) and #4 (back end), as well as to #9.

### 5.1.6 ARRIVING AT DESTINATION

The **literature review** established the role of this stage as important in the perception of Seamless journeys which could also be promoted through integration of station egress modes.

“Arrive at the destination” step was described to participants as the phase when people get off the vehicle to reach their final destination (through one or more means of transport, where needed). This is sometimes referred to as the ‘last mile’.

In the **Stakeholder Workshops** there was no strong evidence that stakeholders considered the remaining onward journey as a significant element in the attractiveness of rail.

From the **passenger survey**, in terms of the onward journey, we found no aspects to be in the Top Ten considerations necessary for undertaking a rail journey. Similarly, we found no aspects to be key factors with which passengers expressed dissatisfaction. For non-rail users, the journey time from arrival station was in the Top Ten necessary improvements required to consider use of train in future.

## RECOMMENDATIONS

In conformity with what emerged from previous research activities (i.e. T3.1, T3.2, T3.3), the recommended actions that would contribute to this journey phase, according to Delphi Survey participants’ prioritisation exercise, are:

- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Making use of more digitalization, to enable end users to view rails as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Utilise digital tools to improve coordination between operators and across modes to create a ‘whole mobility experience’ (ranked #5)

- Designing for the needs of the elderly and disabled (ranked #6)
- Improve the first and last mile travel experience around stations (ranked #2)

Indirectly, more should be done to involve passengers in designing solutions (ranked #13)

### 5.1.7 CROSS-CUTTING FACTORS

The objective and subjective quality of rail services is a factor that cuts across the consideration of the phases of journeys, therefore we summarise some important insights here. In the **literature review** it was established that reliability is key for commuters, although this is difficult to compare between the modes.

Furthermore, accessibility and information aspects were shown to be cost effective to improve in the short term and are relevant across all journey phases. Longer term investments in increasing frequency and speed need a broader justification but would undoubtedly have ancillary benefits for improving the rail passenger experience.

In the **passenger survey**, rail reliability and directness of service were factors in the Top Ten considerations necessary for undertaking a rail journey. There was also dissatisfaction with availability and frequency of night time services. Reliability was in the Top Ten necessary improvements required to consider use of train in future.

In the **Delphi Survey** participants' prioritisation exercise, the recommended action that was highest ranked was perceived as directly contributing to improving the quality of rail services is primarily ("Improve service reliability and availability (more lines, more frequency)"); Four other actions were perceived as being indirectly relevant to rail service quality (i.e. #5, #6, #9 and #10, shown in Table 19 below).

## 5.2 SUMMARY OF PRIORITY ACTIONS BY JOURNEY PHASE

Table 19 below lists the recommended actions, in priority order from top to bottom, and maps them to the journey phases. Two ticks represents a direct association, and one tick represents an indirect association.

*Table 19 Summary table of recommended actions (in priority order from Delphi, top to bottom), mapped to journey phases*

Action (in prioritised order)	Planning	Booking/ Paying	Arriving at station	Waiting	During journey	Arriving at destination	Cross- cutting
Improve service reliability and availability (more lines, more frequency) (#1)	✓✓				✓✓		✓✓
Improve first and last mile travel experience around stations (#2)			✓✓			✓✓	
Improve affordability and ticket flexibility (#3)	✓✓	✓✓					
Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (#4)	✓✓	✓✓	✓✓		✓	✓✓	
Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience' (#5)		✓✓	✓✓		✓	✓✓	✓
Designing for the needs of the elderly and disabled (#6)	✓✓	✓	✓✓	✓✓	✓✓	✓✓	✓
Develop better mechanisms for listening and responding to customer needs (#7)				✓			
Strengthening regulation to increase rail operator focus on responding to customer experience (#8)				✓	✓		
Better tools to plan trips and for accessing travel information through online systems (#9)	✓✓	✓	✓✓	✓✓	✓✓	✓✓	✓
Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort) (#10)					✓✓		✓
Simplified ticket buying processes (#11)		✓✓					
Ensure that the terms of market opening embed improvements to customer experience (#12)				✓	✓		
More should be done to involve passengers in designing solutions (#13)	✓	✓✓	✓✓	✓✓	✓	✓	

It is worth noting that the **literature review** suggested actions will have more success if forming part of a package of measures, possibly targeted at particular groups with potential for mode shift. Therefore the final sections indicate packages of measures that might be prioritised under each plausible future scenario, with information about the passenger types that would be advantaged or disadvantaged in each case.

## **5.3 PRIORITISATIONS BY PASSENGER TYPES**

This section links the priority recommendations back to the passenger group profiles that were developed for the Experience Map. For the passenger survey analysis four main rail passenger group profiles were identified:

- Commuter traveler non frequent rail user
- Commuter traveler, frequent rail user
- Non-commuter traveler, frequent rail user
- Non-commuter traveler, non frequent user

In defining these discrete user categories the following factors were considered:

- individual (habits, expectations and perceptions related to the rail journey);
- demographic (age, gender, occupation).

More emphasis was placed on the individual factors rather than demographic because they allowed to better understand the differences between needs, frequency and modes of use of different typologies of real users.

These profiles were then symbolised in the Experience Map (D3.2) by five personas:

1. The Optimist (Figure 4)
2. The Adventurer (Figure 5)
3. The Growler (Figure 6)
4. The Explorer (Figure 7)
5. The Creature of Habit (Figure 8)

Below a description of the personas (and of the group profile they are related to) and of the scenario they are moving in, is presented. For each persona is also defined a set of needs and recommendations to be implemented to improve their experience while travelling. In the next few pages we explore the smart journey vision for each persona by expanding their touchpoints as described in D3.2 Experience Map, and then map these to the prioritisation of actions to improve the journey experience from the Delphi Survey.

It is important to remember that our personas are not meant to cover every possible type of passenger, and our choice of gender for the persona is not meant to indicate that the gender is relevant to the other attributes. For example, there are many regular commuters (creatures of habit) who are quite happy to use travel apps to plan, book and pay for their travel. Our purpose is not to focus on the ‘early adopters’ but to identify what needs to be improved so that more groups of passengers will feel confident to adopt the new technologies that can improve the overall experience of rail travel.

### **5.3.1 THE OPTIMIST**

The “optimist” belongs to a group of people who travel the most for study and/or leisure during their free time (e.g. sightseeing, visit museums and exhibitions, visit the family) and use the train as their

main mean of transport. They share with the “Commuter traveller frequent rail user” disappointment when the rail services offered don’t meet their expectations/needs, especially because they want to have a good rail journey experience during their free time.

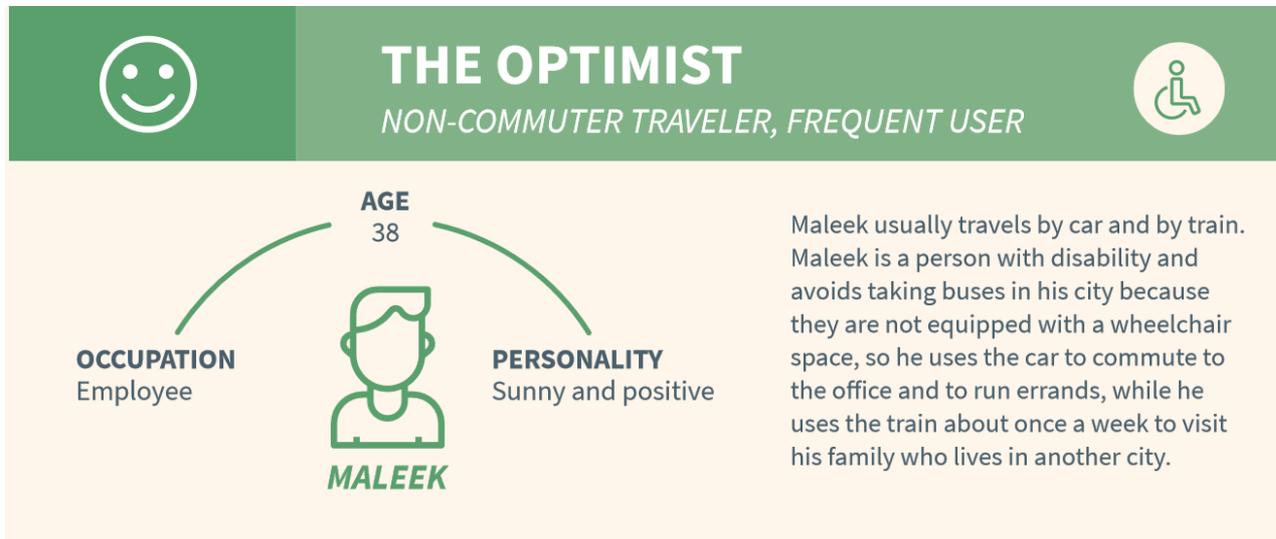


Figure 4 The Optimist Rail Traveller Persona (Source: D3.2 Experience Map)

## SCENARIO

In the Experience Map, Maleek represents a neglected group of rail passengers/potential rail passengers. He has a cheerful optimistic outlook on life, but he is not young any more and has a busy life. As a wheelchair user, he gets around his home city mainly by car, as the local bus service is not accessible. He uses the train regularly for an inter-city journey to visit his family. When he is **planning his rail journey**, he prefers to use the website rather than an app, as he finds it easier for ensuring that he has the accessibility/assistance that he needs to make his journey. He plans and **books/pays** at the same time, so uses the website for this journey stage for the same reason. These phases work quite well and he has no real issues. He is a bit more stressed when he **arrives at the departure station** because he can’t always book a wheelchair space in advance. This is one reason why he might use his car instead, though he would prefer not to. However, he also needs to be sure that he can park his car at the station, and there are not enough disabled access spaces. He’d like to be able to book those too. Having an accessible, bookable parking space would make him really happy. When **waiting at the station** he prefers the stations with the large lifts that are well-maintained. However, it is really frustrating when the accessible waiting areas are closed, and when the staff haven’t been properly trained to assist disabled passengers. During his **rail journey** he can feel very isolated when the wheelchair space is set apart from or facing away from other passengers. He really likes being able to look out of the windows. When he **arrives at the destination** the experience is better at the larger stations, the small stations often have poor accessibility features, and are not reassuring places.

## NEEDS TO BE MET

As a frequent, non-commuter traveller Maleek would need:

- more and better connections to stations, between stations and between stations and airports
- more (reliable) information provided by railway companies (especially in case of delays/breakdowns/disruptions)
- rail and non rail services to be accessible and better integrated
- better signaling and connectivity

## **RECOMMENDATIONS/ACTIONS TO IMPLEMENT**

In conformity with what has emerged cross the research activities (i.e. T3.1, T3.2, T3.3 and the Delphi Survey), the recommended actions that would contribute to meeting the needs of this passenger type are:

- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Simplified ticket buying processes (ranked #11)
- Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort) (ranked #10)
- Making use of more digitalization to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Designing for the needs of the elderly and disabled (ranked #6)

Indirectly,

- Strengthening regulation to increase rail operator to focus on responding to customer experience (ranked #8)
- Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience' (ranked #5)
- Improve affordability and ticket flexibility (ranked #3)

### **5.3.2 THE ADVENTURER**

The “adventurer”, just like the “optimist”, belongs to a group of people who travel the most for study and/or leisure during their free time (e.g. sightseeing, visit museums and exhibitions, visit the family) and use the train as their main mean of transport. They share with “Commuter traveller frequent rail user” people the disappointment when the rail services offered don't meet their expectations/needs, especially because they want to have a good rail journey experience during their free time.



Figure 5 The Adventurer Rail Passenger Persona (Source: D3.2 Experience Map)

## SCENARIO

Sabrina is a post-graduate student. She frequently uses the train, but she is a typical of a growing segment of younger urban people today in that she chose where she lives so that she could walk to her office rather than use transport services. Although she frequently uses different types of rail service, she is using it to visit friends and family and for impulse-driven weekend city breaks. Sabrina would really like personalised special weekend offers from rail companies, just in time for her last-minute **planning for her journey** but she has noticed that the website offers are different from the app offers. She switches a lot between the two and is dissatisfied with this. **Getting to the station** or making interchanges is Sabrina's least favourite part of her weekend travelling. She finds the information confusing, especially as she makes lots of new journeys and isn't familiar with the stations. She doesn't choose some possible destinations because she is uncertain about getting to the departure station or making interchanges due to poor information. Even adventurers prefer things to be easy. **Waiting at the station** is a bit stressful too, for three reasons. Firstly, Sabrina has noticed that the information online isn't always the same as that on her app or at the station. Secondly, Sabrina often decides right at the station where she is going to go, so uses ticket machines rather than buying online. She isn't very happy when the machines can only take cash. Finally, she would find waiting at the station much better if it was less noisy. Some announcements are necessary but adding video advertising spoils the anticipation of her trip because it is intrusive. **During the journey** Sabrina is usually quite happy unless it is too hot or too cold. **Arriving at her destination** Sabrina really likes the app she uses because she can book her hotel and onward travel away from the station with ease.

## NEEDS TO BE MET

Non-commuter traveller, frequent user (of rail services) would need:

- more and better connections to stations, between stations and between stations and airports
- more (reliable) information provided by railway companies (especially in case of delays/breakdowns/disruptions)
- rail and non rail services to be better integrated

- better signaling and connectivity

## RECOMMENDATIONS/ACTIONS TO IMPLEMENT

In conformity with what has emerged cross the research activities (i.e. T3.1, T3.2, T3.3 and the Delphi Survey), the recommended actions that would contribute to meeting the needs of this passenger type are:

- Improve service reliability and availability (more lines, more frequency) (ranked #1)
- Improve first and last mile travel experience around stations (ranked #2)
- Improve affordability and ticket flexibility (ranked #3)
- Make more use of digitalization to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Better tools to plan trips and for accessing travel information through online systems (ranked #7)

### 5.3.3 THE GROWLER

The “growler” belongs to a group of people who travel the most for leisure during their free time (e.g. sightseeing, visit museums and exhibitions, visit the family) but do not use the train as their main mean of transport. They prefer using other means of transport instead of the train especially when they travel within the city they live in or they are visiting, but they would use the train more if some aspects of the rail journey improve. Some of them:

- have a quite consolidated negative perception of the rail journey and in general of the transportation system. They are more likely to confirm their negative expectations about travelling by train than to change their mind about rail services;
- neither have a positive or a negative perception of the rail journey, but they are more likely to find/focus on its positive aspects and on the pleasure of travelling.

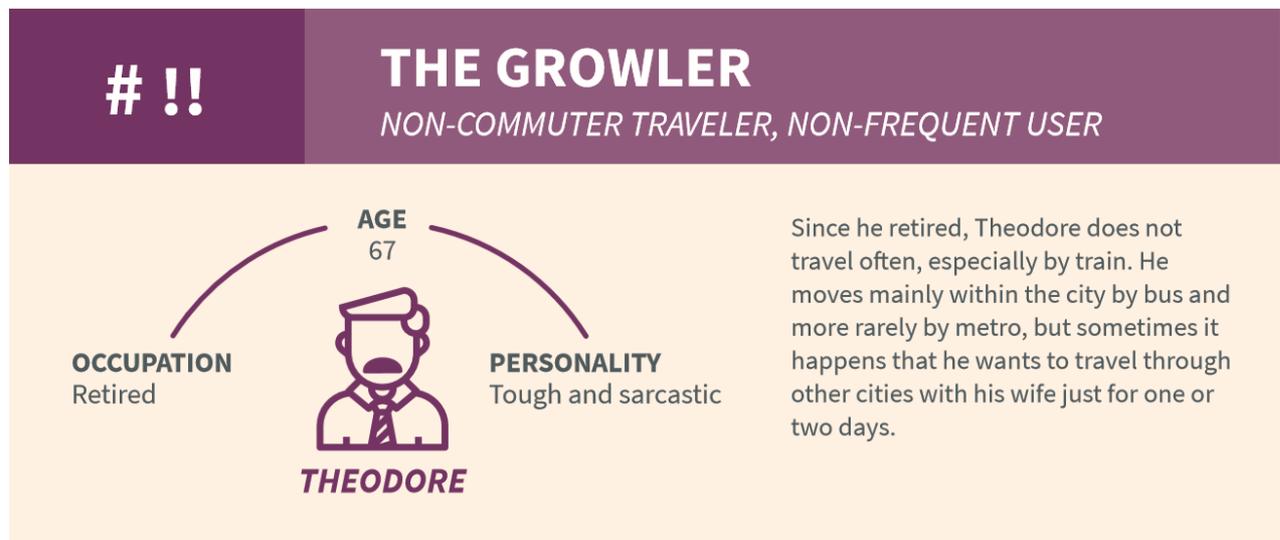


Figure 6 The Growler persona from D3.2 Experience Map

Theodore is recently retired from an office job. He is quite isolated and can seem to be quite a hard person. He is quite happy not to travel much, so mainly stays within the city, mostly using the bus but occasionally using the metro. Occasionally he and his wife go for a short break, and



usually go by train. Neither he nor his wife are very skilled about **planning the journey** online, and still prefer to go to the station to **book and pay for tickets** because it seems quite complex and confusing, so they prefer to be able to speak to railway staff when they are buying their ticket. They do think that they don't always get the best deal that way though. When they need to **Get to the Departure Station** they plan carefully so they don't have to travel in the peak hours when it is very busy, especially with their luggage. Sometimes they do have to travel when it is still busy, because they usually allow extra time for **Waiting at the station**. Because they don't travel often, they find that information at the station is sometimes very last minute, and they feel rushed and stressed trying to find the lifts for the correct platforms, or trying to follow diversions when areas are closed for maintenance. They find it difficult to use escalators with their luggage, even quite small suitcases, and they would like there to be a lot more seating near the trains, where they can sit close to their luggage to keep it safe. They would like to feel safer, with more staff nearby if they need help. They feel the same **during the journey** because they don't always know where to put their luggage and whether it will be safe, where the toilets and food bar are, what they should do in an emergency, when it is their stop. They might travel a bit more if they felt more reassured if the information on the train was as clear as the information at the **destination station**.

## NEEDS TO BE MET

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Non-commuter traveller, non frequent user (of rail services) would need:

- more (reliable) information provided by railway companies in case of delays/breakdowns/disruptions
- online booking / purchase procedures to be simpler and faster
- more offline planning and booking/purchasing procedures
- on-vehicle systems of ticket validation/check
- higher rail frequency, in particular inside the city center

## RECOMMENDATIONS/ACTIONS TO IMPLEMENT

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In conformity with what has emerged cross the research activities (i.e. T3.1, T3.2, T3.3 and the Delphi Survey), the recommended actions that would contribute to meeting the needs of this passenger type are:

- Improve service reliability and availability (more lines, more frequency) (ranked #1)
- Improve affordability and ticket flexibility (ranked #3)
- Designing for the needs of the elderly and disabled (ranked #6)
- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort) (ranked #10)
- Simplified ticket buying processes (ranked #11)

Indirectly,

- Develop better mechanisms for listening and responding to customer needs (ranked #7)
- Strengthening regulation to increase rail operator focus on responding to customer experience (ranked #8)

### 5.3.4 THE EXPLORER

The “explorer” belongs to a group of people who travel the most for work and/or for study and use the train as their main mean of transport. Like “Commuter traveller non frequent rail user” people, they want the transportation system to be flexible and customizable to their needs. They do have preferences between transportation companies and feel disappointed when the services offered don’t meet their needs, not repaying their fidelity. Some of them:

- have a proven travel routine and they tend to take always the same means of transport at the same time slots in order to not incur in unexpected contingencies;
- have a proven travel routine too, but they are more likely to try different/new combinations of means of transport to travel from A to B. They are also interested in the transportation news in their cities.

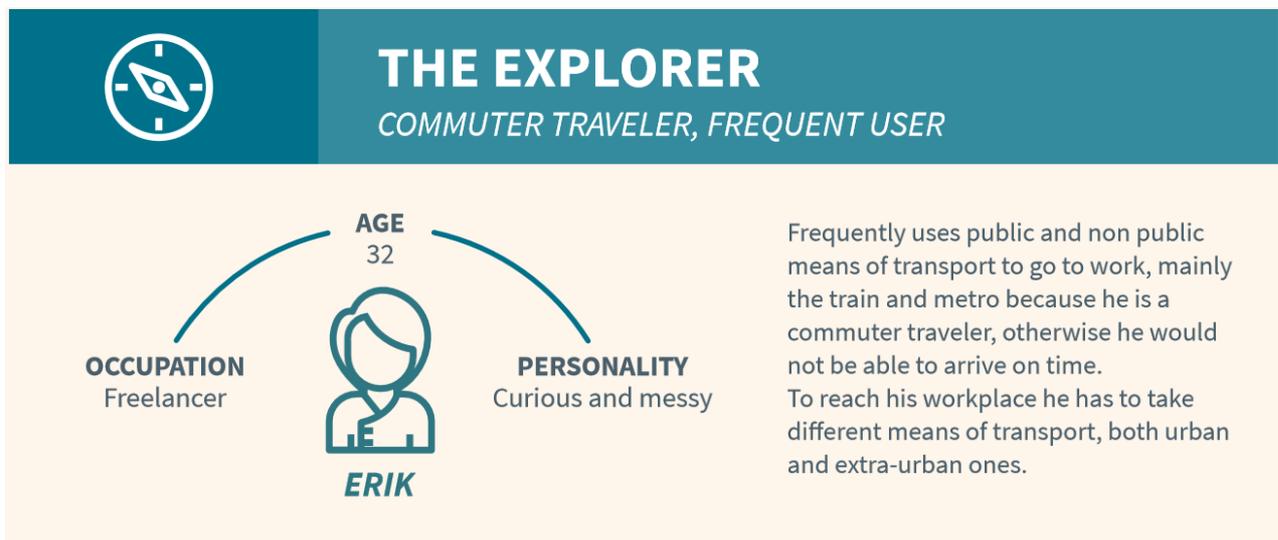


Figure 7 The Explorer Rail Traveller Persona (Source: D3.2 Experience Map)

Erik is self-employed and very busy. He travels a lot and is very multi-modal. Because he is very active and sometimes gets work at the last minute, he can’t plan much ahead. He doesn’t have a regular workplace, but he needs to commute to wherever the next job is. This means that he uses any and all modes. He loves travel apps, and tries every new one that comes out, looking for the one that most closely meets his requirements. What he really wants is a completely integrated app, where he **plan, book and pay** for the best mode for every journey. He is such a frequent traveller he’d like to be able to get discounts, but season tickets are no use if journeys aren’t predictably regular. For **getting to the destination station** he often finds that bike-share or car-share are the most convenient but he thinks that car-share in particular isn’t great value. When the app doesn’t work for some reason, he will use the ticket machines, but he finds them slow and unreliable. He is also irritated by turnstiles – he can see that people can get around them without paying and they just make the whole experience stressful and slow. Because he works in many different locations, Erik is quite familiar with a lot of locations. He has noticed that some of the less central stations which are often outdoors, have few facilities. Sometimes there isn’t even a weather shelter. He always tries to avoid those stations somehow. When he has a choice he will choose a metro system first, because they are good value, dry, fast and comfortable. When he has to **wait at a station** it is important to him that he can find somewhere clean, dry and



comfortable to sit, preferably with a table and sockets so that he can keep working. Erik often works **during the journey** too – inter-city trains are usually really good for this. Once he has reached his **destination station** Erik uses apps to plan what happens next. Much as he loves the apps, it is annoying to need several different ones because they often only work in one or two cities or for individual modes.

## **NEEDS TO BE MET**

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Commuter traveller, frequent user (of rail services) would need:

- more rides to be available both on weekdays and on holidays
- their city to provide eco-friendly travel solutions to reach the stations
- more equal fares
- larger, cleaner and more equipped waiting rooms, both in smaller / peripherals and bigger / central stations
- the stations, even peripheral ones, to be equipped with bars, bathrooms, bookshops, stations to charge the devices (e.g. PC, mobile phones) to better live the waiting experience
- more facilities and offers for those who frequently travel on high-speed trains
- cheaper travel solutions if they are forced to book last-minute
- on-vehicle systems of ticket validation/check

## **RECOMMENDATIONS/ACTIONS TO IMPLEMENT**

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In conformity with what has emerged cross the research activities (i.e. T3.1, T3.2, T3.3 and the Delphi Survey), the recommended actions that would contribute to meeting the needs of this passenger type are:

- Improve service reliability and availability (more lines, more frequency) (ranked #1)
- Improve first and last mile travel experience around stations (ranked #2)
- Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)
- Utilise digital tools to improve coordination between operators and across modes to create a ‘whole mobility experience’ (ranked #5)
- Improve affordability and ticket flexibility (ranked #3)

This group also requires a better equipped waiting environment at stations, although this recommended action was not ranked by the Delphi Survey participants.

### **5.3.5 THE CREATURE OF HABIT**

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The “creature of habit” belongs to a group of people who travel the most for work and/or for study but do not use the train as their main mean of transport. They want the transportation system to be flexible and customisable to their needs. They do not have preferences for any mean of transport or company of services, because their main objective is to arrive as quickly as possible to their destination spending as little as possible.

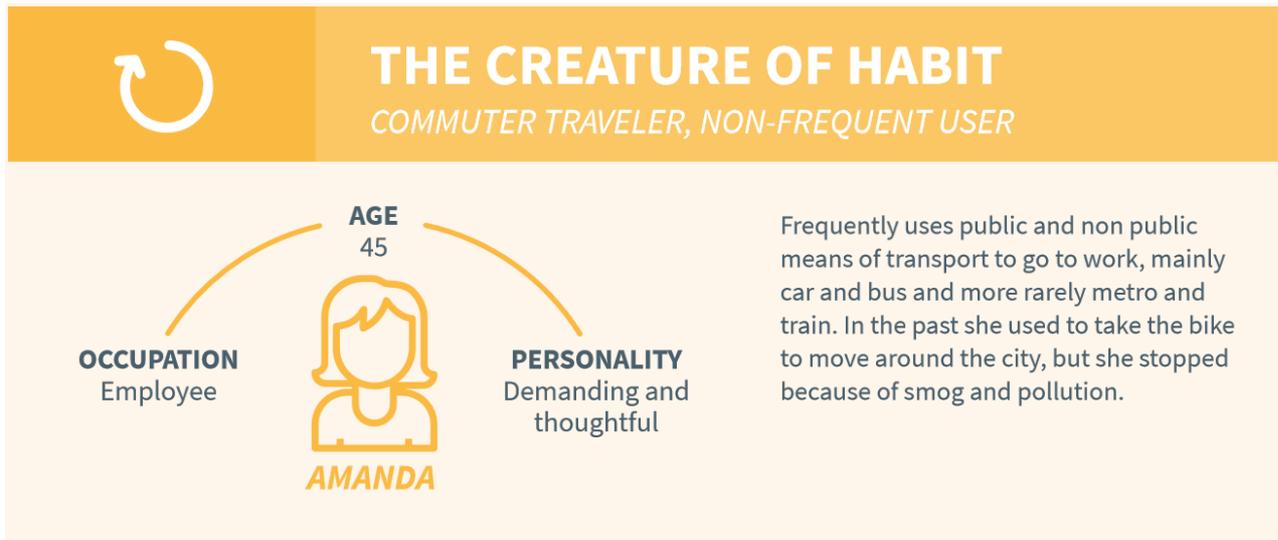


Figure 8 The Creature of Habit Rail Traveller Persona (Source: D3.2 Experience Map)

Amanda’s travel is very regular and predictable. She commutes to work every day, and she mostly uses the car or the bus. The metro and train don’t feature so much because they don’t seem so convenient. Being a very regular traveller, she doesn’t need to **plan** every journey, so she hasn’t really started using travel apps. She isn’t convinced that they make it easier and more convenient to plan journeys that use several different modes for example. She is quite cautious – she gave up cycling to work because she was worried about the pollution, and she finds the process of **booking and paying** for travel quite complex because she wants to get it right. When she does need to take the train, she always books it online, because she doesn’t trust apps yet. For example, she has used mobile apps for travel information when she needs to get to a **departure station**. She found that the information to help her get there was not very up to date and didn’t give her accurate information about traffic delays. She once missed her train for an important business meeting, because she got to the station too late to find a parking space, which was a very negative experience. Because she lives in the suburbs, services aren’t very frequent, so she believes the car is always going to be better for her. By the time she gets inside the station, she can be quite stressed, which makes it harder to navigate the station and understand the information. She has tried digital tickets once or twice, which she booked via her PC. That made some parts of the experience a bit easier. **During the journey**, she feels that she can’t use WiFi easily on the train, so even though she can’t do that when she is driving her car, she has a negative perception of the train. However, she likes interacting with the train staff, who she finds professional and helpful. She trusts their information more than the signs and apps. Amanda doesn’t like to arrive at her **destination station** after dark, especially the smaller stations with few staff. She doesn’t feel safe. She uses her phone to show her the map of how to get to where she’s going, as she finds it comforting.

## NEEDS TO BE MET

Commuter traveller, non frequent user (of rail services) would need:

- planning tools (both digital and non digital) to be more easy-to-use
- more equal fares
- more rides to be available both on weekdays and on holidays
- their city to provide eco-friendly travel solutions to reach the stations

- larger, cleaner and more equipped waiting rooms, both in smaller/peripherals and bigger/central stations
- the stations, even peripheral ones, to be equipped with bars, bathrooms, bookshops, stations to charge the devices (e.g. PC, mobile phones) to better live the waiting experience
- more facilities and offers for those who frequently travel on high-speed trains
- cheaper travel solutions if they are forced to book last-minute

## **RECOMMENDATIONS/ACTIONS TO IMPLEMENT**

In conformity with what has emerged cross the research activities (i.e. T3.1, T3.2, T3.3 and the Delphi Survey), the recommended actions that would contribute to meeting the needs of this passenger type are:

- Better tools to plan trips and for accessing travel information through online systems (ranked #9)
- Improve affordability and ticket flexibility (ranked #3)
- Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort) (ranked #10)
- Improve first and last mile travel experience around stations (ranked #2)
- Improve service reliability and availability (more lines, more frequency) (ranked #1)

Indirectly,

- Make use of more digitalization to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (ranked #4)

## 5.4 SUMMARY OF PRIORITY ACTIONS BY PASSENGER PERSONA

Table 20 below lists the recommended actions that will encompass the needs of our five passenger personas, in priority order from top to bottom, and mapped them to the five passenger personas. Two ticks indicates a direct relationship, and one tick an indirect relationship.

*Table 20 Summarised list of recommended actions (in priority order) by passenger persona*

Action (in prioritised order)	The optimist	The adventurer	The growler	The explorer	The creature of habit
Improve service reliability and availability (more lines, more frequency) (#1)		✓✓	✓✓	✓✓	✓✓
Improve first and last mile travel experience around stations (#2)	✓✓	✓✓		✓✓	✓✓
Improve affordability and ticket flexibility (#3)	✓	✓✓	✓✓	✓✓	✓✓
Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package (#4)	✓✓	✓✓		✓✓	✓
Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience' (#5)	✓			✓✓	
Designing for the needs of the elderly (#6)	✓✓		✓✓		
Develop better mechanisms for listening and responding to customer needs (#7)		✓✓	✓		
Strengthening regulation to increase rail operator focus on responding to customer experience (#8)	✓		✓		
Better tools to plan trips and for accessing travel information through online systems (#9)	✓✓		✓✓		✓✓
Accessible and comfortable rolling stock to improve in-vehicle service quality (e.g. comfort) (#10)	✓✓		✓✓		✓✓
Simplified ticket buying process (#11)	✓✓		✓✓		
Ensure that the terms of market opening embed improvements to customer experience (#12)					
More should be done to involve passengers in designing solutions (#13)					

## **5.5 SUMMARY OF ACTIONS BY DATA SOURCE**

Table 21 summarises the prioritised recommendations to show which data source provides corroboration. This provides additional evidence of their validity. The recommended actions that were ranked by expert participants are shown at the top in rank order. At the bottom of the table there is an additional section of cross-cutting recommendations that were not specifically identified as a result of the Delphi Survey but which nevertheless have a worthwhile evidence base from the previous tasks, thus we draw on those in the Smart Journey Vision described in section 6. The additional four items are numbered A1-A4. In categories #10 and #11 we have expanded the wording of the action set to further incorporate actions identified from other tasks.

The number of ticks in each table cell are the result of a subjective assessment of the project deliverables. For example, the Stakeholder Workshops and Experience Map columns are populated by reviewing D3.2 and by drawing on the findings reported in sections 4.3-4.5 and 5.3-5.5. The number of ticks represents our subjective assessment of the strength of the evidence. Three ticks would equal the strongest evidence, and so on. A blank cell indicates that there is nothing specific from a particular source. For example, action 6 was generated as a result of the Delphi Exercise, where the expert participants identified this practical action as one that responds to a range of passenger and stakeholder concerns. In the final column (Cost) we indicate an estimate of the level of investment needed using a \$ symbol. Three \$\$\$ indicates that the highest costs, versus \$ indicating the lowest cost.

Table 21 Prioritised actions, assessed cost implications and corroborative sources and

Action (in prioritised order) Items A1-A4 emerge as priorities from alternative sources to the Delphi Exercise	Literature Review	Stakeholder Workshops	Experience Mapping	Passenger Survey	Delphi Exercise	Cost
1. Improve service reliability and availability (more lines, more frequency)	✓✓	✓	✓✓	✓✓	✓	\$\$\$
2. Improve first and last mile travel experience in and around stations	✓✓	✓✓	✓✓	✓✓	✓	\$\$\$
3. Improve affordability and ticket flexibility	✓✓	✓✓	✓	✓✓✓	✓	\$ <sup>4</sup>
4. Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package		✓✓✓	✓		✓✓	\$\$
5. Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience'	✓	✓✓✓	✓		✓	\$\$
6. Designing for the needs of the elderly and disabled	✓✓	✓	✓		✓✓	\$\$ <sup>5</sup>
7. Develop better mechanisms for listening and responding to customer needs					✓✓	\$\$
8. Strengthening regulation to increase rail operator focus on responding to customer experience					✓✓	<sup>6</sup>
9. Better tools to plan trips and for accessing travel information through online systems	✓✓✓	✓	✓	✓	✓✓	\$\$
10. Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort, on board security/safety, capacity, cleanliness)	✓✓✓	✓	✓	✓✓✓		\$
11. Simplified ticket buying processes (such as improved online flows and more usable machines)	✓		✓	✓		\$\$
12. Ensure that the terms of market opening embed improvements to customer experience					✓✓	\$
13. More should be done to involve passengers in designing solutions					✓✓	\$
A1 Rail journey time	✓✓			✓✓		\$\$\$
A2 Security and safety around station	✓	✓	✓	✓✓		\$
A3 Facilities/ ambience in waiting environment	✓✓		✓	✓		\$
A4 Wifi/Power Connectivity	✓	✓✓		✓		\$

<sup>4</sup> Whilst this is not costly in itself, it could affect revenue

<sup>5</sup> In general retrofitting for more accessibility is likely to be more expensive than adopting Design for All principles from the outset of any project

<sup>6</sup> Regulatory issues are more dependent on political will than on cost

## 6. THE SMART JOURNEY VISION AND “RAILMAP”

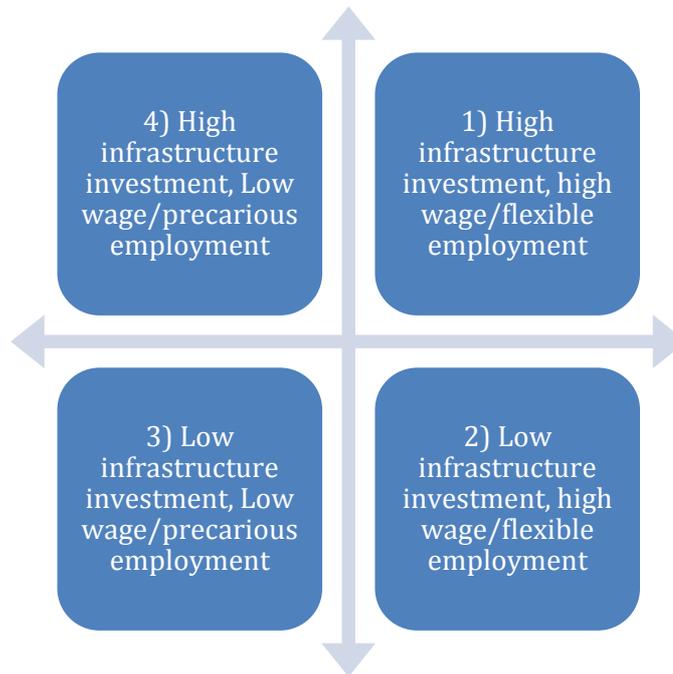


Figure 9 Envisioned scenario dimensions based on the Delphi Survey

Figure 9 depicts a four-quadrant scenario set summarising at high level the key dimensions of variability in the drivers identified by the expert participants in the Delphi Survey PESTLE analysis of future drivers and Porter’s Five Forces assessment of pressures impacting on the passenger rail sector.

The scenarios were developed through an analysis of the Expert Survey material by task members from UNIVLEEDS. It is important to note that future approaches to addressing significant environmental issues, particularly climate change, are also critically important to the role played by rail. For the purposes of this exercise, we are assuming that the level of investment driven by environmental factors (such as climate change mitigation and adaptation) is implicitly part of the High/Low infrastructure investment axis. We go through each of the four scenarios in the subsections below, providing a table for each one showing the elements of strongest agreement in the Delphi Survey and our interpretation of how that could play out in the scenario. We start with the reference or preferable case (Scenario One) with two tables summarising the scenario as emerging from the drivers identified in the PESTEL analysis by the expert participants (see Table 22 and Table 23).

## 6.1 SCENARIO ONE: HIGH INVESTMENT/HIGH WAGE (REFERENCE CASE)

*Table 22 Key points on Political, Economic and Societal drivers for Scenario One from the PESTEL analysis*

<b>Political Table 4</b>	<b>Economic Table 5</b>	<b>Societal Table 6</b>
<p>The high environmental cost of road traffic raises the political profile of rail. There is more focus on significant investment, and improving the customer experience becomes an explicit goal, recognising that the level of rail usage is closely linked to government investment and high employment.</p>	<p>The business case for rail is strengthened by mandated environmental action. Rapid progress is made in making rail better and more attractive. Maintenance and investment in rail accounts for a significant proportion of government spending. The phasing out of diesel has increased costs, but the better air quality and improved passenger experience ensures that rail users perceive value for money.</p>	<p>There is an ageing population, and it is recognised that mobility is an important aspect to well-being and independent living for longer. There is a lot of emphasis on design for all in the rail sector, as younger people are also using rail as they turn away from cars. Rail commuting in peak hours has reduced, as flexible working practices increase working at home or from hubs. Social awareness of environmental impacts encourage a more considered approach to travel with rail used for more journeys instead of car or air. Those who remain dependent on cars to access rail need to be able to book space.</p>



Table 23 Key points on Technological, Environmental, and Legal/Regulatory drivers for Scenario One from the PESTEL analysis

Technological Table 7	Environmental Table 8	Legal/ Regulatory Table 9
Automation and the Digital Railway supports the provision of higher frequency, faster services. Human staff are sometimes less visible at smaller stations and on vehicles, but improvements to surveillance technology and ticket validation ensure that rail users generally feel more secure, and fare dodging is reduced. Journey information and ticketing technologies are far better and easier to use, supporting positive customer experiences through all journey phases and for more passenger groups.	As rail's energy source moves away from diesel, air quality in and around stations has improved, and in-vehicle experiences are improved by the quieter, cleaner vehicles. Continued investment is made to mitigate the legacy damage to infrastructure from historic high pollution levels. There is a lot of investment in adapted to the effects of climate change to reduce rail disruption, and emergency response has improved its focus on passengers as well as restoring rail services.	Support grows for mandating better intermodal integration. Where regional authorities become stronger voices in transport and urban governance, middle and short distance rail services are reinvigorated, with great emphasis on the customer experience.

Under Scenario One the prospects for the rail passenger industry would be excellent. High investment levels in infrastructure and environmental action favours rail as an urban, regional, intercity and international mode, and journey times are in many cases quicker, and services are more reliable. Furthermore there is a high wage economy with large number of people enjoying flexible working practices. As the rail user experience is perceived to be improving rapidly, most users are not greatly concerned by some increase in fares. The conditions in this scenario favour increasing investment in technologies which increase rail capacity, by enabling higher frequencies, but also opening new rail links. The high wage, flexible working system breaks the peak hours commuter pattern, and frequent services exist at even intervals between 6 am and 9 pm. The night time economy is also thriving with 24/7 shift patterns in some sectors, combined with experience-based leisure (theatres, festivals, etc) keeping rail use high in the evenings, leading to more night time services, with clean, secure vehicles and stations. For our five persona, rail travel is a good experience, as their varied needs are being met. Under Scenario One achieving the most desirable future state will be easier to achieve, as the will and finance is available, and there is less need to prioritise the recommendations in terms of cost of implementation.

For **Maleek the Optimist**, the increase in accessibility of urban rail services, including rail and tram has freed him from dependence on his car for accessing the longer distance services he uses to visit his family. When he does use his car, he is able to pre-book space at the departure station, which has plenty of accessible waiting space, and properly trained staff to ensure that the trains are easy for him to board. The interiors of long-distance trains are more pleasant, with better



designed flexible spaces for accommodating different kinds of wheelchairs. When arriving at his destinations, he finds that even the smaller stations can be relied on to be accessible, with high quality ramps, reliable elevators, and responsive security and help points. What **Sabrina the Adventurer** notices is that the information online, via mobile, and at the station is all very reliable and accurate, and she finds it much easier to find good deals for a wider range of last-minute destinations. She can even buy everything she needs to pack for her trip, right at the station. Sometimes she even makes trips where the interchange waits are quite long, because the stations and their precincts are good places to spend time. She travels more often by train than she used to, and uses buses to reach the main departures stations, because the integration has improved through a combination of better infrastructure and service levels accessed via MaaS apps. **Theodore the Growler** and his wife still prefer to go to the station to buy their tickets, usually walking there or getting public transport, but they have recently found that apps are much easier to use, with customisable interfaces to improve their accessibility features (now that his eyesight isn't so good this is very useful). They can travel earlier in the day than they used to, so their trips are to places a bit further away than before, with easy to navigate stations and very comfortable, well designed trains really helping them make the most of their retirement. **Erik the Explorer** really represents the flexible high wage worker that is so prevalent in Scenario One. He doesn't need so many apps these days, as everything is more integrated. All the information and mobile payment methods suit his needs, and he is really impressed by the improved ticket validation methods that have eliminated turnstiles. The times when he has to wait at stations because of meeting schedules have become productive time, with great places to work on his laptop, grab a bite to eat or even have meetings. He finds it easier to work on trains themselves now too, as there are competitive fares for business travellers, and the design of the airline style seating makes it easier to work with a laptop, with the socket and the connectivity that he really needs. **Amanda the Creature of Habit** is still an important passenger group, but not in such large numbers, so the 'traditional' times of day when she travels are much less crowded, which has encouraged her to use the train more than she used to, and it has become much easier to book and pay at the last minute, and she has been encouraged by how reliable the information is, and being able to pre-book a parking space at the station has really helped her become more multimodal, and she has found she enjoys worthwhile time during train journeys, whether she works, listens to podcasts or reads her Kindle.

## 6.2 SCENARIO TWO: LOW INVESTMENT/HIGH WAGE

Under Scenario Two the prospects for the rail passenger industry are a little less favourable, as low investment prospects limit the capacity to address customer experience and environmental demands. Furthermore, there has been less investment in improving journey times and reliability, though these are prioritised before customer experience. However, there is a high wage economy with flexible working practices. This takes the pressure off crowding as peak morning and evening hours which improves passenger experience for **Amanda the Creature of Habit**. **Theodore the Growler** and his wife can also travel more in those times, due to fewer crowds. However, there has been less investment, so **Maleek the Optimist** doesn't really use rail more than he used to, as accessibility has been improving only slowly. Though the information about disabled access is much better than it used to be, as are the tools for pre-booking assistance, the infrastructure itself hasn't improved much. **Sabrina the Adventurer** likes the fact that the information is much more likely to be real-time and pinpoint accurate, particularly about the access and egress from the

stations, helping her be more multimodal. However, there hasn't been as much progress in widening the range of destinations for her adventures, and the commerciality of stations has been emphasised more than the customer need for pleasant waiting spaces. **Erik the Explorer** is finding similar issues with the waiting environment, finding it hard to find good places to work, and the reduction in peak hour crowding hasn't really impacted on him, as his habits aren't so regular. He is still hoping for more frequency and better vehicles, though he is happy that planning, booking and paying has continued to get easier whilst on the move as mobile apps have improved, though this doesn't make up for the continued problems with poor journey times and service reliability.

### 6.3 SCENARIO THREE: LOW INVESTMENT/LOW WAGE

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Under Scenario Three the prospects for the rail passenger industry are the worst of the four scenarios. The low investment environment and the low wage/precarious employment economy is really challenging for maintaining passenger numbers, never mind achieving growth, and it becomes politically difficult to raise more revenue via the farebox. Without the money to increase service levels and routes, the emphasis is either on the 'quick win' recommendations that are lowest in cost for the biggest impact (in practice, this is often around improving the planning/booking/paying and informational environment, with app development outsourced to third parties) or on meeting the regulatory requirements. This has been of some benefit to **Maleek the Optimist** and **Theodore the Growler** because they both need more accessibility provision across all the journey phases. **Sabrina the Adventurer** finds that cost is becoming an issue that is limiting some of her more spontaneous adventures. **Erik the Explorer** also finds cost a bit of an issue, because he is self-employed and doesn't have a steady income. Both **Sabrina** and **Erik** still find that station environments are disappointing, in different ways. **Amanda the Creature of Habit** is also feeling stressed about cost, but this has led to her reducing car use, and making more use of the train, as she feels more in control now that the peak hours are less crowded.

### 6.4 SCENARIO FOUR: HIGH INVESTMENT/LOW WAGE

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Under Scenario Four the prospects for the rail passenger industry are moderately favourable due to the high investment in environmental measures that favour rail, and investment in accessibility to meet equality regulations. Integration of rail with other modes such as bus and cycling has improved as part of the drive to decarbonise transport, as has the availability of accurate information and easy-to-use tools for travel information, booking and payment. Other aspects of customer service such as an expansion of onboard services and providing more attractive facilities at stations have taken a lower priority because growth in passenger numbers has stagnated in the face of a low wage/precarious employment economy. Providing better accessibility has to be ensured through regulation. Whilst the need to invest in rail has been addressed as a transport decarbonisation measure rather than for its own sake, this has had the effect of improving some routes and reliability, but frequency is still focused on serving a peak hour pattern. However, even though private cars are also increasingly restricted as part of the transport decarbonisation and environmental agenda, less money can be raised via the farebox, as the employment conditions make it politically difficult to raise fares. Low wages and precarity mean that growth in leisure travel in the working age population is stagnant and peak hours commuting remains a feature of rail travel

in many towns and cities. The older age groups are having to work longer before reaching pension age, which limits growth in their leisure mobility. However, those who have already retired continue to drive some growth in passenger rail travel. **Maleek the Optimist** represents a group that sees moderate benefits under this scenario, as the emphasis on accessible rail enables more mobility for disabled people (though this group is impacted by some of the restrictions on private car use, they do have some protections). Similarly **Theodore the Growler** benefits because he needs more accessibility provision across all the journey phases. He is in the group that has already retired and can maintain his use of rail for leisure travel, but increased living costs mean that the overall number of trips he makes with his wife are a little lower than before. He feels sorry for the people in the following generation, who are still having to work at the age that he was able to retire. He is reluctant to make journeys during peak hours due to the still quite high number of commuters who aren't able to work flexibly. **Sabrina the Adventurer** is finding it too expensive to keep up her impulsive travel habits, and some of the shopping centres around the stations are half-empty due to the economic conditions, which makes them less attractive. She is also trying to save some money to support herself after her PhD completion as she expects it will take some time to find a job. She is walking much more rather than taking the metro and tram. **Erik the Explorer** is really finding it difficult as a freelancer, he can't benefit from lower cost advance booked fares, as he needs flexibility. He doesn't have any work more often than in the past, and he is thinking about whether he should get an e-bike or e-car to provide more independent mobility because of the rail fares. He can't afford a monthly Mobility as a Service package that doesn't allow him to drop the contract when he has no work. **Amanda the Creature of Habit** is still feeling too stressed by peak-hour crowding (even though it has improved) to switch to rail for all her commute journeys, but when the weather is fine, she has returned to cycling, as there have been a lot of environmental improvements as cars have been restricted. She could be persuaded to use trains more if she thought she could securely park her bicycle at the station.

## 6.5 THE 'RAIL MAP'

In this section we distil our findings by focusing on the actions emerging from Table 21 whilst considering the four different scenarios. In focusing on the key actions to take forward we consider cost implications, applicability across the scenarios and also take into account where we have support for the actions from multiple sources of evidence from earlier tasks.

Firstly, from the long list in Table 21 we drop the following actions from our subsequent discussion:

*#7: Develop better mechanisms for listening and responding to customer needs*

*#8: Strengthening regulation to increase rail operator focus on responding to customer experience*

*#12: Ensure that the terms of market opening embed improvements to customer experience*

*#13: More should be done to involve passengers in designing solutions*

Whilst there was some resonance with the Delphi interviewees these were not issues that emerged within the previous elements of the work package. For this reason we would recommend these as avenues for further research in the future. In particular, *#7 Develop better mechanisms for listening and responding to customer needs*, which by inference would help deliver better results for several of the other actions, and the need for it is articulated in the passenger focus groups, requires research to understand the most effective methods. Whilst in the Delphi survey it was considered that there is already plenty of information coming from customer surveys, passenger and disability groups are plainly dissatisfied. More attention to *#13 More efforts to involve passengers in designing solutions* is also related to this and is relatively low cost (and likely to save costs in relation to addressing #6 for example).

Table 24 below provides an assessment that maps the recommended actions from section 5 onto the scenarios and the underlying evidence from the Delphi study and earlier tasks. The number of ticks in each cell represents the degree of importance in relation to supporting the rail sector in the conditions of the scenario, with reference to the implementation costs estimated previously for

Table 21. A blank cell indicates that the WP tasks have not identified sufficient evidence to inform the Railmap: whilst these actions cannot be ruled out, they do represent a knowledge gap that needs to be addressed. The final column presents the priority ordering for each action and is justified in the following text:

Table 24 'Railmap' of recommended actions by Scenario

Recommended actions numbered according to the Delphi Survey prioritisation (A1-A4 are identified from other WP activities)	Scenario 1 High investment and High Wages	Scenario 2 Low investment/ High Wage	Scenario 3: Low investment/ Low Wage	Scenario 4: High investment/ Low Wage	Costs from Table 21	Action priority
1. Improved service reliability and availability (more lines, more frequency)	✓✓✓	✓✓	✓	✓✓✓	\$\$\$	4
2. Improved first and last mile travel experience in and around stations	✓✓✓	✓	✓	✓✓✓	\$\$\$	4
3. Improved affordability and ticket flexibility	✓✓	✓✓	✓✓✓	✓	\$	1
4. More digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package	✓✓✓	✓	✓✓	✓✓✓	\$\$	5
5. Utilisation of digital tools to improve coordination between operators and across modes to create a 'whole mobility experience'	✓✓✓	✓✓✓	✓✓	✓✓✓	\$\$	5
6. Design for the needs of the elderly and disabled	✓✓✓	✓✓	✓✓✓	✓✓✓	\$\$	6
9. Better tools to plan trips and for accessing travel information through online systems	✓✓✓	✓✓✓	✓✓✓	✓✓✓	\$\$	3
10. Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort, on board security/safety, capacity, cleanliness)	✓✓✓	✓	✓	✓✓✓	\$	2
11. Simplified ticket buying processes (such as improved online flows and more usable machines)	✓✓✓	✓	✓✓	✓✓✓	\$\$	8
A1 Improved rail journey time	✓✓✓	✓✓	✓	✓✓✓	\$\$\$	7
A2 Improved Security and safety around station	✓✓✓	✓✓	✓	✓✓✓	\$	2
A3 Improved Facilities/ ambience in waiting environment	✓✓✓	✓✓	✓✓	✓✓	\$	2
A4 Improved Wifi/Power Connectivity	✓✓✓	✓✓	✓✓		\$	8

1. The recommended action that emerges as offering the lowest risk of being a wrong solution is #3 *Improve affordability and ticket flexibility* as it is relevant for all scenarios and was evidenced from all the work package components.
2. #A2 *Security and safety around station* and #A3 *Facilities/ ambience in waiting environment* emerge as important because they are low cost, and are reflected across the WP3 components as well as the scenarios. In this second tier we would also place #10 *Accessible and comfortable rolling stock to improve in-vehicle service quality* as being relatively low cost, identified as very important from our previous tasks although not emerging from the Delphi study and not deemed as relevant to low investment scenarios.

3. *#9 Better tools to plan trips and for accessing travel information through online systems* also achieves resonance across the work package and scenarios. This is assessed as medium cost.
4. *#1 Improve service reliability and availability (more lines, more frequency) and #2 Improve first and last mile travel experience in and around stations.* These actions emerged consistently in all the work package tasks although they are judged as higher cost and thus not as pertinent to low investment scenarios 2 and 3.
5. *#4 Making use of more digitalization and #5 Utilisation of digital tools to improve coordination between operators and across modes to create a 'whole mobility experience'.* These are applicable to all scenarios, medium cost and resonant in all tasks except the passenger survey. Perhaps it is harder for passengers to visualise improved mobility through digital tools.
6. *#6 Design for the needs of the elderly and disabled* being of medium cost, consistently important across scenarios although less resonant in the preceding tasks.
7. *A1 Rail journey times* also achieved some resonance in our earlier tasks and was applicable to most scenarios but was a high cost.
8. *#11 Simplified ticket buying processes and #A4 Wifi/Power Connectivity.* These were ranked low in the Delphi, had some consideration in the earlier tasks but inconsistent importance across the scenarios.

Whilst all these scenarios are plausible<sup>7</sup>, they are not all equally preferable<sup>8</sup>. Scenario One is the most advantageous for the rail passenger industry, and for society generally, if environmental issues are being addressed as part of the High Infrastructure Investment. No assumptions or prescriptions are made as to who should make the investments. If we were confident in Scenario 1 we would further prioritise #1 and #2 alongside #3.

<sup>7</sup> <http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/scenario/>

<sup>8</sup> <https://www.nesta.org.uk/blog/speculative-design-a-design-niche-or-a-new-tool-for-government-innovation/>

## 7. CONCLUSIONS

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The objective of Task 3.4 was to prioritise areas for improving the rail passenger journey experience. This was implemented by firstly providing selected information from the outputs of tasks 3.1-3.3 namely:

- 1) a high-level survey of demographic and societal factors affecting transport users at different journey stages;
- 2) a Passenger Experience Map from Task 3.2; and
- 3) selected results from a large survey of rail users and non-users;

Secondly we added expert opinion and reflection on future scenarios to synthesise an industry and policy-facing “Smart Journey” vision, with a “Railmap” of recommendations aimed at simplifying the end-user experience of planning and undertaking a trip that includes a rail journey.

The outcome of this task provides a clear prioritising effort to focus on the most significant factors influencing the rail passenger experience in order to best influence travel choices to maintain and increase passenger rail journeys and how the prioritisation of effort might be affected by different future conditions.

The conclusion is that the most favourable Scenario for the rail sector is Scenario One, the reference case, high wage/high investment in which there is no reason why all the identified priority actions shouldn't be implemented. However where prioritisation is required we particularly favoured actions to Improve affordability and ticket flexibility, improve safety and security and facilities around stations, comfort in rolling stock, and the development of trip planning tools.

More costly recommended actions involved Improving service reliability and frequency and first and last mile travel experience around stations.

**APPENDIX 1****SMART MAINTENANCE AND THE RAIL TRAVELLER  
EXPERIENCE****EXPERT DELPHI SURVEY****DELPHI EXERCISE MATERIALS: ROUND ONE PESTLE ANALYSIS**

PESTLE analysis is a framework for surveying and understanding the external driving forces affecting an organisation, industry or sector. PESTLE is a mnemonic for the factors: Political, Economic, Societal, Technological, Legal/Regulatory and Environmental. We provide a survey template below for your responses.

**Background: literature review of macro-trends**

The SMaRTE consortium carried out a review of the outputs of relevant EU-funded projects, as well as academic and non-academic literature. Six clusters of macro trends affecting travel behaviour were identified:

1. Societal need for decarbonisation to increase active travel and reduce air pollution;
2. Demographic evolution and changing lifestyles;
3. Climate change;
4. Evolution of autonomous driving systems;
5. Development of ICT and the Internet of Things;
6. Sharing economy developments.

**Rail customer experience map**

In earlier parts of the project, we conducted passenger and industry focus groups, produced a rail passenger 'Experience Map' (identifying key 'pain points' for different passenger personas) and conducted a survey. We summarise some key points here, and we have supplied the Experience Map for reference as it may help you to contextualise your responses.

**Key survey results**

Findings from the passenger focus groups and stakeholder workshops have also informed the development of a large-scale passenger survey (1,200 respondents). This survey seeks to define the influence of key factors behind the choice, or otherwise, of a specific rail journey in 3 European case study areas. Whilst cost of ticket is the principle consideration for rail journeys, the ability to book journeys in advance, ability to find a seat and security and safety emerge as more important factors than time related elements. Journey planning tools also emerge as important facilitators. More than 80% of our rail travellers reported journeys as satisfactory or better, there are areas for improvement. Most dissatisfaction was with the car parking cost and availability, cleanliness and maintenance of the station, ticket costs, wi-fi and power connectivity and the availability/frequency of services of out of peak times.

For people not using rail, whilst cost again emerges as an important factor requiring 'improvement' for them to switch, the in-vehicle experience was more significant (i.e. non-service level related factors such as on-board security and safety as well as the ability to find a seat). The figure below

displays these findings as ‘attrition factors’ which identify the proportion of non-rail passenger survey respondents who are “lost” at each stage of a potential rail journey through unaddressed needs.

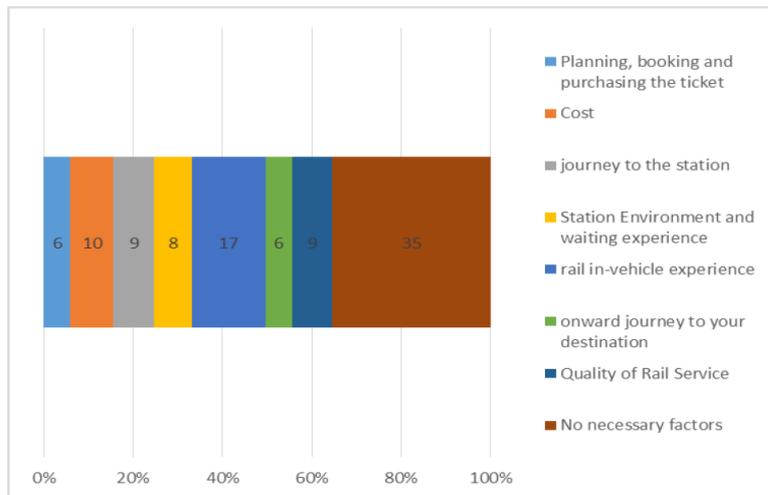


Figure 4 Attrition factors for journey stages (% of non-rail travellers, n=413)

### THE PESTLE ANALYSIS

**Please describe the nature of your expertise here. It is helpful for us to know the length of time over which you have developed your expertise, as well as how it relates to passenger rail (for instance, societal or political research relating to transport, rail economics, rail customer experience, long-distance rail, light-rail/metro/tram, commuter rail).**

#### Political driving forces

Political or politically motivated factors that could affect the development of passenger rail in Europe over the next 20 years. Examples include: Government policy, political stability or instability, bureaucracy, corruption, foreign trade policy, tax policy, trade restrictions, labour/environmental/data/consumer protection laws, competition regulation, funding grants & initiatives, etc.

**Questions** There are four questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.

What government policies or political movements/groups do you anticipate affecting the development of a customer focus in passenger railways (long distance, commuter services, metro/tram/light rail) over the next 20 years?

In your opinion how will this impact on passenger experience?

What geographic areas are you thinking of in answering these questions?

Are there any other political factors that your expert knowledge suggests should be included?



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**Economic Driving Forces**

Overall economic forces that could affect passenger railways in Europe over the next 20 years. Examples include: Economic trends, growth rates, industry growth, seasonal factors, taxation, inflation, interest rates, international exchange rates, International trade, labour costs, consumer disposable income, unemployment rates, availability of credit, monetary policies, raw material costs, etc.

**Questions** *There are five questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.*

What economic factors will impact on passenger railways in Europe in the near or medium future?

--

Are there more long-term economic factors that will start to affect Europe's passenger railways within 20 years?

--

How does the economic climate impact on the rail passenger experience in Europe just now?

--

What are the main economic factors that lead to potential passengers using another mode instead?

--

Are there any other economic factors that your expert knowledge suggests should be included?

--

**Societal Driving Forces**

Social aspects, attitudes, and trends that influence rail and the market that it targets. Examples include: Attitudes and shared beliefs about a range of factors including health, work, leisure, money, customer service, imports, religion, cultural taboos, the environment; population growth and demographics, family size/structure, immigration/emigration, lifestyle trends, etc.

**Questions** *There are four questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.*

What are the main characteristics of passengers for the main rail journey types we are interested in (e.g. long distance, suburban/commuting, metro/tram/light rail)?

--

How are these characteristics changing and why – what key socio-cultural trends are going to affect the rail passenger market up to 2040?

--

What should the passenger rail industry in Europe do to improve the rail passenger experience to respond to these socio-cultural trends?

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Are there any other societal factors that your expert knowledge suggests should be included?

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### Technological Driving Forces

Technology that can affect the way the rail industry develops its networks, operates, markets itself and interfaces with rail passengers and staff. Examples include: Technology and communications infrastructure, consumer access to technology, emerging technologies (hydrogen, digital railway, ticketing, real-time information), automation, legislation around technology, research and innovation, intellectual property regulation, competitor technology and development (i.e. non-rail transport modes), technology incentives, etc.

**Questions** *There are four questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.*

What innovations and technological advances are available or on the horizon that you see being applied to passenger rail networks? Please focus on those that will directly impact on the rail passenger experience.

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What aspects of consumer access to technology are important to the rail industry – how are these likely to develop between now and 2040?

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What innovations and technological advances are emerging for other transport modes that will be a threat to the passenger rail network in relation to customer journey experience? Please be as specific as you can in relation to the threatened journey types.

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Are there any other technological factors that your expert knowledge suggests should be included?

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### Legal/Regulatory Driving Forces

Current and future legal and regulatory requirements impacting on the rail industry. Examples include: Laws regarding consumer protection, labour, health & safety, antitrust, intellectual property, data protection and cyber security, tax and discrimination; international and domestic trade regulations/restrictions, advertising standards, safety standards, etc.

**Questions** *There are three questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.*

What are the key regulations and laws that apply to rail passenger market that impact on rail passenger experience? Please include any imminent changes to the regulatory landscape that you know of.

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How should regulation and law be changed to support innovation in customer services in rail passenger services (for example in supporting integration with other transport modes for seamless journeys)?

--

Are there any other legal/regulatory driving force factors that your expert knowledge suggests should be included because they impact on rail passenger experience or draw people away from using rail?

<b>Environmental Driving Forces</b>
Environmental forces impacting the rail passenger industry locally, other environmental pressures, and natural resources used by the rail industry/smart technologies. Examples include: Weather, climate change, rail's carbon footprint and impact on air quality, environmental regulations, pollution laws and targets, recycling and waste management policies, endangered species/preservation of biodiversity, support for renewable energy, key natural resources that are in short supply (and reasons for that).
<b>Questions</b> <i>There are five questions under this heading. Please provide your answers in the blank boxes below each question. The boxes should expand to the right size as you type. Please put N/A if you don't want to answer a particular question.</i>
How does the environment impact on the rail passenger experience (i.e. the impacts of non-human causes of disruption)?
How does the current range of laws protecting the environment and regulating pollution impact (positively or negatively) on the rail passenger industry and the experience of rail passengers?
What will be the most challenging environmental driving force for the rail passenger industry up to 2040 (e.g. climate-related disruption, or resource shortages, etc)?
Thinking of current rail users and potential rail users, how will any future regulation of carbon emissions impact on rail passenger experience?
Are there any other environmental driving forces that your expert knowledge suggests should be included?

## Thank you!

That is the end of your SMARTE Delphi Questionnaire Round One.

Please return this document to Kate Pangbourne ([k.j.pangbourne@leeds.ac.uk](mailto:k.j.pangbourne@leeds.ac.uk)) by 23rd August 2019.

Members of the SMARTE consortium will synthesise all the expert responses. In Round Two, you will be presented with the synthesis and asked to tell us the degree to which you agree with the synthesised version, using Likert scale questions. We will also ask you to prioritise which parts of the customer experience should be improved from a draft list that we will supply.



**APPENDIX 2**

**SMART MAINTENANCE AND THE RAIL TRAVELLER  
EXPERIENCE**

**EXPERT DELPHI SURVEY**

**DELPHI EXERCISE MATERIALS: ROUND ONE PORTER’S FIVE FORCES**

Porter’s Five Forces (P5F) is a business analysis tool for understanding competitiveness. We have modified the framework to focus on how the competitive environment in the rail industry impacts on passenger experience. Over the next few pages, there is a template for each individual force. We have collated responses from Round One to understand expert perspectives on how each force impacts (or not) the passenger experience and whether there are any opportunities to improve passenger experience.

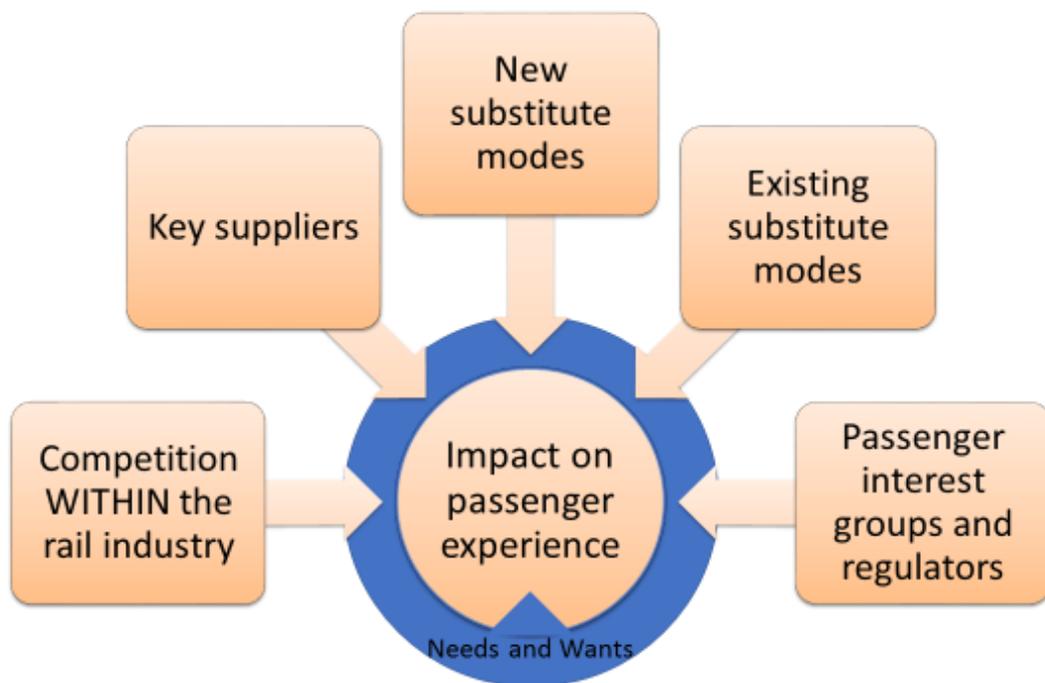


Figure 5 Porters' Five Forces adapted for SMARTE (modified from Michael Porter's original framework, 1979)

<p><i>Effect of key suppliers</i> For SMARTE 'suppliers' could include third party ticket retailers, software companies, hardware companies (e.g. real time information equipment), rolling stock suppliers, network engineering, track access costs, etc.</p>
<p><i>Please provide an assessment of how easy it is for suppliers of rail services, and suppliers to the rail industry to do things which impact positively/negatively on rail passenger experience</i></p>
Empty space for response



*Are there any key opportunities in the supply chain to influence passenger experience for the better?*

*Effect of passenger interest groups and regulators/regulations*

*Please provide an assessment of how actions of passenger interest groups influence current rail passenger experience*

*Please provide an assessment of how regulators/regulation influence current rail passenger experience*

*Are there any key opportunities for rail operators and/or regulators to influence passenger experience for the better?*

*Competition WITHIN the rail industry*

*For SMaRTE, we are interested in understanding how different types of passenger rail might be competing for the same passengers. Please provide an assessment of how this currently impacts passenger experience if they fall within your specialist knowledge and experience.*

*Are there any key opportunities to influence passenger experience for the better?*

<i>Existing substitute modes. When close substitute products exist in a market, it increases the likelihood of customers switching to alternative products in response to price increases.</i>
<i>How are existing substitutes for rail journeys affecting the current provision of passenger rail? (e.g. private vehicles, other forms of public transport, existing sharing services, air travel).</i>
<i>How much of the observed substitution happens because of passenger experience factors?</i>
<i>Are there any key opportunities to influence passenger experience for the better?</i>

<i>Effect of new substitute modes. When close substitute products exist in a market, it increases the likelihood of customers switching to alternative products in response to price increases.</i>
<i>Please provide your assessment of the current threat to rail from new substitute modes, e.g. autonomous driving services or where a mix of existing and new services are combined into Mobility as a Service applications.</i>
<i>Please provide your assessment of the degree to which transfer of activities to internet alternatives (such as working at home, conference calls, online shopping, movie streaming services) is a threat to particular types of passenger rail, in terms of changes to journey purposes/frequencies by particular passenger groups?</i>
<i>Are there any key opportunities to influence passenger experience for the better (e.g. by integrating some new transport modes with rail more effectively for first/last mile travel)?</i>
<i>In the future, self-driving/autonomous vehicles could be a threat to passenger rail for certain journeys – how real is this threat, when will it take effect and how can the rail passenger experience be enhanced in response?</i>

<i>Additional factors in improving the rail passenger experience</i>

**Thank you!**

That is the end of your SMARTE Delphi Questionnaire Round One.

Please return this document to Kate Pangbourne ([k.j.pangbourne@leeds.ac.uk](mailto:k.j.pangbourne@leeds.ac.uk)) by 23rd August 2019.

Members of the SMARTE consortium will synthesise all the expert responses. In Round Two, you will be presented with the synthesis and asked to tell us the degree to which you agree with the



synthesised version, using Likert scale questions. We will also ask you to prioritise which parts of the customer experience should be improved from a draft list that we will supply.



## APPENDIX 3

# SMART MAINTENANCE AND THE RAIL TRAVELLER EXPERIENCE

## EXPERT DELPHI SURVEY FINAL PART

### DELPHI EXERCISE MATERIALS: SUMMARY OF PESTLE EXERCISE

For each driving force in a PESTLE analysis we asked a set of questions. We have summarised the answers to each question for each driving force and supplementary questions below. Please indicate how much you agree with the identified driving forces using the Likert scale provided (X in box). Please select N/A if you don't want to answer a particular question. There is space for your own comments.

<b>Political driving forces</b> affecting the development of passenger rail in Europe over the next 20 years.	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Environmental concerns:</b> high environmental cost of road traffic raises political profile of rail.					
<b>Immigration:</b> increasing political concerns may create less seamless/more surveilled travel.					
<b>Nationalization:</b> Political calls for nationalization in some countries may increase the emphasis on political control, swallow up funding and move the focus away from service improvement.					
<b>Privatization:</b> Continued impetus to privatise rail in some countries might increase investment and put more focus on customer experience.					
<b>Public policy:</b> Level of rail usage is highly dependent on government investment and high employment.					
<b>Devolution:</b> Devolving powers over transport including rail to regional/sub-national level brings decision-making to people affected, which is a positive effect.					
<b>Devolution:</b> Devolving of powers over transport could lead to disruption or significant differences between areas, suggesting that strong national frameworks are needed.					

Comment:



<b>Economic driving forces impacting on passenger railways in Europe in the near or medium future?</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Energy:</b> Drive to diversify rail's energy mix will be costly, and create difficulties in upgrading services, suppressing customer service improvements.					
<b>Growth:</b> A sluggish European economy and Brexit will depress rail travel demand as employment and household income are affected.					
<b>Economic policies</b> to revive the high street/counter out of town sprawl/internet shopping strengthen city centres as destinations accessible by rail.					
<b>Environmental constraints</b> on economic growth affect the business case for rail improvements					
<b>Maintenance and infrastructure</b> investment increasing impact on government budget.					

<b>Economic Push Factors leading to potential passengers using another mode</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Perceived cost:</b> passengers who have cars will perceive rail costs differently to those without cars (i.e. car owners tend to discount the costs of vehicle ownership).					
<b>Value of time:</b> if worthwhileness of time, especially for business travellers, is not enhanced on rail, passengers will use other modes.					

Comment:	
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<b>Societal driving forces influencing rail and the market that it targets.</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Ageing population:</b> Where service providers face economic constraints, it will be difficult to upgrade services to better serve the needs of ageing customers.					
<b>Ageing population:</b> old people (>65 yrs) will tend to travel less than the current equivalent cohort.					
<b>Young people:</b> Young people will use rail more often, due to delaying/not getting a driving licence.					
<b>Technology:</b> working from home becomes easier and more common, reducing rail commuting.					
<b>Inclusion:</b> greater emphasis will be placed on addressing inclusion and rail accessibility for disabled people.					
<b>Environmental awareness:</b> greater awareness of environmental impacts will encourage more rail travel.					
<b>Car parking:</b> some people remain dependent on using cars to access rail (e.g. rural residents). Constraints on car parking around rail stations will limit their mobility options.					

Comment:	
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<b>Technological driving forces that are going to be applied to passenger rail networks and that will directly impact on rail passenger experience</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Automation:</b> digital railway innovations make higher frequency services easier.					
<b>Automation:</b> brings greater surveillance and reliance on technology accompanied by less visibility of staff.					
<b>Automation:</b> Automation in road transport will make people shift away from rail.					
<b>Integration:</b> continued progress with integrated ticketing and journey planning services improves passenger experience.					
<b>Digital technology:</b> 5G reduces pressure to provide free WiFi on trains (but excludes passengers who cannot afford mobile data).					

Comment:

<b>Regulation/law changes to support innovation in customer services in rail passenger services</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
New laws to place a duty on bodies with authority over transport to provide better mode integration would be useful.					
Devolving franchising to appropriate regional bodies would support regional integration of transport modes which would improve the customer offer and in turn the customer experience.					

Comment:

Environmental driving forces impacting on the rail passenger experience	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
<b>Air quality:</b> mitigation of air pollution from rail may lead to improvement of passenger experience in and around stations.					
<b>Pollution:</b> Pollutants damage infrastructure. Existing environmental laws and regulations are important generally to protect infrastructure from the detrimental effects of pollution, and emissions standards for diesel trains have improved air quality. Efforts need to continue.					
<b>Natural disasters or extreme weather events:</b> cause delays and cancellations. Between now and 2040 extreme weather events will increase in severity and frequency. Infrastructure and passenger vulnerabilities will need to be reassessed.					
<b>Energy:</b> Changes are already underway to electrify the rail network, and hydrogen is being explored as an energy source. However, by 2040 power shortages will put pressure on the rail network leading to negative customer experiences from reliability and service level impacts.					
Future regulation will make in-vehicle passenger experience more pleasant due to the shift from diesel to electricity (or hydrogen) – quieter and cleaner.					
If regulation were to phase out the use of diesel, there will be difficulties and significant cost for rail which could be passed on to customers.					

Comment:	
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**DELPHI EXERCISE MATERIALS: SUMMARY PORTER'S FIVE FORCES**

For each of our adapted Porter's five forces analysis we asked a set of questions. We have summarised the answers to each question for each force below. Please indicate how much you agree with the identified forces using the Likert scale provided (X in box). Please select N/A if you don't want to answer a particular question. There is space for your own comments.

<b>Effect of key suppliers on rail passenger experience</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Suppliers of physical infrastructure and facilities have less direct ability to address passenger experience factors than train operators.					
Suppliers of customer-facing technologies can improve rail passenger experience by providing easy and fast service, especially for trip payment. For example, trusted digital identity and innovative payment services.					

Comment:

<b>Influence of passenger interest groups on rail passenger experience</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Passenger interest groups are effective at using direct negotiations and expressions of their opinions on social media to put forward rail passenger concerns					
Passenger interest groups formally participate in consultation on new regulations at national and European level					
Individual passengers have less influence and cannot always express what is really important for them and					

Comment:



<b>Influence of regulators/regulation on current rail passenger experience</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Regulators/regulations influence current rail passenger experience a lot by setting the service standard without being informed by what customers want.					
Regulations are constantly “behind the curve” of technology and business model innovation which slows down the adoption of improvements.					

Comment:

<b>Competition among different passenger rail services or between operators, and how this influences passenger experience</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
On the whole, light rail services are not competing with heavy rail.					
Where there is competition it tends to be based on price rather than passenger experience.					

Comment:

<b>Existing Substitutes affecting the current provision of passenger rail</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
Rail should be able to attract new users from a generalized cost perspective (as the main driver for substitution is cost).					
Passenger experience factors play a critical role in switching to other modes for up to half of those who switch.					
In many European countries, rail now faces increased competition from low-cost coach services, especially on long range trips					

Comment:

<b>Current threat to rail from new substitute modes</b>	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	N/A
New modes take a long time to become established before threatening rail's role in facilitating mass-transit.					



New modes should be viewed as a necessary complement to rail in the provision of sustainable mobility for citizens.					
The transfer of activities to the internet as an alternative to travel is not a specific threat to rail, as will affect the whole transport system.					
Rail will need to respond and adapt to the threat posed by autonomous road vehicles.					
Comment:					

### PRIORITISING AREAS FOR IMPROVING PASSENGER EXPERIENCE

Please rank your top five, with 1 being the most important.

Suggested area	Ranking
Better tools to plan trips and for accessing travel information through online systems	
Simplified ticket buying processes	
Accessible and comfortable rolling stock to improve in-vehicle service quality (comfort)	
Improve services provided on board trains	
Making use of more digitalization, to enable end users to view rail as part of Mobility as a Service where they can configure the available resources into their own package	
Develop better mechanisms for listening and responding to customer needs	
Strengthening regulation to increase rail operator focus on responding to customer experience	
Improve service reliability and availability (more lines, more frequency)	
Ensure that the terms of market opening embed improvements to customer experience	
Utilise digital tools to improve coordination between operators and across modes to create a 'whole mobility experience'	
Improve affordability and ticket flexibility	
Replace season tickets and travel cards with multi-journey carnet tickets	
Designing for the needs of the elderly and disabled	
Improve first and last mile travel experience around stations	
More should be done to involve passengers in designing solutions	

## Thank you!

That is the end of your SMARTE Delphi Survey! We appreciate the time that you have taken to help us with our research. Please return this document to Kate Pangbourne ([k.j.pangbourne@leeds.ac.uk](mailto:k.j.pangbourne@leeds.ac.uk)) by 2<sup>nd</sup> October 2019. If you are interested in the outputs of the SMARTE project, please look at our [website](#).



## APPENDIX 4 – ETHICS LETTER AND CONSENT FORM

The Secretariat  
 University of Leeds  
 Leeds, LS2 9JT Tel: 0113 343 4873  
 Email: [ResearchEthics@leeds.ac.uk](mailto:ResearchEthics@leeds.ac.uk)



# UNIVERSITY OF LEEDS

Kate Pangbourne  
 Institute for Transport Studies  
 University of Leeds  
 Leeds, LS2 9JT

### Social Sciences, Environment and LUBS (AREA) Faculty Research Ethics Committee University of Leeds

30 July 2019

Dear Kate,

**Title of study:** SMaRTE  
**Ethics reference:** LTTRAN-108  
**Grant reference:** 112369

I am pleased to inform you that the above application for proportionate (light touch) ethical review has been reviewed by a representative of the Social Sciences, Environment and LUBS (AREA) Faculty Research Ethics Committee and I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

Document	Version	Date
LTTRAN-108 LightTouchEthicsForm_SMaRTE_leeds_Delphi.doc	1	17/07/2019
LTTRAN-108 Task 3.4 Delphi_5Forces_template.docx	1	17/07/2019
LTTRAN-108 Task 3.4 Delphi_PESTLE_template.docx	1	17/07/2019
LTTRAN-108 Task 3.4 Delphi_info for participants.docx	1	17/07/2019

Please notify the committee if you intend to make any amendments to the original research as submitted at date of this approval, including changes to recruitment methodology. All changes must receive ethical approval prior to implementation. The amendment form is available at <http://ris.leeds.ac.uk/EthicsAmendment>.

Please note: You are expected to keep a record of all your approved documentation, as well as other documents relating to the study. You will be given a two week notice period if your project is to be audited, there is a checklist listing examples of documents to be kept which is available at <http://ris.leeds.ac.uk/EthicsAudits>.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to [ResearchEthics@leeds.ac.uk](mailto:ResearchEthics@leeds.ac.uk).

Yours sincerely

Jennifer Blaikie

Senior Research Ethics Administrator, the Secretariat

On behalf of Dr Kahryn Hughes, Chair, [AREA Faculty Research Ethics Committee](#)

CC: Faculty Research and Innovation Office



# SMART MAINTENANCE AND THE RAIL TRAVELLER EXPERIENCE

## EXPERT DELPHI SURVEY

### PESTLE ANALYSIS

PESTLE analysis is a framework for surveying and understanding the external driving forces affecting an organisation, industry or sector. PESTLE is a mnemonic for the factors: Political, Economic, Societal, Technological, Legal/Regulatory and Environmental. We provide a survey template below for your responses.

### INFORMED CONSENT

<i>If you agree to take part, please complete and return with your responses. This sheet will be stored separately to your expert opinions to preserve anonymity. We comply with GDPR and the research ethics protocol of the University of Leeds (LTTRAN-108)</i>	Add your initials next to the statements below to indicate agreement
<i>Please insert your NAME:</i>	
I confirm that I have read and understand the information above explaining the SMaRTE research project and I have had the opportunity to ask questions about the project.	
I agree for the data collected from me to be stored on the University's secure OneDrive system and deleted once SMaRTE deliverables have been approved by the Shift2Rail Project Officer.	
I understand that taking part in the project will include being contacted periodically by email and that I will need to spend some unremunerated time reading the materials and answering the questions.	
I understand that my name and affiliation will not be associated with any published material*, and known only to the researchers and to any EU research auditors should the project be audited. Personal data is stored for the purposes of conducting the research and will not be kept longer than necessary to comply with GDPR.	
I understand that I can stop taking part at any time, but that any expert opinion data that I have already submitted to the project cannot be withdrawn once the first data synthesis is completed.	
I agree to take part in the research project and will inform the lead researcher should my contact details change during the project and, if necessary, afterwards.	

\* we understand that as an expert contributor to the SMaRTE project, you may wish to have your involvement publicly acknowledged. If this is the case, please initial here instead:

As an expert contributor to the Delphi survey conducted for SMaRTE, I wish to be acknowledged by name in Deliverable 3.4. My personal contact data will be stored only for as long as necessary for the conduct of the research process and not published.	
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Your Delphi Exercise starts on the next page.



