Deliverable D2.1 Summary of User Needs

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Project: STTRIDE

Project full title: **S**MARTER **T**RAVEL **T**ECHNOLOGY **R**EVIEW FOR **I**NVESTMENT **DE**CISIONS

Research Services Agreement: CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME - Agreement for CEDR Call 2015: User Needs: Smarter Travel Technology Review for Investment Decisions (STTRIDE)

Date: 15 February 2017

Version: 2.0

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• TRL UK • VTT Finland • SP Sweden •

Supported by

Document Information

Contractual date of delivery to CEDR	31 January 2017
Actual date of delivery to CEDR	25 January 2017
Work package contributing	WP 2
Circulation	CEDR, project consortium
Abstract	Deliverable D2.1 is the output from task 2.1, identification of user needs. D2.1 summarises findings from a review of relevant literature and secondary data, and from interviews with stakeholders from passenger representation bodies.
Authors	Samantha Jones, Flora Ognissanto and Andy Parkinson, TRL; Jesse Black Fahnestock and Niklas Fernqvist, SP, Erkki Siira VTT
Reviewer	Alan Stevens, TRL

Document Status

Version	Date	Contributor	Reason of change/remarks
0.1	19.01.17	Samantha Jones	First draft to reviewer for comment
0.1_AS	23.01.17	Alan Stevens	Review comments
1.0	25.01.17	Samantha Jones	Submission to CEDR
2.0	15.02.17	Samantha Jones	Submission of revised version to CEDR

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1   EXECUTIVE SUMMARY

Introduction

The STTRIDE project will:
- review travellers' needs and understand the role of emerging technology in meeting those needs
- address how best to use technological advances to deliver positive modal shift.

Deliverable D2.1 relates to identification of user needs. It summarises the findings from an evidence review of traveller needs in a multi-modal context. The evidence comprised relevant literature and secondary data, and data from interviews with stakeholders from passenger representation bodies. The results should be taken into account by STTRIDE when selecting emerging technologies for further investigation.

STTRIDE is focussing on five thematic areas in relation to emerging technologies:
- automation of vehicles
- information
- journey efficiency
- Mobility as a Service (MaaS)
- safety.

User needs

The evidence reviewed suggests that convenience and ease of use, travel time and cost are key factors influencing users' modal choice in European countries. Related dimensions are accessibility, reliability, safety and the level of trust which can be placed in travel modes; travellers hope for seamless, uninterrupted trips. They also need relevant, accurate, timely and practical information, though availability of information in itself may be insufficient to get people to change habitual travel patterns.

Transport interventions and behaviour change

User needs have been targeted through a wide variety of transport interventions across Europe aimed at influencing travel behaviour. These interventions include a number of measures which can be related to one or more of the five technology areas that STTRIDE has identified.

The effectiveness of a specific intervention in encouraging modal shift may depend on whether / how it is deployed with other measures to promote this shift, and on the wider policy context in which it is implemented. It is also evident that behaviour change regarding mode choice is a complex, non-linear process.

Travellers' take up of technology based services

Changing traveller attitudes and needs are influencing the technological focus in transport across Europe. The main factors highlighted during stakeholder interviews were flexible working and willingness to participate in the sharing economy.

There are also a number of drivers and barriers regarding travellers' take up of technology based services and measures within European countries. Travellers' relationship with IT can act as both a driver and barrier to take up of technology based services relating to different modes.

In addition to technological factors, other institutional, commercial, socio-economic, psychological, cultural and physical drivers and barriers exist in relation to user take up of technology based transport measures. For example, regulatory structures for transport fares may limit co-operation between different providers and events that shock people out of habits can make them more open to new information. The drivers and barriers identified in this report should inform more detailed analysis of the emerging technologies shortlisted by STTRIDE.

Involving users in technology innovations

While this report identifies key user needs, the complex nature of behaviour change and interviews with passenger representatives highlight the need for road / transport authorities, transport operators and technology suppliers to engage in ongoing dialogue with users. The process should ensure that travellers' needs are reflected within specific technological innovations in transport in European countries, to aid user take up. Technology innovations may themselves present opportunities to gather relevant user feedback, but more detailed, qualitative engagement is necessary too.

STTRIDE has two key public outputs:
- a high level toolkit of investment options for road and transport authorities, with a clear set of enablers, barriers, probable impacts and priorities which need to be considered
- a European evaluation framework for consistent evidence collation of new technologies.

The toolkit should address how the user perspective can be taken into account when authorities consider investment options for technology based services, and the evaluation framework should address how users can be involved in evaluation.

2   INTRODUCTION

The STTRIDE project will:
- review travellers' needs and understand the role of emerging technology in meeting those needs
- address how best to use technological advances to deliver positive modal shift.

Work Package (WP) 2 relates to gathering evidence. Its strategic objectives are to:
- identify existing evidence on user needs for an optimal journey
- understand which emerging technologies could contribute to meeting these needs.

Deliverable D2.1 is the output from task 2.1, identification of user needs. This task reviewed evidence regarding traveller needs in a multi-modal context. The evidence comprised relevant literature and secondary data, and data from interviews with stakeholders from passenger representation bodies. D2.1 summarises the findings from the evidence review. The results from task 2.1 will inform task 2.2, identification of technologies.

3 REVIEW OF LITERATURE AND SECONDARY DATA

3.1 Methodology

Task 2.1 relates to identification of user needs, while task 2.2 relates to identification of technologies. Both tasks involved a review of literature and secondary data. A protocol was prepared to ensure a consistent approach to evidence reviews in both tasks, and the work of the tasks was co-ordinated. The protocol is at **Appendix 1**.

Protocol for reviews of literature and data in task 2.1 and task 2.2

This document identified issues of scope applicable to both task 2.1 and task 2.2. It then set out protocols for each task, covering:

- work allocation between partners
- issues of scope that were task-specific
- specific sources to consult. This is because the STTRIDE proposal highlighted specific references and the partners were aware of a number of other sources from their existing knowledge
- search vehicles / terms for identifying additional sources
- criteria for assessing whether sources were suitable for review (see below)
- research questions to be addressed when reviewing sources (see below)
- template for recording findings.

The criteria for assessing suitability of a source for review were:
- date of publication - normally should be 2006 or newer
- to what extent does it address our research questions for this task? (Defined subsequently.)
- are findings transferrable on a transnational and /or transmodal basis?
- to what extent is it evidence based, e.g. is it based on empirical research, best practice or informed opinion?
- if it is research based, is the sample size representative? Any notable points such as control group methods should be recorded
- has it been peer reviewed?
- are there any flaws or gaps in the findings? Are these acknowledged?
- apply an 'evidence hierarchy' that places peer reviewed journal articles at the top and industry publications and press reports, at the bottom.

The research questions to be addressed when reviewing sources were:
- what factors influence travel demand?
- what factors influence users' choice of mode? What categories or hierarchies have been developed to describe these factors?
- how do these factors vary between different users and modes?
- what kinds of intervention have been used to influence travel behaviour by targeting these factors?
- which types of intervention / have been found to be most effective at encouraging modal shift? For which modes and users?
- which of these interventions can be categorised under the 5 technology themes identified for the study?
- what behavioural change models have been developed to describe how people can be influenced to change mode or use sustainable modes more often?

Within task 2.1, a total of 32 sources were identified and deemed suitable for review. Individual reviews were completed for each source, using the template incorporated in the protocol at **Appendix 1**. A list of the sources reviewed is at **Appendix 2**.

3.2   Findings

The key findings from the reviews are reported under each research question addressed.

3.2.1   What factors influence travel demand?

There are various socio-demographic factors influencing travel demand. Population size is a fundamental factor, for example Santos et al (2013) note that demand for public transport may increase with population size. Within the population, socio-economic and psychological factors operate at personal / community / local levels relating to life situation and life style. These include personal mobility levels e.g. ability to walk and cycle, and personal safety (Lucas 2012, SMILE 2004, Scheiner & Holz-Rau, 2007). Level of car ownership is also important, along with associated factors like frequency of maintenance, type of driving licence, car performance (Goodwin, 2008). Lucas (2012) identifies the concept of "transport disadvantage". This means travel demand is supressed and latent within deprived, socially isolated populations. There is limited access to cars and public transport, or the public transport that is available is not affordable.

Avoiding or reducing the need to travel is a form of sustainable behaviour change often associated with working practices. This will reduce travel demand, for instance by consolidating trips, rearranging employee duties, homeworking and teleconferencing (Goodwin, 2008).

Local policy and planning processes and decisions may considerably affect travel demand. A number of stakeholders are involved, such as transport operators, road safety authorities, property developers and land use planners (Goodwin, 2008). Policies in favour of sustainable modes may increase demand for these modes; for example, reducing fares and increasing the number of buses may increase demand for public transport, and reallocating road space from motorised transport to bicycles and traffic calming many increase demand for cycling (Santos et al, 2013; SMILE 2004). Local policy makers may also take steps to reduce social isolation - research has identified that public transport improvements in deprived areas have delivered significant improvements in bus patronage and travel uptake (Lucas, 2012).

Availability of seamless trips that are door to door and integrate different modes may increase travel demand. Major factors contributing to seamless travel have been identified as: availability and streamlining of user-friendly information (e.g. door to door journey planning, reliable timetable information, real-time information during trips, information on costs for different modes available) and streamlined booking systems providing single tickets and fares for all public transport modes (All Ways Travelling, 2014; Farag & Lyons, 2012). The part or parts of a journey linking different travel modes are also important, for example access to smooth and easy interchanges (Goodwin, 2008; Hine & Scott, 2000).

3.2.2   What factors influence users' choice of mode? What categories or hierarchies have been developed to describe these factors?

Various classifications have been developed to describe factors influencing mode choice. Handy & Xing (2011) refer to individual factors such as gender, age income, type of accommodation. Susilo & Cats (2014) reported on a survey of 554 respondents in 8 European cities. They noted that certain traveller groups, such as women, young, low-income or unemployed travellers, have a distinctive set of determinants of satisfaction with trip stages for various travel modes. A

related classification is psychological and attitudinal factors (Preston et al, 2006) which includes include image, lifestyles, familiarity and privacy (Crockett et al 2004).

Handy & Xing (2011) also identify physical environment factors, e.g. distance from home to work and social environment factors, e.g. working arrangements for employees. The Rail Safety and Standards Board (2010b) refers to "hard" factors such as out of pocket costs, journey time and reliability, and "soft" factors such as comfort, privacy, status, image, legality, safety and security.

Some evidence sources identify the relative importance of factors affecting mode choice. All Ways Travelling (2014) places these in the following order of importance:
- availability / accessibility
- travel time budget
- price
- reliability
- comfort
- flexibility
- ecological awareness.

Other studies have cited travel time and cost as being the most significant factors. A literature review by Preston et al (2006) found that time and cost - in the form of fares - remained the dominant metrics in modal choice studies. Crockett et al (2004) identify cost, time, convenience, reliability and comfort as the five main factors, with comfort being the least important.

Looking at cost and personal income levels, car use increases with car ownership and GDP per capita, motorcycle use decreases with petrol price rises and increases with motorcycle ownership and public transport use increases with GDP per capita and decreases with public transport fare rises (Santos et al, 2013). Givoni & Rietveld (2007) reported on a satisfaction survey of 2542 customers carried out for Dutch Railways. Passengers' satisfaction with the value for money of traveling by rail had the most influence on the overall satisfaction from traveling by train.

The concept of "generalised time" is used as a measure of the different elements of travelling time, delay and waiting time. (Rail Safety and Standards Board, 2010b). Research shows that people are very sensitive to waiting time. When travellers make decisions about which mode to select, perceptions of reliability and punctuality are key factors. Importantly, perceptions of reliability and punctuality may differ from objectively measured data (Rail Safety and Standards Board (2010b). However, more recent data from stakeholder interviews (see section 4) suggest that travellers value the ability to connect to the internet during trips. This may reduce the significance of waiting and travel time in some circumstances.

Regarding availability and accessibility factors, Santos et al (2013) note public transport use increases with the number of buses operating per 1,000 population. All Ways Travelling (2014) refers to the high-speed rail network in Europe. This is being expanded by around 5,000 km from 2013-2020 and is expected to have tripled in length from 2013-2030. It has been assumed by the rail industry that this extension of the network will lead to an increase in rail demand of around 40%. SMILE (2004) refers to the use of urban planning strategies to improve the mixed use of space, and limit new urban developments to areas served by public transport.

The effect of all kinds of travel information, from in-car navigation to overhead signs and travel websites, is by itself less powerful than many policy makers assume. The form in which information is presented is likely to be crucial in determining the choices people make. Information which includes a description of the effect of a problem, preferably in terms of time or distance, have more effect than a description of the cause of a problem, or than directional advice (Rail Safety and Standards Board, 2010b). All Ways Travelling (2014) highlights the importance of real time information during journeys, as well as the need to co-ordinate information provision across modes. A survey of 151 stakeholders in EC member states (TRL,

2016) showed there was a high level of willingness to change modes amongst respondents if a greater level of multimodality was included within travel information services for comparison. Also, accuracy of geographic and timing information, usability, and breadth of functionality were seen as important quality criteria.

Information provision may be tempered by factors relating to familiarity and habits. If travellers are unsure about trip details, they may choose the mode they are most comfortable with (INFOPOLIS, 1999; Goodwin, 2008). Research shows that making the "right" decision takes more effort than most people are prepared to make. Thus many travel decisions are a matter of habit and routine. Travellers offered alternative routes and transport modes will seldom examine all available options. Instead, they will often choose to make their journey in a satisfactory, but not necessarily the "best" possible way (Rail Safety and Standards Board, 2010b).

3.2.3   How do these factors vary between different users and modes?

With regard to socio-demographic characteristics, Scheiner & Holz-Rau (2007) note that people with high socio-economic status and/or young families are more likely to have access to a car. It is far more important for older people and individuals with lower social-economic status to have public transport close to their place of residence. Looking at gender differences, a study of over 99,500 London cycle hire scheme users (Ogilvie & Goodman, 2012) found that women made up under a third of those registered, were less likely than men ever to use the scheme, and made fewer trips on average. The result was that only 18.4% of all cycling trips under the scheme were made by women. The study also cites other references that explored low uptake of cycling amongst women, with reasons including perceived cultural inappropriateness and fear of road danger.

There are also differences between people living in urban and rural areas. A literature review by Velaga et al (2012) found that the most commonly cited reason for not using public transport in rural areas was lack of convenience. Passengers from rural and remote areas also need more reliable and sophisticated travel information compared to those in urban areas. With increasing availability of electric vehicle use, the distribution of charging points across urban and rural areas becomes a factor affecting take up of this mode.

Susilo & Cats (2014) also looked at how the importance of factors influencing mode choice varied across different socio-demographic groups, categorising findings from previous literature. This is illustrated in the following figure, and demonstrates how needs vary according to employment and socio-economic status, gender, age, personal mobility, and familiarity with the travel and surrounding environment.

Figure 3.1: Summary of salient characteristics of different traveller groups

Group	Special characteristics	Key factors
Full-time employed workers	Regularly incur more temporal constraints than monetary expenditure	Punctuality, reliability, cost
Female travelers	Travel shy, reassurance seeker and cautious planner. Complex scheduling of activities in terms of both time and space and is likely to bring additional bags.	Safe, reliable, affordable and comprehensive access
Parents with small children	More women than men, traveling with buggies and bags	Accessible vehicle and station, onboard space and supportive attitudes
Low income travelers	Tend to be captive to the cheapest mode alternative and spend a significant proportion of income on travel	Availability, adequacy, cost and safety
Children and young travelers	Smaller children highly dependent on their parents' decisions and preferences. For many young teens, travel represents a gateway to adulthood, enabling independence, socialization and a recognition of maturity	Practicalities (such as cost and speed of journey), flexibility and safety
Elderly travelers	Tend to have more limited ability and strength to move. The feeling of being able to travel independently is closely linked with a sense of self-worth. They have increased difficulty in identifying signs, in reading timetables, listening to loudspeakers and responding	Physical and emotional barriers, affordability, flexibility, reliability and support facilities
Disabled travelers	Have physical or mental impairment which has a substantial and long-term adverse effect on their ability to travel. Lack confidence when traveling, experience a lack of flexibility in their travel choices and difficult to be spontaneous	Physical accessibility and availability, support facilities (including information availability), cost, certainty and security and supportive attitudes
Tourists and unfamiliar travelers	Suffer lost-in-translation problem. Have high mobility needs, but limited spatial and linguistic knowledge	A simpler system, more information provision and more helpful and tolerant staff

Source: Susilo and Cats (2014)

Factors affecting mode choice also vary according to users' trip purpose. Preston et al (2006) identify that:

- commuters value reliability above other factors. Cost, time and flexibility are also important considerations
- people travelling during work place high value upon published travel times and comfort. Convenience, customer service and flexibility are also likely to play a role in decision-making
- cost and information are important needs for leisure travellers. Values of time are lower than for other journey purposes.

3.2.4   <u>What kinds of intervention have been used to influence travel behaviour by targeting these factors?</u>

The following table summarises the main types of interventions identified from the literature and data reviewed. The intervention categories are not mutually exclusive and different measures may be used in conjunction with each other, within or across these categories. Within most categories, the relevant measures have been used to encourage shift to a range of modes.

Table 3.1   Interventions used to influence travel behaviour by targeting factors that affect travel demand and mode choice

Type of intervention	Main factors targeted	Scale of operation	Examples of relevant policies & measures	Examples of relevant references
Travel demand management	Availability Accessibility	Regional, local	Land use management, including neighbourhood accessibility planning, relocating workplaces nearer to residential areas, zones with restricted access for cars Road pricing Parking management, including increasing parking prices at workplaces, permit schemes Travel plans	Goodwin, 2008 Graham-Rowe et al, 2011 Van Exel & Rietveld, 2009
Infrastructure & design	Availability Accessibility Comfort Safety	National, regional, local	Accessible / safe design for public spaces & PT vehicles, including removal of physical barriers, improved lighting, low-floor buses, reserved space on PT vehicles for wheelchairs & pushchairs New or improved cycle lanes New or improved cycle parking New or improved railway lines New or improved PT stops, stations, interchanges	Dotter, 2015 Graham-Rowe et al, 2011 Maffii et al, 2016 RSSB, 2010a
Services (excluding information)	Time Cost Flexibility Availability Safety Comfort	National, regional, local, organisational	"Walking buses" to / from schools Cycle hire schemes Workplace initiatives to support active travel, including provision of free lockers & showers, company bikes, cycling 'taster' sessions, on-site cycle repairs, bike accessories New or improved PT services, including park & ride, demand responsive, express & rapid transit services, extending geographical coverage / frequency of / time of day covered by services New or improved priority for PT Improvements to on-vehicle environment for PT, including to cleanliness & security equipment Free trials of PT Subsidised tickets e.g. for students or older people	Dotter, 2015 Goodman et al, 2015 Graham-Rowe et al, 2011 Maffii et al, 2016 Redman et al, 2013 TSC, 2015 Van Exel & Rietveld, 2009 Velaga et al, 2012

Type of intervention	Main factors targeted	Scale of operation	Examples of relevant policies & measures	Examples of relevant references
			PT tickets that are transferrable across operators or specific PT modes	
			Advance / automated booking of PT tickets	
			Car pooling or sharing schemes, sometimes with privileges given to participants e.g. reserved parking	
			Ride sharing schemes	
			Women only taxi or car sharing services	
			Women only parking areas	
			Taxi hailing mobile apps	
			Using an agency to manage all aspects of mobility services, from which users can buy services tailored to their needs	
Information	Time Flexibility Familiarity	National, regional, local, organisational	Integrated travel information via internet / mobile apps	All Ways Traveling, 2014 Brog et al 2009 Dotter, 2015 Graham-Rowe et al, 2011 Redman et al, 2013 TSC, 2015
			Real time information for PT & shared mobility services	
			Parking information systems	
Education, advice & participation	Familiarity Safety Cost Environmental awareness	Regional, local, organisational	Involving users in development of transport & accessibility strategies	Dotter, 2015 Goodman et al, 2015 Graham-Rowe et al, 2011 RSSB, 2010b TSC, 2015
			Workplace & school travel plans	
			Personalised information & advice provided to individuals, e.g. at points of change in their lives, including moving house or starting a new job	
			Cash incentives or other rewards for individuals for reducing car use / using sustainable modes	
			Training & guidance for users, including cycle training, personal travel plans	
			Training & guidance for transport providers e.g. Transport for London's Big Red Book for bus drivers	
			Promotional activities to raise travel awareness	
Removing the need to travel	Time Cost Flexibility	Organisational	Home working	Graham-Rowe et al, 2011 RSSB, 2010b TSC, 2015
			Teleconferencing	
			Home shopping & goods deliveries	

3.2.5   Which types of intervention / have been found to be most effective at encouraging modal shift? For which modes and users?

Redman et al (2013) undertook a literature review of 74 public transport improvement studies in Europe and beyond. All but one study revealed notable levels of success for public transport pricing mechanisms, such as integrated tariff systems and seasonal passes, in terms of increased ridership.

A study of bicycle commuting by Handy & Xing (2011) found that the physical environment of local communities was more important than workplace travel plans for encouraging mode shift. This included distances between residences and workplaces, and the quality of the bicycle facilities linking them. However, the Rail Safety and Standards Board (2010b) suggests that well designed and targeted behaviour change programmes can deliver significant modal shift without significant changes in transport infrastructure.

There is some evidence of the effectiveness of personal travel plans, which require intensive, tailored intervention with individuals (Yang et al, 2010; Brog et al, 2009). This is supported by findings from Graham-Rowe et al (2011) who undertook a systematic review of evaluations of interventions aimed at reducing car use. The study identified one of the most effective measures as personalised information and advice targeting drivers who had a strong driving habit or a strong moral motivation to reduce car use, and people who had just moved residence. Shergold & Parkhurst (2016) also note that measures involving members of the public in voluntary activity, like personal travel planning, can be effective at low cost and delivered quickly.

Easier access to information fosters multimodal travel especially with specific groups like disabled people (All Ways Travelling, 2014). However, Farag & Lyons (2012) note that improved availability of public transport information and awareness of this, may not of itself result in greater consideration of public transport by users. They recommend that public transport information service providers should simultaneously aim to promote public transport use and availability of public transport information.

However, other references reviewed suggest that it may be too simplistic to identify that certain interventions are more effective at encouraging modal shift than others. The effectiveness of an initiative often seems to depend on whether / how it is combined with other measures to promote modal shift, and on the wider policy environment in which it is implemented.

For example, Goodwin (2008) notes that the success of park-and-ride initiatives on the outskirts of cities and towns can be enhanced or undermined by the town centre parking policy. Also, that the success of road pricing schemes is closely bound up with explicit use of the revenues collected, e.g. in London this was mainly used to improve bus services. A study by Goodman et al (2013) evaluated 18 intensive town wide cycling initiatives in England, involving packages of measures to support cycling, e.g. building cycle lanes, providing cycle parking, training, travel plans. This showed that there was a marked increase in cycling to work in the intervention towns compared to towns in a control group. It was also noted that holistic cycling interventions could have an unexpected and positive impact on walking.

Yang et al (2010) also refer to multi-faceted urban level programmes being particularly effective at encouraging modal shift. Shergold & Parkhurst (2016) recommend the use of Sustainable Urban Mobility Plans, to create a holistic strategy for a range of actions that might best achieve sustainable mobility objectives.

3.2.6 <u>Which interventions can be categorised under the five technology themes identified for STTRIDE?</u>

STTRIDE is focussing on five thematic areas in relation to emerging technologies, which are likely to have an impact on modal shift .Themes are defined by the purpose for which technology is used and there is some overlap between them:

- **automation of vehicles** - although the principal driver of automation is likely to be safety, it could also provide many of the benefits of passenger transport - e.g. productive use of travelling time and reduced concern about car parking - in private vehicles, potentially encouraging shift away from mass transport. Conversely, this technology could also be an enabler of vehicle sharing and demand-responsive services, to provide access to public transport and so reduce the proportion of single-occupancy journeys

- **information** - real time multi modal information provision can identify alternative travel options, both before and during the journey, enabling plans to be revised in real time, which reduces the risk and uncertainty associated with public transport and enabling better use to be made of travelling and interchange time. This reduces the "generalised cost" of public transport in demand modelling theory, and would be expected to encourage greater uptake of it

- **journey efficiency** - new technologies can help transport authorities to give greater priority to public transport vehicles, making it more attractive compared to driving. It can also help operators to make better use of capacity enabling improved cost-effectiveness, potentially leading to lower fares and improved investment

- **Mobility as a Service (MaaS)** - enabling the provision of new mobility services, such as bike hire or car sharing, which cannot realistically be managed without sophisticated information and payment systems

- **safety** - technological improvements to individual modes or the wider environment which impact on the people's perception of safety and willingness to use alternative modes. For example, an improved environment for cyclists.

The following figure illustrates how interventions identified in this report relate to the five technology areas. Some interventions are relevant to more than one area – the main links are denoted by cross references (e.g. "**+ MaaS**"). Only those interventions likely to have emerging technology components are shown. Such measures could still be supported by other interventions that are unlikely to involve emerging technology in a significant way e.g. personalised travel planning, training and free trials of public transport. N.B. task 2.2 and deliverable 2.2 of STTRIDE will provide more detailed consideration of innovative technologies that may be utilise within transport services and measures.

Figure 3.1:   Mapping of modal shift interventions to STTRIDE technology themes

Vehicle automation	**Information**	**Journey efficiency**	**MaaS**	**Safety**
Car pooling / sharing (**+ MaaS**)	Integrated travel info. via internet / mobile apps (**+ MaaS**)	Innovative types of PT infrastructure	Cycle hire	Innovative types of cycle lane **(+ journey efficiency)**
Road pricing	Multi-modal real time info. (**+ MaaS**)	Innovative PT services (**+ MaaS**)	Ride sharing	Innovative types of cycle parking
	Parking info. systems (**+ vehicle automation**)	Priority for PT	Taxi haling apps	Innovations to on vehicle environment for PT (**+ information**)
		Advance / automated booking of PT tickets (**+ MaaS**)	One-stop mobility services agency	
		Multi operator / modal PT tickets (**+ MaaS**)		

3.2.7 <u>What behavioural change models have been developed to describe how people can be influenced to change mode or use sustainable modes more often?</u>

There are numerous different sorts of behavioural choice, many of which are in continual flux, and subject to a wide range of incentives (Goodwin, 2008). This is relevant to travel behaviour, with Goodwin noting that there are very many more travel choices which people make other than which mode to use, including the amount and location of travel, driving styles, levels of car ownership, where to live, work and shop, and the type of activities they participate in.

Funding and support mechanisms must be in place long enough for sustainable transport measures to be accepted and utilised by travellers. Such measures may take time to become "tuned" to local circumstances (Shergold & Parkhurst, 2016). Goodwin (2008) found that individual behavioural responses are often relatively small in the short term, but build up to much more flexible lifestyle choices in the longer run - at least 5-10 years. However, this pattern may be disrupted by changes in personal circumstances. Human behaviour will change at lifestyle milestones, e.g. when moving house, changing jobs or children starting school. These present opportunities for targeting people when they are likely to be most receptive to messages relating to behaviour change (Rail Safety and Standards Board, 2010b).

The TAPESTRY project final report (2003) also refers to how changing behaviour is a lengthy process. TAPESTRY modelled the process of individual behaviour change in relation to take up of sustainable modes, identifying seven stages:
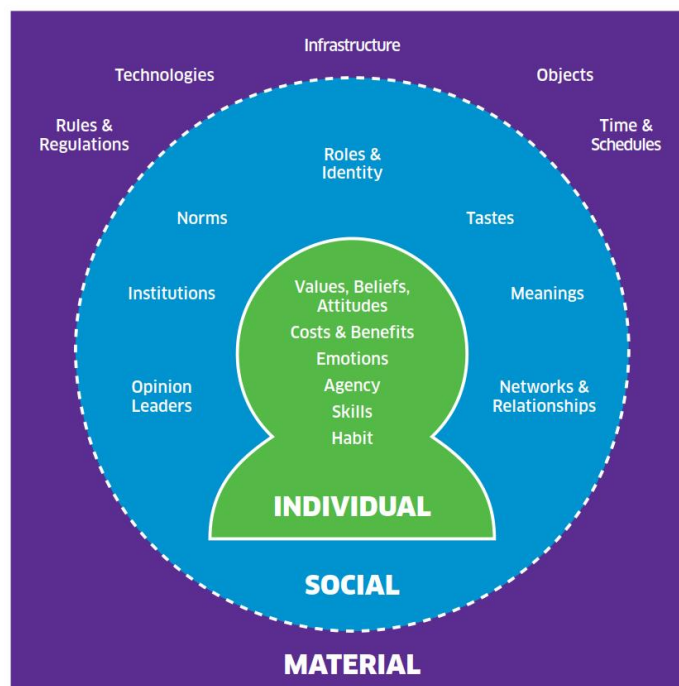- awareness of problem
- accepting responsibility
- perception of options
- evaluation of options
- making a choice
- experimental behaviour
- habitual behaviour.

It is noted that this process might not be linear; people can move back and forth between stages. TAPESTRY recommended that communication campaigns about sustainable transport should be targeted at a particular stage or few stages of the model.

Some theories divide members of the public into segments, each with distinct attitudes and beliefs (Rail Safety and Standards Board, 2010b; Transport Systems Catapult, 2015). The segments differ in the extent to which they are aware of sustainability and transport issues, attached to cars, willing to consider alternative modes and willing to take action to change. It is suggested that different segments of the population should be targeted with different, tailored messages about sustainability issues.

Individuals do not operate in isolation. Friends, family and colleagues can also influence attitudes and behaviour (TAPESTRY, 2003). Handy & Xing (2011) discuss the importance of the social environment in influencing an individual's behaviour change. For example, they refer to changing the social culture of the workplace through promotional events such as "bike to work day" or through support such as guidance on bicycle commuting routes and training for bicyclists. Looking at the wider environment, as new shopping, leisure or educational facilities become available, people may change their travel behaviour to access them; building of new transport infrastructure that enables such opportunities to be accessed more conveniently may also lead to people changing their travel behaviour (Rail Safety and Standards Board, 2010b).

Darnton & Horne (2013) report on the ISM tool, which identifies three different contexts - the Individual, Social and Material - that influence human behaviours, see figure 3.2. A key recommendation is that interventions should take account of influences across these multiple contexts in order to achieve substantial and enduring change.

Figure 3.2: Factors that influence behaviour in the individual, social and material contexts

Comparative perceptions of different modes should also be taken into account. When considering the attractiveness of public transport for car users, basic levels of access, reliability and competitive costs must be provided by public transport services to meet those already offered by a private motor vehicle. Interruptions of habitual car use such as periodically free or low price tickets can be successful instigators to mode change as long as public transport services have attributes that are perceived as at least equally appealing as travel by car. Once this is achieved, more context specific, perceived attributes of public transport should be communicated and demonstrated to car users, aimed at appealing to their individual motivations and values (Redman et al, 2013).

Transport Systems Catapult (2015) notes that there are short-term opportunities in better presenting transport information to travellers that effectively "nudges" their behaviour towards sustainable mode use. Nudge theory advocates a range of non-regulatory interventions aiming to influence behaviour by altering the context or environment in which people make choices and in ways that they often do not notice (Science and Technology Committee, 2011). However, the Science and Technology Committee report also questioned the effectiveness of non-regulatory measures used in isolation, including "nudges". It is stated that effective policies often use a range of interventions.

4   INTERVIEWS WITH PASSENGER REPRESENTATIVES

4.1   Methodology

The STTRIDE proposal envisaged conducting interviews about user needs with experts from the European Passengers Federation (EPF) and three national traveller/passenger representation bodies. The EPF, www.epf.eu, is a network of national passenger representation bodies [1]. The national bodies were identified via partner contacts, taking into account the following factors:

- whether they were members of the EPF - all three bodies identified were members
- geographic spread
- availability of appropriate stakeholders to interview, in English or another language used by the partners.

A question list was prepared to guide interviews. This was informed by the findings from the task 2.1 review of literature and secondary data. The interview guide is at **Appendix 3**. The guide was sent to interviewees prior to interviews. Interviews were conducted by telephone during January 2017, and lasted around 45 minutes each.

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[1] An interview was arranged with the Chairman of the EPF's Management Board. This had to be cancelled due to the Chairman being on sick leave and it not being possible to re-arrange the interview within the timescale for completion of task 2.1. However, two of the stakeholders interviewed are also members of the EPF's Management Board and the Chairman is willing to be involved in future stakeholder activities within STTRIDE.

Table 4.1:   Passenger representatives interviewed

Passenger representation body	Country	Who is represented?	Name of interviewee	Role of interviewee
ROVER www.rover.nl/	Netherlands	• Union around of 5,000 subscribing individual members with around 200 very active volunteers. • Local branches all over the Netherlands. • In principle, all types of PT passengers are represented; most are over 50 years old. Young people are mainly engaged with via social media & student unions. • ROVER works closely with national body representing cyclists. Many people in the Netherlands access PT stations by bike. • Also co-operates with organisations representing commuters, disabled people & car users. 60% of car user body's members also use PT.	Arriën Kruyt	Chairman since 2010, does a lot of lobbying. Also a member of EPF Management Board.
ResenärsForum www.resenarsforum.se/	Sweden	• Non-governmental not-for-profit organisation with over 6,000 members. • Acts as umbrella group for over 30 local & regional passenger groups throughout Sweden. • Financed by membership fees & support from Swedish consumer agency. • Represents all users of all types of PT, both publicly & privately operated. • Maintains dialogue with regional transport authorities & commercial transport companies. According to law, all Swedish regional transport authorities must consult with passengers via representative groups. Resenärsforum is co-ordinating point for this consultation.	Kurt Hultgren	Secretary General, with overall responsibility for Resenärsforum activities. Also a member of EPF Management Board.
Transport Focus www.transportfocus.org.uk/	UK	• UK's independent transport user watchdog. • Sponsored by UK government's Department for Transport. • Developed from 'Passenger Focus' which originally represented rail passengers, commissioning national Rail Passenger Survey • Subsequently gained responsibility for bus passengers &, very recently, users of English trunk road network (i.e. roads managed by Highways England).	Ian Wright	Head of Insight. Involved with Transport Focus's research into future trends, mostly focused on rail rather than roads.

4.2   Findings

4.2.1   What are the main factors influencing travellers' choice of travel mode?

The main factor, identified by all three interviewees, is that the travel mode has to be easy and convenient to use. This encompasses aspects such as reliability, trustworthiness, frequency and accessibility of service, which are most important at the level of the timetable. Operators in Sweden have begun making adjustments to services in response to demand levels - from a passenger perspective, even temporary changes to the usual/expected timetable can permanently undermine trust. Transport Focus previously conducted research with non-rail users. A key finding was that availability of direct door to door travel was often a "deal breaker" for travellers. Interchange put them off - even when free rail travel was provided as a trial - as it introduces additional uncertainty and risk; for example, relating to missed connections.

Availability of information is also important. The Swedish passenger representative observed that access to information has actually decreased for many passengers. This is partly due to digitalisation. Many public transport operators have moved to almost exclusively internet-based information provision. Yet, an investigation was cited showing fewer than 50% of Swedes actively access information on the internet via mobile devices. The other major driver in Sweden has been privatisation and unbundling of services, with operators providing little support in person or via telephone. In station environments, customer information "is always someone else's responsibility".

However, one interviewee commented that people rarely check traffic information before starting a car journey, so there is limited potential to encourage changed behaviour once a journey is planned. It was noted that travel behaviour is habitual, but habits can be "shaken or shocked". For instance, planning for the Olympics in London in 2012 involved persuading many people to change their travel patterns for the period of the games. Also travellers might ask themselves "What if everyone takes the same advice?"; for example, on alternative routes, in which case congestion would quickly follow them, reducing the benefit of following advice.

Two passenger representatives thought that cost was a significant factor. The Transport Focus research with non-rail users also highlighted the "sunk costs" of car ownership, which have already been incurred and cannot be recovered. These make rail travel expensive on a trip basis, especially for groups, and also mean that car users underestimate the true costs of driving. However, one interviewee considered that pricing was of relatively low importance and often exaggerated.

4.2.2.   How do these factors vary between different users and modes?

One interviewee felt that the needs of all users are essentially the same at the top level. Similarly, another interviewee referred to the importance of accessibility for all types of passenger. A key dimension is orientation - ability to read surroundings is a challenge for most passengers at some point. One passenger representative promoted the catchphrase "That which is necessary for disabled people is advantageous for everyone." However, it was also noted that convenience of travel modes will be influenced by different constraints on different groups, for example mobility issues, and travelling with children or luggage. A disabled person's travel needs depend on his/her specific disability, and (s)he may require adaptations to travel information systems.

Information is less important for regular public transport users, as they are already familiar with their journeys. Occasional users can find public transport complicated, compared with travelling by car with a navigation system. For less frequent public transport users and to attract new users, information is needed on all legs of a trip, and on fares - both the cost and how to buy

tickets. Ability to use the internet while travelling is important, especially for younger people and during longer journeys.

In the Netherlands, public transport is doing well in urban areas, and in some cities people on low incomes get free travel. Public transport is not faring well in rural areas. Many villages have hourly services, which are mostly empty. Alternatives offering more flexibility are being explored, like electric bicycles or car sharing, while some villages have organised their own minibus services. The Swedish passenger representative also noted that car-sharing options are likely to replace rural bus services eventually, and that the Uber model was not directly acceptable due to safety, responsibility, and competition issues. Both the development of rural rideshare services and self-driving cars will make collective car usage more common in Sweden.

The Dutch passenger representative commented that electric bicycles are likely to become increasingly important. He referred to research that has shown people would be prepared to cycle regularly for up to 30 minutes, and could cover 12-14km on electric bikes during this time period. Now some people are using electric bikes instead of cars to commute, which is cheaper than driving and avoids parking problems. However, electric bikes could also compete with public transport. Another interviewee highlighted a further, potential form of competition with public transport - automation of driving could lead to car travel becoming as safe as public transport and make it possible to use travel time productively, which is currently a unique selling point for public transport.

4.2.3   What are travellers' main needs for an optimal journey?

Interviewees highlighted the following main needs in relation to public transport:
- it should be reliable and trustworthy, with uninterrupted trips, e.g. avoiding traffic accidents
- travel information should be of high quality, and if disruptions do occur, information is especially important and should be given to passengers in advance
- comfort, e.g. passengers expect seats to be available.

Other needs identified with regard to public transport were:
- stops and stations should not be hidden to travellers. They should be located right by intersections, rather than mid-block. Road dividers and islands are important in shortening passenger road crossings and making car traffic slow down
- availability of an internet connection during the journey
- safety.

N.B. For the following sections 4.2.4 - 4.2.6, interviewees were asked to consider specifically the five technology areas covered by STTRIDE.

4.2.4   How are changing traveller needs influencing the technological focus in transport?

Two passenger representatives referred to more flexible work habits. These can impact on travel patterns, e.g. frequency of commuting being reduced due to people working part time or working from home more often. There is a demand for a different kind of season ticket, which could perhaps be based in some way on the more km travelled by a passenger, the less (s)he pays.

While the need for flexible ticketing was highlighted, another interviewee said that complexity of ticket purchasing is a fast-growing concern. This relates to the issue of digitalisation: initiatives like new payment cards, payment via SMS/app are a convenience for some, but leave others behind and drive them away from collective transport options. Some passengers do not know how to pay for fares, see the potential for embarrassment and choose cars instead. One-card solutions, such as Oyster in London or the Swiss all-transport pass, are a big improvement. However, fall-back options like cash, printed timetables and customer service (in person and via telephone) are necessary.

Another interviewee referred to "not needing to own stuff" - people are already used to leasing items such as mobile phones. Now services like Uber and Air BnB are extending the idea of short term hire of shared facilities and services to other areas. At the same time, people increasingly expect that services are personalised and are willing to share data for personal benefits, e.g. as supermarket loyalty cards have shown. An example was given of a service called Zip About, which provides personalised travel information. It works with Transport for London (TfL) and certain local authorities in the UK.

4.2.5   What drivers and barriers influence travellers' take up of technology based transport services and measures? How do these drivers and barriers vary between different users?

The main issue identified by interviewees was familiarity with and willingness to use IT services. For example, this may be linked to ageing of populations. IT may be particularly beneficial in rural areas where transport provision is more limited; however, rural demographics may not be so receptive to IT. The increasing use of connected mobile devices was highlighted. Designs which make these more accessible - such as natural interfaces, one-card systems, context-sensitive solutions - may also increase uptake of collective transport.

It should be recognised that some people do not / cannot use mobile phones and their access to transport may be limited if there are no back-up options. For instance, it may be necessary to retain displays of public transport times at stations and stops, rather than assuming travellers will obtain this information via phones. Some people will require personal assistance during trips. Therefore staff presence is needed at stations - especially the larger ones - which also improves security and safety. Reference was also made to the proliferation of ticketing and information systems in a city or region. The existence of multiple cards and apps may discourage use of any given one.

If public transport providers - whether publicly or privately owned - identify and satisfy user needs when developing technology based services, this will aid their take up by users. A good example cited was an app created by the Oslo transport authority. This was developed entirely from the passenger viewpoint, with limited input from IT specialists. The app. tells a person at any bus stop when the next bus will arrive and then allows him/her to buy a ticket. However, public transport operators do not always take account of and address user needs when developing technology based transport services. So this lack of consultation can be a barrier to user take up.

It was apparent from interviewees that institutional, commercial, socio-economic, psychological, cultural and physical drivers and barriers can be as important as issues with the technology itself; for instance:
- regulatory structures for transport fares and competition rules limiting co-operation between different providers
- how important is cost to users and how time-critical are their journeys?
- events that shock people out of habits can make them more open to new information
- language barriers
- the physical process of interchange has to work - services connecting and access / egress modes available, so that door to door journeys are practical and competitive
- there is a prospect of increased security measures surrounding public transport due to threats of terrorism. This could actually deter people from using public transport, as it would become less accessible.

4.2.6   <u>What are the best ways of ensuring user needs are considered when developing and evaluating technology based transport services and measures?</u>

Technology may be developed for early adopters and not for actual users of public transport. Users should be included in the process of developing, implementing and evaluating technology based transport services. The role of dialogue between passengers and local/regional/transport authorities, public transport companies and national governments is important. One interviewee suggested that it should be compulsory for public transport operators and public authorities to seek passenger views on measures relating to this mode. This usually leads to improvement in service quality.

Consultation should take place in the following ways:
- online surveys with concise questions. Such surveys may be triggered when people make use of web-based services in connection with travel, e.g. buying tickets
- more in-depth engagement via dedicated user groups, such as operated by TfL.

5   CONCLUSIONS AND NEXT STEPS

The analysis of literature, secondary data, and interviews with passenger representatives has identified the main user needs which should be considered when investigating emerging technologies in the context of modal behaviour change. The results should be taken into account by STTRIDE when selecting emerging technologies for further investigation.

5.1   User needs

The evidence reviewed suggests that convenience and ease of use, travel time and cost are key factors influencing users' modal choice in European countries. Related dimensions are accessibility, reliability and the level of trust which can be placed in travel modes; travellers hope for seamless, uninterrupted trips. They also need relevant, accurate, timely and practical information, though availability of information in itself may be insufficient to get people to change habitual travel patterns.

While convenient and time / cost effective trips are fundamental needs for most users across different modes, these and other needs may vary in importance according to personal characteristics and circumstances, trip purpose and frequency of mode use. In addition, new ways of providing transport in rural areas are likely to be required, as traditional forms of public transport are not seen as convenient or accessible by users.

5.2   Transport interventions and behaviour change

User needs have been targeted through a wide variety of transport interventions across Europe aimed at influencing travel behaviour. These interventions:
- cover the broad areas of demand management, infrastructure and design, service and information provision, education campaigns and reducing the need to travel
- have promoted the use of a range of modes - different forms of public transport, cycling, walking and different models of car use
- include a number of measures which can be related to one or more of the five technology areas that STTRIDE has identified. Some of these measures may be implemented in conjunction with other interventions that do not utilise emerging technologies.

The effectiveness of a specific intervention in encouraging modal shift may depend on whether / how it is deployed with other measures to promote shift, and on the wider policy context in which it is implemented. It is also evident that behaviour change regarding mode choice is a complex, non-linear process. It is subject to many influences operating at individual and wider societal levels, and relative perceptions of different modes. Behaviour change may be incremental and take a relatively long time, but can also be triggered by changes that disrupt or "shock".

5.3   Travellers' take up of technology based services

Changing traveller attitudes and needs are influencing the technological focus in transport across Europe. The main factors highlighted by passenger representatives were flexible working and willingness to participate in the sharing economy. These could impact on the development of shared mobility services and ticketing options.

There are also a number of drivers and barriers regarding travellers' take up of technology based services and measures within European countries. Travellers' relationship with IT can act as both a driver and barrier to take up of technology based services relating to different modes.

Many travellers are increasingly utilising IT services and expect internet connections to be available during journeys; however, not all travellers use mobile devices. There is a need to ensure that ticketing and fare options are flexible, but not complicated or bewildering in their diversity.

In addition to technological factors, other institutional, commercial, socio-economic, psychological, cultural and physical drivers and barriers exist in relation to user take up of technology based transport measures. This reinforces the findings that the impact of modal shift interventions is influenced by the wider policy environment, and technology based services may need to be supported by other measures. These findings, along with the drivers and barriers identified in this report, should inform more detailed analysis of the emerging technologies shortlisted by STTRIDE (WP3).

5.4   Involving users in technology innovations

This report has identified key user needs. However, the complexity of behaviour change processes and the interviews with passenger representatives highlight the need for road / transport authorities, transport operators and technology suppliers to engage in ongoing dialogue with users. The process should ensure that travellers' needs are reflected within specific technological innovations in transport in European countries, to aid user take up.

This is relevant for all types of technology based service, whatever mode is being targeted. User engagement should happen at all stages - development, deployment and evaluation - of the technology based service. Technology innovations may themselves present opportunities to gather relevant user feedback, but more detailed, qualitative engagement is necessary too. The latter could be via dedicated user groups, ensuring that different types of user are represented.

STTRIDE has two key public outputs:
•   a high level toolkit of investment options for road and transport authorities, with a clear set of enablers, barriers, probable impacts and priorities which need to be considered (WP5)
•   a European evaluation framework for consistent evidence collation of new technologies (WP4).

The toolkit should address how the user perspective can be taken into account when authorities consider investment options for technology based services, and the evaluation framework should address how users can be involved in evaluation.

APPENDIX 1 - PROTOCOL FOR REVIEWS OF LITERATURE AND DATA IN TASK 2.1 AND TASK 2.2

The purpose of this protocol is to ensure that the literature reviews in tasks 2.1 and 2.2 are co-ordinated and their methodologies are compatible. **All four STTRIDE partners are involved in these tasks, so should all follow this protocol.**

The document starts with issues of scope that apply to both task 2.1 and 2.2. It then sets out protocols for each task, including issues of scope that are task-specific. For each task, search vehicles are identified as well as specific references to consult. This is because the STTRIDE proposal highlights specific references, the partners are aware of a number of other references from existing knowledge and PEB members are expected to suggest some references.

N.B. this protocol does not cover interviews with experts on user needs, to be conducted within task 2.1. Interview questions will be informed by findings from the task 2.1/2.2 literature reviews. This protocol and the results from the task 2.1/2.2 literature reviews will be shared with the ISAAC project (Stimulating Safe Walking and Cycling Within a Multimodal Transport Environment).

A. SCOPE – APPLICABLE TO BOTH TASKS

Broad geographical scope: Focus on Europe, but can extend beyond in relation to any evidence that is particularly relevant / interesting, as long as findings are applicable to the European context.

Age of references: As we are investigating new technologies, only recent references should be considered, normally not more than six years old for technology, but 10 years for user needs and travel behaviour research is likely to have greater longevity.

Impacts: Our focus is on technology measures that influence modal choice. These measures may have other impacts, which we will report on where evidence is available, and which may add to the business case for implementing them, but modal shift remains the priority.

Applicability / target audience: CEDR represents national road authorities, so the primary focus is on measures that are applicable on the national (trunk) road network, accepting that many will have broader applicability, for example to local transport authorities.

B. TASK 2.1 IDENTIFICATION OF USER NEEDS

1. WORK ALLOCATION BETWEEN PARTNERS

- Task Leader - TRL
- Protocol development - TRL / VTT
- Protocol technical review - TRL
- Literature review - TRL (lead) / VTT / SP
  - TRL, as task leader will allocate already identified references across partners, to assess whether they are suitable for review
  - Partners should then report back to TRL on this, summarising the research questions covered by the references
  - TRL will then ask partners to review suitable references, search for others on specific topics if necessary and review further suitable references identified
  - Partners should report back to TRL on the outcome of any searches, so it can monitor whether sufficient evidence is being gathered
  - Partners will be expected to record findings from each reference reviewed
  - **At all stages of the literature review, partners should use the protocol set out below**
- Synthesis of findings in summary of user needs (D2.1) - TRL
- D2.1 technical review - TRL.

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2. SCOPE

The following factors are in addition to those identified in **section A**.

Users should be categorised as follows:
- people with mobility problems, including disabled and older people
- people with other mobility challenges, including travelling with luggage or accompanied by children
- people travelling in groups
- by gender
- young people
- urban dwellers
- rural dwellers
- people on low incomes
- users of different modes:
  - car users (potentially differentiating between drivers and passengers?)
  - buses
  - rail
  - cyclists (differentiating between bicycles and e-bikes)
  - pedestrians
  - powered two wheelers?
  - taxi users (differentiating between conventional taxi services and new models like Uber)
  - car sharing schemes, e.g. pool cars, hire cars.

NB the focus for car users differs from the others, in that in understanding car users' needs we seek to identify the factors that would help them to change to a different mode; while for the others we are interested in what factors could make it easier / more attractive to use that mode.

Drivers of modal choice In considering user needs we will have to focus on those that could (in principle) be influenced by technology. At the top level we would expect the main drivers of modal choice to be:

- cost

- availability

- journey time

- journey time reliability

- safety, real and perceived (both in terms of accidents and personal security e.g. fear of crime)

- comfort

- Information.

So for each of these we need to identify how a technology based service could have an impact encouraging modal change. However, we need to avoid getting stuck in a purely 'rational choice' model of travel behaviour, as this does not take account of important attitudinal factors like awareness, social acceptance, habitual behaviour. So we should also consider what can be learned from behaviour change research, including outside the transport world where applicable.

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3. SPECIFIC REFERENCES TO CONSIDER

We will begin by considering specific references/projects identified in the STTRIDE proposal and suggested by partners/PEB members. N.B. regarding projects, there will be a need to search project outputs and identify appropriate references to review. **All these references should be assessed against the checklist in section B.5 and any that do not meet the criteria should be discounted.**

From the proposal

- Transport Systems Catapult Traveller Needs and UK Capability Study (2015)

- Rail Safety and Standards Board Topic Note on Travel Behaviour and Behavioural Change (2014)

- numerous EC DG MOVE studies in support of ITS Directive Priority Actions A and B

- the issues raised and results of the EC Strategic Transport Research & Innovation Agenda (STRIA)

- transnational and national projects - 'All Ways Travelling', AUNT-SUE and INFOPOLIS, MOTOS, SaMERU and SMILE.

Suggested by partners / PEB members

See files uploaded in the STTRIDE online shared file space at the following location: *STTRIDE / WP2 Gathering Evidence / Task 2.1 Identification of user needs / Suggested references to review*.

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4. SEARCH VEHICLES / TERMS

Should the above references not generate sufficient evidence, one or more of the following search vehicles should be used. These are split into two categories – search vehicles which have open and free access, and search vehicles which require subscription and log in details. In the latter category we have only listed vehicles which specific STTRIDE partners subscribe to.

Open and free access

- Google Scholar http://scholar.google.co.uk/
- Directory of Open Access Journals https://doaj.org/ - access to full text of peer reviewed journals
- Directory of Open Access Books http://www.doabooks.org/ - access to full text of peer-reviewed books
- Digital Commons Network http://network.bepress.com/ access to peer-reviewed journal articles, book chapters, dissertations, working papers, conference proceedings, and other original scholarly work
- European Local Transport Information Service (ELTIS) www.eltis.org/ - see the discover and resources sections.
- Transport Research & Innovation Portal (TRIP) www.transport-research.info/web/.

Subscription / log in details required

- Science Direct www.sciencedirect.com/ - TRL subscribes
- Transport Research International Documentation (TRID) http://trid.trb.org/ - TRL subscribes.

Search terms are as follows. N.B. within each term, we have identified there are often multiple combinations that need to be searched separately, e.g. for each separate mode and user group.

- Future / changing / drivers of / predictors of transport / travel demand
- Factors affecting / influencing / emerging trends in transport / travel demand
- Factors determining / influencing mode / modal choice
- Factors determining / driving / predicting use of/demand for public transport / rail / bus / cycling / walking / car share/ E-bikes multi modal use / interchanges [i.e. search separately for each mode]
- Transport user / traveller / passenger needs/ travel behaviour & older people / disabilities / impaired mobility / mobility problems / gender / urban areas / rural areas / low income / accessibility
- Interventions / initiatives / schemes & causing / delivering / encouraging modal shift
- Interventions / initiatives / schemes & increasing public transport / bus / rail / cycle / car share / walking / multi modal use / interchanges
- Behaviour / behavioural change model & transport / travel / mode / modal choice.

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5. SELECTION CRITERIA FOR REFERENCES

The following checklist should be used to select which references to review.

✓ Date of publication - normally should be 2006 or newer

✓ To what extent does it address our research questions for this task? (Defined subsequently.)

✓ Are findings transferrable on a transnational and /or transmodal basis?

✓ To what extent is it evidence based, e.g. is it based on empirical research, best practice or informed opinion?

✓ If it is research based, is sample size representative? Any notable points such as control group methods should be recorded

✓ Has it been reviewed?

✓ Are there any flaws or gaps in the findings? Are these acknowledged?

✓ Apply an 'evidence hierarchy' that places peer reviewed journal articles at the top and industry publications, press reports, at the bottom.

6. RESEARCH QUESTIONS

The research questions to be addressed when reviewing the literature are:

- What factors influence travel demand?

- What factors influence users' choice of mode?

- What categories or hierarchies have been developed for these factors? (e.g. the user needs hierarchy described in the proposal)

- How do these factors vary between different users and modes?

- What kinds of intervention have been used to influence travel behaviour by targeting these factors?

- Which types of intervention / have been found to be most effective at encouraging modal shift? For which modes and users?

- Which of these interventions can be categorised under the 5 technology themes identified for the study?

- What behavioural change models have been developed to describe how people can be influenced to change mode or use sustainable modes more often?

7. RECORDING FINDINGS

Findings should be recorded using the template at **Annex 1**. This is based on the selection criteria for references and the research questions for task 2.1.

C. TASK 2.2 IDENTIFICATION OF TECHNOLOGIES

1. WORK ALLOCATION BETWEEN PARTNERS

- Task Leader - VTT

- Protocol development - VTT / TRL

- Protocol technical review - TRL

- Literature review - VTT (lead) / SP / TRL
  - VTT, as task leader, will allocate already identified references across partners, to assess whether they are suitable for review
  - Partners should then report back to VTT on this, summarising the research questions covered by the references
  - VTT will then ask partners to review suitable references, search for others on specific topics if necessary and review further suitable references identified
  - Partners should report back to VTT on the outcome of any searches, so it can monitor whether sufficient evidence is being gathered
  - Partners will be expected to record findings from each reference reviewed
  - **At all stages of the literature review, partners should use the protocol set out below**

  - Synthesis of findings in outline of emerging technologies. NB WP2 should aim for a shortlist of around 15 technologies. (D2.2) – VTT

- D2.2 technical review - TRL.

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2. SCOPE

The following factors are in addition to those identified in **Section A**.

Geographic scope We should work at urban as well as wider geographical levels.

Technological scope

- **Automation of vehicles:** the principal driver of automation is likely to be safety and it could also provide benefits of passenger transport in private vehicles. Could also be an enabler of vehicle sharing and demand-responsive services to provide access to public transport.

- **Information:** real time multi modal information provision

- **Journey efficiency:** giving greater priority to public transport vehicles and also helping public transport operators to make better use of capacity

- **Mobility as a Service (MaaS):** new mobility services, such as bike hire or car sharing, with sophisticated information and payment systems.

- **Safety:** technological improvements to individual modes or the wider environment impacting on perception of safety and willingness to use alternative modes.

Level at which technologies operate

- Hardware

- Application

- Service provided to users.

We expect that it is the service provided to users that is the level at which users will be most affected.

Foresight period This runs to 2035. However, IT changes a lot over the longer term, so for certain technologies, it would be wise to define short and medium term periods. The actual definitions will depend on the results of literature review.

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3. SPECIFIC REFERENCES TO CONSIDER

We will begin by considering specific references suggested by partners/PEB members. (None were identified in the STTRIDE proposal.) **All these references should be assessed against the checklist in section B.5 and any that do not meet the criteria should be discounted.**

Suggested by partners / PEB members

See files uploaded in the STTRIDE online shared file space at the following location: *STTRIDE / WP2 Gathering Evidence / Task 2.2 Identification of technologies / Suggested references to review*.

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4. SEARCH TERMS AND VEHICLES

Open and free access

- Google Scholar http://scholar.google.co.uk/

- Directory of Open Access Journals https://doaj.org/ - access to full text of peer reviewed journals

- Directory of Open Access Books http://www.doabooks.org/ - access to full text of peer-reviewed books

- Digital Commons Network http://network.bepress.com/ access to peer-reviewed journal articles, book chapters, dissertations, working papers, conference proceedings, and other original scholarly work

- European Local Transport Information Service (ELTIS) www.eltis.org/ - see the discover and resources sections.

- Transport Research & Innovation Portal (TRIP) www.transport-research.info/web/.

Subscription / log in details required

- Science Direct www.sciencedirect.com/ - TRL / VTT subscribes

- Frost & Sullivan http://ww2.frost.com/ - market foresight and research - VTT subscribes

- BCC Research - market foresight and research - VTT subscribes

- eKnowledge search - aggregated search for articles, books, journals, etc.; almost 100 databases- VTT subscribes

- Gartner technology research http://www.gartner.com/technology/home.jsp - VTT subscribes

Search terms:

- Emerging technologies transportation / road infrastructure
- Technology foresight
- Intelligent / smart transportation systems
- Intelligent mobility technology
- Traffic management technology
- Mobility service / MaaS
- Self-driving / autonomous vehicles
- Automation vehicles
- V2X communication technologies
- Road / passenger safety technologies
- Technologies commuting / travelling / modal shift
- Multimodality / multimodal in travelling technology.

5. SELECTION CRITERIA FOR REFERENCES

- ✓ Date of publication – should be 2010 or newer
- ✓ To what extent does it address our research questions for this task? (Defined subsequently.)
- ✓ Are findings transferrable on a transnational and /or transmodal basis?
- ✓ To what extent is it evidence based, e.g. is it based on empirical research, best practice or informed opinion?
- ✓ If it is research based, is sample size representative? Any notable points such as control group methods should be recorded
- ✓ Has it been reviewed?
- ✓ Are there any flaws or gaps in the findings? Are these acknowledged?
- ✓ Apply an 'evidence hierarchy' that places peer reviewed journal articles at the top and industry publications, press reports, at the bottom.

6. RESEARCH QUESTIONS

The research questions to be addressed when reviewing the literature are:

- How are changing traveller needs changing the technological focus in transportation?
- What technological trends are affecting transportation in general?
- Which kind of technical advancements are seen to make a paradigm shift?
- What technologies can be identified behind the trends?
- How mature are the identified technologies?
- Which technologies are competing with each other?

7. RECORDING FINDINGS

Findings should be recorded using the templates at **Annex 2** and **Annex 3**. These is based on the selection criteria for references and the research questions for task 2.2.

ANNEX 1

TEMPLATE FOR RECORDING FINDINGS FROM LITERATURE REVIEWS FOR TASK 2.1, IDENTIFICATION OF USER NEEDS

BASIC INFORMATION	
Reference: please use Harvard system	
Type of publication: e.g. journal article, other article, book, book chapter, working paper, project report, conference paper	
Client (if relevant): e.g. government dept, EC, industry	
Type of study: e.g. literature review, primary research, meta analysis; quantitative or qualitative	
Geographic scale: • **is the scale transnational / country / regional / local?** • **which transnational area / country / region / locality is covered?**	
QUALITY	
Level on 'evidence hierarchy':	
Are findings transferrable on a transnational basis?	
To what extent is the document evidence based? e.g. is it based on empirical research, best practice or informed opinion	
If research based – • **what is the sample size & is it representative?** • **what are the key elements of the methodology?** e.g. randomised control / before & after surveys / after survey only / focus groups / interviews • **which year were data collected?**	
Has the document been reviewed? If so, please specify method of review:	
Are there any flaws or gaps in the findings? • **specify flaws/ gaps** • **are these acknowledged?**	

FINDINGS
What factors influence travel demand?
What factors influence users' choice of mode?
What categories or hierarchies have been developed for these factors? (e.g. the user needs hierarchy described in the proposal)
How do these factors vary between different users and modes?
What kinds of intervention have been used to influence travel behaviour by targeting these factors?
Which types of intervention / have been found to be most effective at encouraging modal shift? For which modes and users?
Which of these interventions can be categorised under the 5 technology themes identified for the study?
What behavioural change models have been developed to describe how people can be influenced to change mode or use sustainable modes more often?

ANNEX 2

TEMPLATE FOR RECORDING FINDINGS FROM LITERATURE REVIEWS FOR TASK 2.2, IDENTIFICATION OF TECHNOLOGIES

BASIC INFORMATION	
Reference: please use Harvard system	
Type of publication: e.g. journal article, other article, book, book chapter, working paper, project report, conference paper	
Client (if relevant): e.g. government dept, EC, industry	
Type of study: e.g. literature review, primary research, meta analysis, quantitative or qualitative	
Geographic scale: • **is the scale transnational / country / regional / local?** • **which transnational area / country / region / locality is covered?**	
QUALITY	
Level on 'evidence hierarchy':	
Are findings transferrable on a transnational basis?	
To what extent is the document evidence based? e.g. is it based on empirical research, best practice or informed opinion	
If research based – • **what is the sample size & is it representative?** • **what are the key elements of the methodology?** e.g. randomised control / before & after surveys / after survey only / focus groups / interviews • **which year were data collected?**	
Has the document been reviewed? **If so, please specify method of review.**	
Are there any flaws or gaps in the findings? • **specify flaws/ gaps** • **are these acknowledged?**	

FINDINGS
How are changing traveller needs changing the technological focus in transportation?
What technological trends are affecting transportation in general?
Which kind of technical advancements are seen to make a paradigm shift?
What technologies can be identified behind the trends?
Which technologies are competing with each other?
How mature are the identified technologies?

ANNEX 3

TEMPLATE FOR TECHNOLOGIES FOUND IN LITERATURE REVIEW IN TASK 2.2

Technology:		**ID:**	
Technology readiness level:		**Time horizon:** in years	
Operational level:		**Domain:** STTRIDE thematic area	
Geography: where the technology will be used		**Source:**	
Relation to modal change:			

APPENDIX 2 - LIST OF SOURCES REVIEWED IN TASK 2.1

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Handy, S. L. & Xing Y. (2011) *Factors correlated with bicycle commuting: A study in six small U.S. cities* International Journal of Sustainable Transportation, vol. 5, issue 2, pp. 91-110

Hine, J. & Scott, J. (2000) *Seamless, accessible travel: Users' views of the public transport journey and interchange* Transport Policy, vol. 7, issue 3, pp. 217-226

INFOPOLIS 2 (1999) *Needs of travellers: An analysis based on the study of their tasks and activities - Deliverable 3* EC http://cordis.europa.eu/telematics/tap_transport/library/infopolis2-d3.html

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APPENDIX 3 - GUIDE TO INTERVIEWS IN TASK 2.1

About STTRIDE

STTRIDE (**S**marter **T**ravel **T**echnology **R**eview for **I**nvestment **De**cisions) is a European project funded by the Conference of Directors of European Roads (CEDR). The project will address how best to use technological advances to deliver positive modal shift. Technology innovation provides an opportunity for significant change in traveller behaviour without always requiring major infrastructure investment or legislative intervention. The pace of change means it could be a challenge for road and transport authorities to understand potential impacts and timescales associated with a wide range of technologies. Thus there is a knowledge gap for authorities in understanding how to respond to and invest in the right technologies to deliver their preferred outcomes.

STTRIDE is focussing on five thematic areas in relation to emerging technologies. Themes are defined by the purpose for which technology is used and there is some overlap between them:

(i) Automation of vehicles Although the principal driver of automation is likely to be safety, it could also provide many of the benefits of passenger transport in private vehicles. This technology could also be an enabler of vehicle sharing and demand-responsive services to provide access to public transport.

(ii) Information Multi modal information provision can identify alternative travel options, both before and during the journey, enabling plans to be revised in real time, which reduces the risk and uncertainty associated with public transport and enables better use to be made of travelling and interchange time.

(iii) Journey efficiency New technologies can help transport authorities give greater priority to public transport vehicles. It can also help operators make better use of capacity enabling improved cost-effectiveness, potentially leading to lower fares and improved investment.

(iv) Mobility as a Service Enabling the provision of new mobility services, such as bike hire or car sharing, managed with sophisticated information and payment systems.

(v) Safety Technological improvements to individual modes or the wider environment which would impact on the perception of safety and people's willingness to use alternative modes. For example, an improved environment for cyclists through new transport infrastructure, including more advanced junction designs.

STTRIDE will review travellers' needs and understand the role of emerging technology in meeting those needs. The study will draw together disparate existing foresight research for fresh macroeconomic and impact analysis. STTRIDE will then provide a high level toolkit of investment options for road and transport authorities, with a clear set of enablers, barriers, probable impacts and priorities which need to be considered. The project will also develop a European evaluation framework for consistent evidence collation of new technologies and will pilot the viability of this approach before publishing guidance.

Interviewer's introduction

As part of the study, project partners TRL and SP are interviewing several experts from passenger representation bodies about traveller needs in a multimodal context. The organisations involved are the European Passengers Federation plus and three national passenger representation bodies. Interviews should last no more than 45 minutes.

We envisage including the names and roles of the experts in our report on user needs, along with analysis of interviews. Some reported observations may be attributable to specific interviewees. However, interviewees should let the interviewer know if there are any particular comments which they wish to be reported but to remain anonymous. We will send you a copy of the final report on user needs, as well as the toolkit of investment options for road and transport authorities.

Questions

1. Please outline your role within the passenger representation body.

2. What kinds of travellers and passengers are represented by this body?

3. What are the main factors influencing travellers' choice of travel mode?

4. How do these factors vary between different users and modes?

   Users may include: people with mobility issues, e.g. disabled and older people, people travelling with luggage or accompanied by children; people travelling in groups; men and women; young people; urban dwellers; rural dwellers; people on low incomes.

   Modes may include: public transport, e.g. bus, rail, tram, metro, ferry; cycling; walking; car; taxi; powered two wheelers.

5. What are travellers' main needs for an optimal journey?

6. How are changing traveller needs influencing the technological focus in transport? *Please focus on the five technology areas covered by STTRIDE as outlined in the project information on page 1, i.e.* vehicle automation, information provision, journey efficiency, Mobility as a Service and safety.

7. What drivers influence travellers' take up of technology based transport services and measures? Please focus on the five technology areas covered by STTRIDE. How do these drivers vary between different users?

8. What barriers influence travellers' take up of technology based transport services and measures? Please focus on the five technology areas covered by STTRIDE. How do these barriers vary between different users?

9. What are the best ways of ensuring user needs are considered when developing and evaluating technology based transport services and measures? Please focus on the five technology areas covered by STTRIDE.

10. Future STTRIDE activities include:

- Drawing up a shortlist of emerging technologies most likely to encourage modal shift, then holding a stakeholder workshop to help identify enablers, barriers and impacts associated with the shortlisted technologies

- A final dissemination event.

Would you be willing to be involved in these activities?