

## Research Article

# Research of the Passenger's Preferences and Requirements for the Travel Companion Application

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Received 8 June 2018; Revised 21 September 2018; Accepted 23 October 2018; Published 6 November 2018

Guest Editor: Stefano Ricci

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Currently, passengers have access to a lot of information when planning their trip by public transport. They can use a lot of applications, which are not compatible with each other. Sometimes it can be even quite difficult to collect all relevant information. The creation of one application (Travel Companion), which contains all relevant data needed for optimal planning of a trip can make travelling by public transport more attractive. This paper identifies and describes conditions for a large market uptake of the Travel Companion approach by the end-users: the travellers. The paper deals with research of the passenger's preferences and requirements for the travel companion. Research consists of four steps based on analyses of interaction points, interviews, and workshops. Every step of methodology brings interesting feedback on the design and functionality of the travel companion. The paper is based on particular results of the H2020 project - 730842 Governance of the Interoperability Framework for Rail and Intermodal Mobility (GoF4R).

## 1. Introduction

The increase in individual car transport brings many problems, including congestion, air pollutions, energy consumption, and other negative effects to environment [1]. This negative effect can be eliminated by an increased use of public transport, which is environmentally friendlier than individual car transport [2] and is a way how to develop sustainable mobility. Airports, ports, railway, metro, and bus stations should increasingly be linked and transformed into multimodal connection platforms for passengers to increase the use of public transport [3]. Alonso et al. [4] compared passenger transport sustainability in European cities. They propose an analysis of sustainability of urban passenger transport systems based on available indicators

in most cities and created composite indicators to measure the sustainability of urban passenger transport systems. Rail transport has a key role in the urban passenger transport system. However, in the many large agglomerations there are problems with the available capacity of railway lines. [5, 6]. The European Commission is encouraging a modal shift towards railway, what is considered as one of the key factors for the development of a more sustainable European transport system. The coveted increase in railway share of transport demand for the next decades and the attempt to open up the rail market (for freight, international, and recently also local services) strengthen the attention to capacity usage of the system [7]. However, railway transport must be integrated with all modes of public transport [8].

Public transport has to be more comfortable and attractive for passengers. Customers are influenced by many factors when choosing a mode of transport. Psychological factors have an important role among them. Understanding the psychosocial factors that influence public transportation usage behaviour can provide important implications for transport policies aimed at managing travellers' mobility behaviour [9]. Another important factor is an access to the relevant timely information. Monzon et al. [10] describe how Real Time Passenger Information systems help people change their travel behaviour towards more sustainable transport modes. It could significantly contribute to decarbonising the EU passenger transport system [11].

Currently, there are a lot of noncompatible applications designed to find the information for the passenger but it is necessary to combine the data from these numerous applications to find all needed relevant data about the journey. Stopka [12] was dealing with user requirements for mobile application to support door-to-door mobility in public transport. These applications are often created by transport operators for coordination of timetables, synchronising arrival and departure times between the different transportation modes, and the traveller information system [13].

Bak and Borkowski [14] researched the applicability of Information and Communications Technologies solutions in passenger transport from the perspective of transport users taking into consideration real case studies from different European backgrounds. Their main conclusion was that users in various regions with very different characteristics such as wealth, GDP levels, geography, and cultural back-grounds represent surprisingly similar attitudes towards Information and Communications Technologies.

This paper shows the particular results of project H2020 - 730842 Governance of the Interoperability Framework for Rail and Intermodal Mobility (GOF4R) about passenger preferences/requirements to the 'Travel Companion' (TC) application, which functions as a 'front end' user interface, giving users full control of their door-to-door travel experience [15]. TC stores and shares passenger's personal preferences in a wallet. It will give access to all travel services needed for the journey, shopping, and booking and allow storage of the rights to travel. At the same time, retailers and operators will be able to identify and authorise the TC to access their own systems and networks [16].

Paper is focused directly on the results of Work Package 2 User demand. General objective of WP2 is to map the current and future demand for the Interoperability Framework (IF) and the specific objectives are to analyse the market actors' interests in the IF and to analyse the travellers demand for the Travel companion. Travellers can use the Travel Companion (which considers personal preferences, including mobility constraints) to plan their trip, manage bookings, validate entitlements, navigate at interchanges, and, in case of disruptions, find alternative solutions for rerouting and reaccommodation. In the 'back end', the 'Interoperability Framework' (IF) provides technical interoperability of multimodal services by insulating consumer applications from the task of locating, harmonising and understanding an open-ended world of

data, events, and service resources, which are consequently made available 'as a service' [17].

The GoF4R project is the follow-up to the results of IT2Rail project. Objective of the GoF4R project is to define sustainable governance for the interoperability framework that will create the right conditions to introduce seamless mobility services and foster the development of multimodal travel services. GoF4R will help to overcome obstacles currently impeding development of market innovation by fostering a large acceptance of the "semantic web for transportation." The project and the paper are not oriented on developing the Travel companion or any other applications and their usage on the market. There actually exist many TC provided by municipalities, regional, or national carriers in every kind of transport mode. But there does not exist a defined sustainable governance and interoperability framework for their vertical and horizontal cooperation.

## 2. Materials and Methods

There is extensive literature concerning the factors that can influence (positively or negatively) the adoption of new technologies by consumers as well as research methods to analyse behaviour of passengers. A brief synthesis of the seminal works in this field is described in Table 1.

Different models coexist with a diversified range of factors, but it is possible to identify recurrent elements, that are consolidated in the literature:

- (i) Performance expectancy: the degree to which using the Travel Companion will provide benefits to consumers in different phases of the travel experience (i.e., perceived usefulness)
- (ii) Effort expectancy: the degree of ease associated with consumers' use of the Travel Companion (i.e., ease of use, usability of technology)
- (iii) Social influence: the extent to which users perceive, that important others (e.g., family and friends) believe they should use the Travel Companion and in turn promote it to their peers
- (iv) Compatibility with current resources: the degree to which the Travel Companion can rely on available resources/technologies like smartphones or similar
- (v) Habit: the extent to which people tend to repeat behaviour automatically because of learning
- (vi) Hedonic motivation: fun or pleasure derived from using the Travel Companion
- (vii) Value for money: value/monetary benefit or superiority compared with alternatives
- (viii) Perceived risk: the perception of safety and security in providing private information
- (ix) Reliability and trust: the reliability of the information that users obtain and the trustworthiness of the provider (keep promises, keep consumers' interests in mind)

TABLE 1: aTable 1: State-of-the-Art.

Method	Authors	Author's access description
Concepts of perceived usefulness	Davis [20]	First introduced the concepts of perceived usefulness and ease of use.
UTAUT (Unified Theory of Acceptance and Use of Technology)	Venkatesh et al. [21]	Defined the UTAUT according to which the main concepts influencing the use of a technology are: performance expectancy, effort expectancy, social influence, facilitating conditions and attitude towards using technology.
	Venkatesh et al. [22]	Refined UTAUT to UTAUT2 with the addition of some further factors: hedonic motivation, price value and habit.
	Wang et al, [23] Pura [24] Slade et al. [25]	Integrated the UTAUT model with other factors like perceived risk, trust, behavioural intentions, monetary value.
	Fenton, (n. d.) The World Café Community Foundation, 2015	Described Word Café method.
Ethnographic research	Goetz and LeCompte [26]	Dealt with strategies for analysing records or transcripts of human behaviour. They described some techniques such as the constant comparative method, typological analysis, enumeration systems, and standardized observational protocols.
	Fetterman [27]	Described ethnography as “the art and science of describing a group or culture”
	Narain [28]	Used qualitative research design, an ethnographic approach and a diversity of data sources showing how social heterogeneity, land use change and other transformations in rural-urban links brought on by urbanization shape periurban transportation needs and practices.
	Jordi [29]	Used ethnographic research for analysis a socio-cultural point of view perceptions about the health of those who use bicycles as means of transportation.
	Cass and Faulconbridge [30]	Dealt with theoretical insights into understanding everyday travel (from the mobility turn and theories of social practice) in an analysis of everyday mobility using data from ethnographic research.
	Jones et al. [31]	Used an ethnographic study for making sense of new transport.
	Gossling and Stavrinidi [32]	Designed and embedded in a grounded theory approach, the study investigates the mobility patterns of one Generation Y network based on an ethnographic research.
	Brown, Iacono [33]	Described that ethnographic research produces an extra-ordinary depth of knowledge on the context of the research study and can therefore produce rich insight into the problem.

(x) Learning effects: the ability of the Travel Companion to learn from previous searches, preferences, etc. to improve suggestions, routes, etc. to users

Many research methods can be used to analyse the behaviour of a passenger. Interviews, ethnographic workshops, and international expert workshops were used in this project. Ethnographic workshops and international expert workshops

were realised on the World Café principle. Respondents were common passengers/potential passengers at the Ethnographic workshops and transport experts at the International expert workshop.

A “World Café” is a common method for fostering interaction and dialogue within large or small groups [18, 19]. It is particularly effective in identifying the collective wisdom of large groups of diverse people. The format is very flexible

A		Consumer interaction points	IT2RAIL concepts
On-going communication		User identity	User identity / E-passport / Wallet
		Preferences	Preferences
		Planning	Location resolver / meta-network Construction / multimodal shopping / booking and ticketing
		Buying	Wallet
		Receiving entitlement	Booking and ticketing / Wallet / E-passport
		Information	Trip-tracking / interchange navigation / business analytics
		Disruption	Disruptive ticketing and validation
		After trip	Business analytics
B			

FIGURE 1: Overview of TC consumer interaction points & corresponding IT2Rail concepts.

and adapts to many different purposes: information sharing, relationship building, deep reflection, exploration, and action planning. The host begins by putting participants at ease. The process then consists of rounds of approximately 20 minutes of conversation for each group on a specific question or item that needs to be explored and discussed. At the end of each round, everyone moves to another table. The moderator summarises after every change what was said in the previous group. One group continues on the findings of the previous group. Afterwards, insights gathered by each table are shared with the larger group and presented visually, for example, by means of graphics.

The methodology of research within the GoF4R project consisted of 4 steps:

- (i) As a first step, the Travel Companion has been 'deconstructed' into its consumer-oriented capabilities and interaction points.
- (ii) For each interaction point, a series of assumptions have been formulated with regard to factors (incentives, needs, constraints, barriers) that could (positively or negatively) influence the consumer uptake of the TC approach. These assumptions were validated by means of interviews with relevant stakeholders.
- (iii) Workshops were organised in Belgium, Italy, Slovakia, and the Czech Republic, in order to better understand the conditions for market uptake of the Travel Companion approach and to assess potential ethnographic differences between countries and cultures.
- (iv) Finally, the findings obtained during the interviews as well as the national workshops were presented and further discussed at a European-wide workshop with Shift2Rail IP4 members and other experts.

### 3. TC Consumer Interaction Points

Based on the results of IT2Rail project TC should be conceived as the interface between the traveller (user) and the travel and transportation network system which

- (i) supports the user in all phases of the travel: preparation, execution and after-trip operations;
- (ii) stores travel-related documents.

IT2Rail focuses on a number of concrete use cases, specific instances of an individual traveller's journey, that follow the traveller throughout the different stages of planning, booking, and executing a multimodal journey, in order to better understand actual user needs along the way.

Without going into details about code information and IT technicalities, it is for our purposes interesting to consider the Travel Companion (TC) from an end-user point of view in order to understand how it could work in practice.

The IT2Rail concepts have been taken as a starting point to define 'consumer interaction points', i.e., all those situations in which the Travel Companion may assist the user in different phases of the travel experience (Figure 1). The main consumer interaction points are described below.

**User identity:** in order to be able to use the Travel Companion, users will need to register and create an account. They will also be asked to provide some personal information (for example, name, address, age, gender, e-mail address, phone number, payment details). The aim is that the Travel Companion will thus be able to provide the user with customised assistance and information.

**Preferences:** a consumer will need to complement the user identity with their individual preferences. Some of these preferences may be transport related, e.g., PRM status, seating preferences, and modal choices (possibly linked to weather or other circumstances, e.g., working day-weekend, business-leisure) and some may not be transport related, e.g., preferred social media, dietary needs, etc.

**Planning:** travellers can use the TC to plan their journey from A to B comparing different travel options and combining different variations of transport modes. The TC can provide personalised routing results according to the user's specific travel preferences or needs, including, for example, the fastest or cheapest route. A user might reiterate a planning request, altering the input or the preferences.

TABLE 2: Overview of the workshops.

Date	City & country	Number of participants	Responsible partner
30/10/2017	Ghent (Belgium)	12	European Passengers' Federation
07/11/2017	Žilina (Slovakia)	18	University of Žilina
07/11/2017	Milano (Italy)	28	Politecnico di Milano
20/11/2017	Brno (Czech Republic)	12	University of Žilina
22/11/2017	Bratislava (Slovakia)	18	University of Žilina

Buying: after planning a journey, a user will have the possibility of buying a ticket/entitlement. This is a separate step because not all planning will lead to buying.

Receiving entitlement: after paying for the journey, the ticket or entitlement will be stored in the Travel Companion (primary carrier). As a back-up (in case the smartphone cannot be used), the E-passport is planned to store data on the user's journey within its NFC chip.

Information: a traveller will need different types of information during the trip: both transport related and possibly also nontransport related (e.g., information on the weather, shopping, tourist information, food and drinks, etc.). The TC will be able to offer context-dependent information, based on the current location of the traveller (using the GPS and possibly the accelerometer in the user's smart device), which could, for example, be useful in the case of navigation at interchanges.

Disruption: when a disruption occurs, a traveller will interact with the Travel Companion most likely a multitude of times to plan alternative solutions and to receive information.

After trip: after the trip, the user will be able to interact with the Travel Companion to give feedback on the trip and/or receive additional information in case something went wrong.

On-going communication: since travelling carries a certain degree of uncertainty, a user will seek on-going communication throughout the journey.

For each interaction point, we aim to identify possible needs/expectations as well as barriers/constraints from the point of view of the end-user: the traveller.

The methodology of our research consists of 3 steps; in the first round interviews were done with specialist from the praxis (carriers, transport authorities, governance) for defining the needs/expectations and the barriers of the TC. Results from the first round were used as a base for the second step. In the second round we got information from random passengers about their travel preferences, which the TC should take in account. These workshops were the main part of the research. In the last round the mismatched opinions of the passengers were consulted with experts in the field of transport.

**3.1. Interviews.** The purpose of the interviews conducted within the research was to collect information on the following:

- (i) What are the needs experienced by the customers in connection with the TC?

- (ii) What factors are relevant 'in general' to explain customers' the TC adoption?

- (a) What factors can obstacle the TC use?
- (b) What factors can facilitate the TC use?

- (iii) What factors are relevant for each interaction point (cf. above) and how could they influence the customer acceptance and use of the TC?

When selecting potential interviewees the following profiles were used:

- (i) Familiar with consumer-oriented ICT applications
- (ii) Preferably with expertise in consumer sciences (psychology, behavioural sciences, marketing, user-centred design, user experience researcher)
- (iii) Preferably with expertise in Human-Machine Interaction
- (iv) Mobility professional but she/he can also be active in another sector as long as she/he has a strong consumer focus

The study also aimed at collecting a relative coverage of the whole mobility sector (local, urban transport, rail, car, aviation, etc.).

In total, 16 in-depth interviews were carried out for research with experts from 5 different countries.

To ensure basic information, uniformity and as much objectivity as possible, interview guidelines were developed including 28 prepared questions to structure the interviews.

The interviews were divided into 9 main sections related to the above-mentioned 'interaction points' between the Travel Companion and its user. The answers have been recorded and translated into English and have been sorted so that all of the answers to each question are presented together to allow for comparison and analysis of the results. A summary of the results from each question is presented in the following section of this report along with the conclusions.

**3.2. Ethnographic Workshops.** In order to collect further information on factors that could influence the uptake and use of the Travel Companion (building upon the findings of the interviews), and also to detect possible cultural/ethnographic differences (East/South/West-Europe), five workshops were organised (Table 2).

People were chosen on the basis of random choice with reflecting the structure of the potential passengers: students,

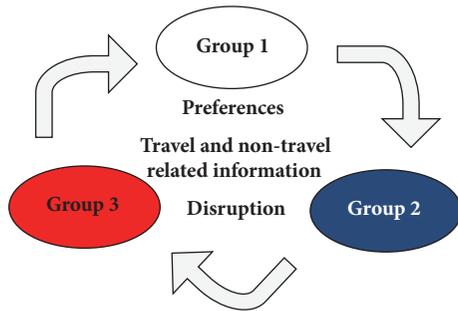


FIGURE 2: The World Café method was used to discuss three topics (In the Milan workshop, four teams each discussed two topics).

seniors, employees, nonemployees, men and women, user and nonuser of public transport.

To ensure basic information, uniformity, and comparability of results, workshop guidelines were developed including tips on how to select participants, how to organise the workshop, themes to be addressed, workshop methods to be used, and reporting instructions.

The target number of participants was 15/20 per workshop. The method used for selecting participants is the so-called ‘purposive’ or ‘convenience’ sampling. The focus group approach being a qualitative methodology does not aim at providing results that describe how an entire population would respond to the same questions, but aim to achieve a better understanding on how users relate with a certain topic, through a discussion and a comparison between participants’ personal attitudes towards the theme. In selecting participants to be invited to the workshop, attention was paid to the following criteria:

- (i) Balance between men and women
- (ii) Balance between younger and elderly people
- (iii) Inclusion of at least one person with reduced mobility
- (iv) Balance between experienced and nonexperienced travellers
- (v) Balance between regular and nonfrequent travellers
- (vi) Balance between digital natives and digitally impaired travellers
- (vii) Inclusion of people that travel for different purposes (business, leisure, other)
- (viii) Inclusion of people that travel both within their own country and outside their own country

The workshops all lasted 2-3 hours and were held in the local language. The workshops all followed a similar structure:

- (i) Introduction
- (ii) First round: discussion on three topics (preferences, travel related & nontravel related information, disruption & feedback) using the World Café method (Figure 2)
- (iii) Second round: discussion on barriers and incentives to use the TC

Each workshop started with a brief introduction of the GOF4R project, the workshop objectives and a description of the Travel Companion and its functionalities, followed by a short round of acquaintance (20 mins in total). Then, the participants were divided into smaller groups.

During the first round of discussion (ca. 50 min.), the World Café method was used to tackle three topics.

The three topics discussed during the first round in each workshop were as follows:

#### (1) Preferences

- (i) Do you think that the ability to indicate their preferences will be considered by users as an incentive to use the Travel Companion and/or could it be a barrier? Please explain.
- (ii) Do you think more people would use the TC if it is not necessary to set preferences first?
- (iii) Which preferences do you think are most important?
- (iv) Do you think the Travel Companion should ‘remember’ preferences from previous choices the user has made when planning / booking a trip?

#### (2) Travel related info vs. nontravel related info:

- (i) Travellers especially need information on cost, travel/transfer time, travel modes and transfer points. Are any important items missing from this list? If so, what is missing?
- (ii) Is it useful that the Travel Companion provides nontransport related information too? If so, which are most relevant?
- (iii) The Travel Companion will be able to offer context-dependent information, based on the current location of the traveller (using the GPS and possibly the accelerometer in the user’s smart device). Could this be a barrier for using the TC or do you think it will more likely be an incentive?
- (iv) Should users be able to communicate with other travellers on the same route (e.g., to find out where in the vehicle there are any free seats left)? Why (not)?

#### (3) Disruption / feedback:

- (i) Which kind of assistance should be offered by the Travel Companion in case of a disruption? (planning an alternative route, offering the possibility to ‘buy’ a new ticket, offer also nontransport related information, e.g., on accommodation, food/drinks, and so forth).
- (ii) Should the TC only communicate about how the journey is going in case of disruptions or also reassure the user during the journey if everything is going according to plan?

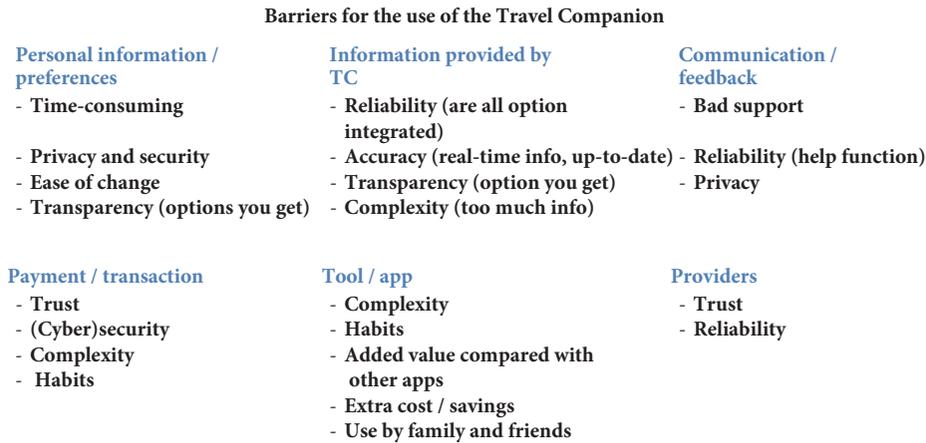


FIGURE 3: Barriers for the use of the TC.

- (iii) What kind of information should the Travel Companion offer the user after the trip has finished? (e.g., lost property, how to file a complaint, information on passenger rights).
- (iv) Which options for on-going communication should be offered by the TC? (e.g., chat, social media, hotline, personal assistance, SMS, and notifications on the TC).

In the second round of the discussion (ca. 40 mins), workshop participants were asked to discuss potential barriers for the use of the Travel Companion. They were presented with a map showing the most important barriers detected in the interviews (cf. above) and asked how to get rid of these barriers (Figure 3).

In a final part (ca. 15 mins), each group was asked to think about incentives to use the TC. Which functionalities/characteristics would they highlight? How would they try to reach certain target groups? Which communication channels would they use? What type of campaign would they propose? What are the main advantages of the TC compared with existing travel apps?

**3.3. International Expert Workshop.** An international expert workshop was held in Brussels (UIC premises) on December 5<sup>th</sup> 2017. The workshop had the following objectives:

- (i) Exchange knowledge between different IP4, S2R and other experts
- (ii) Validate findings of the end-user research done so far in the research
- (iii) Detect the (potential) implications of the user requirements on the IF and its governance

24 people attended the workshop, including 14 external experts (from outside the GOF4R consortium) from different countries and different fields of expertise.

To start with, the participants were introduced to the Shift2Rail programme and the GOF4R project. The Travel Companion's objectives and functionalities were presented

as well as the main findings obtained so far from the interviews and national workshops. A 'tour de table' followed in order for all meeting participants to present themselves. In particular, the external experts explained their experience and connection to this and other EU-projects and their expectations.

## 4. Results and Discussion

The fields of our research and their particular results are described in Figure 4.

More detailed research results are described in the next chapters.

**4.1. Interview Results.** The interviews have provided valuable feedback on the design and recommended functionality of the Travel Companion. From these the following design considerations should be implemented:

- (i) It should be possible to use basic functions such as journey planning without registration.
- (ii) Registration and setting preferences should be kept simple and information should only be requested when it is required. It should in that case also be clear to the user why it is required and how it will be used, they should be able to understand the benefits from this.
- (iii) The user should have the option for the TC to remember any preferences.
- (iv) The TC should be transparent on options you get when you plan a trip (linked to preferences).
- (v) Complexity of the tool was identified as the greatest barrier, so simplicity should be prioritised.
- (vi) Another primary barrier is trust: the TC must provide a trusted platform for e-commerce and build up trust in providing the most appropriate ticket prices and real-time info.
- (vii) The opinions were mixed regarding whether payments should be before or after trip. The advantages

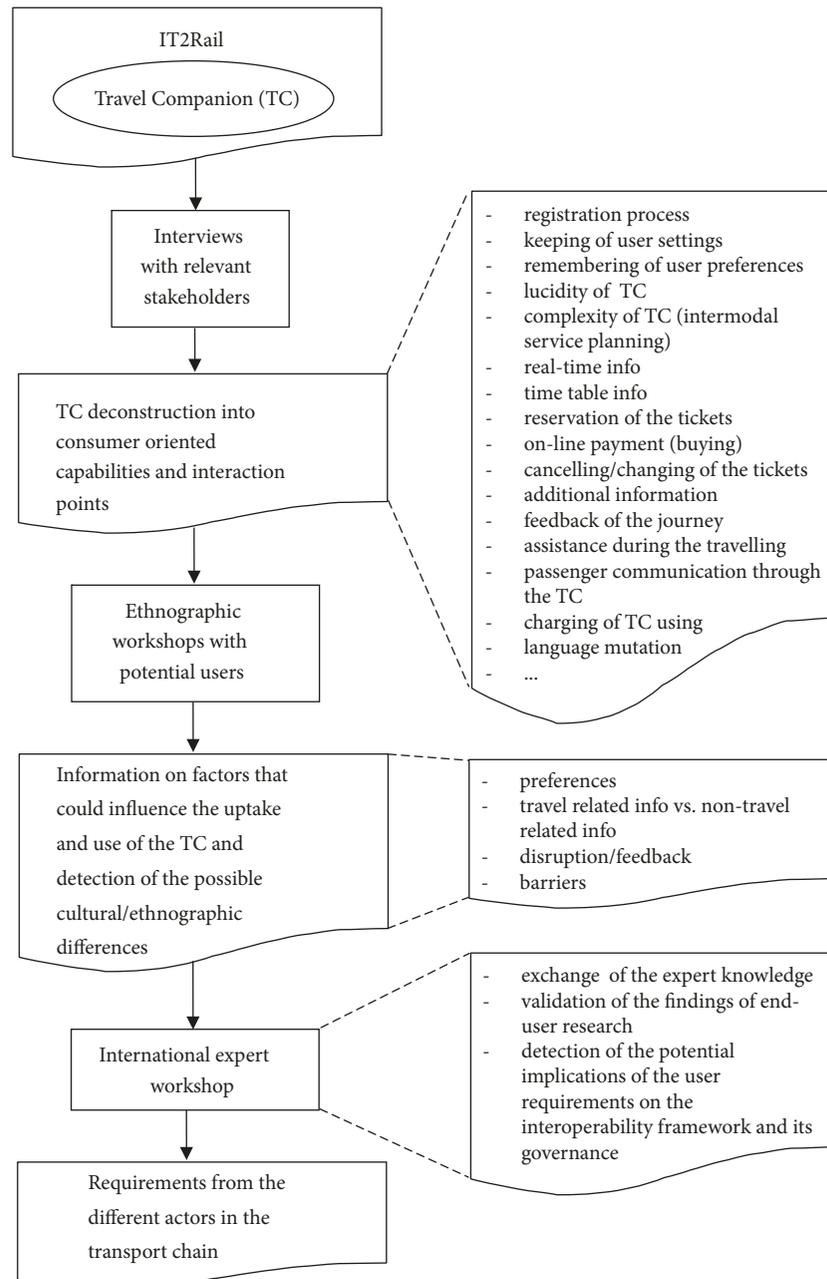


FIGURE 4: Partial topics of research.

of post payment were that it is easier to provide compensation/discount in case of disruption. But customers are used to prepayment for purchasing public transport journeys. Post payment could be an option for business users or frequent travellers.

(viii) The TC should allow the users to buy tickets for others.

(ix) Most respondents felt that there was no benefit to storing tickets on an NFC chip. Instead, QR codes which could be printed or displayed on a mobile device are considered preferable.

(x) Flexibility was highlighted as a key user requirement and the ability to cancel or change tickets, although charges may apply for increased flexibility. There was also a concern that although a single ticket may be simpler for the user, it may result in less flexibility for the user to change sections of their journey.

(xi) Additional information may be useful, as long as it does not overcomplicate the tool, but also some information is available in alternative tools.

(xii) The ability to provide feedback on the tool and journey was considered as a useful functionality.

- (xiii) The tool should provide a method and the data for claiming compensation, or automatically provide feedback.
- (xiv) Assistance could be provided through the tool and would be particularly useful for PRM, children, and the elderly. However, it may present additional cost to the transport operators.
- (xv) There were mixed reactions about passenger to passenger communication through the Travel Companion; it could be useful for arranging to share part of the journey, e.g., share a taxi, but could also degenerate. Also, many other social media tools are already available.
- (xvi) The Travel Companion should be free of charge, unless it offers additional services.
- (xvii) The Travel Companion should be available in language of the user.

4.2. *Workshop Results.* The main barriers to use the TC, identified during the national workshops, were:

- (i) *Accuracy, related to information:* the tool should be able to manage extraordinary situations in real-time, signalling (as some existing apps already do) delays, strikes, changes in the status quo. Information (in particular, related to disruption) should be updated as often as possible and the replanning should be guaranteed and timely.
- (ii) *Reliability related to information provided by the TC* has been detected as a key feature. The TC should be able to consider all possible options (first and last mile, special deals, and prices) and show them to users, so that they can check and to choose the best alternative.
- (iii) *Profile/preferences: time-consuming:* users should be able to decide which information they want to register and it should be possible to enter only very little information. It should be possible to use the TC without creating a profile or set preferences first.
- (iv) *The complexity of the tool/app:* participants agreed that it is a key issue to provide a smart and intuitive interface, avoiding complex and too technical issues.
- (v) *Bad support during and after trip* is also indicated as a barrier. Users want to communicate with the tool when necessary and get personal assistance. Giving feedback should be as easy as possible. A simple yes/no question, choosing a smiley face or a sad face, thumbs up or thumbs down, and so forth are preferable over long questionnaires. Gamification and rewards could help to incentivise travellers to give feedback on the services. It would be useful if user feedback could also be given during the journey.
- (vi) *Cyber security:* the TC should be as reliable/safe as competing applications in terms of on-line payment. The system must offer the payment method(s) that people prefer (which can differ from country to

country). It may be a problem only if the user is generally suspicious of using any form of online payment.

- (vii) *Existing habits:* most people already use an alternative app. TC has several competitors from which it has to differentiate clearly showing what its added value is. Habits become a problem when a user has a loyalty with a specific company that guarantees him some benefits. The TC platform could also release a fidelity card to avoid the issue.
- (viii) *Privacy:* privacy concerns are related specially to profile (personal data) and buying (card details); however, this is not considered as one of the most important barriers.

The main incentives that were found in the workshops that can facilitate the uptake of the TC:

- (1) Usefulness of the TC: today, organising complex, multimodal, European wide trips requires a lot of effort and is time-consuming. Travellers must adjust to a variety of interfaces, devices, tools, etc. The IF and the TC could make the planning & buying process a lot easier.
- (2) Better protection of the passenger rights: in case of a disruption, the TC should offer full assistance, informing the user on alternatives, if the original plan is no longer feasible, and also on passenger rights and reimbursement procedures. Currently, passenger rights apply independently to each individual transport mode and only under a single contract of carriage.
- (3) Accurate and reliable information: consumers need to feel confident that they receive an overview of the best travel solutions, taking into account preferences and needs. Reliability (of data, information) and transparency (e.g., how will the user's personal data be stored and processed) are two important aspects that will determine whether a traveller will use the TC. Crowdsourcing can be a good tool to complement information from 'official' sources.

4.3. *International Expert Workshop Results.* An international workshop with IP4 and other experts was held in Brussels on December 5th 2017, in order to validate the findings of end-user research done so far in project as well as to detect (potential) implications of these user requirements for the IF and its governance. Some interesting issues addressed during this expert workshop are listed below.

- (i) Transport Service Providers should be stimulated to share data. For example, PTAs could include this as a contractual obligation in Public Service Contracts with PTOs.
- (ii) It is important to integrate the data of small service providers and cycle infrastructure as well, in order to get a complete picture of what overall, the best travel options are.

- (iii) For third-party players that aggregate (or sometimes scrape) data from different sources, it is important to have good quality datasets.
- (iv) Various technical methods can be used to improve data provision, including the use of mobile phone sourced data (which implies a contractual relationship with providers).
- (v) Different (or absent) approaches to open data exist in EU countries.
- (vi) Regulation can make it easier to exchange data. The EC could, for example, provide guidelines on standardisation.
- (vii) New business models can be developed to incentivise TSPs to share data and provide good data sets. The 'roaming' principle from the telecom sector was mentioned as a good example.
- (viii) One of the biggest barriers for a small scale developer is the economics balance between marketing costs and ticket revenues.
- (ix) A key issue is the speed and accuracy of the process to investigate the 'raw' data and turn it into useful information for the customers.
- (x) Segmenting the data set (e.g., based on the type of trip or the type of traveller) can facilitate that the data fit the user's personal needs.
- (xi) Individual datasets should not be published. The GDPR is seen as a good initiative. It would save developers and TSPs time and effort if the EC could prepare clear guidelines on how to implement this Regulation in practice.
- (xii) If existing UX research could be shared between all IF-stakeholders, this could be an incentive to cooperate (especially for start-ups who do not have large research budgets).
- (xiii) The experts suggested to make the TC a modular tool so that users can start with a 'simple' version and if needed afterwards upgrade/expand.
- (xiv) If possible, developers should adopt the principles of universal design to make sure also PRM can use the TC.
- (xv) When a disruption occurs, TSPs should be forced to cooperate.
- (xvi) A harmonisation of passenger rights across all modes is desirable.
- (xvii) As an extra (paid) service, the TC could offer users an insurance that guarantees rescheduling in case of disruption. Paid in advance, this could be economically feasible.
- (xviii) Crowdsourcing could be a good way to improve reliability of data, on the condition that there is a critical mass and that cross-reference with official channels is made.

*4.4. Generally Results and Discussions.* Our research confirmed some part of the concept of Interaction points established in IT2Rail but some of them were not confirmed. The differences are listed below.

User identity:

- (i) some customers do not agree with registration and using personal info in TC (e.g., when users search only information about the trip)

Preferences:

- (i) the users require the individual preferences only at planning the trip; it was not confirmed

Planning:

- (i) the users prefer simplicity of the TC before complexity mainly for planning of the short distance trips

Buying:

- (i) the customers were afraid of e-commerce security of TC
- (ii) the users require the possibility to buy tickets not only for registered users

Receiving entitlement:

- (i) the potential users prefer QR code before NFC chip

Information:

- (i) the users do not require additional information (weather, shopping, etc.); they require detailed information about travelling

Disruption:

- (i) the users agreed with what the IT2Rail experts suggest

After trip:

- (i) the potential passengers require easy feedback (simple click to the icons at TC)

The results of our research show that potential users of the TC require a simple system of the TC, access to the main function without registration, flexibility (the possibilities of changing the kind of transport, final destination, etc.) mainly in unexpected situations in traffic (riots, accidents, natural disasters, etc.), protection of personal data, and secure platform for e-purchasing.

In case of real use of the TC it should be required to mandatorily share the information between all carriers (state, private) which offer public transport services and nonobligatory for other carriers. Design of TC should be universal with a modular structure. TC should offer valid and real time information, which is necessary for ordinary passengers as well as for businessmen.

## 5. Conclusions

In order to design and develop a sustainable and successful governance for the Interoperability Framework (IF) for semantic technologies that are being developed under the IP4 Shift2Rail programme (which is the overall objective of the GoF4R project), the requirements from the different actors in the transport chain need to be mapped and analysed. This paper presents the outcomes of particular results within GoF4R, which focuses on the “Analysis of the consumer demands and interest in using the TC capabilities”.

As a first step, the Travel Companion has been ‘deconstructed’ into its consumer-oriented capabilities and interaction points, i.e. all those situations in which the Travel Companion may assist the user in different phases of the travel experience. The main consumer interaction points identified are: user identity, preferences, planning, buying, receiving entitlement, information, disruption, after trip, and on-going communication.

For each interaction point, a series of assumptions have been formulated with regard to factors (incentives, needs, constraints, barriers) that could (positively or negatively) influence the consumer uptake of the TC approach. In order to validate these assumptions, interviews were conducted with experts from different countries. In order to collect further information and to better understand the factors that could influence the uptake and use of the Travel Companion (building upon the findings of the interviews), and also to detect possible cultural/ethnographic differences, workshops were organised in Belgium, Italy, Slovakia, and the Czech Republic. And then finally a workshop with experts was held in Brussels, Belgium.

The interviews and workshops have provided valuable feedback on the design and recommended the functionalities, which the Travel Companion should have.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

This paper was supported by the European Commission, H2020 project - 730842 Governance of the Interoperability Framework for Rail and Intermodal Mobility (GoF4R).

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