User Requirements for the Design of Efficient Mobile Devices to Navigate Through the Public Transport Network,

Please cited as: Pronello, C., Camusso, C., (2015): User requirements for the design of efficient mobile devices to navigate through public transport networks, in "*Ict for transport Opportunities and Threats*", Thomopoulos, N., Givoni, M., Rietveld, P., editors,: Edward Elgar Publishing. Cheltenham, UK, pp.55-93.

User requirements for the design of efficient mobile devices to navigate through public transport networks

Cristina Pronello and Cristian Camusso

1 INTRODUCTION

Public transport, supported by the development and deployment of Intelligent Transport Systems (ITS), is increasingly considered key to achieve a sustainable transport system. To speed up and coordinate the deployment of ITS in road transport and its interfaces with other transport modes, the Commission adopted an Action Plan in 2008 (EC, 2008), followed by the Directive 2010/40/EU (European Parliament and Council, 2010). In addition, the EU global positioning system, Galileo291, is expected to be operational by 2016–17; the early services started in 2014, while 18 satellites are expected in 2015–16.

Within such a framework, the research presented in this chapter resulted in the design of 'Smart-Way', an application developed in the cities of Turin (Italy) and Dresden (Germany), conceived to use Galileo to support navigation through a public transport network.

At present the application is based on the NAVSTAR GPS (NAVigation Satellite Timing And Ranging Global Positioning System), but it will be switched to Galileo when this becomes available, thus bringing new developments in ICT (Information and Communication Technology) for transport, at least in Europe1.

The motivation for this research comes from the awareness that, without a policy to reduce automobile use, the introduction of high quality public transport does not guarantee significant modal diversion (Mackett and Edwards, 1998; Pronello and Camusso, 2011).

However, a joint policy of providing high quality and reliable information could induce people to consider a modal shift. The difficulty lies in persuading habitual car users that public transport could be an alternative to the car; however, with the provision of suitable traveller information the perceived inconvenience of using public transport is reduced by making it easier to plan and execute a journey (Lyons and Harman, 2002).

Smart-Way is an Advanced Traveller Information System (ATIS), an ICT for transport, which would like to bridge the gap between user needs and their behaviour, making the latter more sustainable.

ATISs are data integration systems delivering accurate, reliable and timely information to travellers (Hyejung, 2009), enabling them to plan their route, estimate their travel time, and make informed decisions using real-time information (Kumar et al., 2003).

Abdel-Aty (2002) stated that it is not easy to define and quantify ATIS impacts due to the lack of real-world environments in which travellers' behaviour can be observed under the influence of ATISs.

The potential of ATISs to influence mobility behaviour has hitherto rarely been researched (Gotzenbrucker and Kohl, 2011; Chorus et al., 2006).

However, there have been many attempts to evaluate ATIS benefits, gathering data from various sources, predominantly from surveys but also from field observations and simulations (Williams et al., 2008).

Most of the surveys concerned the effects of traffic information on car drivers, mainly commuters, to estimate user satisfaction and the effects of ATIS operation (Khattak et al., 1993; Asakura et al., 2000; HongCheng and LiJun, 2006; Chorus et al., 2006).

Instead, only a few studies explored the consequence of information on public transport (PT) ridership, notwithstanding its potential role in increasing it and improving customer satisfaction (Jou, 2001).

Moreover, as observed by Pronello and Camusso (2011), there is another component in determining behaviours: daily activities and habits can result in a resistance to change, even if opinions towards modal change are favourable. In fact, the choices made regarding the daily trip represent a repeated behaviour which can gradually become a habit and this very repetition hinders the ability of people to change it (Aarts et al., 1998).

Fujii and Gärling (2003) also argued that context is a true determinant of actual behaviour; however, habits remain a key aspect in modal choice (Gärling and Steg, 2007).

Real-time information is the novelty introduced by Smart-Way, one of the first smartphone applications for PT when it was developed in 2010–11. Nowadays there are a few more real-time applications, as those developed for Zurich (ZVV, 2013), Vienna and London.

Abdel-Aty et al. (1996) reported that about 38 per cent of non-public transport users indicated that they might consider using transit if appropriate public transport information were available to them.

Further, Abdel-Aty (2001), using telephone interviews in two metropolitan areas in northern California, showed that commuters seek several types of PT information to be encouraged to use transit: operating hours, frequency of service, fare, transfers, seat availability and walking time to transit stops.

---

[1] More information about EU support of Location Based Services (LBS) can be found at: http://ec.europa.eu/enterprise/policies/satnav/galileo/applications/location-based-services/index_en.htm.

He also noted that the accuracy and the quality of the information to travellers are decisive (Abdel-Aty, 2002).
The Transportation Research Group (2000) found that the five most important factors that users seek in PT have been ranked in the following order: reliability, travel time, convenience, cost and comfort.
People using traveller information on a daily basis are still a small portion of all travellers, but the rapid evolution of the information given to public transport users will probably increase such a proportion (Bunch et al., 2011).
Initially, general and not customized information about scheduled arrival time (timetables and network maps at bus stops), was followed by the first ATISs applied to public transport, which transferred the information available at the bus stops to the operator's website.
However, this information was not yet customized, and reported only estimated arrival times. In the meantime, transport companies started offering diverse public transport information services, such as emails and SMS about estimated arrival time at stops (Tang and Thakuriah, 2012).
Now even more transport companies have equipped their stops with displays showing vehicles' arrivals estimated in real time.
Tang and Thakuriah (2012) compared transit ridership before and after the implementation of real-time transit information systems, concluding that their increasing use leads to PT ridership gains.
However, simple before-and-after comparisons may not be enough to explain the gains since factors other than the implementation of transit information
systems – such as population, fuel price, transit fare and employment levels – might influence changes in PT patronage. Thus, it would be problematic to conclude that the observed increase in ridership is a direct result of the traveller information system based on this type of study (Schweiger, 2003).
If, and in what way, systems like these have an effect is highly dependent on how they are utilized by users. Obviously, this is not only a technological but also a social process which merits technology assessment (Gotzenbrucker and Kohl, 2011).
Farag and Lyons (2012) showed how travel behaviour, travel attitudes and socio-demographics have the strongest effect on pre-trip PT information use for both business and leisure trips.
The research reported in this chapter aims at defining the characteristics of a real-time traveller information device by asking the users directly what features they want to really benefit from it, to use (more) PT, and to induce car drivers to divert to PT.
A further aim is to define the potential business model to keep such a system updated and operational.
The view of both transport companies and transport authorities completes the picture since they were asked about their requirements for strengthening users' loyalty and attracting new users, in addition to possible barriers with using Galileo-based applications on mobile devices.
The next section of this chapter describes the quali-quantitative approach employed for the data collection exercise.
The results are presented in section 3, distinguished between PT users on one hand and companies and authorities on the other. Section 4 discusses the results and contrasts them with the relevant literature.

2 METHODOLOGY

The methodology comprises four steps:

- data collection design;
- sample selection;
- administration of surveys;
- data analysis.

The first step relied on a quali-quantitative approach based on two tools: the web-questionnaire and the focus group that were meant to work in parallel. Focus groups are typically used in market analysis; for details, see Krueger and Casey (2000).
The focus groups were used both to collect users' needs and investigate the effect of the technology studied on travel behaviour as well as to investigate thoroughly the psychological and social attitudes of the sample and their perception of the technology.
Different focus group outlines and questionnaires were prepared for the PT users and for the companies and authorities.
Two groups of transport users were established, one in Turin and one in Dresden, to observe possible differences due to social and cultural backgrounds.
European PT companies and authorities were involved in a single group.
Approximately 10 individuals per group of users were selected following a stratified convenience sampling plan according to the gender (male, female); age (<25, 26–65, >65); profession/educational level/income (low-middle, high); used mode (car, PT).
Fourteen people took part in the focus group in Turin, including four physically disabled persons to gain a wider view of mobility needs. The German focus group had seven participants without any disabled people.
Ten companies and authorities were stratified by geographical location (north, south, and east of Europe) and city size (medium, large).

Many PT companies were initially contacted and asked to fill in the web-questionnaire. Given the limited availability to travel to the focus group's venue, six transport companies and one transport authority participated at the focus group:

- Transports Metropolitans de Barcelona TMB, and Athens Urban Transport Organisation OASA (large cities in southern Europe);
- Budapest Transport Private Corporation Transman, and Zarząd Transportu Miejskiego ZTM (Warsaw Public Transport Authority) (large cities in eastern Europe);
- Dresdner Verkehrsbetriebe AG DVB (from Dresden, a medium-size city in north-eastern Europe);
- Empresa Municipal de Transportes de Valencia S.A.U. EMT, and Gruppo Torinese Trasporti GTT (medium-size cities in southern Europe).

One more transport company responded to the questionnaire: Strathclyde Partnership for Transport (SPT) from Glasgow (medium-size city in north-western Europe).

2.1 Focus Group Outlines

Transport users were selected to offer input to develop the application incorporating user needs, thus the focus groups started with a presentation of the Smart-Way project and an explanation about the concept of the real-time travel planner for PT. Then, a '*tour de table*' allowed participants to meet and got the discussion going, which was divided in four parts.

The first part was dedicated to understanding the personality traits of the participants, mainly related to the emotions felt during their trips (for example ability to 'navigate' in the networks, sense of direction and attitude towards changing routes).

The second part dealt with travel habits, to understand mobility behaviour and attitudes towards public transport and car.

The third part concerned technological issues, aimed to understand the level of confidence of the participants with technologies, such as the internet, mobile phones, computers, and contemporary tools such as social media.

Participants were then asked whether they own technological devices and whether those are equipped with GPS.

The last part revolved around the Smart-Way concept: the interest in using the application and the characteristics it should embody were discussed. Finally, participants were asked about which features are required of the devices to induce modal diversion or increase use of PT.

After the presentation of the project and the introduction of the participants, the transport companies and authorities focus group focused on understanding which information services are offered by companies, how, and who manages those. Privacy issues were also examined since it is an important concern of users when discussing ICT for transport issues.

Before entering the 'core' of the Smart-Way application, the discussion concerned the use of GPS and its possible drawbacks, the opinions about Galileo and the willingness to use it.

Further points investigated included: the utility of using Smart-Way for the transport companies and transport authorities, their expectations, their opinion about what users expect from such a device and about its ability to attract more people to public transport, the possible privacy implications, the information they would like to obtain and their willingness to implement such a system, including the point regarding whether its management should be in-house or outsourced.

2.2 Questionnaires Supporting the Focus Groups

A web-questionnaire was administered and filled in by the transport users and PT companies and transport authorities before the focus group.

Initial questions for PT users covered personal information and were complementary to the topics of the discussion. Further questions regarded travel behaviour of users (the characteristics of their most frequent trip and of trips in their spare time) and their opinions about private and public transport, and about technological tools, expressed according to a five-point Likert scale (Table 3.1).

The web-questionnaire for PT companies and transport authorities started with requests for general figures (number of employees, revenues, territorial coverage, used modes and fleet), followed by questions about information services: the characteristics of their system in terms of the time release of the data (static or dynamic), the time interval in the case of real-time information, the kinds of services offered (SMS, WEB, info point, call centre) and the costs of offering them, as well the data given to users.

Finally, questions about privacy issues explored potential drawbacks of the Smart-Way implementation, highlighting again any concerns about this matter, which may be related to the concerns discussed in Chapter 9.

Table 3.1 Extract from the questionnaire administered to transport users: attitudinal/perceptive section and use of technological tools section

ATTITUDINAL AND PERCEPTIVE

Please give your opinion on the following statements

11) I like driving cars

1 Not at all	2	3	4	5 Very much

12) I like commuting by car

1 Not at all	2	3	4	5 Very much

13) I like using Public Transport

1 Not at all	2	3	4	5 Very much

14) If Public Transport was free of charge, I would avoid using car

1 Not at all	2	3	4	5 Very much

15) If Public Transport was free of charge, I would still use the car, but I would use Public Transport more

1 Not at all	2	3	4	5 Very much

16) If public transport was free of charge, I would not change my habits

1 Not at all	2	3	4	5 Very much

17) Public transport suits my transport needs well

1 Not at all	2	3	4	5 Very much

USE OF TECHNOLOGICAL TOOLS

Please give your opinion on the following statements

25) Do you feel confident with technology?

1 Not at all	2	3	4	5 Very much

26) Do you enjoy using new technological tools/instruments?

1 Not at all	2	3	4	5 Very much

27) Are you usually updated on new technologies?

1 Not at all	2	3	4	5 Very much

28) Do you usually change your devices for the newest ones?

1 Not at all	2	3	4	5 Very much

29) Please specify the relevance of cost when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

30) Please specify the relevance of design when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

31) Please specify the relevance of fashion when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

32) Please specify the relevance of user-friendliness when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

33) Please specify the relevance of reliability when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

34) Please specify the relevance of durability when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

33) Please specify the relevance of being most up-to-date when you choose to buy an electronic device

1 Not at all	2	3	4	5 Very much

33) Please specify the relevance of other eventual characteristics, if applicable, when you choose to buy an electronic device: please specify which characteristic:………

1 Not at all	2	3	4	5 Very much

2.3 Data Analysis Method

The discussions during the focus groups were recorded by both audio and video and subsequently transcribed. The transcriptions were then carefully read in order to draw a synoptic grid including main themes and sub-themes, thus creating the structure for the content analysis. Then the participants' wordings on the different topics were reported in the grid. This work was carried out iteratively, to organize raw data in a definite structure (Krueger and Casey, 2000). The data collected through the questionnaires were analysed together for the Italian and German groups, to better show similarities and differences and check whether the geographical location, in conjunction with different cultural habits, makes people behave differently. Only descriptive statistics were used due to the small size of the sample.

3 RESULTS

3.1 Transport Users

The 21 participants of the Italian and German focus groups were not selected to represent the Turin or Dresden population, but to include different users' profiles so as to better test all possible reactions. However, comparing the characteristics of the two samples with those of the population of their two cities (ISTAT, 2012; Demographie konkret on line, 2013), it can be observed that the Italian sample is biased only in terms of educational level (65 per cent of participants hold a university degree whereas only 12 per cent of the residents do) (ISTAT, 2013), while the German sample is biased only in terms of gender balance (42 per cent were women compared to the national average of 51 per cent) and age (no elderly people, compared to 26.8 per cent in Dresden). Most of the participants are single, and the most frequently occurring household size is 2 people (2.2 in Dresden and 2.13 in Turin). Table 3.2 offers an overview of 19 out of the 21 participants' socio-economic characteristics and travel habits; two disabled persons are not included as they did not respond to the questionnaire. In general, the German participants use public transport more than the Italian ones, preferring tram and bus services for both their most frequent (almost daily) and leisure journeys. The Italian participants are tied to their car and unwilling to divert even in the event of free-of- charge public transport. This is confirmed by national and regional statistics; in fact, Italians do not use public transport often, and usually do not have a yearly pass, but prefer monthly or weekly options as shown by the observatory (Audimob) of the Italians' travel behaviour (Isfort, 2011), which reports a modal share of 11.4 per cent for PT and 65.6 per cent for private cars. Comparing the two cities, the EPOMM data (2013) show a modal split for the car of 64 per cent in Turin versus 38 per cent in Dresden. PT modal shares are closer: 28 per cent in Turin versus 21 per cent in Dresden. The details about the PT services are given later in Table 3.4. Table 3.3 presents the answers to the questions on travel habits, opinion on PT, attitude towards technology and GPS, and willingness to pay (WTP) to save time. WTP was examined asking the question 'Suppose you could complete your MOST FREQUENT TRIP saving 20 per cent of your actual travel-time. Which monetary value would you assign to the saved time?' (choice among: None; 0.5 €; 0.6 – 1.5 €; 1.6 – 3 €; 3.1 – 5 €; More than 5 €). A final open question gave respondents the opportunity to indicate which features the Smart-Way application or device should have in order to attract car users to public transport. The participants think that in order to attract users to PT, Smart-Way should be an easy-to- use application working on mobile phones, giving fast, reliable and real-time information about all possible trip solutions, public transport network connections, tickets' costs and parking. Users want user-friendliness, and German respondents ask for a large display to show adequately the network; the timetable; the routes; the stops; the position along the route of the bus they are travelling on, or of the vehicle which is marked as the next departure; information on connections at the stop where they get off a vehicle or the distance to the stop where they will find a connecting service. Finally, they ask for information about tickets and the option to buy them, because 'a lot of car-drivers are not able to use a ticket machine, and looking for a convenient ticket can be annoying'. The Italian respondents require a multilingual application that is interactive with central assistance.

Both the Italian and German participants need the application to locate them, give their route plan with departure and arrival times, and they stress the importance of having the best PT solution in real time, taking into account waiting times and accidents. That way they expect to save a lot of time by PT in rush hours and declare that public transport could be competitive in terms of cost and travel time because of reserved bus lanes and because public transport can enter the area where car access is restricted (in central Turin). German respondents require features assisting with travelling by modes other than PT: flexible guidance to their target with different means of transport; the ability to guide car drivers who are unfamiliar with local public transport. They want an application that is: 'easy to use like a navigation system to follow their entrenched habit'. Only two Italian participants believe that improving PT quality (increasing reliability and frequency) could contribute to modal diversion more than ITS services. They also ask for a low priced application and for the option to purchase it for a limited number of days. The discussion confirmed the preference for car use by the Italian group; they feel more stressed than Germans while travelling, especially when they drive for work; however, they think the car is their only choice due to its greater flexibility. This is the main reason they drive instead of using public transport. The latter is seen as unreliable in terms of arrival time and not acceptable for work-related travel. Both German and Italian participants using PT declared that they do not feel stressed while travelling. However, they noted problems related to connections, ticket machines (especially for German participants) and crowded vehicles during rush hours. The majority declared that when they plan a trip they start a day before the departure using internet services and public transport websites. When travelling in unknown cities they use maps and information points. All the users stated they are not afraid of getting lost in an unknown city because they believe they have a good sense of direction or they can easily obtain help to find the right way.

Table 3.2 Main socioeconomic characteristics and trip habits of the users (not including disabled people)

Transport mode used in the most frequent trip		On foot	Bus Tram Car driver	Car driver	Metro Train Taxi	Bus/Tram	Metro, Train Car (driver passenger)	Bus Tram Train	n.d.	n.d.	Car driver Bicycle	Bus Tram On foot	Bus Tram Metro Train Taxi Car driver	Bus/Tram Train, Car driver	Bus Tram On foot	Bus Tram Car driver On foot	Bus Tram	Bus Tram	Bus Tram Car (driver/ passenger)	Bus Tram Train, Car passenger, On foot
Number of modes owned by household	Bike	4	1	0	0	2	0	2	2	1	2	2	2	2	3	1	2	5	3	4
	Motorbike	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0
	Car	3	2	2	1	1	2	3	3	1	2	1	2	1	0	1	0	2	1	1
Family size		4	3	2	1	3	2	4	2	2	3	2	1	3	2	2	2	6	2	4
Monthly income level	Household[1]	2	3	3	3	3	3	3	3	4	3	2	n.d.	3	3	3	2	3	3	3
	Individual[2]	n.d.	n.d.	3	5	2	2	3	n.d.	7	n.d.	3	n.d.	2	6	6	1	2	4	1
Occupation		Student	Student	Professional accountant	Freelance advisor	University employee	Responsible of project communication environment	Freelance advisor	Retired	Retired	Student	Employee	n.d.	Employee administration	Consultant/ engineer	German professional providing auditing services	Apprenticeship/ trainee industrial clerk	Paralegal (working at a lawyer´s)	Research assistant	Voluntary Year of Social Service
Education[3]		Degree	Degree	Degree	Degree	PhD	Degree	Degree	Degree	Degree	Degree	Degree	HSD	HSD	Degree	Degree	SS	HSD	PhD	SS
Age		26	26	41	52	47	27	32	64	59	27	58	40	24	31	42	19	33	57	17
Sex		M	F	F	F	F	F	M	F	M	M	M	M	M	M	M	F	F	M	M
Users code		User 5	User 6	User 7	User 8	User 9	Users 10	User 11	User 12	User 13	User 14	User4208	User4209	User4210	User4211	User4212	User4213	User4214	User4215	User4216
Nation		Italy	Italy	Italy	Italy	Italy	Italy	Italy	Italy	Italy	Italy	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany

Notes:

1. Household monthly income level: 1 = ‘Up to 1000€’; 2 = ‘1–2000€’; 3 = ‘2–5000€’; 4 = ‘5–8000€’; 5 = ‘8–12000€’; 6 = ‘more than 12000’.

2. Personal monthly income level: 1 = ‘Up to 1000€’; 2 = ‘1–1500€’; 3 = ‘1.5–2000€’; 4 = ‘2–2500€’; 5 = ‘2.5–3000€’; 6 = ‘3–4000€’; 6 = ‘more than 4000€’.

3. Education: SS = ‘Secondary School’; HSD = ‘High School Diploma’.

Usability findings

Whilst discussing Smart-Way, everybody declared that they prefer a mobile application rather than a new device. Such an application could be useful for leisure trips and in unknown cities, and those are probably the only cases when they are willing to spend money for the service.

The main suggestions about Smart-Way features are:

- using the device should be low cost, also considering that fees for internet connections are different around Europe.
- users prefer to buy and download the application only for the time needed, thus paying for it according to an hourly rate or for a specific period: day, week, month. Additionally, it should be possible to buy and download the application using Bluetooth or infrared, for example in airports, main railway and bus stations, information points.
- a market segmentation is preferable, distinguishing the business or everyday users from the tourists. Regarding leisure time, the Smart-Way application could be distributed as a CD with the software needed for the cell-phone or together with a traditional tour guide.
- smart-Way must be useful for optimizing travel time.
- it could be useful to locate children, sending a SMS to their device, which should then answer automatically, reporting its position.
- the system should be scalable and compatible with all cell-phones, interacting with all the interesting information and adding new data (restaurants, hotels, other services, etc.) when they become available.
- users would like to buy tickets simply using the mobile phone.

The desired characteristics of the Smart-Way device were as follows:

- easy to use;
- large screen, large buttons;
- option to change languages, large fonts for the elderly;
- low-battery;
- consumption.

Considering the possibility of a modal diversion caused by Smart-Way, all the participants envisaged a potential, although they expressed concerns and doubts.

In fact, a device helping users to save time – especially professionals with time limitations – is not enough to bring about a real change if public transport services are not improved in terms of frequency, trip time and reliability. Moreover, saving time is not a main requirement for leisure trips, and people on holiday could be unwilling to pay for Smart-Way.

Thus, market segmentation, both in terms of transport users' profile and in terms of travel purpose, is mandatory to achieve market penetration.

Willingness to pay (WTP) is also different for users of different types and from different countries:

- German participants would spend money once only for the device or the application (about 30 euros), and would like to use it without any further payment. Regarding a fee, they think it would be reasonable to spend 20–30 per cent of the overall cost of the tickets. Some Italian respondents stated that they were willing to spend from 5 to 10 euros per month for the application while others declared a willingness to spend from 7 to 8 per cent of their actual monthly cell-phone bills.
- Italian pensioners in the sample, not having any time constraints, are unwilling to spend money. They think that Smart-Way should be given free of charge by municipalities or PT companies, because it is a tool that could encourage people to use public transport more. In other cases, the suggestion is to include Smart-Way fees in the PT pass price.

Regarding privacy issues, a lot of participants were aware of the possibility to be localized with GPS devices and therefore also with the Smart-Way application.

While German participants do not have privacy concerns, some Italian respondents wish to be able to switch off the device in order to decide whether to be located.

These privacy and surveillance-related issues are further discussed in Chapter 9.

Table 3.3 – Focus group transport users: travel habits, PT opinions and attitudes towards technology as declared in the quantitative questionnaire

Characteristics	Italian users	German users
Most frequent trip: reasons of car use[2]	1.Inadequate coverage of PT network, flexibility, other 2.Time constraints, habits, comfort	1.Time constraints, comfort, other 2.Inadequate coverage of PT network, route constraints, habits, personal safety
Most frequent trip: reasons of PT use[2]	1.Time constraints, cost 2.Good coverage of PT network, route constraints, other 3.Good PT service (frequency), route safety, personal safety	1.Cost, good coverage of PT network, good PT service (frequency) 2.Time constraints, other 3.Habits
Transport mode used in leisure trips[2]	1.Car (as driver), car (as passenger) 2.On foot 3.Bus/tram 4.Metro, train	1.Bus/tram 2.On foot 3.Car (as driver), car (as passenger) 4.Train, taxi, bicycle 5.Metro, other
Declared reasons to use car in general[2]	1.Time constraints 2.Inadequate public transport network coverage 3.Route constraints, flexibility, comfort 4.Inadequate Public Transport service (frequency) 5.Habits, personal safety, other	1.Time constraints, habits 2.Inadequate Public Transport service (frequency) 3.Comfort, route constraints, inadequate public transport network coverage 4.Personal safety, other 5.Habits, costs
Reasons to use PT in general[2]	1.Car parking unavailability 2.Costs, time saving, other 3.Personal safety, health/environment, comfort	1.Costs, car parking unavailability, health/environment 2.Habits 3. No car availability, time saving, road safety 4.Comfort 5.No driving licence, personal safety
Weakness of PT services in your city [2]	1.Reliable time schedule 2.Time flexibility 3.Comfort, travel-time 4. Cleanliness, inadequate user-information, uneasy park and ride 5.Disadvantages in moving heavy and large items	1.Disadvantages in moving heavy and big goods, inadequate PT service (frequency), costs 2.Time flexibility 3.Inadequate coverage of PT network, reliable time schedule, travel time 4.Difficult park and ride, inadequate user-information, cleanness, comfort
Distance and duration of the most frequent trip (declared by the users)	User5: 0,8 km; 10 minutes User6: 4 km; 12 minutes User7: 20 km; 60 minutes User8: 5 km; 20 minutes User9: 36 km; 30 minutes User10: 15 km; 20 minutes User11: 65 km; 150 minutes User12: 4 km; 20 minutes User13: 4 km; 30 minutes User14: 12 km; 20 minutes	User4208: 4 km; 30 minutes User4209: 165 km; 180 minutes User4210: 12 km; 30 minutes User4211: 1 km; 7 minutes User4212: n.a.; 75 minutes User4213: 7 km; 20 minutes User4214: 6 km; 30 minutes User4215: 16 km; depends User4216: 20 km; 8 minutes
User approach and confidence towards technology	Less confident towards technology. They like to upgrade their device but do not like to change them frequently. Most users own a device like mobile phone, digital camera and use a service such as the internet and social media. 50% of users have a GPS navigator	Confident with technology, they do not enjoy using these kind of device. They like to upgrade their tools but do not like to change them frequently. Most of the users owns a tools like mobile phone, digital camera, internet and social network. 33% of users have a GPS navigator
Most frequent trip: WTP for 20% time reduction	1.None (5 users) 2.0,50€ (1 user), 0,6-1,5€ (1 user); 1,6-3€ (1 user); 3,1-5€ (1 user); more than 5€ (1 user)	1.None (6 users) 2.0,50€ (1 user), 0,6-1,5€ (1 user); 3,1-5€ (1 user)

[2] The answers are reported in order of importance from the most chosen to the lowest one

Focusing on particular groups

The point of view of physically disabled people is very different. They have high expectations of the Smart-Way project and gave precise suggestions. When asked about their feeling towards travelling, their perception was clear: fear, dread, anxiety. Physically disabled people like moving in their city and also abroad, but are worried since they are not sure whether public transport will take them home. Being able to move is a great freedom for them and affects their quality of life. Physically disabled participants are confident with technology because it helps their everyday life: PCs and the internet are used on a daily basis for both work and leisure. When they want to make a trip, they have to plan it in advance:

- in Turin, not all PT vehicles are equipped for passengers who use wheelchairs, and they often have to book a special service two days in advance;
- concerning leisure trips in Italy or abroad, travellers with disabilities have to book in advance special train services and assistance for train or air travel and even the travel destination is chosen taking into account their specific needs.

All those tasks are time consuming because of bureaucracy, and Smart-Way could reduce this problem, offering all the required information in real time. For those reasons, people with disabilities require information such as:

- whether the vehicle arriving is equipped with the facilities to accommodate them or when such a vehicle will arrive;
- the characteristics of bus stops and their equipment: if there is a ramp, if the bus stop platform is at the same level as the bus floor;
- the functioning of elevators in metro stations;
- the presence of special parking near bus, metro and train stations.

All such information is essential for physically disabled people and they need it before their departure and during the whole duration of the trip. The device should be extremely easy to use, with a few buttons only. Touch-screens are not so useful: there are people with hand mobility problems who struggle with the precision required for touch-screen tools. In addition, they also prefer that the device is a mobile application rather than an additional device. If Smart-Way were to help physically disabled people with their needs, they would be willing to spend money for it: 100–200 euros for the application with all the information or a monthly fee from 5 to 30 euros.

3.2 Transport Companies and Authorities

Table 3.4 reports some data about territorial coverage and profile of the eight PT companies and transport authorities who answered the questionnaire.

An overview reveals that they differ regarding their size (number and length of lines, employees), territorial coverage, available budget and service types. Some of those managing different transport modes and services on an urban and metropolitan scale use a single control centre, whereas others operate several centres.

Table 3.5 presents the main outcomes of the questionnaire, showing a variety of technological equipment to acquire and distribute data as well as the different types and quality of real-time information. Currently available technological equipment is key when developing ICT for transport applications, so this comparative table is useful when designing such policies at a European-wide level.

The focus group confirmed the differences among the companies: some of them collect all the data about their services in an automated way, whereas others still do it manually, so the Smart-Way application should consider that in some cities insufficient data management platforms may exist.

The main characteristics that PT companies expect from Smart-Way are the following:

- it should be a mobile application compatible with all the mobile operators and with the standards of all European cities; it could be a multi-platform application showing standard information together with a real-time service giving more information than Google Maps;
- it should assist companies with recording data concerning their fleet;
- it should be conceived as a pedestrian travel aid, giving directions to reach stops on foot, including information on inclines and providing information about alternative routes.

Regarding potential barriers to using Smart-Way, the PT companies are able to provide all the useful information to the Smart-Way application, but want to filter it before it is distributed to users. They would prefer managing the Smart-Way system in-house to be sure of disseminating only appropriate and useful information. Moreover, many PT companies use GPS for their service management: thus they do not see problems with using the system, and the precision of the signal and the data acquisition are adequate for their needs. The main problem related to GPS is the different equipment on different vehicles of the fleet, which varies according to vehicles' age. A weakness of some on-board GPS systems is that the position of the vehicles is relayed to the control centre by radio. This is an interesting issue related to development of ICT for public transport.

Finally, PT companies do not have any particular opinion of the Galileo system, and express some scepticism about when this system will become operational. The main use of the new Galileo system would be to replace the traditional system, using the odometer as a back-up when the present GPS does not work.

TABELLA 3.4 - PT Organization profile

City	Organization	PT service territorial extension						Organization role	Number of employees
		City area		Metropolitan area		Regional area (if the PT service also covers this area)			
		Surface (km^2)	Inhabitants (mn)	Surface (km^2)	Inhabitants (mn)	Surface (km^2)	Inhabitants (mn)		
Barcelona	TMB (private company)	98	1.6	319	2.8			Metro and main urban bus operator	Bus company: 4,197; Metro company: 3,703
Budapest	Transman (private company)	525	1.7	Budapest Transport Association covers 192 settlements + Budapest but in some papers the agglomeration is much smaller		1,215	2	Operator	11,839 employees (Full-time headcount figure in 2008). Other personnel engaged 728
Valencia	EMT (public company)		0.8		1.8			Metro and main urban bus operator	1,652
Athens	OASA (public company)	50	0.65	544	4	1,450		Operator	Authority (207), Operators (11,858)
Dresden	DVB (public company)	328	0.5	n.a.	n.a.	100	69,700	Operator	1,673
Torino	GTT (public company)	130.3	0.9	1,127	1.7	25,399	4.4	Planning, organization, coordination and control of the P.T. system	5,500
Warsaw, Mazovia, Poland	ZTM (public company)	517.2	1.7	2,279	2.4			Public transport provider in Dresden	533
Glasgow / West of Scotland	SPT (public company)	177	0.58	3,397	1.8	9,310	2.2	Missing	700

TABELLA 3.4 - Continued

City	Information about organization's financial conditions			Mode	Number of vehicles	Number of lines
	Fares revenues (k€/year)	Public subsidy (k€/year)	TOTAL (k€/year)			
Barcelona	340,000	306,000	646	BUS	1,080	108
				METRO	791	8
Budapest	252,000	191,000	442	BUS	1,409	213
				TROLLEYBUS	167	16
				TRAM	607	32
				METRO	392	3
				SUBURBAN RAILWAY	294	4
Valencia	44,000	64,000	108	BUS	480	63
Athens	272,000	140,000	411	BUS	2,145	324
				TROLLEYBUS	366	23
				TRAM	35	3
				METRO	95	3
				SUBURBAN TRAIN	n.a.	2
Dresden	101	DVB AG is a part of Dresden's public holding. Profit and shortage will be set off in this holding.	n.a.	BUS	154	28
				TRAM	196	12
				MOUNTAIN RAILWAY	4	2
				FERRIES	5	4
Torino	Missing	Missing	Missing	BUS	1,180	80
				TRAM	220	8
				METRO	33	1
Warsaw, Mazovia, Poland	142	-	141	BUS	1,479	243
				TRAM	780	26
				METRO	162	1
				RAPID URBAN RAIL SKM	18	1
Glasgow / West of Scotland	52,000	117	168	BUS	50 (+leased vehicles)	133
				METRO	41	2

TABELLA 3.4 - Continued

City	Length of lines	Tot km of the service	Passengers per year	Passenger*km per year
	[km]	[km per year]	[millions]	[millions]
Barcelona	923.92	42,221,000	361.7	14,390.30
	96.7	79,044,000	189.9	3,520.70
Budapest	819	1,676	546	2,662
	66	73	77	222
	154	231	333	943
	35	31	297	1,220
	103	239	55	499
Valencia	939	20,400,000	100	5
Athens	3,646	113,063,000	419	n.a.
	195	12,019,000	92.2	n.a.
	50	2,341,000	19.6	n.a.
	148	40,996,000	320.3	n.a.
	n.a.	n.a.	3.5	n.a.
Dresden	311.4	13.3	Not specified	199.2
	204.5	13.5	Not specified	493
	0.547	Not specified	Not specified	Not specified
	0.274			
Torino	1,109	56	n.a.	n.a.
	74.3	n.a.	n.a.	n.a.
	13	n.a.	144 (2013)	n.a.
Warsaw, Mazovia, Poland	3,952	114,084,910	396.6	3.48
	360	51,368,422	223.2	4.35
	23.1	25,404,070	220.8	8.69
	37.4	4,033,805	30.9	7.65
Glasgow / West of Scotland	90,500	4,063,000	3.055	0.752
	10	n.a.	14.1	n.a.

Table 3.5 - Technological equipments and information given by PT companies

City	BARCELONA		BUDAPEST	VALENCIA	ATHENS	DRESDEN		TURIN	WARSAW	GLASCOW
(Organizations)	(TMB)		(Transman)	(EMT)	(OASA)	(DVB)		(GTT)	(ZTM)	(SPT)
Data recorded about the fleet position	GPS Position and time in order to calculate deviation between real and planned situation		The data are collected for operational traffic management; the data are stored in the central database	All information	Static view of daily programme	Position, time stamp, car ID number, car model/type, car features (wheelchair ramp, information system for unsighted), destination, route number, tour/circulation number		n.a.	Transport Authority cannot locate individual vehicles. Each carrier has its own communication and positioning system	Time, location (nearest to postcode area, vehicle registration number, current speed, mph), direction, map location
System used for data recording	Operational Assistance System (OAS) for buses; Regulation System (RS) in the metro		Automatic Vehicle Monitoring System of OTE (IT) on 44% of the bus fleet.	GPS / HSDPA 36+	Stationmaster uses mobile phone to obtain and record fleet position	Computer aided operations control system of producers CSC and TRAPEZE		n.a.	ZTM does not use any system to obtain and record fleet position information	Two separate GPS tracking systems (including mobile data terminals)
Fleet position real time data	Continuous (real time)	Intermittent (discrete)	Intermittent (discrete)	Continuous (real time)	n.a.	Continuous (real time)	Intermittent (discrete)	Intermittent (discrete)	n.a.	Continuous way (real time)
Delay or time interval between data transmission	About 15 sec	30 sec	The vehicles are tracked when they reach a checking point. The “real time” data are archived on daily basis	15 sec	n.a.	Less 1 sec.	Once in 15 sec,, around the stops less than 15 sec (dynamic polling)	n.a.	n.a.	3 minutes for DRT services, 5 minutes for subsidized bus services
Recorded information about service characteristics (time of arrival, on-time arrival, delays, trip duration, etc.)	Arrival time, on-time arrival, delays, trip duration, fuel consumption, sales on-board, ticket validation, vehicle diagnosis		Time of arrival, on-time arrival, delays	Schedule, frequency, position, ticketing, accidents	Arrival time, departure time, delays, trip duration, percentage of completed routes	The system permanently compares schedule and performance to get: in schedule, delay, early arrival		n.a.	ZTM gets information about arrival time, on-time arrival, delays, trip duration	Arrival time, on-time arrival, time delays, trip duration
Systems used to get and record time characteristics of the service	SAP		Automatic Vehicle Monitoring System of OTE (IT) on 44% of bus fleet	Business Intelligence (Oracle)	Manual counts by crew using forms	Computer aided operations control system of producers CSC and TRAPEZE		n.a.	Information is available for employees on the server	Same system as above (GPS tracking)

Table 3.5 - Continued

City		BARCELONA	BUDAPEST	VALENCIA	ATHENS	DRESDEN		TURIN	WARSAW	GLASCOW
(Organizations)		(TMB)	(Transman)	(EMT)	(OASA)	(DVB)		(GTT)	(ZTM)	(SPT)
Time data typologies		Intermittent (discrete)	n.a	Continuous (real time)	n.a.	Intermittent (discrete)	Continuous (real time)	n.a.	Intermittent (discrete)	Continuous (real time)
Delay or time interval between data		Depends on the data needed; between 30 sec and 24h.	n.a.	15 sec	n.a.	Once in 15 sec, around the stops less than 15 sec (dynamic polling)	Less 1 sec	n.a.	Data are loaded with variable time interval	3 min for DRT services, 5 min for subsidized bus services
INFORMATION SERVICES	SMS service (user can ask information about arrival time at stops)	Yes for some bus lines	-	Yes	-	Yes		Yes	-	Yes
	WEB service for online travel planning	Yes	-	Yes	Yes	Yes		Yes	Yes	Yes
	WEB service for getting real time information	Yes	-	Yes	-	Yes		-	Yes	Yes
	WEB service for online ticket purchasing	-	-	Yes	-	-		Yes	-	Yes
	Info point	Yes	Yes independent from TMC	Yes	-	Yes		Yes	Yes	Yes
	Call centre	Yes managed externally by the City hall of Barcelona	Yes	Yes	Yes	Yes		Yes	Yes	Yes
	Other (specify)	-	-	-	-	Ticket purchasing for mobile phones		-	-	-
TELEMATIC INFORMATION GIVEN TO USERS AT STOPS/STATIONS	Timetabled Arrival/departure times at stops	Yes	-	Yes	-	Yes		Yes	-	Yes
	Real time Arrival/departure times at stops	Yes for metro and partially for bus	Yes but few stops	Yes	-	Yes		Yes	Only tramway in Al. Jerozolimskie and underground railway	Yes
	Service frequencies	Yes	-	-	Yes	-		Yes	-	Yes
	Unexpected service break (e.g. caused by an accident)	Yes for metro and partially for bus	-	Yes	Yes	Yes		-	-	Yes
	Planned service variation (e.g. caused by road works)	Yes	-	Yes	Yes	Yes		-	-	Yes
	Other (specify)	-	-	Marketing	-	-		-	-	-

Table 3.5 - Continued

City		BARCELONA	BUDAPEST	VALENCIA	ATHENS	DRESDEN	TURIN	WARSAW	GLASCOW
(Organizations)		(TMB)	(Transman)	(EMT)	(OASA)	(DVB)	(GTT)	(ZTM)	(SPT)
ON-BOARD INFORMATION GIVEN TO USERS Visual information	Which is the next stop	Yes for metro and partially for bus	Yes	Yes	Yes	Yes	Yes	Yes	-
	Time arrival for the next stop	-	-	-	-	-	-	-	-
	Connection with other lines	Yes for metro and partially for bus	Yes	Yes	Yes	Yes	-	-	-
	Unexpected service break (e.g. caused by an accident)	Yes for metro and partially for bus	-	-	-	Yes	-	-	-
	Planned service variation (e.g. caused by road works)	Yes	-	Yes	-	Yes	-	Yes	-
ON-BOARD INFORMATION GIVEN TO USERS Audio information	Which is the next stop	Yes for metro and partially for bus	Partly	Yes	Yes	Yes	Yes	Yes	Yes
	Time arrival for the next stop	-	-	-	-	-	-	-	Yes
	Connection with other lines	Yes for metro and partially for bus	Yes	-	Yes	No line numbers, only means of transport	-	-	-
	Unexpected service break (e.g. caused by an accident)	Yes for metro and partially for bus	-	-	-	By driver	-	-	-
	Planned service variation (e.g. caused by road works)	-	-	Yes	-	By driver	-	-	-
ANNUAL COST	SMS services (€/year)	40,000 Cost shared between SMS & Telematic info at stops	-	15,000 sms, price shared between costumer and EMT (50%)	n.a.	>145,000	n.a.	-	-
	WEB services (€/year)	130,000	-	40,000	1,000	6,000	n.a.	1,200	5,000
	Info point (€/year)	0	-	60,000	87,000	n.a.	n.a.		70,000
	Call centre (€/year)	56,000	-	200,000	587,407	n.a.	n.a.	11,200	n.a.
	Telematic info given to users at stops (€/year)	Cost shared between SMS & Telematic info at stops	-	55,000	n.a.	n.a.	n.a.		
	On-board information given to users (€/year)	0	-	Free: BUSSI system is a commercial channel paid to EMT (it also installs hardware and TFT screens onboard)	n.a.	n.a.	n.a.	-	n.a.
	Other (€/year)	226,000	-	-	32,120: Maps	n.a.	n.a.	930: website	-

4 DISCUSSION

The literature presented in section 1 shows that travellers respond to travel information in diverse ways and that it is difficult to quantify the impacts of ATISs on travellers' behaviour.

The quali-quantitative approach (questionnaire and focus group) followed in this research proved very fruitful. In fact – notwithstanding the small sample – the research obtained the user needs for the Smart-Way application as well as several key aspects about the possible market segmentation and business model.

To satisfy the needs expressed by the users, Smart-Way offers innovative features to satisfy technological challenges, as shown in the screenshots in Figure 3.1, namely:

- matching of several data sources (GIS, timetable information, real-time information on vehicles and disturbances) and corresponding design of interfaces;
- 'non via'-navigation in case of delays or disturbances to identify alternative connections by incident-dependent weighting of nodes or edges of the PT network;
- location of vehicles, re-routing of vehicles and inaccurate tracking results are recognized and compensated in the GIS line network in real time;
- passenger status re-estimation in case of deviation from the route, by matching the user to the GIS or to a vehicle based on the current GPS position; or in case of lost user position (e.g. no GPS available in metro tunnel) by using the smartphones' inertial sensor data to decide whether the user is in a vehicle, walking or waiting at a stop.

The findings confirmed the users' requirements for PT traveller information systems obtained in previous studies (Harris and Konheim, 1995; Abdel-Aty, 2002) and the concerns in Schweiger (2003), Gotzenbrucker and Kohl (2011) and Tang and Thakuriah (2012). A PT real-time information service will never make a real difference without major improvements in the quality of PT services.

This point emerges clearly from the different travel behaviour of German and Italian users: PT is less used in Italy also because its quality is lower than in Germany, as became clear from the questionnaires and the focus group discussion.

Also the cultural attitude towards PT is different in the two countries: the Italians are particularly tied to their cars and think that nothing can be better.

Compared to previous studies, the work discussed here obtained additional information for designing a customized device and make it a tool to encourage a diversion from car to PT.

For example, users prefer a mobile phone application, and also one that may be installed on very basic mobile telephones so that a smartphone is not necessary.

This could be a problem because all current applications work only on up-to- date smartphones. In fact, during the test of the Smart-Way application with both German and Italian users, the difficulty in using it with older releases of smartphones was clearly evident.

Another interesting result is that market segmentation seems to be the only viable solution for funding the service, which otherwise risks being expensive for the PT transport companies.

The market should be divided into two large segments: people on repeated regular trips (work, study or other frequent trips) and people on leisure trips.

The regular travellers should have an application offering real-time information to optimize their travel time, check traffic conditions in real time, assist with watching their children, and to support them in the event of emergency.

For leisure travellers, time optimization is not the primary aim and the use of the device could be 'on demand', on a time basis (for example, for one day or one week), according to their holiday needs and location. The usage price must take into account that Smart-Way could be used abroad in places totally new to the users where it would be particularly useful to locate and guide them. Users are willing to buy a 'package' in which Smart-Way could be sold with a tourist guide and map. The price could vary with the time availability of the application: different expiry dates would influence the selling price. This implies a different business model, considering a different and, usually, higher WTP for an 'inessential' service, but allowing a high quality of leisure travel.

The declared WTP for real-time information (from 5 to 10 euros per month or 7–8 per cent of the monthly cell-phone expenditure) is consistent with the PROMISE project outcomes (Ojala, 2001) – which stated the primary role of cost in users' needs – and is comparable with the values in Dziekan and Kottenhoff (2007), who obtained a WTP in the range of 5–20 per cent of the ticket price for the trip, but also nothing at all, as also shown by Chorus et al. (2006).

Further segmentations should be considered for disabled and elderly users. Disabled users have specific needs regarding the information required and the usability of the device; current smartphones may not be suitable for them, while a more traditional mobile phone could work better. They also have higher willingness to pay than other people, because of the added value they may get from the device. They declared that such devices (incorporating the features presented in section 3.1) could radically change their quality of life, allowing them to travel without any setbacks thanks to the real-time knowledge of travel conditions.

Figure 1 - From the top to bottom, snapshots on: get connection input masks; multiple ways to select the start and destination; select a connection; interchange at risk with connection update; better connection after early arrival; update the connection after deviation from the route

Disabled people like to travel, including for tourism, but they avoid doing it if they do not know the conditions they will face while travelling. The freedom of travelling has a huge value for them, bringing them closer to their social circle and other PT users.
Elderly people are a different case altogether since they have no willingness to pay, and see no real advantage in such an ICT for transport application. Thus, a social policy could possibly be devised to offer the application almost free of charge (social fare) as a bonus to the service for certain types of users such as the elderly (and, perhaps, disabled persons, despite their higher WTP) to compensate them for the problems they encounter with an offer often not directly addressing their needs.
In brief, the approach to follow with systematic users and the disabled or the elderly could be to add a price pro rata to the mobile phone subscription, or a variable price depending on the monthly mobile phone expense or pro rata to the PT pass for public transport users.
Within this framework, the transport companies have expressed their interest in contributing, although this application is now seen mostly as a back-up tool to collect data currently gathered using GPS.
Companies see Smart-Way as a tool to support their own data collection and to give users travel information and directions to stops. PT companies are willing to supply all the information useful for travellers in order to improve the use of public transport services. However, what a project like Smart-Way is going to do with these data remains for them an open issue. Besides, in some cities more operators compete in the public transport service market, in which case the operators do not intend to make their data available to competitors.
Using Smart-Way, PT companies expect to increase their customer volume, and obtain valuable statistics to plan and improve their services, confirming the findings of the Transit Cooperative Research Program (2003). The evidence that real-time information will generate sufficient demand to offset its costs is key for them, even though such services have become a clear trend and PT companies are becoming increasingly willing to spend on them (Lyons and Harman, 2002). The system also needs to be good enough to replace their current information system, since they now pay external providers to run it. Smart-Way has to be complementary to other contemporary solutions since the European Commission is working on a platform for a European ITS and Smart-Way must be compatible with it. Thus, the crucial point is that companies need standards for the system. Currently every application works with different data standards and languages, and every standard is a significant cost for the operators.
This also fits well with users' needs, as discussed in this chapter.

5 CONCLUSION

The conclusion is that there is a market for Smart-Way, but serious attention must be paid to the features on offer and the business model. Both are focal to guarantee market penetration. A smart and clever design of the concept behind Smart-Way could convince transport companies to fully switch to this approach as they have already declared strong interest.
The research is continuing through the evolution of Smart-Way to a new application giving multimodal real-time information, whose need was already declared by Chorus et al. (2006). The new system was tested during the autumn of 2013 in the city of Lyon and the tests will continue in five other European cities: Turin, Madrid, Birmingham, Gothenburg and Wroclaw. The research approach will be the same as for Smart-Way, but more structured and with a larger sample. The behaviour of the sample (150 people in each city) will be analysed before and after the use of the application (four months of tests) and monitoring will extend to all the transport modes (PT, car, bike, walk, car sharing), to provide an ICT application addressing integrated transport.
Early results about user needs in Lyon (with a sample of 50 individuals) before the experimentation, have confirmed the outcomes discussed in this chapter and are consistent with the literature. In fact, other authors have reported that people most inclined to use the ATIS instead of their own car (Zhang and Levinson, 2008; Grotenhuis et al., 2007; Williams et al., 2008) have a high educational level (Williams et al., 2008), have an open approach to technology (Neuherz et al., 2000), are familiar with using ICT to travel (Abdalla and Abdel-Aty, 2006; Khattak et al., 2003), and do not belong to the age group characterized as elderly (Zhang and Levinson, 2008). Furthermore, barriers possibly hampering the use of ATIS in encouraging travel behaviour change are similar to those discussed in this chapter, which can be summarized as the level of comfort and frequency of PT, the level of confidence with the technology, the lack of interest in the application, and its cost. Notably, the importance of usage cost of the application has clearly emerged from the Italian and German samples and has been confirmed by the larger French sample. Thus, a business model sustaining the application while keeping users' cost as low as possible is of the utmost importance. However, the improvement of PT services and soft interventions (mainly bike paths and parking) are also crucial to achieve modal diversion.
User needs discussed in this chapter may also be employed to identify opportunities and threats for the deployment of ATISs and, generally, ICT for transport. Opportunities include the potential increase of PT patronage and the interest in integrated transport information (as a tool for integrated transport policies). A significant opportunity concerns enabling disabled people to travel more confidently by PT, or to feel able to travel altogether, for example in new places, thereby improving their quality of life. Threats comprise the cost for users, as stressed previously, due to the low WTP reported. Threats are also related to the simplicity and ergonomics of the device, which is crucial for those not confident with the technology, as well as privacy matters, because some users are concerned about having their location continuously tracked.

Threats for companies and authorities include the current lack of standards and the related costs. Confidentiality of data, when operators compete with each other, is also a threat to the operation of ICT for transport.

A suggestion to decision makers is to run public campaigns to make ICT for transport more familiar to users, employing the outcomes of this research and using the same method for a European-wide bottom-up approach to identify both common and local user requirements.

ACKNOWLEDGEMENTS

This research has been carried out within the project ‘SMART-WAY. Galileo based navigation in public transport systems with passenger interaction’, funded by the European Commission under the Seventh Framework Programme, GALILEO.2008.1.7.1: LBS.

REFERENCES

Aarts, H., B. Verplanken and A. Van Knippenberg (1998), Predicting behaviour formations in the past: Repeated decision making or a matter of habit?, *Journal of Applied Social Psychology*, **28** (15), 1355–74.

Abdalla, F. and M.A. Abdel-Aty (2006), Modeling travel time under ATIS using mixed linear models, *Transportation*, **33**, 63–82.

Abdel-Aty, M. (2001), Using ordered probit modeling to study the effect of ATIS on transit ridership, *Transportation Research Part C: Emerging Technologies*, **9** (4), 265–77.

Abdel-Aty, M. (2002), Design and Development of a Computer Simulation Experiment to Support Mode/Route Choice Modeling in the Presence of ATIS, Orlando, FL: Civil and Environmental Engineering Department, University of Central Florida.

Abdel-Aty, M.A., R. Kitamura and P.P. Jovanis (1996), Investigating effect of advanced traveler information on commuter tendency to use transit, *Transportation Research Record*, 1550/1996.

Asakura, Y., E. Hato, M. Kashiwadani and S. Katsuki (2000), The simulation study of traffic information strategies using the computer for data collection on drivers’ responses to ATIS, proceedings of the Fifth International Conference on Urban Transport and the Environment for the 21st Century, Southampton: WIT Press, pp. 343–52.

Bunch, J., C. Burnier, E. Greer, G. Hatcher, A. Jacobi, F. Kabir, C. Lowrance, M. Mercer and K. Wochinger (2011), Intelligent transportation systems benefits, costs, deployment, and lessons learned desk reference: 2011 update, Final Report, September 2011. FHWA-JPO- 11- 140, Washington, DC: ITS Joint Program Office, Research and Innovative Technology Administration, US Department of Transportation.

Chorus, C., E.E. Molin and B. Van Wee (2006), Use and effects of Advanced Traveller Information Services (ATIS): a review of the literature, *Transport Reviews*, **26** (2), 127–49.

Demographie konkret on line (2013), available at: http://www.demographiekonkret.de/Dresden_Wachsen_und_Schrumpfen.72.0.html (accessed 20 December 2013).

EC – European Commission (2008), Action Plan for the Deployment of Intelligent Transport Systems in Europe, COM(2008)886, Brussels.

European Parliament and Council (2010), Directive 2010/40/EU on the Framework for the Deployment of Intelligent Transport Systems in the Field of Road Transport and for Interfaces with other Modes of Transport, Brussels.

Dziekan, K. and K. Kottenhoff (2007), Dynamic at-stop real-time information displays for public transport: effects on customers, *Transportation Research Part A*, **41** (4), 489–501.

EPOMM (2013), available at: http://www.epomm.eu/tems/index.phtml (accessed 20 December 2013).

Farag, S. and G. Lyons (2012), To use or not to use? An empirical study of pre-trip public transport information for business and leisure trips and comparison with car travel, *Transport Policy*, **20**, 82–92.

Fujii, S. and T. Gärling (2003), Application of attitude theory for improved predictive accuracy of Stated Preference method in travel demand analysis, *Transportation Research Part A*, **37**, 389–402.

Gärling, T. and L. Steg (2007), *Threats from car traffic to the quality of urban life*, Amsterdam: Elsevier.

Gotzenbrucker, G. and M. Kohl (2011), Sustainable future mobility by ICTs. The impacts of Advance Traveler Information Systems on mobility behavior, *Proceedings of the 8th ITS European Congress*, pp. 1–15.

Grotenhuis, J., B. Wiegmans and P. Rietveld (2007), The desired quality of integrated multi-modal travel information in public transport: customer needs for time and effort savings, *Transport Policy*, **14**, 27–38.

Harris, P. and C. Konheim (1995), Public interest in, and willingness to pay for, enhanced traveler information as provided by IVHS in the New York Metropolitan Area, *Proceedings of the 5th Annual Meeting of ITS America, Vol.1*, pp. 247–51.

HongCheng, G. and S. LiJun (2006), Advanced Traveler Information System for metropolitan expressways in Shanghai, Transportation research record, *Journal of the Transportation Research Board*, pp. 35–40.

Hyejung, H. (2009), Measuring the Effectiveness of Advanced Traveler Information Systems (ATIS), Raleigh, NC: North Carolina State University.

Isfort (2011), La domanda di mobilita degli italiani, Rapporto congiunturale di meta anno, Rome: Audimob, Osservatorio sui comportamenti di mobilita degli italiani.

ISTAT (2012), Dati statistici sulla Provincia di Torino (Piemonte), available at: http://www.comuni-italiani.it/001/statistiche/ (accessed 20 December 2013).

ISTAT (2013), Annuario statistico italiano 2013, Rome: ISTAT.

Jou, R.C. (2001), Modeling the impact of pre-trip information on commuter departure time and route choice, *Transportation Research Part B*, **35** (10), 887–90.
Khattak, A.J., J.L. Schofer and F.S. Koppelman (1993), Commuters' en-route diversion and return decisions: analysis and implications for advanced traveller information systems, *Transport Research Board Part A*, **27** (2), 101–11.
Khattak, A.J., Y. Yim and L.S. Prokopy (2003), Willingness to pay for travel information, *Transportation Research Part C*, **11** (2), 137–59.
Krueger, R.A. and M.A. Casey (2000), *Focus Groups: A Practical Guide for Applied Research*, 3rd edn, London: Sage Publications.
Kumar, P., R. Dhanunjaya and S. Varun (2003), Intelligent transport system using GIS, Proceedings of the Map India International Conference on GIS, GPS, Aerial Photography, and Remote Sensing, New Delhi.
Lyons, G. and R. Harman (2002), The UK public transport industry and provision of multi-modal traveller information, *International Journal of Transport Management*, **1** (1), 1–13.
Mackett, R. and M. Edwards (1998), The impact of new urban public transport systems: will the expectations be met?, *Transportation Research Part A*, **32** (4), 231–45.
Neuherz, M., V. Patz, T. Pischner and H. Keller (2000), User acceptance and impacts of new multimodal traffic information services in BayernInfo, Working Paper.
Ojala, T. (2001), PROMISE – Project Summary, available at: http://www.cordis.lu/telematics/tap_transport/research/projects/promise.html, (accessed 1 August 2012).
Pronello, C. and C. Camusso (2011), Travellers' profiles definition using statistical multivariate analysis of attitudinal variables, *Journal of Transport Geography*, **19** (6), 1294–308.
Schweiger, C.L. (2003), Real-time bus arrival information systems. TCRP Synthesis of Transit Practice No. 48, *Transportation Research Board*, available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_48.pdf (accessed 23 June 2012).
Tang, L. and P. Thakuriah (2012), Ridership effects of real-time bus information system: a case study in the City of Chicago, *Transportation Research Part C*, **22**, 146–61.
Transit Cooperative Research Program (2003), *Real-Time Bus Arrival Information Systems: A Synthesis of Transit Practice*, Washington, DC: Transportation Research Board.
Transportation Research Group (2000), *Establishing User Requirements from Traveller Information Systems*, Final Report to Engineering and Physical Sciences Research Council.
Williams, B.M., H. Hu, A.J. Khattak, N.M. Rouphail and X. Pan (2008), *Effectiveness of Traveler Information Tools*, Final report, Raleigh, NC: North Carolina State University.
Zhang, L. and D. Levinson (2008), Determinants of route choice and value of traveler information: a field experiment, Transportation Research Record, 2086, 81–92.
ZVV (2013), Zurich Transport Network, available at: http://www.zvv.ch/en/timetables/mobile_timetable/iphone_application.html (accessed 20 December 2013).