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Final report from CEDR Research Programme Call 2015

"User Needs in a Multimodal Context"

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Final report from CEDR Research Programme Call 2015 "User Needs in a Multimodal Context"

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- ISAAC - Stimulating safe walking and cycling within a multimodal transport environment: Consideration of vulnerable road users in a multimodal context)
- STTRIDE - Smarter Travel Technology Review for Investment Decisions: Impact of new technologies on modal choice

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Abbreviations

AIS	Automatic Identification System (for vessels)
ANPR	Automated Number Plate Recognition
BASt	Federal Highway Research Institute

Glossary

Consolidation	A process where consignments from one shipper or different shippers are grouped together to a single, large shipment. Normally organised by forwarders.
Drayage	The transport of goods over a short distance, often as part of a longer overall move, such as moving goods from a ship into a warehouse.

Executive Summary

The CEDR Transnational Research Programme Call 2015 was developed by CEDR Working Group Innovation and funded by the CEDR members from Germany, Netherlands, Finland, Ireland and Sweden. The aim of this research programme is to advance the understanding of the motives of transport users by national road authorities, the needs of users for choosing different transport modes, and the impacts of appropriate incentives for a modal shift.

Two projects were funded:

- ISAAC - Stimulating safe walking and cycling within a multimodal transport environment – which focused on the consideration of vulnerable road users in a multimodal context
- STTRIDE - Smarter Travel Technology Review for Investment Decisions – which investigated the impact of new technologies on modal choice

ISAAC

As the populations of large cities continue to grow, there are major challenges relating to supporting a change from car use to the use of public transport, walking and cycling. One of the main challenges is the use of major road links into large cities and efforts to curb the increase in road traffic.

The focus of ISAAC is on vulnerable road users - pedestrians, cyclists, riders of powered two-wheelers – as they move from point A to B and the travel chain they choose in a multimodal context. In order to encourage more sustainable modes of mobility the preferred modes require that the urban structure be designed so that walking and cycling trips are convenient, pleasant and safe.

ISAAC developed a web-based tool (Pedbikeplanner) for policy makers in large cities where they can find evidence-based information about measures that can contribute to modal shift from car to walking and cycling without compromising safety. This web-based tool is hosted by TOI and will be maintained until July 2021 so that its use and benefits can be evaluated. A major conclusion of a survey carried out within ISAAC study is that walking and cycling should not be treated as one group of “active transportation”. Both have their own motivations and barriers, and therefore need to be addressed by policy makers as well as researchers separately.

It appeared that the perceptions of Personal e-Transporters are still relatively unfavourable, especially in terms of safety and cost. Nevertheless, in several cities the percentage of respondents that use them as a transport mode at least monthly can be up to 10%, implying that they should not be considered as a marginal phenomenon in traffic.

The final event provided an opportunity to discuss priorities for future actions and research: these include:

- Apply the “External costs of mobility report” which gives economic arguments for the importance and impact of modal shift. These arguments are vital for decision making on different levels (EU, national and Local).
- Research is required for evidence-based road safety promotion to enhance a safe modal shift from motorized traffic to walking and cycling in urban environments. Include evaluation of the option for speed reduction in cities and automatic speed adaptation in cars.
- Evaluate if the increased interest in sustainable mobility (SUMP) will help to speed up the modal shift to walking and cycling in cities.

- Evaluate if mobility as a service, will help cities to reduce the increased traffic flow.
- The current space that cars use in cities needs to be reconsidered in order to enhance the modal shift to other modalities (like walking and cycling).
- Monitor the mobility developments in different cities. Data should be made available and shared in order to learn from experiences. Define a limited basic dataset for all cities providing a possibility for benchmarking.

STTRIDE

Many emerging technologies are having a significant impact on preferred mode of transport. Once a new technology has appeared, it can also be difficult to assess the impact it has had. As a result, there is a knowledge gap how to support, respond or invest in the right technologies to deliver their preferred outcomes.

STTRIDE addresses how best to use technological advances to deliver positive modal shift. The project reviewed a number of potential technologies identified from an evidence review and used them as examples to demonstrate a set of evaluation techniques. These included PESTLE, foresight analysis and logic mapping of outcomes and impacts. The experience gained from trailing these methods with the example technologies was then used to develop a toolkit of evaluation guidance for more general application to technology-based interventions.

A joint final event for STTRIDE and ISAAC was held on 8-9 May 2019 in Brussels. This was coordinated by the POLIS network alongside a POLIS event so that delegates could choose to attend the STTRIDE and ISAAC event as part of a two-day programme on integrated transport, featuring new mobility options such as e-scooters.

The final event provided an opportunity to discuss the principles of STTRIDE with a range of potential users and stakeholders. Workshops were held, one focusing on positive and negative impacts presented by new technological developments, the second on the practical implications of conducting trials and evaluations, including research methods. The issues discussed show that a wide range of potential impacts needs to be considered beyond simply changes in travel behaviour. Evaluation has to consider how people use a service, their perceptions of it and a number of social implications, in particular for non-users who may become socially excluded or exposed to risk.

Priorities for future research have been recommended, focused on particular themes identified in the final project event. These include:

- Data-sharing and co-operation: how can transport authorities best work with new mobility service providers to deliver the benefits of shared data, taking account of concerns such as with privacy and commercial interests.
- Social impacts: how can impacts on employment conditions or social exclusion be identified and mitigated in new mobility services.
- Safety performance - how can the safety of different modes be measured and compared meaningfully (appropriate performance indicators), including perceived safety and the barrier it can present to modal shift.

1. Introduction

The CEDR Transnational Research Programme Call 2015 "User Needs in a multimodal context" was developed by CEDR Working Group Innovation and funded by the CEDR members from Germany, Netherlands, Finland, Ireland and Sweden. As in previous collaborative research programmes organised by CEDR, the participating CEDR members established a Programme Executive Board (PEB) made up of experts in the topics covered. The PEB acted as a steering committee for the programme.

The main objective of this Transnational Research Programme is to gain better knowledge and guidance of how to promote multimodality in the transport system.

1.1. Aim of the Call

The aim of this research programme is to advance the understanding of the motives of transport users by national road authorities, the needs of users for choosing different transport modes, and the impacts of appropriate incentives for a modal shift.

The call has three sub-themes:

A: Multimodality for a decrease in car usage
B: Consideration of vulnerable road users in a multimodal context
C: Impact of new technologies on modal choice

1.1.1. Consideration of vulnerable road users in a multimodal context

The focus on this sub-theme is on vulnerable road users (pedestrians, cyclists, riders of powered two-wheelers) moving from point A to B and the travel chain they choose in a multimodal context. In order to encourage more sustainable modes of mobility the preferred modes require that the urban structure be designed so that walking and cycling trips are convenient, pleasant and safe. Some questions arise from this concern:

- How can walking/cycling be encouraged?
- How can we plan for a multimodal environment that is safe, secure and comfortable?
- Under which conditions will walking or cycling be unsafe (especially for elderly users and kids)?

The number of people using bikes for commuting is increasing rapidly in different countries in Europe. The question is how to avoid safety conflicts or the safety concerns which will discourage the use of the bike. Other questions include:

- What measures can contribute to a safe and secure environment for vulnerable users?
- How can we encourage the choice of walking/cycling?
- What incentives can be offered to people to change their mobility behaviour?
- Do we have to focus on different subgroups of vulnerable road users?

To answer these questions, two approaches have to be considered:

1. Choosing a behavioural model which points out the different outcome expectations people have concerning mobility, safety and security; and
2. Collection of mobility data (e.g. motivation/purpose of a trip) to identify the exact modal split and relevant predictors of modal choice.

1.1.2. Impact of new technologies on modal choice

The dynamic development of new technologies in the field of personal mobility devices, innovative communication applications and tools as well as the progressing automation of cars will significantly influence the future use of transport modes. It is essential to evaluate and monitor the impact of these new technologies on modal choice. Since the market penetration rate plays a major role in the impact analysis, the opportunities and barriers for a broad deployment have to be identified and assessed. Evidence based approaches are needed in order to overcome the barriers and to implement successful solutions to change the current automobile-centric modal split in passenger transport. Therefore, the identification and evaluation of practical solutions should take into account the outcome of behavioural models such as acceptance of and experience with new technologies, social values, etc.

1.2. Selected Projects

Two projects were selected for conducting the work of the programme.

Related to the sub-theme B and some aspects of A:

ISAAC - Stimulating safe walking and cycling within a multimodal transport environment
The consortium that worked on this project is composed of the following partners:

SWOV: Netherlands	Institute for Road Safety Research, (Coordinator),
VIAS:	Belgian Road Safety Institute, Belgium
POLIS: Belgium	Promotion of Operational Links with Integrated Services,
TØI:	Transportøkonomisk institutt, Norway
TU-Dresden:	Techhnische Universität Dresden, Germany

Related to the sub-theme C:

STTRIDE - Smarter Travel Technology Review for Investment Decisions
The consortium that worked on this project is composed of the following partners:

TRL:	(Coordinator) UK
VTT:	Finland
SP:	Sweden

In the next section, a summary is provided of the work and results for each of the projects.



1.2.1. Modal shift: Multimodality for a decrease in car usage

The specific concern of this sub-theme is to encourage less car use and a change to more sustainable modes of mobility: walking, cycling, public transport. This concern is derived from the observation that car driving is accompanied by several disadvantages for society (e.g. congestion, pollution). Active transport on the other hand provides benefits for individuals by increasing their daily physical activity levels. Active transport includes non-motorised forms of transport involving physical activity, such as walking and cycling. It also includes public transport, as public transport trips generally include walking or cycling components as part of the whole journey. As the populations of large cities continue to grow, there are major challenges relating to supporting a change from car use to the use of public transport, walking and cycling. One of the main challenges is the use of major road links into large cities and efforts to curb the increase in road traffic.

Commutes are particularly challenging because they are concentrated in time and space. There are capacity problems in both the road network and public transport on roads that lead to large cities. We need a better understanding of the factors that can lead to a multi-modal use of the transport system.

Some questions need to be answered:

- What measures contribute to modal shifts and less car use?
- How can choosing alternative modes of transport be increased?
- What incentives can be offered to achieve this goal?

2. ISAAC project

The starting point of ISAAC (Stimulating safe walking and cycling within a multimodal transport environment) is that an increasing number of European countries, regions and cities are in process of promoting walking and cycling as an environmentally friendly, healthy and efficient mode of transport for short trips, particularly for short trips in built-up areas and as feeder transport to longer distance public transport. Walking and cycling (including power assisted bicycles and mopeds) also diminish congestion and alleviate parking problems in urban areas. However, while there are many advantages, there is a serious negative side effect of promoting walking and cycling and that is related to road safety and accident risk. Pedestrians and cyclists (including power assisted bicycles and mopeds) are much more prone to injuries in case of accidents, both in the case of collisions with other road users and in individual accidents (e.g. single vehicle accidents). Existing scientific knowledge in this area is currently not well disclosed and available for policy makers on a local and national level.

2.1. Research objectives and outputs

The ISAAC project aims to provide a checklist and guideline with evidence-based recommendations for realising a modal shift from car to walking and cycling in urban and suburban areas without compromising road safety, social security and road user comfort.

The research questions that the project will answer are:

- Which factors generally affect a modal shift from car to walking and cycling, positively and negatively and how do these factors mutually relate (behavioural models)?
- Which features of the road environment, the population and the prevailing transport or health policy (co)determine the success of a modal shift to walking and cycling and have to be taken into account (segmentation)?
- What are the preconditions for ensuring that an increase in pedestrian and cyclist mobility does not lead to more traffic injuries and fatalities, whilst at the same time ensuring that road

safety measures do not increase (feelings of) social insecurity or decrease the experienced comfort of walking and cycling (preconditions)?

- What are theoretically promising concepts and the practically proven approaches and measures with which to realise a safe modal shift from car to walking and cycling without compromising security and comfort (interventions)?

The ISAAC project included a survey study entitled "Determinants and barriers of walking, cycling and using Personal e-Transporters: a survey in nine European cities". The aim of the survey was to better understand people's travel mode choices and to investigate how they can be encouraged to use more sustainable active transport modes.

2.2. The Pedbikeplanner web-based tool

The final product of ISAAC is the web-based tool, available at https://www.pedbikeplanner.eu/, consisting of a guide and checklist for city planners and policy makers to assist them in:

- Identifying potentially relevant measures (without compromising safety, social security and comfort), given the current status of the city and the ambitions for the future;

- Assessing the potential political and public support for implementation of the measures.

ISAAC covers a wide range of information from a wide variety of disciplines. The tool is based on available knowledge and documents. It does not provide exhaustive information; it will provide fact sheets with general instructions on how to implement measures, the relevant actions, the general principles, the aspects that should not be forgotten. Whenever possible links to concrete examples are given, and further reading and more detailed implementation instructions are identified.

The Pedbikeplanner tool provides a checklist and guideline with evidence-based recommendations - in the form of fact sheets - for realising a modal shift from car to walking and cycling in urban and suburban areas without compromising road safety, social security and road user comfort. This information is provided in the form of fact sheets and is to a certain level tailor-made. This means that users obtain the most relevant information based on a profile of their city. In the fact sheets, available information about road safety measures, social security and road user comfort are also included.

A checklist for the level of policy support is also included in the tool. This checklist gives an indication if proposed measurers will be implemented in practice. This checklist is based on results of the STTRIDE project which is related to the ISAAC project.

The hosting of the tool will be conducted by the Institute of Transport Economics (TØI, Norway) for a period of two years following the completion of the project. The hosting includes monitoring of the web site, updating technical issues and licenses, as well as coordinating these activities. The hosting is financially supported by CEDR.

Related to the tool the following conclusions are drawn:

1. From the consultations of the tool in different presentations and workshops it appears that potential users (representatives of cities) are generally positive about the tool and the usefulness for their policy.
2. Based on a city profile, the information (fact sheets) can be tailored to the specific characteristics of the city. It is also possible for users to get a full list of fact sheets or a selection based on certain topics addressed.
3. The number of fact sheets included in the tool is not fixed. New factsheets can be added and existing factsheets required regular updating.

4. In order for the tool to be used in the future, the tool should be monitored in order to be able to evaluate its added value in relation to the costs of hosting.

The tool can be accessed via the following link:

https://www.pedbikeplanner.eu/ie/index.php#home

The screen as shown in figure 2.1 will appear.

Figure 2.1 Screen that appears as you start the Pedbikeplanner tool.

In the top of this screen, by clicking on the corresponding word, you can immediately go to:

Measures: Giving options for searching information about measures for enhancing modal shift (fact sheets)

Policy: Checklist for calculating the level of support for implementing measures

Benefits: Brief text about general benefits of active mobility modes; see figure 5.10

About: Description of the organisations involved in planning/financing and building the tool; see figure 5.11

Contact: Contact information for questions/remarks about the tool.

Search: Selecting all the fact sheets where the corresponding term is present.

In table 2.1 a list of the titles of the types of measures is given that are included in the web-based tool.

	Title	Type of measure	Type of Road User Bike (B) Pedestrian (P)
1	Operation and maintenance of cycling facilities	Infrastructure	B
2	Bicycle parking	Infrastructure	B
3	30 km/h speed limits	Infrastructure /Policy	B
4	Commuter parking for cyclists	Infrastructure	B
5	Intelligent Transportation Systems (ITS) for bicycles	Infrastructure	B
6	Bicycle superhighways	Infrastructure	B
7	Bicycle Street	Infrastructure	B
8	Bicycle sharing systems	Infrastructure /Policy	B
9	Direction signing for pedestrians/cyclists	Infrastructure	B
10	Cycling roads and cycling road networks	Policy	B
11	Interim design strategies	Policy	B/P
12	Improved road safety for bicyclists and pedestrians	Infrastructure	B/P
13	Two-way bicycle traffic in one-way streets	Infrastructure /Legislation	B
14	Promoting use of cargo bikes	Policy /Infrastructure	B
15	Shared bus lanes	Legislation	B
16	Shared Space	Infrastructure /Legislation	B
17	Bicycles right turn red	Legislation /Infrastructure	B
18	Specific actions towards the elderly	Services	B/P
19	Sustainably safe road traffic	Policy / Infrastructure	B/P
20	Thoroughfare redesign	Infrastructure	B/P
21	Financial incentives to buying/using bicycles	Financial /legislation	B
22	Awareness campaigns and information	Education	B/P
23	Shortcuts for pedestrians	Infrastructure	B/P
24	Land use planning	Urban planning	P/B
25	Awareness campaigns and information	Education	P/B
26	Benches and resting areas	Urban planning/ Infrastructure	P
27	Continuous recreational walking network	Urban planning/ Infrastructure	P
28	Traffic calming	Infrastructure	B/P
29	Improved road safety for bicyclists and pedestrians	All	B/P
30	Infrastructure for pedestrians	Infrastructure	P
31	Pedestrian crossings	Infrastructure	B/P
32	Facilities to take bicycles on board of Public Transport	Policy/infrastructure	B
33	Universal design	Infrastructure	B/P
34	Lighting for pedestrians	Infrastructure	B/P
35	Bicycle training / E-bike training	Education	B
36	Local walking strategy	Policy	B
37	Improving school environments	Infrastructure (+education and enforcement)	B/P
38	Local stakeholder information and involvement	Education	B/P
39	Promoting electric bicycles	Education	B
40	National walking strategies	Policy	P
41	Sidewalk design	Infrastructure	P
42	Sign plans for pedestrians	Infrastructure /policy	P
43	Traffic laws for pedestrians	Legal /policy	P

44	Walking school buses	Services	P
45	Walking to public transportation	Infrastructure/Urban planning	P

Table 2.1 A list of the titles of the types of measures that are included in the web-based tool

An example of a factsheet is given in Appendix A.

2.3. The survey

This paragraph describes the results of an extensive online survey that has been conducted to collect empirical data on the psychological determinants and barriers of a travel mode shift in favour of active transport modes. The modes that have been focused on are walking, cycling and the use of Personal e-Transporters (PeTs) (e.g. electric scooter, monowheel, Segway, etc). The survey was conducted in nine cities spread over the four countries of the consortium partners involved in the ISAAC-project: Tilburg and Groningen (The Netherlands), Ghent and Liège (Belgium), Trondheim and Bergen (Norway), and Dortmund, Düsseldorf and Berlin (Germany). A representative sample (in terms of age and gender) of 250 respondents per city was interviewed.

The aim is to better understand people's travel mode choices, and to investigate how the use of more sustainable active transport modes can be increased.

A factor and cluster analysis was conducted to identify coherent groups of participants that are similar to each other regarding psychological determinants of travel mode choice, but different from participants in other groups. Two clusters of participants with similar psychological determinants of travel mode choice were identified. The difference between both clusters was mostly explained by cycling related factors. As a result, a clear 'pro-cycling' cluster was identified (55.6% of participants in the sample), consisting of people with more favourable cycling-related factors, and a 'non-pro-cycling' cluster of people with less favourable cycling-related factors. This suggests that the psychological determinants of cycling have a higher level of variation compared to the psychological determinants of walking. In other words, respondents' answers related to cycling are more diverse than answers related to walking, or alternatively, people's feelings related to cycling are more 'pronounced' than those related to walking.

Significant differences in respondents' characteristics are identified between both clusters. Higher shares of respondents from Groningen, Tilburg, Ghent and Düsseldorf are found in the pro-cycling cluster, while this cluster contains a lower fraction of respondents from Bergen, Liège and Trondheim. In addition, the pro-cycling cluster contains more young people (aged 18-34), more men and higher-educated, and more people living with a partner and children. They possess a higher number of all types of vehicles (including PeTs), except cars. The pro-cycling cluster also contains a higher share of respondents with a season ticket for public transportation and to a car or bike sharing system. The pro-cycling cluster contains fewer people who have difficulties to park a bicycle at home. Respondents in the pro-cycling cluster logically cycle significantly more often, but they also show higher rates of walking, riding a moped or motorbike, taking a taxi and using a PeT.

The analyses confirm that the classic components of the Theory of Planned Behaviour, supplemented by habit, provide the best fit for the behavioural model of cycling and walking. People's intentions to walk/cycle for their everyday trips are most strongly affected by their attitudes related to these modes, and to a lesser extent by norms and perceived behavioural control.

The biggest obstacle indicated by all respondents combined that hinders them from cycling more frequently, is traffic safety (Figure 2.2.). The second biggest obstacle is time, followed by the required

physical effort and the environment (climate, hilliness…). Cost is considered the least important obstacle. Significant differences between cities are observed. Traffic safety is considered a stronger barrier in the Belgian cities (mostly Liège) and in the German cities compared to the Dutch and Norwegian cities. From the cluster analysis it becomes clear that traffic safety is considered to be a significantly more important obstacle for respondents in the non-pro-cycling cluster. Improving traffic safety will therefore be a key element in realising a modal shift towards more cycling, especially for people who currently do not cycle much yet. The required physical effort and the environment (climate, hilliness…) are also considered significantly more important obstacles by the non-pro-cycling cluster, but the difference between both clusters is smaller than for the traffic safety. Cost on the other hand is a relatively more important obstacle for the respondents in the pro-cycling cluster.

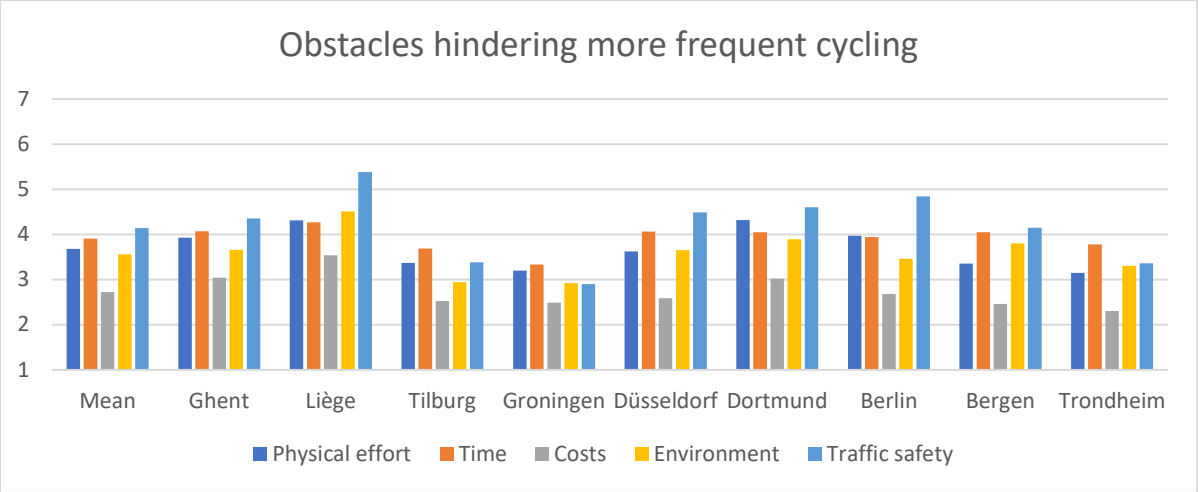

Figure 2.2: Obstacles hindering more frequent cycling

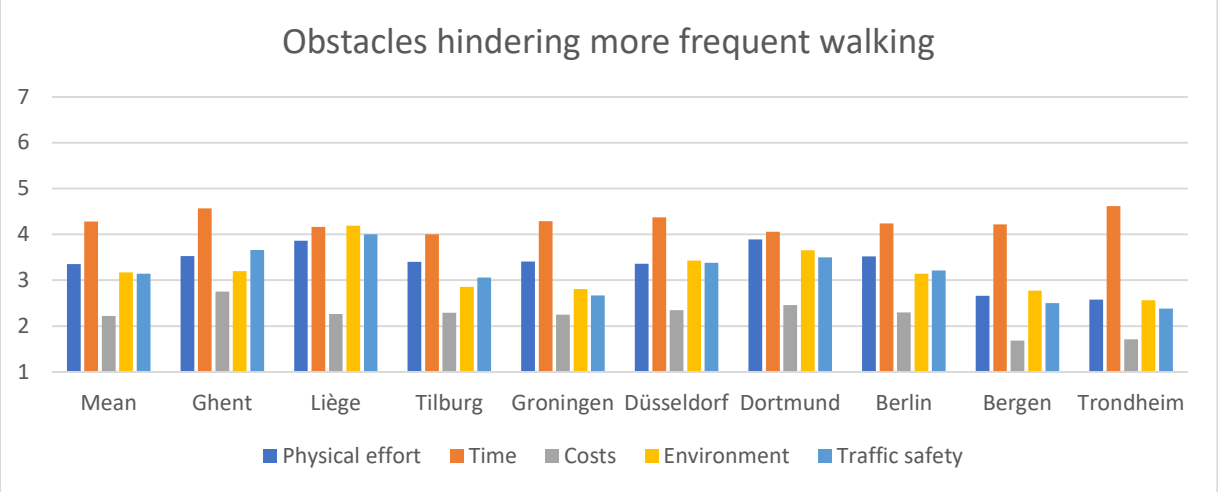

Figure 2.3: Obstacles hindering more frequent walking

The biggest obstacle hindering more frequent walking is time (Figure 2.3). Physical effort, environment and traffic safety receive an approximately equal weight. The pro-cycling group (that walks significantly more than the other group) considers time a significantly more important obstacle for walking more frequently than the other group. There are no significant differences between both groups in terms of the importance of physical effort, environment and traffic safety as obstacles for walking more frequently.

Generally, respondents' perceptions of PeTs are not (yet) very favourable. Respondents' perceptions related to cost and safety received the lowest scores. Significant differences between the cities can be observed. The most favourable perceptions are reported in the German cities, especially in Dortmund. The least favourable perceptions are reported in the Norwegian cities Bergen and Trondheim. The current frequency of use of PeTs is highest in Groningen and in the German cities, where around 10% of participants indicates an occasional/frequent usage of PeTs (at least on a monthly basis, or more often).

The stage model shows that respondents' stage of behavioural change towards using PeTs more frequently is affected by various aspects. Some noteworthy findings are the following. Respondents with higher cycling norms are more likely to be in the higher stages of behavioural change. Respondents who walk more often are more likely to be in the higher stages as well, but respondents with more favourable walking attitudes have a lower probability. Stronger transport mode habits are related to a lower chance of being in the higher stages. Respondents who indicate stronger cycling obstacles have a higher probability of being in the contemplation stage of using PeTs. Respondents with a subscription to a bike sharing service have a lower probability of being in the higher stages of behavioural change.

The findings in this report highlight the intrinsically different nature of walking and cycling as transport modes, with different factors and perceived obstacles affecting their usage. As a result, stimulating these modes will require a different approach. While this may seem like a trivial conclusion, it is not uncommon in research as well as policy and practice to treat 'active modes' as being a coherent way of transportation with similar features.

2.4. Implications and recommendations for policy and practice

The general recommendations arising from the project are:

- The findings in this report clearly highlight the intrinsically different nature of walking and cycling as transport modes, with different factors and (perceived) obstacles affecting their usage. As a result, it is important to make a clear distinction between walking and cycling as very different transport modes in policy and practice. While this may seem a trivial conclusion, it is common in research as well as policy and practice to treat 'active modes' as being a coherent way of transportation with similar features. This study clearly stresses that walking and cycling have very different motivations and perceived obstacles and stimulating them will therefore need a different approach.
- Generally, literature suggests that it is easier to change behaviour when there is no or a less strong habit, since transport mode habits can circumvent rational decision making and therefore make people 'immune' to changes in the different transport modes. Since respondents generally express a lower level of transport mode habit for leisure trips, it is expected that this type of trips might be most susceptible to a modal shift. Generally, respondents in Liège show the lowest level of transport mode habit, which might indicate that a modal shift could be more easily accomplished in Liège than in the other investigated cities.

Recommendations related to stimulating cycling are:

- Traffic safety has been mentioned by respondents as the most important obstacle preventing them from cycling more. This was especially the case for the non-pro-cycling cluster. This indicates that one of the key elements to stimulate cycling in cities is to improve traffic safety (both objectively and subjectively). Various strategies can contribute to improving traffic safety for bicyclists. These include:

  - Providing more and better infrastructure for bicyclists. High-quality infrastructural design that takes into account the safety of bicyclists is one of the key elements to make cycling a safe and attractive transport mode. Well-designed infrastructure does not only contribute to safety, but also to making cycling a fast, convenient and attractive means of transportation
  - Awareness raising campaigns and legislation
  - Stimulating protective gear such as helmets and high-visibility clothing.

  More detailed recommendations on how to improve safety, are provided in the Pedbikeplanner webtool and by Schepers et al. (2017).
- Since travel time, required physical effort, and the physical environment (hilliness, climate, etc) are relevant obstacles as well, all measures that address one or more of these elements have potential to stimulate cycling as well. E-bikes are quite promising, because compared to regular bicycles, they offer benefits on all three dimensions; for most users they will increase average speed and therefore reduce the trip time, and the support of the electric engine will reduce the required physical effort and make it easier to overcome slopes and warm weather. Financial or other incentives to stimulate e-bike possession/use therefore seem promising. It will, however, be important to ensure that encouraging e-bikes does not conflict with the previous recommendation of improving traffic safety. The higher speed of the e-bikes could lead to an increase in the number and severity of accidents, so it will be important to take the higher speed into account in the design of the cycling infrastructure.
- A high-quality network of cycling infrastructure can contribute to reducing the required travel time and physical effort as well, for instance by providing fast and direct routes between important destinations, reducing unnecessary stops, etc. Denser and more diversified urban areas can also reduce the average trip length by providing many suitable destinations within short distances, hence reducing the required trip time by bicycle and increasing the number of trips that could potentially be cycled. Land use planning therefore has the potential to increase walking.
- The non-pro-cycling cluster includes a large proportion of the respondents who indicate that they cannot easily park a bicycle at their home. This indicates that lack of possibility to park a vehicle correlates with less favourable perceptions of cycling and with less cycling behaviour. As a result, it could be a barrier for people to cycle. While the percentage of people reporting difficulties to park their bicycle is relatively small, it is worthwhile to critically assess the availability of decent and safe (public) bicycle parking spaces, and increase bicycle parking capacity in areas where the current availability may not suffice.
- Having access to a bicycle is a necessary prerequisite to make cycling a viable transport mode option. The stage model showed that higher bicycle possession as well as subscription to a bike sharing service correlate with being in a higher stage of behaviour change towards cycling more frequently. Various measures can be considered to increase bicycle ownership/accessibility. Financial incentives can be considered to encourage acquisition. However, given the findings, it seems to be especially worthwhile in urban areas to implement bike-sharing systems. Somewhat related to this, is to ensure that people's personal bicycles can be parked securely, because research suggests that 7% of stolen bicycles are not replaced (Van Lierop et al, 2015). This implies that some people will stop cycling after a bicycle is stolen.
- Various psychological constructs positively affect people's intention to cycle more frequently, but cycling attitudes show by far the strongest relation. Improving people's attitudes towards cycling will therefore contribute to increasing cycling.

Recommendations related to stimulating walking are:

- Time is mentioned by respondents as the most important obstacle for walking more frequently. To stimulate walking, reducing travel time will therefore be an important strategy. Measures to stimulate walking through reducing travel time are creating direct routes (for

example by creating short cuts for pedestrians) and reducing the number of necessary crossings and waiting times at crossings. In addition, denser and more diversified urban areas can reduce the trip length by providing many suitable destinations within short distances, hence reducing the required trip time by foot and increasing the number of trips that could potentially be walked. Land use planning therefore has the potential to increase walking.

- Various psychological constructs positively affect people's intention to walk more frequently, but walking attitudes show by far the strongest relation. Improving people's attitudes towards walking will therefore contribute to increasing walking.
- Respondents with a public transport season ticket are in the higher stages of behavioural change towards walking more frequently, which implies that there is a positive relation between public transport use and walking. This most likely relates to walking as a first/last mile solution when using public transport. Walking can therefore indirectly be stimulated through enhancing and encouraging public transportation.

Recommendations related to stimulating PeTs are:

- Improve the safety of PeTs. An important aspect of this will be to improve stability and safety of the devices themselves. This can be achieved through a clear regulatory framework and rules of conduct, and through safety standards for PeTs. Another important element will be to improve the infrastructure for usage by PeTs. The rise of PeTs will add to the growing variation in the types of vehicles that make use of cycling infrastructure; the infrastructure will need to be designed and updated to allow for safe usage by these diverse users. PeTs can also put pressure and safety hazards on pedestrian areas and sidewalks.
- Lowering the costs of PeTs could increase the number of people using PeTs. It is, however, questionable whether one should prioritise providing (financial) incentives for PeTs. There are some concerns about the safety of these devices, and they may replace more active transport modes such as walking and cycling that have additional benefits. A possible way for a city to make PeTs available for users at a low cost could be to invest in a system of shared electric scooters.
- Interventions could be targeted at improving people's perceptions of PeTs. While safety and cost turned out to be the most problematic aspects of perception, other aspects received relatively low scores as well. This emphasizes the importance of improving people's attitudes towards PeTs in order to encourage their usage as a transport mode in urban areas.
- Given the exploratory nature of this study, further research is needed to further investigate people's opinions on PeTs, and how vehicles as well as regulations and infrastructure can be designed to stimulate their use without compromising safety.

2.5. Dissemination activities

ISAAC consortium partners disseminated the project at a number of relevant conferences in their countries and on the European level. Presentations were given or ISAAC material such as the leaflet was distributed during the following events:

- International Cycling Conference Mannheim, 19-21 September 2017, ISAAC leaflets were distributed. More information: https://www.umweltbundesamt.de/en/international-cycling-conference-startseite.
- Volvo Road Safety Days Gothenburg, 7-8 November 2017: ISAAC was presented within a presentation about urban road safety strategies. More information: https://www.volvogroup.com/en-en/about-us/traffic-safety/safety-days.html .
- 2017 Annual Polis Conference, Brussels, 6-7 December 2017: ISAAC stand in exhibition area and presentation in a parallel session delivered in session 2D "New ways to assess the impact

of walking and cycling measures on the urban transport system". Presentation available here: "Identifying the most effective measures for walking and cycling: How the ISAAC tool helps".

- Polis Working Group meeting on Active Travel Brussel, 12 March 2018: ISAAC was presented in a presentation to the attending European local and regional authorities. Feedback was collected on the development and functionalities of the ISAAC tool, the Pedbikeplanner .
- 2018 Transport Research Arena TRA Vienna, 16-19 April 2018: ISAAC was presented in the poster exhibition. More information: https://2018.traconference.eu/ .
- 2018 International Transport Forum pre-summit research day Leipzig, 22 May 2018: ISAAC was presented through a poster exhibition.
- FGSV Congress Erfurt, 12-14 September 2018, ISAAC leaflets were distributed. More information: https://www.fgsv-kongress.de/.
- 2018 CIVITAS Conference Umea (Sweden), 19-21 September 2018: ISAAC had a stand in the exhibition area where participants could test the tool and inform themselves. In addition, a parallel workshop session was dedicated to ISAAC in which the tool was demonstrated, factsheets discussed and future research need elaborated both with practitioners and researchers.
- Fußverkehrskongress Berlin, 11.-12. October 2018, ISAAC leaflets were distributed. More information: https://fussverkehrskongress.de/.
- 2018 Polis Conference in Manchester, 22-23 November 2018: ISAAC had a stand in the exhibition area where participants could test the updated tool. In addition, a demonstration of the tool was given in parallel session 2B "How active mobility, road safety and health play together". Presentation: "The CEDR ISAAC project: A web-based tool for enhancing modal shift from car to walking and cycling without compromising road safety".
- FGSV Kolloquium Kommunales Verkehrswesen, 19-20 March 2019: ISAAC leaflets are distributed. More information: https://www.fgsv.de/wissenstransfer/veranstaltungen/event-data/events/2019/kolloquium-kommunale-verkehrswesen-2019/dienstag-19-maerz-2019.html .
- Annual European Mobility Week Workshops Brussels, 20-21 March 2019: the ISAAC tool is demonstrated in parallel sessions, leaflets will be distributed. More information: http://www.mobilityweek.eu/news/?c=search&uid=xdebYvoT .
- Annual national event with local EMW coordinators, Luxembourg, 15 April 2019: The ISAAC tool will be presented to Luxembourg's local coordinators of European Mobility Week.
- Benelux Interuniversity Association of Transport Researcher's BIVEC-GIBET Transport Research Days in Ghent, 23-24 May 2019.
- National Cycling Congress (NRVK) in Dresden, 13-14 May 2019: ISAAC leaflets are distributed. More information: http://www.nationaler-radverkehrskongress.de/.
- ISAAC and STTRIDE Final Conference: Modal choice in a multimodal transport system, Tools to understand the impact of new technologies, walking and cycling measures on modal choice and on road safety. Brussels, 9 May 2019, Brussels with a pre-conference social evening on 8 May.

Additional dissemination activities are:

- 2019 Walk21 Conference Rotterdam, October 2019: An abstract is submitted to present the ISAAC tool and survey results.

- Fortbewegung & Fortschritt Annual Conference in Luxembourg, 20 September 2019: The ISAAC tool will be demonstrated.

2.6. List of deliverables

No	Deliverable / Report title	Due date
1	Report providing an overview of the available multidisciplinary knowledge on behavioural models, segmentation, preconditions and interventions	June 2017
2	Final version of operational guideline and checklist for further field testing	Dec 2018
3	Report (extension; WP1.1.2) Report with empirical evidence psychological determinants travel mode shift	May 2019
4	Final version of operational guideline and checklist + user instructions	May 2019
5	Final report, giving account of the work done published as a CEDR Contractor Report.	July 2019

3. STTRIDE project

3.1. Background to the project

Many emerging technologies are having or could have a significant impact on citizens' preferred mode of transport. This presents a challenge to transport planners, but also provides an opportunity to change traveller behaviour without necessarily requiring major infrastructure investment or legislative intervention. Once a new technology has appeared, it can also be difficult to assess the impact it has had.

The pace of change means that it could be a challenge for road and transport authorities to understand the potential impacts and timescales associated with a wide range of technologies. Current transport modelling and appraisal tools are not usually designed to take account of new types of transport intervention. Thus, there is a knowledge gap for authorities in understanding how to identify and invest in the right technologies to deliver and evaluate their preferred outcomes. As a result, there is a knowledge gap how to support, respond or invest in the right technologies to deliver their preferred outcomes.

3.2. Project aims

The STTRIDE project aimed to address how best to identify technological advances that can deliver positive modal shift and how to evaluate their impacts; developing tools and guidance to help transport authorities undertake these assessments. In order to do this STTRIDE aimed to review travellers' needs and understand the role of emerging technology-based services in meeting those needs. The project objectives were:

- Identify road authority requirements for an emerging technology toolkit - taking into account requirements for impact assessment, evaluation and cost benefit analysis;
- Provide information on the emerging technology toolkit available to road authorities for medium & long-term investment decisions to 2035;
- Understand likely political, economic, social, technological, legal & environmental (PESTLE) barriers to uptake of prospective new technologies; and
- Establish a common monitoring and evaluation approach to modal usage impact of new technologies;
- Develop a 'toolkit' to help transport authorities to apply the monitoring and evaluation framework.

3.3. Project tasks

Gathering evidence

The project began by gathering evidence, namely to:

- Identify existing evidence on user needs for an optimal journey
- Understand which emerging technologies could contribute to meeting these needs

The evidence reviewed by the team comprised relevant literature and secondary data, and data from interviews with stakeholders from passenger representation bodies.

The next task involved identification of technologies that are emerging and have an impact on modal change. First of all a long list of 66 potential technologies was identified, which could have impact on a road user's modal choice. Then a short list of 10 technologies was selected from the long list, which was verified by engaging stakeholders. The selected shortlist comprised:

- Advanced fare management and beacon-based ticketing
- Traffic management systems
- Electric vehicles
- V2X
- Open data
- HD mapping
- Voice recognition
- Augmented reality
- Wearable technology
- Powering smart infrastructure

Comparison of technologies

The shortlisted technologies were then investigated in further detail as examples to demonstrate different assessment techniques A 'PESTLE' analysis (Political, Economic, Societal, Technological, Legal and Environmental) of Drivers and Barriers was undertaken for each technology.

A foresight analysis was also undertaken that looked at 10 technology groups in terms of their potential uptake and impact on modal shift in transport. The analysis included an investigation of how the drivers and barriers affect the technology in terms of:

- The prospects for and potential of the technologies
- Deployment and impact on modal shift

For each technology group, a high-level 'logic map' was developed to provide a reader with an understanding of how interventions in support of the technologies can generate impacts related to modal shift. Other impacts from these interventions, such as improved safety or personal security, are addressed to the extent that these affect modal shift positively or negatively. Likewise, unintended consequences of interventions are highlighted if they are expected to affect modal shift, particularly negatively. Logic mapping is an established technique for impact assessment and program evaluation.

Definition of evaluation framework and toolkit

Experience from the assessment exercises with the shortlisted technologies was then used to develop and pilot an evaluation framework that can be used more generally to assess the impacts of implementing new technology interventions aimed at encouraging modal shift. Evaluation might include the transport impacts of 'non-transport' interventions and the potential benefits of the transport industry implementing technologies from other industries to achieve transport objectives, as well as applying technology to transport interventions.

A draft version of the framework was piloted by reviewing it with volunteer road authorities in Ireland and Sweden. The draft was then refined in the light of this experience and comments from road authorities, before making this final version available for use.

The final impact evaluation framework was developed into a set of online tools and modules that was published on the STTRIDE microsite.

The STTRIDE microsite was designed, hosted and maintained by TRL. Each section was built with suitable imagery to accompany each section. The microsite was designed to be user friendly with ease of navigation. All the deliverable reports were uploaded as PDFs and are easily accessed to view and download.

The following screenshot presents the structure of the toolkit within the STTRIDE microsite.

Figure 1: Drop down menu

Figure 2: Links to modules

To support the dissemination of the project outputs TRL attended the following events:

- 2nd workshop of the EC Collaborative Innovation Days in Brussels. The main objective of the event was to share and discuss achievements, challenges and opportunities addressed by new and ongoing projects to build up strong links across them.
- Transport Research Arena (TRA) 2018. Marcus Jones from TRL presented a poster paper under the Session "Mobility as a Service and Mobility Management".

4. Outcomes of the final conference

A joint final event for STTRIDE and ISAAC was held on 8-9 May 2019 in Brussels. This was coordinated by the POLIS network alongside a POLIS event so that delegates could choose to attend the STTRIDE and ISAAC event as part of a two-day programme on integrated transport, featuring new mobility options such as e-scooters.

4.1. ISAAC

In the morning plenary session members from the ISAAC consortium gave a presentation describing ISAAC and its outputs. This covered:

- The outline of the ISAAC project.

The design and results of the survey study and the Implications and recommendations for policy and practice as described in paragraph 2.1.4 of this report. Key takeaways are the following.

- The results clearly show that walking and cycling should not be treated as one group of 'active transportation'. Both have their own motivations and barriers, and therefore need to be addressed by policy makers as well as researchers separately.
- The main barrier for cycling more frequently is road safety, especially in Belgian and German cities. Road safety is a particularly important barrier for people who are generally less pro-cycling. On the other hand, the main barrier to walk more as a means of transport is time.
- The most important determinant for people's intention to walk or cycle more in the future are their attitudes towards the transport mode.
- Peoples' perceptions of Personal e-Transporters are still relatively unfavourable, especially in terms of safety and cost. Nevertheless, in several cities the percentage of respondents that use them as a transport mode at least monthly can be up to 10%, implying that they should not be considered as a marginal phenomenon in traffic
- Alice Ciccone introduced the PedBikeplanner webtool: a mobility tool used to stimulate safe walking and cycling within a multimodal transport environment. The PedBikeplanner webtool can provide tailor-made recommendations on how to boost walking and cycling in your city. In addition, it functions as a repository of condensed and user-friendly information on the expected effects of more than 50 measures to boost walking and cycling on mobility, road safety and security. Alice showed how to use the tool step by step in order for you to become more familiar with different functionalities and get a better understanding of its content.

Workshop 1A, 2A: Test the tool!

- During this workshop facilities were available for those attending to work with the tool and select fact sheets based on different queries (for instance on city profile, specific topics or priorities (most effective or least expensive) or the full list of fact sheets.

Workshop 1B, 2B: Proven measures that boost walking/ cycling

- Providing for walking is a particularly important and also challenging task at the border between urban and transport planning. It is about enabling safe and convenient movements of pedestrians from A to B and at the same time it is about quality of urban space and street environments. Pedestrians not only want to move but they also want to rest, wait, communicate, shop, eat, and enjoy their life in a pleasant environment. In addition, pedestrian volumes are heavily influenced by the built environment, this is particularly density and diversity of urban structures. The Pedbikeplanner tool takes all these known relationships and dependencies into account and provides, based on these, proven measures to boost walking in each specific context.

- ISAAC issued factsheets about a range of measures promoting cycling as a transport mode. These show what impact on modal shift and on road safety have researchers found each intervention to have. During the workshop ten factsheets about cycling were distributed to

participants and discussed to what extend these measures were known and applied in their environment (city).

4.2. STTRIDE

In the morning plenary session, TRL gave a presentation describing STTRIDE and its outputs. This covered:

- Factors influencing modal choice, and how technology can help to reduce perceived barriers by reducing the uncertainty attached to alternative modes and interchange between them.
- The behaviour change process and how IT can target opportunities when people are most open to change behaviour.
- Examples of technologies review in STTRIDE, grouped into technology based services, such as advanced ticketing systems and technology enablers, such as open data.
- Methods for assessing technologies such as the Technology Innovation System (TIS)
- Assessment of potential considering ability of transport authorities to influence and levels of uncertainty around adoption and impact.
- The need for impact evaluation guidance.
- How STTRIDE fits into existing evaluation processes such as *ex-ante* transport appraisal
- The evaluation process- best practice involves a process in which the intervention and its potential impacts are formally defined at the start of any process.
- Intervention logic- defining ‚context', inputs, outputs, outcomes and longer term impacts.
- Defining indicators for different kinds of intervention; for example, considering whether the intervention targets trips, passenger-km or vehicle-km.
- Introducing the STTRIDE toolkit; a set of online guidance documents with a navigation structure defined around stages in the recommended evaluation process.

In the afternoon TRL held two workshops.

The first workshop was on the theme "New technologies: threats or opportunities?"

Participants were asked to choose a short list of new technologies and consider the threats and opportunities each presents, i.e. the negative and positive impacts that would need to be considered in a potential evaluation. The key discussion points are summarised below.

Opportunities

- New technology can reduce uncertainty in sustainable modes, for example helping cyclists find a suitable route; finding alternative ways to travel when there is disruption to public transport.
- Traffic signals or even vehicles could detect and respond to vulnerable road users
- 'Big Data' – shared data driven services can benefit users, offering services targeted to individual needs and facilitating integration
- Greater citizen participation in shared services and data.

Threats

- Social exclusion for non-users if transport become too reliant upon particular devices or online services
- Reduced safety for non-users if detection systems using wearable devices become the default
- Privacy and data security concerns with shared data on online services
- Algorithms controlling services might discriminate against some social groups

- Reduced choice for users with unusual needs if services become geared to majority travel patterns
- Autonomous vehicles could lead to a dystopian' future- cities designed for vehicles rather than people
- New personal travel modes could lead to extra traffic generation and abstraction from public transport, walking and cycling.

The issues discussed show that a wide range of potential impacts needs to be considered beyond simply changes in travel behaviour. Evaluation has to consider how people use a service, their perceptions of it and a number of social implications, in particular for non-users who may become socially excluded.

The second workshop was on the theme of **"**Trials and evaluation: putting it into practice**".** The group was asked to consider questions about how a trial or evaluation could be designed, taking account of methods used, data availability and resources.

Challenges raised were:

- How to measure social impacts such as employment conditions for workers in new services
- Consideration of social exclusion, for example reliance on the use of mobile devices and online payment methods
- Impacts on vulnerable groups, such as blind people, who can easily be missed through user surveys, market research
- Ensuring that representative samples are obtained in surveys, for example in terms of age, gender, socio-economic groups
- Concerns about data privacy, use of data in ways that discriminates against particular groups.

Surveys of users would be necessary to assess modal impacts and would need to find out what users used to or would otherwise do. It is necessary to consider non- users, both as potential users and to identify any unintended consequences. All modes need to be considered, not just the one directly involved in an intervention.

Online surveys are very cost-effective but can exclude important sections of the population. Consultation with groups representing vulnerable groups, such as those with disabilities, or minority groups, is essential to identify potential impacts and ensure that the necessary data are collected for them to be assessed.

A fundamental question was 'how do you identify what impacts need to be measured before you have undertaken the trial?' The logic-mapping process described in STTRIDE is intended to help with this. It could involve getting stakeholders together to do a brainstorm at the start of the project, involving a wide range of user organisations and conducting public consultations and pilot surveys.

To measure safety impacts there is a need for good data on accident levels; however, this can be limited in availability, so accident numbers are not usually sufficient. The perception of safety can be a barrier, so it is necessary to measure perceptions of risk and other indicators of risk

A technology-based trial is likely to involve companies that collect a lot of data as part of the operation of a new service. Ensuring their cooperation and willingness to share data is essential in an evaluation; taking account of concerns about privacy and use of personal data. It was suggested that measures could be introduced to require operators of new technology-based services to make data available to

transport authorities for evaluation and to ensure new services are integrated with other services to ensure they deliver public benefits.

4.3. Presentations on new mobility services in a multimodal transport system

- **European approaches on new mobility services**
  Matthew Baldwin, European Commission, DG MOVE

Bio: Matthew Baldwin is Deputy Director General of the European Commission's DG MOVE, with responsibility for the transport modes land (road and rail), waterborne (including ports policy) and aviation. He has held this post since July 2016.

Previously, Matthew was Head of the Cabinet of Commissioner Hill from 2014 to 2016. He also served in the Cabinets of President Barroso and Commissioner Lamy.

Abstract (DK written based on discussions with Matthew Baldwin): Matthew shed light on different member state approaches to regulating new mobility services. His insights derives from his role as the chair of the High Level Group of Road Safety brining EU member state representatives together 3 times a year. The Spanish Ministery launched a survey among High Level Group members to map ongoing activities in member states. Full results will only be shared in the next group meeting on 15 May (closed meeting) but Matthew will be able to share some preliminary information on the different approaches.

- **Free-floating bike-sharing regulation in Brussels**
  Matthias Van Wijnendaele, Brussels Capital region

Bio: Matthias Van Wijnendaele is a cycling policy expert. He is responsible for the bike infrastructure and cycling policy at the office of Brussels Mobility Minister Pascal Smet. He finds inspiration for good public space design as a father of two city kids.

Abstract: Cities in Europe are looking to reconquer public space from the car. Brussels is the Capital of Europe, but also designed in de 20th century as a Capital for cars. Our main goal is to give public space back to the people creating squares and pedestrian zones and therefore we need to change mobility behaviour. Urban cycling policy should not be limited to constructing separated bike lanes but should welcome also new actors promoting cycling and micro-mobility. Especially in Brussels, electric micro-mobility is rapidly becoming a part of the solution. Investors in micro-mobility are welcome in Brussels but must meet basic licensing & operating conditions. Therefore, Brussels adopted a licensing system – with no limits in the number of licenses - creating a level playing field for companies and imposing standard rules (e.g. prohibition on combustion-engines). We seek an equilibrium between empowering innovation and meeting public interest such as saving public space. Urban cycling policy should integrate more and better the different cycling services such as parking, registration, route-planning in order to prepare to the MaaS-era. Cycling & micro-mobility should be in the centre of the MaaS frameworks for short distances. This is the most important way of reconquering public space from the car.

- **Responsible scooter sharing in cities**
  Emma Silver, Bird

Bio: Emma works on Government Partnerships and public policy across EMEA and APAC for Bird. She is a former Special Adviser to the UK Government, working in both the Transport and Environment briefs during her time in government.

Abstract: The world's cities need more affordable, environmentally friendly transport solutions. Bird's mission is to make cities more liveable by reducing car usage, traffic, and carbon emissions. Our vehicles are 100% electric, reducing reliance on combustion engine-powered cars that pollute our world, clog our streets, and result in tens of thousands of deaths in Europe each year.

E-scooters could soon become the best transportation solution to replace the 40 per cent of car trips that are less than 3 miles. Often these cars have only one occupant. To give up car trips, people need transport options that are reliable, fast, and convenient, like Bird.

Micromobility like Bird can also give back to the local economy through earning opportunities and connecting traditionally underserved areas, boosting local commerce in those places. And E-scooters are just as safe as bicycles; cars remain the biggest killers on our roads. This transport revolution is already here in over 100 cities globally and it's impact in creating more liveable cities is only set to grow.

4.4. Plenary debate

Karen Vancluysen, Secretary General POLIS
Matthew Baldwin, *European Commission, DG MOVE*
Pedro Gouveia, City of Lisbon
Noora Lahde, Traficom Transport and Communications Agency, Finland
Emma Silver, Bird

The following issues were discussed:

- Baldwin mentions the 'External costs of mobility report' which gives economic arguments for the importance and impact of modal shift. These arguments are vital for decision making on different levels (EU, national and Local). This report is expected to be published by early summer 2019.
- There is a safety issue due to modal shift from motorized traffic to walking and cycling which requires attention. Walking and cycling and also scooters are modes of transport which provide no protection in case of a crash.
- Related to safety is the option for speed reduction in cities and automatic speed adaptation in cars. This is last issue is not popular by car manufacturers.
- The increased interest in sustainable mobility (SUMP) will help to speed up the modal shift to walking and cycling in cities.
- Other developments, like mobility as a service, will help cities to reduce the increased traffic flow.
- The current space that cars use in cities needs to be reconsidered in order to enhance the modal shift to other modalities (like walking and cycling).
- In order to monitor the mobility developments in different cities data should be made available and shared in order to learn from experiences. POLIS might have a coordinating role in this. It was mentioned that a limited basic dataset should be defined for all cities providing a possibility for benchmarking.
- Bird owns data about mobility on the vehicles they provide. They can provide these data for cities.

5. Future implementation

5.1. ISAAC

5.1.1. The Pedbikeplanner

In order to facilitate the application of the ISAAC tool Pedbikeplanner, the project group proposed to CEDR a plan - including a financial paragraph - for hosting of the ISAAC tool by the Institute of Transport Economics (TØI, Norway). Hosting of the tool was not a part of the ISAAC project plan.

The hosting will be conducted by the Institute of Transport Economics (TØI, Norway) for a period of two years. The hosting includes also the monitoring of the web site, updating technical issues and licenses, as well as coordinating these activities. The hosting is financially supported by CEDR.

5.1.2. The results of the survey study

The results clearly show that walking and cycling should not be treated as one group of 'active transportation'. Both have their own motivations and barriers, and therefore need to be addressed by policy makers as well as researchers separately.

The implementation of this result is mainly based on publication and presentation of the results for policymakers in order to make them aware that stimulating people to walk and cycle require different approaches. The following findings give some specific issues that need to be taken into account:

- The main barrier for cycling more frequently is road safety, especially in Belgian and German cities. Road safety is a particularly important barrier for people who are generally less pro-cycling. On the other hand, the main barrier to walk more as a means of transport is time.
- The most important determinant for people's intention to walk or cycle more in the future are their attitudes towards the transport mode.

Peoples' perceptions of Personal e-Transporters are still relatively unfavourable, especially in terms of safety and cost. Nevertheless, in several cities the percentage of respondents that use them as a transport mode at least monthly can be up to 10%, implying that they should not be considered as a marginal phenomenon in traffic.

This finding implicates that monitoring the use of these means of transport is required, as well as their traffic safety implications.

5.2. STTRIDE

The STTRIDE toolkit and other deliverables are currently available on a TRL-hosted microsite and have been disseminated through TRL's usual promotional routes, such as social media updates and research reports. They are also being promoted via CEDR's dissemination routes to CEDR members and others in the wider transport practitioner community who make use of CEDR project outputs. The final event by POLIS has further increased the range of potential users to cities and other local transport authorities. Although the latter are not the usual national road authority audience represented by CEDR this is a helpful development because many of the issues for those undertaking transport evaluations are similar for both national and local transport authorities. Furthermore, recognising that most of the journeys undertaken on national road networks being and end on local roads, national road authorities wishing to tackle congestion and carbon emissions will need to work more closely with local authorities to provide alternatives for the 'door to door' journey.

It is recognised that national roads authorities usually have their own detailed guidance and procedures covering how transport schemes are selected, designed and implemented; and how *ex-ante* assessments should be undertaken. STTRIDE recognises this and includes some guidance on how the recommended processes fit alongside existing assessment processes. In the longer term it is hoped that transport authorities would start to incorporate the evaluation principles set out in STTRIDE (which are in turn based on examples of good practice identified during the project) within their own national guidance documents. This would involve drafting and updating bespoke documents for each NRA rather than simply adopting the existing STTRIDE documentation. For this reason, we would not expect the STTRIDE toolkit would require updating in its own right at a later date- rather it would be used as a tool to inform users of basic principles that they would eventually adopt in their own guidance, tailored as required to their own needs.

We therefore recommend that any follow-up activity undertaken by CEDR focuses on dissemination and raising-awareness of the principles of good evaluation, to stimulate their adoption by road authorities; together with some targeted research focused on particular themes identified in the final project event. We suggest these are:

- Data-sharing and co-operation: how can transport authorities best work with new mobility service providers to deliver the benefits of shared data, taking account of concerns such as with privacy and commercial interests.
- Social impacts: how can impacts on employment conditions or social exclusion be identified and mitigated in new mobility services.
- Safety performance - how can the safety of different modes be measured and compared meaningfully (appropriate performance indicators), including perceived safety and the barrier it can present to modal shift.

As the STTRIDE guidance addresses issues relating to both local and national road networks we also suggest that work is undertaken to explore the link between local travel and the factors that affect modal choice for long distance journeys. New mobility models will make it easier for people to use a number of different modes within a single trips, i.e. a train for the long distance leg and a combination of public transport or shared e-bikes or scooters for the final km. Traditional transport demand models are not suited to such multi-modal trips making it hard to evaluate the potential for local transport improvements to deliver modal shift on long-distance journeys. Further research would help to provide more insight into the potential for modal shift and to identify the need for further assessment tools.

6. References

Aarts, H., Dijksterhuis, A. (2000). The automatic activation of goal-directed behaviour: The case of travel habit. Journal of environmental psychology, 20, pp. 75-82.

Appendix A: Example of ISAAC Fact Sheet from Pedbikeplanner

Operation and maintenance of footpaths, pavements and crosswalks

Operating and maintaining footpaths, pavements and crosswalks is a prerequisite for increasing the number of people who walk on quotidian trips and should therefore be a high priority both during summer and winter. Operation and maintenance is important to ensure that footpaths, pavements and crosswalks seem attractive, safe and accessible to pedestrians. Ploughing, gritting and improving the tarmac are measures that make it easier for pedestrians to travel on footpaths and pavements. Good signage showing crosswalks may help pedestrians remain visible in traffic, which is of high importance as they are more vulnerable in traffic than other road users. There are standards regulating operations and maintenance of national, county-level and municipal roads, but these differ greatly when it comes to requirements and responsibilities. Following up these requirements also seems to be very difficult in practice. Still, it is better if the road owner holds full responsibility for winter operations in the entire municipality, rather than leaving it to property owners.

Introduction

It is desirable to facilitate walking – especially so that more people can walk for shorter trips. Increasing the number of people who choose walking over driving may lead to more environmentally friendly cities and built-up areas with good residential areas and reduced car traffic. This will also lead to fewer traffic jams, noise and local pollution, less perceived unsafety and fewer traffic- and falling accidents. Facilitating for pedestrians may also help more people use public transport on their trips.

We must consider that pedestrians are more vulnerable in traffic than most motorized road users. According to official accident statistics, some 20-30 pedestrians are killed in Norwegian traffic accidents annually. 70-130 suffer serious injuries and 600-800 minor injuries (Statistisk Sentralbyrå 2011). We also see a high number of falling accidents (not defined as traffic accidents), with personal injuries in pedestrian zones, especially following bad maintenance and inadequate gritting of footpaths during winter.

So that more people may choose to walk, the quality of footpaths, pavements and crosswalks must be high, i.e. operation and maintenance must be satisfactory.

Mode change effects

The assumption that if more people elect to walk rather than drive this would have a positive effect on environment and climate is plausible. It should be investigated whether improved operation and maintenance would increase the number of pedestrians. Here as well studies that give direct data are lacking. Some studies, however, indicate that operation and maintenance are of importance. Below are some examples:

- Travel habit surveys show great seasonal variations for cyclists, where the number who cycle during winter is lower than during summer (Vågane 2006). For pedestrians, we see an opposing trend. According to Vågane (2006), this could indicate that many bike trips are exchanged for walks during winter, or potentially that some walk rather than drive because of the road conditions. This highlights the need for operating and maintaining footpaths and pavements year-round.
- Several international studies point out that continuous operation of these measures is of paramount importance for their keeping their positive effect and appear navigable, safe and

secure in traffic (Sørensen and Loftsgarden 2010). Lacking operation and maintenance of footpaths, pavements and crosswalks will aggravate conditions for pedestrians. For example, holes in the asphalt, lacking care for vegetation and lacking ploughing or gritting will aggravate conditions for pedestrians. These may, for example, impede navigability, aggravate a feeling of insecurity and lead do dangerous situations in traffic.

Examples of use

The Norwegian Public Roads Administration's standard requirements

In "håndbok 111" the following distinction between operating and maintaining is used (Statens vegvesen 2003):

Operation for good quotidian traffic management

Under operation, all tasks and routines necessary to ensure that road infrastructure serves normal, quotidian, traffic management well. Examples of such tasks and routines are as follows:

- Ploughing, gritting with salt and/or sand
- Sweeping, washing and cleaning
- Signage, posting signs, maintaining green areas
- Constructing/repairing traffic control systems, traffic information, lighting, etc.

Maintenance for long-term service

Under maintenance, all actions towards the physical infrastructure that ensure that said structures' function and lifetime remain as planned are understood. Such actions include:

- Laying new asphalt and other actions that maintain the standard of road surfaces
- Reparations of ditches, bridges, tunnels and technical structures/installations according to established requirements to quality.

Specific requirements for when measures should be implemented

According to "håndbok 111", the following is required when it comes to operation and maintenance of footpaths, bike lanes and pavements:

- For road surfaces: Difference in levels along and across the road shall not exceed 25mm over a length of 2 meters. Pools of water shall not cover more than half the width of the road. Holes that endanger road users shall be repaired immediately. Holes in the tarmac shall be patched up within one week. Curb height at crossing points and barriers between lanes shall not exceed 20mm. Cracks wider than 10mm must be sealed.
- Regarding cleaning: Footpaths and bike lanes shall be kept free of gravel, dirt, shards of glass, rubbish and the like. Gravel spread on ice shall be removed as soon as the winter season comes to an end.
- During winter: Footpaths and bike lanes shall be ploughed by 06:00. In case of snowfall between 06:00 and 22:00, ploughing shall be undertaken when the snow depth reaches 3 cm. On footpaths, bike lanes and pavements, areas with ice shall be gritted by 06:00 or within 2 hours of the forming of the ice when friction is less than 0.3.

- Defect lighting in areas of great importance for traffic, e.g. crosswalks, shall be repaired within one day.

Effects on safety and security

Some of the measures assessed by Sørensen and Mosslemi (2009) are given below:

Laying new asphalt/repairing pavements' and bike lanes' surfaces increases safety: Pedestrians may be vulnerable to holes and tears in the tarmac. This is especially true for people of impaired mobility. If the surface is inadequate, this may lead to more pedestrians walking other places (e.g. on the carriageway) which may lead to dangerous situations in traffic.

Repainting pedestrian structures and supplementing measures increases safety: A review of effect studies and experiences with varying measures for pedestrians in intersections shows that continuous operation and maintenance as well as the existence of other supplementing measures are fundamental to ensure that the measures retain their positive effect on safety (Sørensen and Loftsgarden 2010).

Winter maintenance of pavements, footpaths and bike lanes: Large amounts of snow or ice on footpaths or pavements may make pedestrians fear lest they fall or otherwise injure themselves thus aggravating perceived insecurity. Several studies show that better winter maintenance of pavements, footpaths and bike lanes has a positive effect on perceived safety. This derives from good pavement-, footpath- and bike lane conditions' reducing fear of accidental falls or injuries on snow or ice.

Challenges and opportunities

Operation and maintenance are important to ensure that footpaths, pavements and crosswalks appear attractive, safe and navigable for pedestrians. In practice, it seems that prioritizing these measures is difficult, which again leads to too little resources being earmarked for these purposes. The causes likely stems from two factors;

1. Competition over resources between future construction projects and operation and maintenance of existing structures. This is a competition that operation and maintenance loose, a trend which has lasted for years and which has led to a large maintenance lag.
2. Competition between operation- and maintenance resources earmarked for road structures for cars and resources earmarked for structures for weaker road users. In this competition cars are usually prioritized. This is clearly visible when there is snow and ice on roads during winter, and the carriageway is plowed, and gritted with salt and/or gravel and before pavements and footpaths.

This prioritization gives rise to great challenges. Pedestrians are more vulnerable in traffic than hard road users. Inadequate operation and maintenance of footpaths, pavements and crosswalks aggravates conditions for pedestrians. Good winter operations (ploughing and gritting) as well as reparations to the tarmac are measures that ease pedestrian movement on footpaths and pavements. Good signage around crosswalks can also be an important aid in ensuring that pedestrians are seen in traffic. This entails that operation and maintenance should be a higher priority than today.

As mentioned, there are set requirements to operation and maintenance of footpaths and pavements, both in relevant regulations and in road owner's contract with the operating service provider. This is especially the case during winter. Removal of snow and ice through ploughing and gritting with salt and/or gravel in the carriageway receives higher priority than on footpaths and pavements. This gives reduced navigability for pedestrians and may cause accidental falls. Additionally, many pedestrians

may perceive the conditions as so unsafe, that they choose other routes, or even walk on the carriageway, take other means of transport or skip desired walks during winter.

Inadequate operation of footpaths and pavements thus aggravate the situation for people with impaired mobility, further reducing their mobility. Many elderly do not dare to use footpaths or pavements when these are insufficiently gritted or plowed. This will entail that people who used to be able to walk or take public transport become dependent on the help of others or ordering transport services in order to complete quotidian errands. Where regulations and requirements are not followed up in practice, the authorities responsible for roads (municipal, county, or governmental authorities) should review their own practice with a critical eye and follow up with service providers, to ensure that the work is done according to relevant regulations and the requirements as specified in the contract with the service providers.

In "Transportetatenes" (the transport authorities') proposal for a new NTP (national transport plan) (2014-2023) they stress the importance of prioritizing the transport network for public transport users, cyclists and pedestrians in towns. This will require more resources and a new prioritization of resources. If we are to create better conditions and solutions for these road users, we need to aspire to higher quality. This entails that both planning, building and maintenance of structures must be of high quality. So that more people may perceive walking on quotidian trips as attractive, operation and maintenance must hold a high priority during summer and especially during winter.

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