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MAASiFiE

Impact Assessment

Deliverable Nr 4

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Executive summary

This deliverable, D4 Impact Assessment, presents a summary of the work completed within WP4 of the MAASiFiE project.

The overall objectives of WP4 were formulated as:

- to evaluate more in-depth two case studies (one in Sweden and one in Austria). In order to provide a broader basis for the assessments, also information on a sample of additional MaaS and MaaS-related services has been gathered and analysed;
- based on these evaluations, to assess the consequences of introducing MaaS concepts on a broader scale from an individual (user), organisational, and societal perspective respectively;
- to assess the (potential) economic, environmental and social impacts of MaaS; and hereby provide a basis and support for stakeholders' decision making.

Based on a literature review, a web-survey to experts and stakeholders, and the knowledge and experience of the members of the MAASiFiE project team, a tentative impact assessment framework was proposed consisting of altogether 17 impact areas: six on an individual level, six on a business level, and five on a societal level. Compared to most other impact assessments, the business aspects of MaaS were added in terms of revenues, collaboration, and responsibilities.

The framework was used in order to evaluate the case studies (UbiGo and SMILE) and the additional MaaS and MaaS-related services where at least some information of relevance was available.

In a more in-depth analysis of the UbiGo case, UbiGo was found to have potential to reduce or suppress car ownership, i.e. it is a good option for those who consider investing in a family car (or not) but in particular for those who otherwise would invest in a second family car. Furthermore, it will attract users who experience it to be an economically feasible alternative – or who consider the service to offer considerable additional benefits; and it will mainly attract households in areas with (i) high availability to public transport in terms of routes and frequency and (ii) access to carsharing within less than approximately 300m (suggestion). Results from the field trial of UbiGo show an overall decrease in private car use (as well as private vehicles taken off the road for the duration of the FOT) and an increase in the use of, for instance public transport and carsharing services. Furthermore, attitudes towards for instance public transport improved while attitudes towards private car use became less positive. As the UbiGo field trial was not designed to mirror the population of Gothenburg, but to target households that were believed to benefit in particular from having access to the UbiGo service, it is difficult to extrapolate potential due many and complex interactions between various demographic factors, not to mention good enough physical and economic access. However, based on assumptions outlined, several simplified scenarios illustrate the potential for UbiGo to facilitate a reduction of private car ownership in the city centre.

Considering the evaluation of the SMILE service, SMILE app users were found to have used alternative routes more often, especially for non-routine trips such as leisure and shopping trips. Furthermore, the generation up to 40 years old showed a changed mobility behaviour regarding public transport usage in the urban region of Vienna. Overall multimodal combinations were used more often, for example combinations of bike and public transport as well as vehicle sharing. Hand in hand with the trend of using shared mobility facilities instead of privately owned vehicles, a reduction in car usage especially in inner city areas was observed. A reduced number of parking spaces, congestion in peak-hours and enlarged parking zones work additionally as deterrents for private car usage.

Overall, the assessments suggest that a broader introduction of MaaS could result in overall positive impacts, in terms a modal shift, a change in attitudes and an increase in perceived accessibility to the transport system (as illustrated in the table presented below). However,

some conflicts between impacts on different levels were identified where, for instance increased accessibility to the transport system – a desired impact on an individual and societal level – may result in an increase in the number of trips made – possibly a desired impact on an individual level but an undesired impact on a societal level with negative implications for emissions as well as congestion. When planning for a further introduction of MaaS from a societal perspective, such conflicts must be addressed in order to best determine how to potentially integrate overall societal goals into the MaaS offer and business model.

		Impact areas		
Level	KPIs	Environmental	Economic	Social
Individual /user level	Total number of trips made	x		x
	Modal shift (from car to PT, to sharing, to ...)	x		
	Number of multimodal trips (combining different modes of transport)	x		
	Attitudes towards PT, sharing, etc.	x		
	Perceived accessibility to transport			x
	Total travel cost per individual/household		x	x
Business/ organisational level	Number of customers		x	
	Customer segments (men/women, young/old, ...)		x	x
	Collaboration/partnerships in value chain		x	
	Revenues/turnover		x	
	Data sharing		x	
	Organisational changes		x	
Societal level	Emissions	x		
	Resource efficiency (roads, vehicles, land use, ...)	x	x	
	Citizens accessibility to transport services		x	x
	Modification of vehicle fleet (electrification, automation)	x		
	Legal and policy modifications	x	x	x

Overall positive increase/decrease	
Both positive and negative increase/decrease	
Overall negative increase/decrease	
Not possible to assess	

From the services covered, it is clear that the business level is not typically addressed in analyses of MaaS or the information is not generally available. Thus, there is a gap between information needed and topics covered in evaluations (if any), as there is an active search for knowledge in the transportation/MaaS community regarding business and collaboration models, roles and responsibilities of various stakeholders, etc., so as to better understand how to sustainably operationalize the concept of MaaS. From the limited experience that has been documented, MaaS will result in (or necessitate) impacts on the business level including increased collaboration and partnerships in the value chain, increased data sharing, as well as changes in organisations and their roles. MaaS also has the potential to attract new customer segments, although the impacts on revenues and numbers of customers are unclear due to their intimate link with the specific MaaS offer (number of modes, subscription levels, relative prices, etc.).

A fundamental issue for feasibility studies in general and the assessment of possible impacts which have been part of the present project, is the lack of empirical evidence. The argued impacts of MaaS, positive and/or negative, are to a large extent based on informed assumptions and experts' opinions. Hence, it is important that different pilots and trials are initiated, with the intention to be developed into a fully functioning service, in order to provide further evidence of the possible impacts of an implementation of MaaS. Resources must then be allocated to address and evaluate different types of impacts (economic, environmental, and social) on different levels (individual, business and societal). However, in order to allow for a comparison between, for instance, different levels of integration and/or different business models, a common assessment framework would be beneficial. The framework introduced in the report provides a first attempt.

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1. Introduction

The transnational research programme "**Call 2014: Mobility and ITS**" was launched by the Conference of European Directors of Roads (CEDR). CEDR is an organisation that brings together the road directors of 25 European countries. The aims of CEDR are to contribute to the development of road engineering as part of an integrated transport system under the social, economic and environmental aspects of sustainability and to promote co-operation between the National Road Administrations (NRA).

The participating NRAs in this Call are Finland, Germany, Norway, the Netherlands, Sweden, United Kingdom and Austria. As in previous collaborative research programmes, the participating members have established a Programme Executive Board (PEB) made up of experts on the topics to be covered. The research budget is jointly provided by the NRAs who provide participants to the PEB as listed above.

1.1 The MAASiFiE project

Mobility as a Service for Linking Europe (MAASiFiE) is a two-year project that investigates the prerequisites for organising user-oriented and ecological mobility services in order to provide consumers with flexible, efficient and user-friendly services covering multiple modes of transport on a one-stop-shop principle. In addition, the project examines the opportunities of combining passenger and freight transport operations, especially with respect to urban delivery and distribution in rural areas. This deliverable, D4 Impact Analysis, focuses on transportation of people, primarily in urban areas.

The project is organised in five work packages (Figure 1.1.).

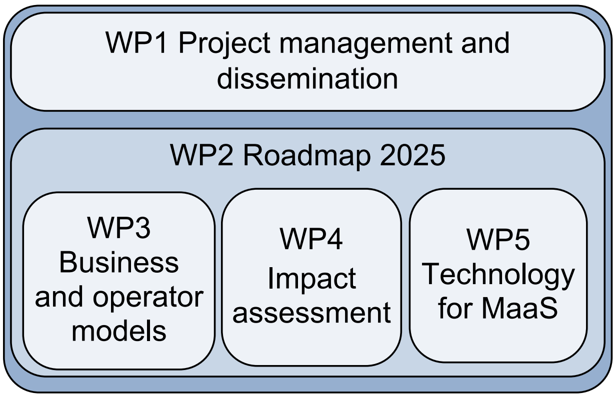

Figure 1.1. MAASiFiE Work Package structure.

The Roadmap 2025 for MaaS in Europe that is to be defined in WP2 is the expected main result of the project and can be considered as an umbrella for exchanging information, contributing and interacting with activities related to work packages 3, 4 and 5. WP2 will be accomplished as a series of four workshops held in three European countries – Austria, Finland, and Sweden – with the following respective themes: Creating a MaaS vision; Impact assessment based on existing cases; Building a Roadmap 2025; and Implementation and consolidation of MaaS. The roadmap includes roles and responsibilities of different stakeholders, as well as legal enablers and challenges.

WP3 is completed and has analysed state-of-the-art and future trends of MaaS including multimodal traveller information services, ticketing/payment systems and sharing concepts. It has also analysed MaaS value networks, and developed business and operator models (reported in D3 Business and Operator Models for MaaS).

WP4, reported in this deliverable, involves assessments of the economic, environmental and social impacts of MaaS.

WP5 will analyse technological requirements and interoperability issues of MaaS, and provide recommendations.

The project is coordinated by VTT Technical Research Centre of Finland Ltd. Consortium partners are AustriaTech, Austria, and Chalmers University of Technology, Sweden. The steering committee consists of the Finnish Transport Agency and the Swedish Transport Administration.

1.2 Objectives

This deliverable, D4 Impact Assessment, presents a summary of the work completed within WP4. The overall objectives of WP4 were formulated as:

- to evaluate more in-depth two case studies (one in Sweden and one in Austria). In order to provide a broader basis for the assessments, also information on other MaaS and MaaS-related services has been gathered and analysed;
- based on these evaluations, to assess the consequences of introducing MaaS concepts on a broader scale from an individual (user), organisational, and societal perspective respectively;
- to assess the (potential) socio-economic and environmental impacts of MaaS;

and hereby provide a basis and support for stakeholders' decision making.

1.3 Completion

WP4 has encompassed the following tasks:

- A **literature study** was completed in order to identify impact areas and key performance indicators (KPIs) commonly mentioned in relation to evaluations of transport-related interventions in general as well as those argued in relation to MaaS and MaaS-related services;
- Identified impacts and KPIs on an individual, organisational/business and societal level were compiled and formed the basis for the design of a web-survey. The **web-survey** was distributed to the networks of MAASiFiE project partners using different communication channels. The responses were in turn used to determine which impacts were deemed by different stakeholders to be the most important to consider when conducting an impact assessment of MaaS;
- The impacts considered the most important shaped a tentative **assessment framework**.
- The framework was used in order to **evaluate the main study cases**. In these cases, efforts were made to formulate a 'baseline' for the evaluation and assessment. Primary and secondary information sources provided information on the outcomes of the respective trials, and a comparison was made between baseline and outcomes. In a next step, an attempt was made to extrapolate the results from the trial to the larger setting.
- The assessment framework was also used to assess the impacts of an additional sample of MaaS and MaaS-related services in an effort to provide a broader basis for the final assessment. The services included here were those where primary and/or secondary information on (at least part of) the KPIs and impact areas were available.
- As a final step, the findings from the literature study, the web-survey, and the evaluations and assessments were used as a basis for an assessment and

discussion of the potential impacts of MaaS, hereby addressing the question: *What are the potential socio-economic and environmental impacts of a further development and implementation of MaaS?*

1.4 Definitions

Several descriptions and definitions of MaaS exist. The MAASiFiE project defines MaaS as follows: *"Multimodal and sustainable mobility services addressing customers' transport needs by integrating planning and payment on a one-stop-shop principle".* By this definition, MaaS comprises the following three main components that enable and provide integrated mobility services to end-users: Shared mobility, Booking/ticketing/payment and Multimodal traveller information.

Some mobility services put the main emphasis on only one or two component(s) (e.g. Uber taxi services), but do not provide integrated, cross-linked (among different transport modes) mobility services over one common mobility platform. The MAASiFiE project therefore differentiates between "MaaS-related services" representing mobility services integrating only one or two of the three MaaS components, and "MaaS services" providing all three components according to the MAASiFiE definition of MaaS.

1.5 Organisation of deliverable

The deliverable is organised as follows:

- Chapter 1 provides an introduction to the MAASiFie project and this deliverable, D4 Impact Assessment;
- Chapter 2 summarises the results of the literature study, the results of the web-survey, and presents the tentative assessment framework;
- Chapter 3 presents the results from the in-depth analysis of the two cases of MaaS: UbiGo and SMILE;
- Chapter 4 provides a summary and overview of the identified effects of a sample of additional MaaS and MaaS-related services;
- Chapter 5 presents an analysis of impacts based on the results presented in Chapter 3 and Chapter 4 reflected against additional literature;
- In Chapter 6 the results are discussed and implications suggested.

2. Development of an assessment framework

An impact assessment aims at estimating the positive or negative effects of an 'intervention' or change. Impacts to be considered include, for example fiscal, economic, demographic, social and environmental impacts but most often they are grouped into three main categories: economic, environmental, and social. This is also the case for the MAASiFiE project.

Several actors argue to need for a framework in order to assess the impacts of MaaS. However, no such framework exists as yet (according to the authors' knowledge). The overall purpose of this Chapter 2 is to present a tentative assessment framework and the underlying work.

2.1 Literature study

A literature study was completed in order to identify indicators and impacts commonly used and/or mentioned in relation to evaluations of transport-related interventions.

2.1.1 Method

The literature study encompassed an inventory of reports, articles, and other documents which fit the terms "transport"; "impact" and/or "evaluation" and/or "assessment"; "social", "economic", "socio-economic", and/or "environmental". A particular focus was given documents generated within the EU. In addition, reports and other documents specifically addressing possible impacts of MaaS solutions were included.

2.1.2 Results

Impact areas

According to ISO 14001:2004, **environmental impacts** describe "*any changes to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects*". The term 'aspect' describes the element of an organisation's activities or products or services that can interact with the 'environment', i.e. the surrounding in which the organisation operates including air, water, land, natural resources, flora, fauna, humans as well as the interaction between these.

One way of defining **economic impacts** is in terms of "*effects on the level of economic activity in a given area*" (Weisbrod & Weisbrod, 1997). These can include business output or sales volume, personal income, or jobs (ibid.). However, social impacts may include the valuation of changes in quality of life factors (such as health, safety, recreation, air or noise quality) which can be valued in economic terms.

Social impacts have been defined as the effects which characterize and influence the community's social and economic wellbeing (Canter et al.1985). Another and more recent definition suggests that social impacts refer to changes that "...*(might) positively or negatively influence the preferences, well-being, behaviour or perception of individuals, groups, social categories and society in general (in the future)"* (Geurs et al., 2009, p.71). Social impacts can be derived from the provision of transport (e.g. infrastructure, vehicles, facilities, etc.) and from user experience (e.g. the experience of travelling) (Markovich & Lucas, 2011).

Impacts and indicators

A number of more or less well defined impacts and/or indicators, used in relation to different types of interventions (projects, policies, etc.), were extracted from the definitions and from literature (Table 2.1). Several of the impacts and indicators are argued to be of relevance to more than one impact area, for instance to environmental as well as social impacts.

Regarding MaaS and MaaS-related services, the assumed impacts comply more or less with the most common, generic ones.

Table 2.1. Generic impacts and indicators extracted from literature. Bold type indicates those impacts mentioned specifically in relation to MaaS and MaaS-related services.

Impact / indicator	Description/explanation	Reference(s)	Suggested impact area
Air pollution/ air quality	Cf. also health. Pollution in the form of gas and particles that affect air quality	Weisbrod & Weisbrod, 1997b; Geurs et al. 2009; EU 2009; EU 2013; Rodrigue, 2017;	Environmental impact Social impact
Noise	Cf. public health. Noise is associated with sleep deprivation, high blood pressure, etc. Noise is also correlated with quality of life.	Geurs et al. 2009; Markovich & Lucas, 2011; WHO, 2011; EU 2013; Rodrigue, 2017	Environmental impact Social impact
Congestion	No common definition exists of 'congestion' and there appears to be no common way to measure it. Instead other indicators are used such as environmental pollution, journey reliability, travel time, perceived stress, or punctuality.	Kamargianni et al. 2015	Environmental impact
Emissions	Cf. air quality. Transportation results in harmful gases (CO, NO_2, NOx, etc.). Increased efficiency and reduction in private car use are expected to result in reduced emissions.	Weisbrod & Weisbrod, 1997b; Cascajo, 2005; EU 2009; EU 2013; Rodrigue, 2017; Burrows et al. 2015; Moving Forward Consulting, 2016	Environmental impact
Efficiency	Efficient use of available resources. Higher efficiency of transport network.	Burrows et al. 2015; Moving Forward Consulting, 2016	Environmental impact
Energy use	Increased transport efficiency results in reduction in transport energy use	Moving Forward Consulting, 2016	Environmental impact
Travel time		Weisbrod & Weisbrod, 1997b; Cascajo, 2005; Kamargianni et al. 2015	Environmental impact Economic impact

Land use/land take	Use of space for roads, parking, etc., creation of physical barriers, reduction of urban aesthetics	EU 2009; Geurs et al. 2009; Rodrigue 2017	Social impact Environmental impact
Infrastructure	A more multimodal transportation system will require an increased number of hubs for interchange between modes	Moving Forward Consulting, 2016	Environmental impact
Accessibility	Includes: • availability and physical access to facilities • 'mental' accessibility, safety and security • **the level of service provided in terms of operating hours, travel time, cost, and comfort** • the spatial distribution of transport services, and their spatial and temporal constraints	Geurs et al. 2009; EU 2013; Kamargianni et al. 2015; Burrows et al. 2015; Moving Forward Consulting, 2016	Social impact
Quality of life	Travel is often oriented towards interaction with others. Cf. social inclusion/exclusion.	Axhausen 2008; Markovich & Lucas, 2011; Kamargianni et al. 2015	Social impact
Journey quality	Intrinsic value of travel, enjoyment from travel itself; comfort; reliability	Weisbrod & Weisbrod, 1997b; Markovich & Lucas, 2011; Kamargianni et al. 2015	Social impact
Travel behaviour	Includes • type of trips undertaken, • number of trips, • km travelled, • the choice of mode(s) of transport	Cascajo, 2005	Environmental impact
Modal split/modal share	The split between private car / public transport / bicycle / walking	Kamargianni et al. 2015; Burrows et al. 2015; Moving Forward Consulting, 2016	Environmental impact
Travel cost/savings	Individual or household costs of travel	Weisbrod & Weisbrod, 1997b; Kamargianni et al. 2015; Moving Forward Consulting, 2016	Economic impact

Social inclusion/exclusions	Cf. quality of life. Mobility, wellbeing and independence are interconnected. Lack of transport is a contributing factor to social exclusion.	Kenyon et al. 2003; EU 2009; EU 2013; Schwanen & Ziegler, 2011; Burrows et al. 2015	Social impact
Safety	Casualties and injuries due to traffic. An increase in the use of PT could result in a decrease in traffic accidents	Weisbrod & Weisbrod, 1997b; Cascajo, 2005; Geurs et al. 2009; Markovich & Lucas, 2011; EU 2013; Moving Forward Consulting, 2016	Economic impact Social impact
Public health	Health is influenced by accessibility, air quality, noise etc. Cf. also safety. Physical activity associated with cycling or walking will influence health.	EU 2009; EU 2013; Burrows et al. 2015	Economic impact Social impact
Business revenues (or business output)	Includes the full (gross) level of business revenue, which pays for costs of materials and costs of labour, as well as generating net business income (profits).	Weisbrod & Weisbrod, 1997a; Cascajo, 2005; EU 2009; Moving Forward Consulting, 2016	Economic impact
Employment	Refer to the additional number of jobs that is the consequence of an 'intervention' (project, ...)	Weisbrod & Weisbrod, 1997a; Weisbrod & Weisbrod, 1997b; Cascajo, 2005; Kamargianni et al. 2015; Moving Forward Consulting, 2016	Economic impact Social impact
Business models	Involve pricing, purchase patterns	Burrows et al. 2015	Economic impact
Staff competence		Kamargianni et al. 2015	Economic impact Social impact
Integration of ride sharing platform		Kamargianni et al. 2015	Economic impact
ICT use	**Use of cloud services**	Moving Forward Consulting, 2016	Economic impact Social impact

2.2 Survey

The aim of the survey was to determine which impacts that different stakeholders and experts consider to be the most important ones to include in an impact assessment of a wider introduction of MaaS.

2.2.1 Method

The indicators and impacts identified in the literature study formed the basis for the design of a web-survey. However, an assessment of MaaS and MaaS-related services was judged to require further focus on the actions of the users of the services, as well as the businesses/organisations that provide the services. Additional impact topics were therefore added the list provided in Table 2.1, less specific ones were excluded (e.g. quality of life); and the remaining items were organised according to an individual, organisational/business and societal level respectively. A draft version of the web-survey was distributed to project partners and modified based on the input received. The final survey is found in Appendix I.

The web-survey included altogether 16 questions. The initial three questions collected information on the respondent's background and present employment. In the following questions, the respondents were asked to consider the relevance of a number of items to be included in an impact evaluation of MaaS on a 4-step scale ranging from 'No relevance' to 'High relevance'. One question concerned impacts on an individual (user) level (e.g. number of trips made, use of public transport), a second question impacts on the private organisations/businesses that provide (part of) the service (e.g. number of customers, change in customer relationships), a third question the impacts on the public transport organisation, and the final question concerned the impacts on a societal level (e.g. emissions, congestion, public health). An open question allowed the participants to provide additional suggestions for impacts on each of the levels and/or add other comments. Finally, the respondents were asked to indicate in a list what three aspects they thought would have the largest impact on an individual/user, private organisation/business, public organisation, and societal level respectively when MaaS was introduced on a larger scale.

The web-survey was distributed to the networks of the MAASiFiE project partners using different communication channels (direct e-mail, announcements via networks and committees, LinkedIn posts, flyer at the ITS World Congress in Melbourne in October 2016, etc.). All in all, the survey had 136 respondents from primarily Finland, Sweden, and the U.S. However, also other nationalities in Europe (e.g. Austria, Belgium, Germany, Great Britain, Spain) as well as Australia and Canada were represented. Not all, however, completed the questionnaire.

The majority of respondents worked in public administration (21%), universities/research institutes (17%), consultancies (17%) or ICT service providers (16%). Approximately 10% represented interest organisations (e.g. ITS national organisation) and only a few percent were employed by public or private transport service providers (6% respectively). Overall the respondents had long experience of working in the area of transportation, 55% more than 10 years and another 15% between 6 and 10 years.

2.2.2 Results

Impacts on an individual/user level

Overall, most of the suggested impacts were considered of high or moderate relevance on an individual/user level why differences in average ratings were small (Table 2.2). However, the one considered the <u>most</u> relevant was 'Combining different modes of transport' which 80% of the respondents who answered the question (n=107) considered to be of high relevance. Other items thought important were those that concerned changes in transport modes, i.e. use of private car, use of public transport, etc. In addition, seventy-six percent rated 'Overall satisfaction with transport solution' to be of high importance. Deemed least relevant to address in an impact assessment were 'Internet shopping/home deliveries' and 'General health/wellbeing'.

Additional suggestions for impacts on an individual/user level concerned for instance, time used for pre-trip planning, changes in car ownership, the use of green transport (i.e. electric vehicles and low carbon emission vehicles), and the use of automated vehicles.

Furthermore, the respondents suggested that more social impacts could be considered, such as more/less trips made together with family/friends/colleagues.

Table 2.2. The 10 impacts rated most relevant on an individual/user level (n=107).

	No relevance	Little relevance	Moderate relevance	High relevance
Combining different modes of transport (increase/decrease)	1.87% 2	3.74% 4	12.15% 13	80.37% 86
Use of private car(s) (increase/decrease)	1.87% 2	5.61% 6	14.02% 15	74.77% 80
Use of public transport (increase/decrease)	1.87% 2	9.35% 10	9.35% 10	76.64% 82
Overall satisfaction with transport solution (increase/decrease)	1.87% 2	2.80% 3	25.23% 27	67.29% 72
Use of car sharing (increase/decrease)	1.87% 2	2.80% 3	26.17% 28	66.36% 71
Perception of access to different transport modes (better/worse)	1.87% 2	5.61% 6	20.56% 22	69.16% 74
Use of electronic information services, e.g. via apps and websites (increase/decrease)	2.80% 3	6.54% 7	17.76% 19	69.16% 74
Use of electronic payment methods (increase/decrease)	1.87% 2	10.28% 11	19.63% 21	64.49% 69
Use of car pooling (increase/decrease)	1.87% 2	8.41% 9	28.97% 31	58.88% 63
Total travel cost (per individual and month) (increase/decrease)	2.80% 3	5.61% 6	31.78% 34	57.94% 62

The three major impacts on an individual/user level were considered to be increase/decreases in:

- the use of private car (55%)
- combining different modes of transport (49%)
- use of electronic payment methods (35%)

Impacts on business/organisational level

Also on a business/organisational level, most of the suggested impacts were considered of high or moderate relevance (Table 2.3; Table 2.4).

In relation to **private service providers**, the area considered most relevant was changes in the organisations' 'Business models'. This was rated highly relevant by 78% of the altogether 93 respondents who answered the question. Furthermore, changes in the 'Number of customers', ‘Business value proposition’, and revenue-related aspects such as 'Turnover' and 'Revenue sources' were deemed being of particular importance. Of less relevance were items such as changes in the 'Number of employees' and ' Brand identity/image'.

Table 2.3. The 10 impacts rated most relevant on a business/organisational level for private service providers (n=93).

	No relevance	Little relevance	Moderate relevance	High relevance
Business model(s)	**1.08%** 1	**2.15%** 2	**15.05%** 14	**78.49%** 73
Number of customers (increase/decrease)	**1.08%** 1	**2.15%** 2	**21.51%** 20	**69.89%** 65
Business value proposition	**1.08%** 1	**5.38%** 5	**19.35%** 18	**68.82%** 64
Revenues/turnover (increase/decrease)	**1.08%** 1	**1.08%** 1	**29.03%** 27	**64.52%** 60
Data sharing (among partners)	**1.08%** 1	**3.23%** 3	**25.81%** 24	**64.52%** 60
Revenue sources (new, other than today)	**1.08%** 1	**2.15%** 2	**27.96%** 26	**61.29%** 57
Need for investments (e.g., in technology, infrastructure, vehicles)	**1.08%** 1	**4.30%** 4	**29.03%** 27	**60.22%** 56
Partnerships in the value chain (new, other than today)	**1.08%** 1	**5.38%** 5	**33.33%** 31	**55.91%** 52
Distribution of costs (change)	**1.08%** 1	**5.38%** 5	**36.56%** 34	**50.54%** 47
Customer segments (change)	**3.23%** 3	**3.23%** 3	**41.94%** 39	**45.16%** 42

In the case of **public service providers,** the impact areas thought to be of high relevance differed slightly. In this case, 'Data sharing' among partners was considered the impact of highest relevance (74%, n=85). Also 'Number of customers' and 'Partnerships in the value chain' received high scores in that more than 60% of the respondents indicated these to be of high relevance. However, also in the case of public service providers, changes in the 'Number of employees' and 'Brand identity/image' were considered impacts of less relevance.

Table 2.4. The 10 impacts rated most relevant on a business/organisational level for public service providers (n=85).

	No relevance	Little relevance	Moderate relevance	High relevance
Data sharing (among partners)	0.00% 0	5.88% 5	17.65% 15	74.12% 63
Number of customers (increase/decrease)	0.00% 0	2.35% 2	25.88% 22	69.41% 59
Partnerships in the value chain (new, other than today)	0.00% 0	7.06% 6	29.41% 25	61.18% 52
Business model(s)	0.00% 0	7.06% 6	34.12% 29	54.12% 46
Need for investments (e.g., in technology, infrastructure, vehicles)	1.18% 1	7.06% 6	32.94% 28	54.12% 46
Customer segments (change)	1.18% 1	5.88% 5	37.65% 32	50.59% 43
Organisational changes (e.g. new ways of working within the organisation, change in work tasks)	2.35% 2	7.06% 6	34.12% 29	52.94% 45
Business value proposition	2.35% 2	8.24% 7	32.94% 28	50.59% 43
Channels for reaching customers (new, other than today)	2.35% 2	5.88% 5	40.00% 34	49.41% 42
Revenue sources (new, other than today)	0.00% 0	10.59% 9	36.47% 31	47.06% 40

Additional suggestions regarding the impacts on a business/organisational level concerned reaching societal goals for sustainable travel and equity (i.e. providing access to MaaS to all or most segments of the population).

The three major impacts on a business/organisational level were for private service providers considered to be:

- changes in business models (57%)
- data sharing among partners (38%)
- new partnerships in the value chain (37%)

For public service providers, the same list read:

- new partnerships in the value chain (36%)
- organisational changes, i.e. new ways of working within the organisation (32%)
- changes in business models (31%)

It should be remembered though that the results presented here are based primarily on judgements made by other stakeholders than private or public service providers.

Impacts on a societal level

The impact considered most important to address on a societal level concerned 'Access to mobility solutions for citizens' which was considered of high relevance by 82% of the respondents (n=82). Also impacts in terms of changes in 'Congestion' and 'Emissions' were thought to be highly relevant by a majority (69% and 60% respectively) and were changes in ‘Utilization Rate of Vehicles’ (59%) but still by considerably less of the respondents compared to the former mentioned aspect. Deemed of least importance (in relative terms) were changes in 'Public health' and increases/decreases in 'Traffic safety' (Table 2.5).

Table 2.5. The 10 impacts rated most relevant on a societal level (n=82).

	No relevance	Little relevance	Moderate relevance	High relevance
Access to mobility solutions for citizens (increase/decrease)	0.00% 0	1.22% 1	13.41% 11	81.71% 67
Congestion (increase/decrease)	0.00% 0	6.10% 5	21.95% 18	69.51% 57
Utilization rate of vehicles (increase/decrease)	0.00% 0	9.76% 8	28.05% 23	58.54% 48
Laws and regulations, e.g. re procurement etc. (changes)	0.00% 0	7.32% 6	35.37% 29	54.88% 45
Emissions (Co2, NOX, etc.) (increase/decrease)	0.00% 0	14.63% 12	24.39% 20	59.76% 49
Occupancy rate of vehicles (increase/decrease)	0.00% 0	9.76% 8	39.02% 32	48.78% 40
Public investments in e.g. infrastructure (increase/decrease)	1.22% 1	8.54% 7	41.46% 34	47.56% 39
Number of parking spaces (increase/decrease)	1.25% 1	11.25% 9	36.25% 29	48.75% 39
Land use (more efficient/less efficient)	1.22% 1	8.54% 7	45.12% 37	43.90% 36
Vehicle types in use, incl. EV-fleets, hybrids etc. (changes in)	2.44% 2	14.63% 12	35.37% 29	45.12% 37

The three greatest impacts on a societal level were considered to be increases/decreases in:

- access to mobility solutions for citizens (69%)
- congestion (46%)
- emissions (36%)

2.3 Formulation of tentative assessment framework

The web-survey asked the respondents to consider altogether 57 different types of impacts (27 on an individual/user level, 18 on a business/organisational level, and 12 on a societal level). Even though most impacts were considered highly relevant by a substantial portion of the respondents, the number of impacts needed to be reduced to a feasible number. Nevertheless, the survey provided indications of what impacts should be included in an assessment framework.

The results of the web-survey were discussed at a face-to-face meeting in which participated partners from Chalmers, Austria Tech, and VTT (i.e. the project team). Based on these discussions, and taking the MaaS ecosystem (as described in D3) into consideration (see also Figure 2.1. Overview of MaaS ecosystem (copyright Aapaoja, A., Sochor, J., König, D. & Eckhardt, J. 2016) the list was reduced to 17 topics - or KPIs; six on an individual level, six on a business level, and five on a societal level related to the generic impact areas: environmental impact, economic impact and social impact (Table 2.6).

Table 2.6. Suggested KPIs and relevant impact areas.

Level	KPIs	Environmental	Economic	Social
Individual /user level	Total number of trips made	x		x
	Modal shift (from car to PT, to sharing, to ...)	x		
	Number of multimodal trips	x		
	Attitudes towards PT, sharing, etc.	x		
	Perceived accessibility to transport			x
	Total travel cost per individual/household		x	x
Business/ organisationa l level	Number of customers		x	
	Customer segments (men/women, young/old, ...)		x	x
	Collaboration/partnerships in value chain		x	
	Revenues/turnover		x	
	Data sharing		x	
	Organisational changes, changes in responsibilities			
Societal level	Emissions	x		
	Resource efficiency (roads, vehicles, land use, ...)	x	x	
	Citizens accessibility to transport services		x	x
	Modification of vehicle fleet (electrification, automation)	x		
	Legal and policy modifications	x	x	x

Individual level

The individual level describes the impacts that relate to changes in people's travel behaviours, attitudes, etc. (Table 2.7). These changes are a prerequisite in order for the successful dissemination of MaaS.

Table 2.7. KPIs and impacts on an individual level

KPI	Impact
Number of trips made	A reduction in the total number of trips made could have a positive effect on congestion as well as emissions, and hence on the environment.
Modal shift	The KPI refers to a modal shift from private car to other, more sustainable transport modes such as public transport, bicycling, walking, but also to car sharing and other sharing facilities. A general assumption is that the introduction of MaaS will result in a modal shift, from trips made by private cars to other modes of transport. This could have a positive effect on emissions and consequently also on the environment.
Number of multimodal trips	Another possible effect of the introduction of MaaS is that travellers with make use different modes of transport as well as combine different modes of transport in a way that will result in a mode efficient use of available resources.
Attitudes	MaaS could result in changed attitudes towards different modes of transport providing an increased use of different modes of transport. Indirectly a less positive attitudes towards the use of private car use and a more positive attitude towards public transport, car- and bikesharing, etc. could result in environmental impacts.
(Perceived) accessibility to transport	MaaS has been argued to result in an increased accessibility to transport and as a consequence also an increased access to, for example social services. This would have positive social impacts.
Total travel cost per individual/household	MaaS could potentially results in a decrease in the total travel costs per individual and/or household.

Business/organisational level

The business/organisational level describes impacts that refer to business conditions and the way organisations have to work in order to operationalise MaaS (Table 2.8).

Table 2.8. KPIs and impacts on a business/organisational level

KPI	Impact
Number of customers	Given a shift from private car to other modes of transport, including public transport, car sharing, taxi, etc., service providers could be expected to face an increase in the number of customers which could results in a positive economic impact
Customer segments	With a transport service offer that has a less narrow focus on a shift from private car to public transport specifically but instead from private car to other modes of transport, i.e. including different modes of transport in the service offer, it is feasible that MaaS will attract new and other customer segments. This could be expected to result in an increase in the number of customers which could results in a positive economic impact.
Revenues/turnover	Depending upon how the streams of customers move, revenues could increase or decrease. These moves (and resulting revenues) are also dependent on the payment model, e.g. pre-paid packages with or without credit rolled over, pay-as-you-go, minimum monthly subscription level, etc., and the relative prices of the modes.
Data sharing	A further implementation and dissemination of MaaS relies on the collection and processing of data from different service providers, and hence on data sharing. Data sharing is thus a prerequisite for and a feasible impact of MaaS.
Collaboration/partnerships in value chain	MaaS will require further collaboration between transport service providers, public as well as private, why it is feasible to assume further collaboration between different stakeholders and (depending upon the business model) possibly new roles in the value chain.
Organisational changes, changes in responsibilities	With the assumption that MaaS will require further collaboration between transport service providers, public as well as private, it is feasible to assume that organisational changes will be one result of a further implementation of MaaS.

Societal level

The societal level refers to impacts that are a consequence of changes on an individual and business level. In addition, legal and policy modifications may be a necessary prerequisite for changes to happen on a business/organisational level (Table 2.9).

Table 2.9. KPIs and impacts on a societal level

KPI	Impact
Emissions	A reduction in emissions relies on a reduction in trips made and/or reduction in km travelled, and/or a modal shift from petrol/diesel fuelled car to other modes of transport. If MaaS results in a modal shift, from trips made by less energy using modes of transport, this could result in a reduction of emissions. If MaaS also results in a reduction in the overall number of trips made, a further positive effect on the emissions resulting from transport could be expected.
Resource efficiency (roads, vehicles, land use, ...):	Given a reduction in number of trips made, MaaS could possibly result in an increase in resource efficiency due to a reduction in congestion. Given a reduction in the ownership and use of private cars, a reduction in the need for parking spaces can be expected. Furthermore, a further use of shared resources in terms of public transport, carsharing, and bikesharing, etc. results in an overall increase in resource efficiency.
Composition of vehicle fleet (electrification, automation)	The introduction of MaaS has been argued to facilitate a further electrification of the vehicle fleet. Also automated vehicles are frequently mentioned in relation to MaaS.
Citizens' accessibility to transport services	MaaS has been argued to result in an increased accessibility to transport as well as, provided this increased accessibility to transport, also an increased accessibility to the different services offered by society.
Legal and policy modifications	The implementation and dissemination of MaaS must take place taking national as well as international laws and regulations into considerations. Further implementation and dissemination of MaaS may require changes in laws and regulations and/or policy.

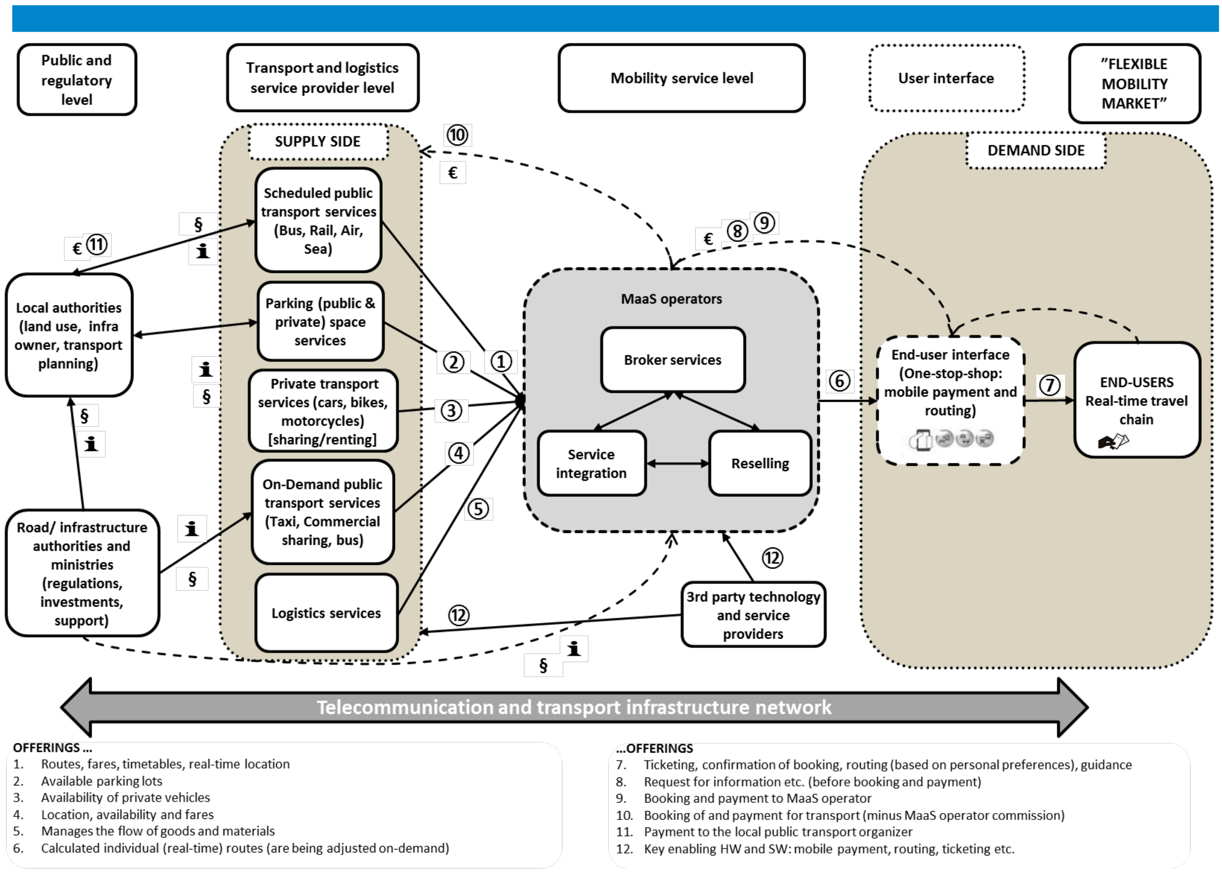

Figure 2.1. Overview of MaaS ecosystem (copyright Aapaoja, A., Sochor, J., König, D. & Eckhardt, J. 2016)

3. In-depth analyses

In order to provide a basis for an assessment of the impacts of MaaS, two case studies have been analysed more in-depth: UbiGo in Gothenburg, Sweden and SMILE in Vienna, Austria.

3.1 The case of UbiGo

3.1.1 Approach

In order to collect information on the use case, different information sources have been used. During the project, data was collected by means of surveys (before, during, after), travel diaries (before and during) and personal interviews (after) to/with UbiGo participants as well as with a sample of non-participants. This has been documented in for example Sochor et al. (2014; 2015a; 2015b; 2016a). Additional information has been collected by interviews/workshops with service providers and other stakeholders. In addition, participant observations were carried out throughout the project by authors M. Karlsson and J. Sochor.

3.1.2 Results

The Gothenburg context

The City of Gothenburg is second largest city in Sweden by population. The city has a surface of approx. 2,400 km^2 and approximately 540,000 inhabitants. Including the metropolitan area, the number of inhabitants rises to around 900 000. The population is increasing by 1-1.5% each year. Sixty per cent of the inhabitants is aged between 20 and 64 while 15% is older than 65 (www4.goteborg.se). The income per inhabitant is on average 244,000 SEK or (approx.) 26,500 Euro.

According to statistics, public transport (PT) covers approximately 29% of all trips, 48% are done by private car, 14% by motorcycles and non-motorized vehicles such as bicycles while 9% are accomplished walking. However, there are differences when comparing different areas of the city. For instance, car usage is used to a lesser degree and walking is used to a higher by those citizens living in the city centre compared to Gothenburg overall.

Description of UbiGo

The Go:Smart project ran a six-month field operational test (FOT) of the UbiGo[1] service from November 2013 through May 2014, involving around 200 participants from private, urban households. The goal was to test the business concept and the service looked to lessen or eliminate the need to own a (second) private car. Although the end-users were highly satisfied and used the service to test new and more sustainable travel behaviours, the service was discontinued after the pilot ended, mainly due to difficulties in finding a cooperative (business) model that worked for both the region/PT-provider and UbiGo as an emerging private, commercial service (Sochor et al. 2015a; 2015b; 2016a).

UbiGo features and services included:

- Access to public transport, bike sharing, car sharing, taxi and rental cars;
- A personalized, monthly household subscription (and single invoice), which could be modified on a monthly basis and which included the possibility to top up and roll over credit;
- A customer service phone line open 24 hours per day;

[1] http://ubigo.me/

- Subscription access via web interface adapted to smartphones, in which users could activate tickets/trips, make/check bookings, and access already activated tickets (e.g. for validation purposes), check one's balance, bonus, and trip history, and get support (in terms of FAQ/customer service);
- A smartcard, used for instance to check out a bicycle from the bikesharing service or unlock a booked car, but also charged with extra credit for the public transport system in case there was any problem using the UbiGo service;
- Compensation for not using a private vehicle during the FOT, i.e. to offset insurance, parking, etc. up to a fixed limit.

Impact assessment

In summary, using the UbiGo service resulted in a number of changes to the participants' use of different modes. Overall the participants decreased their use of private car and increased their use of, for instance public transport and carsharing services. Furthermore, their attitudes towards for instance public transport improved while attitudes towards private car use became less positive. See Table 3.1 for an overview, and Sochor et al. (2014; 2015a; 2015b; 2016a) for further breakdowns.

Table 3.1. Changes as a consequence of UbiGo **(↑)** *= increase,* **(↓)** *= decrease,* 0 *= no change, n.a. = no information available.*

Level	KPI	Increase/ decrease	Comment
User level	Total number of trips made	↓	Participants report fewer spontaneous trips, as well as report increased trip planning and trip chaining
	Modal shift (from car to PT, to sharing, to...)	↑	46% net reported greater **bus/tram** use (50% more use and 4% less use); 5% more tram use (travel diaries); 35% more bus use (travel diaries)
		↓	8% net reported less local **train** use (15% less use and 7% more use); 20% more train use (travel diaries)
		↓	44% net reported *less* **private car** use (48% less use and 4% more car use); -50% car use (travel diaries)
		↑	51% net reported greater **carsharing** use (57% greater use and 6% less use); +200% more car sharing use (travel diaries)
		↑	15% net reported greater **car rental** use (28% greater use and 13% less use)
		↑	8% net reported greater **taxi** use (20% greater use and 12% less use)

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		↑ ↓ ↑	7% net reported greater use of **bikesharing** (23% greater use and 16% less use) 3% net reported less use of **private bike*)** (19% less use and 16% greater use) *) note that UbiGo ran during the winter half of the year from November through April) 15% net reported more **walking** (21% greater use and 6% less use)**); 5% less walking (travel diaries) **) note that UbiGo ran during the winter half of the year from November through April
	Multimodal trips, combining different modes of transport	n/a	
	Attitudes towards PT, sharing, etc.	↑ ↑ ↓ ↑ ↑ ↑ ↑ ↑	50% net reported a more positive attitude towards **bus/tram** (52% more positive and 2% less positive) 5% net reported a more positive attitude towards **local train** (8% more positive and 3% less positive) 20% net reported a *less* positive attitude towards **private car** (23% less positive and 3% more positive) 58% net reported a more positive attitude towards **carsharing** (61% more positive and 3% less positive) 17% net reported a more positive attitude towards **car rental** (21% more positive and 4% less positive) 12% net reported a more positive attitude towards **taxi** (18% more positive and 6% less positive) 41% net reported a more positive attitude towards **bikesharing** (42% more positive and 1% less positive) 11% net reported a more positive attitude towards **private bicycle** (14% more positive and 3% less positive)

		↑	14% net reported a more positive attitude towards **walking** (16% more positive and 2% less positive)
	Perceived accessibility to transport	↑	68% net perceived having more alternatives from which to choose (73% agree and 5% disagree)
	Total travel cost per individual/household	↓	49% net perceived a reduced transportation expenditure (63% agree and 14% disagree) *Also 69% net perceived that it became easier to pay and keep track of transportation expenditure (77% agree and 8% disagree)*
Business level	Number of customers	↑	Nearly 200 (new) customers in approximately 80 subscriptions*) *) To be noted though that UbiGo did not exist before the trial
	Customer segments (men/women, young/old, ...)	n.a.	*~ 50/50 participant gender split; employed (i.e. not retirees or students); highly educated; mix of household types; 30-64 years old (83% of subscription holders and 67% of respondents); good access to transport/mode infrastructure, e.g. city centre residents (49% of subscription holders and 42% of respondents)*
	Collaboration/partnerships in value chain	↑	UbiGo established new partnerships in the value chain
	Revenues/turnover	↑	UbiGo demonstrated the business potential of MaaS
	Data sharing	↑	UbiGo set up limited data sharing between partners
	Organisational changes, changes in responsibilities	↑	UbiGo triggered internal discussions in partner organisations
Societal level	Emissions	↓ *)	reduced private vehicle use (see above) should result in reduced emissions 38% perceived a reduced environmental impact (49% agreed and 11% disagreed)

	Resource efficiency (roads, vehicles, land use, ...)	↑*)	20 vehicles were taken off the road for the duration, 17 of those from single vehicle households; UbiGo reduced private car use and increased shared/public mode use
	Citizens accessibility to transport services	↑	no increased physical access as UbiGo utilized existing infrastructure, other types of access increased. 54% net perceived being better able to match mode choice to the individual trip conditions (61% agree and 7% disagree)
	Modification of vehicle fleet (electrification, automation)	0	no modification as UbiGo utilized existing fleets
	Legal and policy modifications	TBD	UbiGo triggered an ongoing local and national discussion of legal and policy issues

*) assumptions based on other data

Extrapolated potential

A comparison between the demographics of Gothenburg municipality and the subscribers of UbiGo show some important differences (Table 3.2) that must be considered in assessing who could potentially be MaaS users. However, based on existing statistics and the complex interplay between different factors (e.g. household composition, residential location, car ownership, age, occupation, and access to mode infrastructures, particularly public transport and carsharing), no exact calculation can be made as how many households could become MaaS users.

One difference concerned the type of household where UbiGo subscribers were adults with children to a higher degree than compared to Gothenburg overall. It has been argued that MaaS would not be a feasible option for families with (at least) younger children as children are often a reason for investing in a family car. This assumption could not be confirmed in the UbiGo case, although interviews suggested that carsharing becomes more problematic for families with multiple younger children in need of car seats. However, the evaluations also showed that many households became Ubigo customers to find out if they could manage without a car or if they could manage without a second car. Thus, a service such as UbiGo is **an option for those who consider investing in a family car (or not) but in particular those who otherwise would invest in the second family car**.

Furthermore, the share of retired subscribers was low (1%) compared to Gothenburg overall (19%) and the share of students slightly lower, 11% compared to the municipality, 15%. In this case, economic factors probably played a significant role. It is possible that a service as UbiGo is less of an option for students and retired persons in general but it is probably more realistic to consider cost. In this case, to become a subscriber (requiring a minimum monthly subscription of 1200 SEK) would increase travel costs for the individual compared to existing solutions (discount PT etc.). Hence, a service such as UbiGo will **attract users who experience the service to be an economically feasible alternative - or who consider the service to offer considerable additional benefits.**

Another major difference concerned residential location. For instance, 42% of UbiGo subscribers lived in the city of Gothenburg compared to 23% when considering all Gothenburg citizens (Table 3.2). However, neither the UbiGo service, nor the trial intended to mirror the population of Gothenburg, rather the purpose was to target those households that were believed to benefit in particular from having access to the UbiGo service, i.e. who had good access to public transport and good access to a carsharing service. The distribution of participants across different location areas in Gothenburg (i.e. city centre, southwest, southeast, northeast, and north) mirror fairly well access to carsharing facilities. A further analysis indicates that subscribers living in some areas of Gothenburg were more content with using the UbiGo service than subscribers living in other. Thus, even if a few subscribers lived more than 40 km from Gothenburg city centre, a service such as UbiGo is considered to **mainly attract households in areas with (i) high availability to public transport in terms of routes and frequency and (ii) access to carsharing within less than approximately 300 m** (suggestion).

Table 3.2. Demographics of the citizens of Gothenburg municipality compared to the participants in the UbiGo FOT.

Demographic		Gothenburg municipality (N=548 190)	UbiGo (baseline) (N=164)
Gender	*Men* *Women*	50% 50%	51% 49%
Age	*Younger (19-29)* *Middle (30-44)* *Older (45-64)*	19% 23% 23%	31% 35% 32%
Household *Ngbg = 250,716*	*Single, 0 children* *Couple, 0 children* *With minors*	43% 20% 24%	9% 31% 29% 16%: 3+ adults 15%: extended hh
Occupation	*Employed* *Retired* *Student* *Other*	59% 19% 15% 7%	80% 1% 11% 8%
Education	*Post-high school education (at least 3 years)*	34%	76% university or higher 6% professional education 16% high school (n=109)
Residential location	*City centre* *Southwest* *Southeast* *Northeast* *North (Hisingen)* *Other*	23% 20% 11% 18% 28% -	42% 14% 13% 1% 20% 9%
Driver's license		85% (region)	88%
Public transport card		80%	88%
Cars per household	*0* *1* *2+*	55% 36% 9%	52% 36% 12%
Mode split, all year	 *Car* *Public transport* *Bike* *Foot*	Gbg / Center 40% / 24% 27% / 31% 8% / 8% 23% / 37%	Travel Diaries (n=40) 27% 34% 10% 24%

As already mentioned, due to the complex interplay between different factors (e.g. household composition, residential location, car ownership, age, occupation, and access to mode infrastructures, particularly public transport and carsharing), no exact calculation can be made as how many households could become MaaS users, or how many fewer private cars there could be. However, one can make some aggregate estimations based on a subset of factors (see scenarios below). Given more information on variable interactions and a geographic analysis of demographic access to public transport *and* carsharing (and bikesharing) infrastructures in all areas of the city, and for participants versus interested non-participants versus the general population, one could perhaps further refine these calculations of potential impact.

Table 3.3 compares the UbiGo subscription holders' residential location and car ownership with that of Gothenburg citizens.

Table 3.3. Demographics of the citizens of Gothenburg municipality compared to the UbiGo subscription holders – residential location and car ownership.

Residential location	**Gothenburg**			**UbiGo (non-project-related subscription holders, N=72)**		
	Population / Households		*HH Car Ownership*	*% HH*	*Car Ownership*	*Ownership + Use Categories*
Gothenburg Municipality (5 areas)	Npop = 548,190 Nhh = 250,716	100% pop 100% hh	36% 1 car 9% 2+ 55% no	100%	39% 1 car 8% 2+ 53% no	59% shedders 41% keepers 53% accessors 47% carsharing
City centre	Npop = 124,241 Nhh = 66,899	23% pop 27% hh	29% 1 car 3% 2+ 68% no	49%	37% 1 car 6% 2+ 57% no	73% shedders 27% keepers 50% accessors 50% carsharing
Southwest	Npop = 110,888 Nhh = 47,185	20% pop 19% hh	43% 1 car 13% 2+ 44% no	14%	30% 1 car 10% 2+ 60% no	25% shedders 75% keepers 67% accessors 33% carsharing
Southeast	Npop = 58,430 Nhh = 29,736	11% pop 12% hh	36% 1 car 6% 2+ 58% no	13%	44% 1 car 11% 2+ 44% no	60% shedders 40% keepers 75% accessors 25% carsharing
Northeast	Npop = 99,488 Nhh = 39,790	18% pop 16% hh	32% 1 car 10% 2+ 59% no	1%	100% 1 car - 0% no	100% shedders - - -
North (Hisingen)	Npop = 153,599	28% pop 27% hh	40% 1 car 12% 2+ 48% no	22%	44% 1 car 6% 2+ 50% no	50% shedders 50% keepers 37.5% accessors 62.5% carsharing

Many persons expressed interest in UbiGo, but did not eventually join the service due to various reasons (subsequently referred to as non-participants). Of the 145 such persons who completed a questionnaire, stated reasons as to why they did not eventually become customers can be grouped into broader categories such as economy (i.e. more expensive than their current solution); a perceived mismatch between customer and service (e.g. between current travel patterns or lifestyle and what UbiGo offered, such as mostly traveling by bike and foot already, which is also related to economy); a (perceived) lack of "alternative" transportation infrastructure, for instance 15% felt that the carsharing sites were "too far away" for practical use; and effort for example 16.0% claimed that they were too busy, that it was too difficult to find time to participate in an information meeting, to learn more about the project, etc. (Sochor et al., 2014).

A total of 122 persons who had expressed interest in UbiGo but did not eventually become customers could be geo-located, of which 46 (38%) are in the city centre. A statistical analysis (2x2 contingency table, Fisher's exact test, $p=0.1749$) revealed no significant difference between residential location (city centre or not) and participation (expressing interest and becoming or not becoming a participant). Of all geo-located persons/households who expressed interest and lived in the city centre, 43% became participants. Below we assume that car ownership-related factors are similar between these participants and non-participants.

For the simplified analysis below, let us only consider those living in the city centre (23% of Gothenburg's population = 124,241 persons, and 27% of the households = 66,899 households for 2015), where residents are more likely, overall, to have fewer transport infrastructure-related obstacles to non-car ownership (i.e. relatively "good" access to public transport and carsharing infrastructure, as well as bikesharing) and thereby fewer such obstacles to adopting UbiGo compared to other areas of the city. By doing so, one can more reasonably disregard lack of (perceived) access in the continued analysis. Additionally, the analysis assumes that carsharing and bikesharing infrastructure could and would be expanded accordingly for the significantly increased numbers of customers/non-car owners in the scenarios below, although estimations of the increased numbers of carsharing vehicles required for this are not included in this analysis.

Comparing UbiGo participants with Gothenburg (see Tables 3.2 and 3.3), UbiGo was very attractive for those living in the city centre (49% of subscription holders versus 23% of the population and 27% of households). The city centre has an over-representation of single-person households (51.6% or 34,547 households) compared to Gothenburg as a whole (43%), a demographic that was under-represented in UbiGo subscription holders (13%) as well as in UbiGo subscription holders in the city centre (14%). (As mentioned above, this is likely related to the minimum monthly subscription of 1200 SEK.) The city centre also has an under-representation of households with minor children (15%) compared to Gothenburg as a whole (24%), a demographic that was over-represented in UbiGo subscription holders (32%) and even more so among UbiGo subscription holders in the city centre (37%).

The city centre also has an under-representation of car ownership (32% or 21,639 households – 29% or 19,609 are single-vehicle households and 3% or 2,030 are multi-vehicle households – compared to Gothenburg as a whole (45%), a demographic that was similar on the whole for UbiGo (47%) compared to Gothenburg, but over-represented among subscription holders in the city centre (43% = 37% single-vehicle households + 6% multi-vehicle households). Of the UbiGo car owners in the city centre, 73% were shedders (who gave up their car during the UbiGo FOT) and 27% were keepers (who did not give up their car during the UbiGo FOT). In fact, 55% of the total shedders during the UbiGo FOT lived in the city centre.

When further considering UbiGo household composition in the city centre, for single-person households, all those who owned cars (40% of such households) were shedders from single-vehicle households, i.e. no keepers. For car-owning couples (25% of couples, all single-vehicle households), half were shedders and half keepers. For car-owning families with minor children (46% of such families, 83% of which were from single-vehicle households), half were shedders and half were keepers. Of car-owning families with adult children (67% of such households), 100% were shedders and 75% were single-vehicle households.

In other words, UbiGo was particularly more attractive for those living in the city centre, and for car owners living in the city centre, but particularly less attractive for single person households and particularly more attractive for families with minor children. When taking into consideration household composition and car ownership in the city centre, a majority of car-owning single-person households and households with adult children were interested in shedding their cars (mostly single-vehicle households). For households comprising couples or families with minor children (mostly single-vehicle households), half were interested in shedding their cars.

Scenario 1: UbiGo participation rate of 43% in the city centre and 2-5% of cars sold due to carsharing alone (Martin & Shaheen, 2016) *applied to cars the city centre.*

The online Gothenburg Statistical Database reports 28,346 registered cars on the road in the city centre in 2015, of which 25,293 are registered to physical persons (Sw 'fysisk person') and 3,053 to single-person companies (Sw 'personligt företag'). Applying a 43% overall participation rate in the city centre as well as a 2-5% reduction in ownership due to sales (from a North American analysis where potential reductions are likely lower due to differences in urban planning and cost of car ownership) to the 25,293 vehicles owned by physical persons results in 218-544 cars sold in the city centre due to carsharing (0.43 x 25,293 x 0.02 and 0.05 respectively).

Scenario 2: UbiGo participation rate of 43% and UbiGo shedding levels in the city centre applied to car-owning households in the city centre.

Car-owners in the city centre were particularly attracted to UbiGo. Applying a 43% overall participation rate in the city centre, and if 73% of car-owning households in the city centre were interested in shedding a car (as in UbiGo), this would mean 6,793 fewer privately owned cars in the city centre (0.43 x 0.73 x 21,639).

If one splits the households into single-and multiple-car households and applies those UbiGo shedding rates, one gets a similar answer of 6,929 fewer private cars, as follows. If half of multi-car households in the city centre were interested in shedding one car (as in UbiGo), this would be a reduction of 436 cars (0.43 x 0.50 x 2,030). Furthermore, if 77% of single-vehicle households in the city centre were also interested in shedding their car (as in UbiGo), this would be a reduction of 6,493 cars (0.43 x 0.77 x 19,609), for a total of 6,929 fewer private cars.

Scenario 3: UbiGo participation and cars per mille reduction rates applied to the city centre.

Using a completely different metric, Gothenburg's statistics flyer (Göteborgsbladet) reports 285 cars per mille, and 230 cars per mille in the city centre for 2014, the equivalent of 28,575 cars in the city centre with the 2015 population (124,421), although the online Gothenburg Statistical Database reports 28,346 registered cars on the road in the city centre in 2015, of which 25,293 are registered to physical persons (Sw 'fysisk person') and 3,053 to single-person companies (Sw 'personligt företag'). Only considering those registered to physical persons, for comparative purposes, gives 204 cars per mille in the city centre. Keeping in mind that single-person households were very under-represented in UbiGo (overall and city centre), and families with minors were over-represented (overall and city centre), when considering the number of cars per number of persons in the UbiGo subscriptions and households before and after shedding, on the whole there is an approximate 50% reduction (from approximately 190 to 100 cars per mille), and for the city centre there is an approximate 65% reduction (from approximately 170 to 60 cars per mille). With a 43% participation rate, for the city centre this would mean a drop from 204 to 147 cars per mille, or the equivalent of 7,082 fewer cars owned by physical persons [(204 x 0.57) + (204 x 0.43 x 0.35) = 116.3 + 30.7 = 147].

Scenario 4: Considering household composition (single-person households, families with minors, and all others). UbiGo single-person household participation, car-ownership and shedding rates also applied to single-person households in the city centre. Overall UbiGo participation rate applied to other household types.

Instead of using a 43% participation rate for single-person households in the city centre as this demographic was under-represented in UbiGo, if one considers that UbiGo may only be attractive to 14% of single-person households in the city centre, and considering that 40% of such UbiGo subscription holders were car owners, and 100% of them were shedders, for the city centre, this would be the equivalent of a reduction of 1,935 cars for that demographic (0.14 x 0.40 x 34,547hh).

Families with minor children in the city centre were highly over-represented in UbiGo (37% versus 15%), but if one applies the 43% participation rate for the city centre, and if half of the 46% car owners are shedders (as in UbiGo), this would be the equivalent of a reduction of 1,020 privately owned cars for that demographic (0.43 x 0.46 x 0.50 x 10,317hh).

Aggregating the rest of the city centre UbiGo subscription holders' car ownership and shedding rates (41% ownership of which 86% are shedders) and applying these together with an overall participation rate of 43% to the remainder of households in the city centre, this would be the equivalent of a reduction of 3,341 private cars (0.43 x 0.41 x 0.86 x 22,035hh), for a total of 6,296 fewer private cars in the city centre.

3.2 The case of SMILE

3.2.1 Approach

In Vienna, the SMILE project focused on the provision of a multimodal traveller information system providing ticketing, booking, payment and billing features together with routing services to users. The SMILE information system represents a smartphone app, which was provided for testing purposes for one year to a group of more than 1000 registered pilot users of which around 200 participated in a survey and were assumed as representative for the sample. The pilot area included operations across Austria as well as with local partners in Vienna, Salzburg and Graz. The main location was Vienna due to its high population and the high number of cooperation partners (smile-einfachmobil.at).

3.2.2 Results

The Vienna context

The following general aspects of transport in Vienna provide a setting for the interpretation of results of the project,

In 2014, the modal split in Vienna was as follows: 39% of trips are done by PT, 26% by walking, 7% by cycling and 28% by car (Figure 3.1).

In 2015, the shares only changed for car-driving (-1%) and walking (+1%). Additionally, the percentage of the Viennese population using a car several times a week was 42% in 2013 and the percentage of the population using at least two modes of transport within a week (multimodality) was 52% in 2013. (Further details: STEP 25 and https://www.fahrradwien.at/2016/01/28/modal-split-2015-aktive-mobilitaet-auf-dem-vormarsch/)

The availability of bike-sharing stations was 24.6 % in 2013 and will reach 40% by 2025. Access to public transport stops was already 97.3 % in 2013 and will be maintained until 2025 (STEP 25).

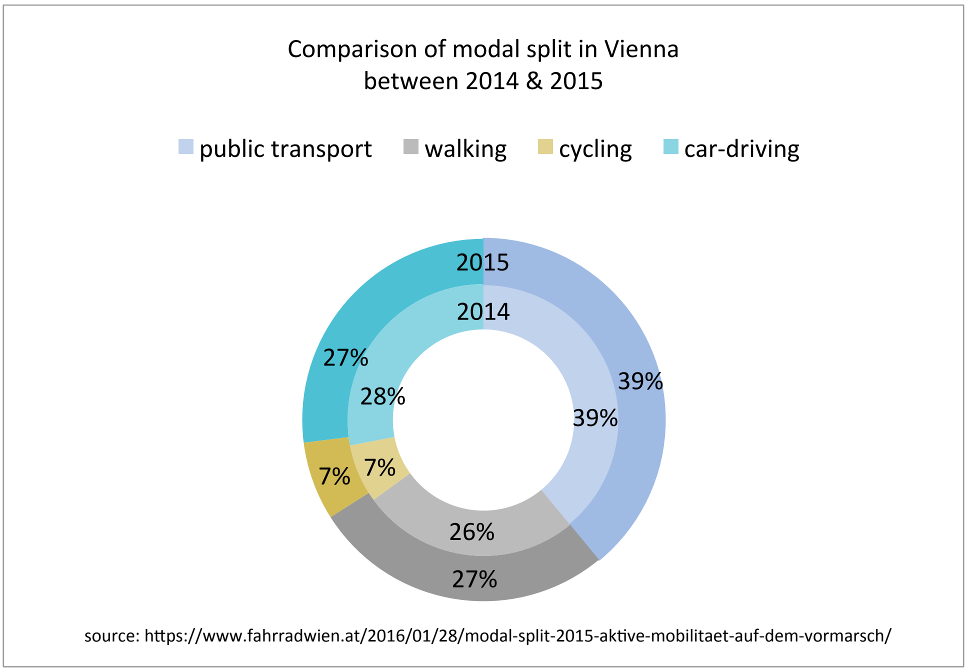

Figure 3.1. Modal split in Vienna 2014 and 2015 (Source: fahrradwien.at)

Description of SMILE

The aim of the SMILE project was the development and testing of a prototype for a multi-modal information, booking and payment system, combined with a personal mobility assistant. The project started in 2012 for the duration of 39 months. In spring 2014, the one year pilot operation started. The pilot operation was split into three phases, of which the first two phases were project internal. The first phase was set up to test the app by all involved project staff to gain feedback for further technical development of the app. The second phase started in July 2014, where all mobility partners of the project were invited to test the app for further feedback and development. In November 2014, the final external phase started, in which pilot users used the app. About 1,200 registrations were counted, whereof 1,000 users were chosen for the final pilot phase. All 1,000 users were invited to answer questionnaires and around 200 users participated. An android version of the app was distributed via Google Play Store to the participants and featured a ‘feedback-button’ for direct feedback. Furthermore, a call-centre, a website, and e-mail functioned as additional feedback channels. User satisfaction was very high; 75% of the respondents were very satisfied or satisfied with the *smile* app (smile-einfachmobil.at).

As far as the demographic data of the SMILE survey participants is concerned, around 79 % of the respondents were male and 22% female. Most of the participants were from Vienna (74%) followed by those from other Austrian federal states (26%). Fifty-one percent of the respondents were between 20 and 40 years old, 21% were between 50 and 60 years old and 14% were older than 60 year. The average *smile* user has a high level of education and a high income and is male.

Seventy-seven percent of the respondents owned a bicycle, 59% owned a car, 7% an e-bike and 2% owned an electric car (Figure 3.2). The share in yearly tickets was very high with 84% having one from Wiener Linien. Forty-nine percent were holders of discount cards for ÖBB (smile-einfachmobil.at).

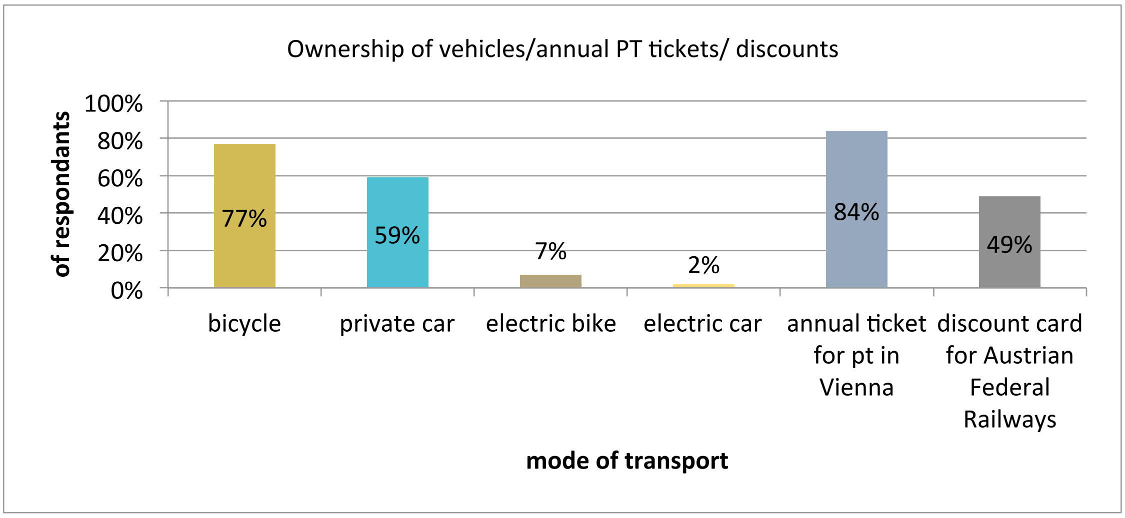

Figure 3.2. Ownership of vehicles/annual PT tickets (Source: smile-einfachmobil.at)

Impact assessment

The impact assessment focuses on those aspects where information is available.

Usage rate and use of smile app

The *smile* app was used by 6% of the users daily and by 30 % several times a week. It was mostly for private purposes (64%), secondly for leisure (59%) and for trips with unfamiliar transport companies (45%). Thus, *smile* is used particularly for non-routine trips such as leisure trips, where additional information is needed. A high percentage (50%) of users never used the payment function, which can be explained by high percentage of ownership of annual tickets

Mobility behaviour

Smile pilot users used PT intensively (86% daily to several times a week). Almost one third (30%) drove their private car daily to several times a week and 27% used their bicycle. Approximately half (51%) of the respondents also used carsharing and bikesharing offers regularly. A more frequent combination of PT and other modes of transport, especially bike-sharing, private bicycle, private car and carsharing is reported since the introduction of the app (Figure 3.3).

The following shares show that the use of the *smile* app had a significant influence on the mobility behaviour of the users:

- 48 % stated that their mobility behaviour changed through the use of the *smile* app
- 55 % stated that they combine different modes of transport more often
- 60 % stated that they discovered new routes on their leisure trips with the app
- 69 % said that suggested routes are faster than the ones they used before.

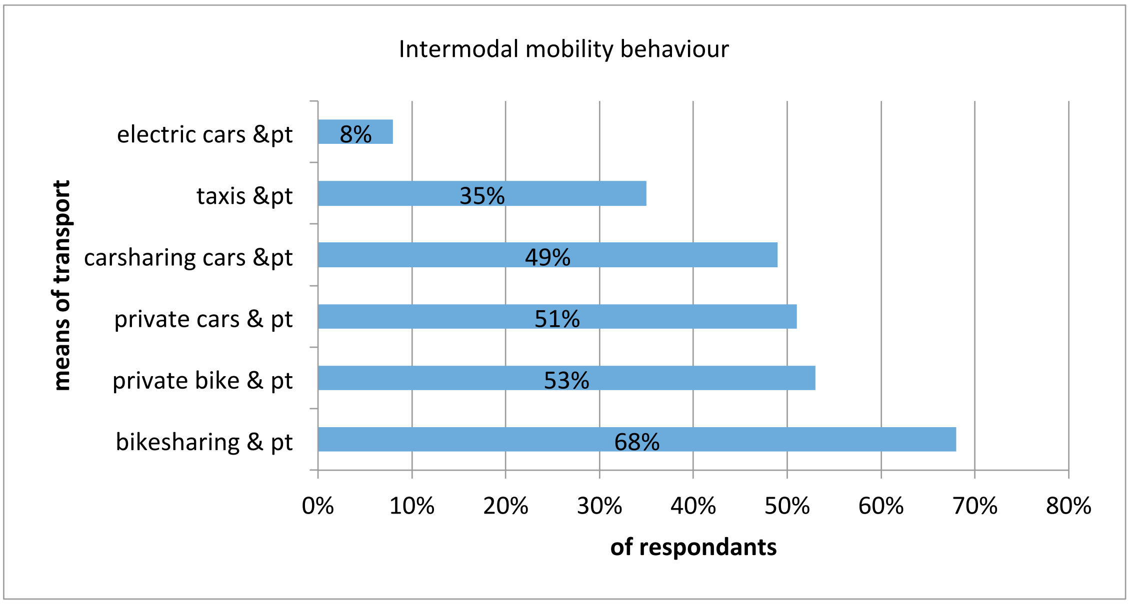

Figure 3.3: Intermodal mobility behaviour (Source: smile-einfachmobil.at)

Another aspect is that users of the *smile* app changed the selection of transport modes:

- 48 % stated that PT is used more often (26 % urban public transport, 22 % regional public transport)
- 10 % used bikesharing more often
- 4 % used electric carsharing more frequently
- 4 % used their electric bike more often
- 21 % of the pilot users stated that they reduced the usage of their private car

Overall results

Based on a comparison between the travel behaviour of *smile* users and the Viennese average (Table 3.4), the following conclusions can be drawn: In total the *smile* app promotes minimally (≥10% of respondents) the use of sharing offers and electric mobility as well as a higher usage of PT can be found. It can lead to a reduction in car use and increased multi/intermodal mobility behaviour. It is important to consider that most users stated that they used the app for non-routine trips.

Table 3.4: Comparison of mobility behaviour/demographics of Vienna statistics and smile case

Comparison of characteristics of *smile* users and Viennese average			
	Smile user	Viennese avg.	Source (visited: 2017/01/04)
Mobility behaviour			
Daily and several times a week bike use	27%	13%	https://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/viz_2011_gesamtbericht.pdf http://smile-einfachmobil.at/
Daily and several times a week public transport	86 %	65 %	https://www.wien.gv.at/statistik/bevoelkerung/tabellen/bevoelkerung-alter-geschl-bez.html http://smile-einfachmobil.at/

Car drivers and passenger	27 %	49 % (wien.gv.at: 42 %)	https://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/viz_2011_gesamtbericht.pdf https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008444.pdf http://smile-einfachmobil.at/
Regular use of carsharing	51 %	n.a.	https://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/viz_2011_gesamtbericht.pdf0 http://smile-einfachmobil.at/
Regular use of bikesharing	34 %	n.a.	https://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/viz_2011_gesamtbericht.pdf http://smile-einfachmobil.at/
Demographics			
Male	79 %	48 % (2014)	https://www.wien.gv.at/statistik/pdf/wieninzahlen.pdf http://smile-einfachmobil.at/
Female	22 %	52 % (2014)	Own calculation based on: https://www.wien.gv.at/statistik/pdf/wieninzahlen.pdf http://smile-einfachmobil.at/
Age: 20-40 years old	51 %	32 % (2016 19-39 years old)	Own calculation based on: https://www.wien.gv.at/statistik/bevoelkerung/tabellen/bevoelkerung-alter-geschl-bez.html http://smile-einfachmobil.at/
Age: 50-60 years old	21 %	33 % (2016 40-64 years old)	Own calculation based on: https://www.wien.gv.at/statistik/bevoelkerung/tabellen/bevoelkerung-alter-geschl-bez.html http://smile-einfachmobil.at/
Age: Older than 60 years	14 %	17 % (2016 40-64 years old)	Own calculation based on: https://www.wien.gv.at/statistik/bevoelkerung/tabellen/bevoelkerung-alter-geschl-bez.html http://smile-einfachmobil.at/

The mobility shares indicate that the *smile* users are more PT- and bike- and less private car oriented than the Viennese average, as also concluded in the STEP 2025 analysis (STEP 2025). Regarding the demographics, the share of the *smile* users which are 20-40 years old is higher than the Viennese average and all other peer groups are lower than the Viennese average. Also, the share of male Smile users is higher than Viennese average.

A summary of the effects of SMILE is provided in Table 3.5.

Table 3.5. Changes as a consequence of SMILE.. (↑) = increase, (↓) = decrease, 0 = no change, n.a. = no information available.

Level	KPI	Increase/ decrease	Comment
User level	Total number of trips made	n.a.	
	Modal shift (from car to PT, to sharing, to...)	↑	48% of respondents stated that they used PT more often 10% used bikesharing more often 4% used electric carsharing more often 4% used the electric bike more often 21% reduced their car use No information about previous mobility behaviour available.
	Multimodal trips, combining different modes of transport	↑	26 % of respondents stated that they combined their private car & PT more often; 20% also combined bikesharing & PT more often
	Attitudes towards PT, sharing, etc.	n.a.	
	Perceived accessibility to transport	n.a.	
	Total travel cost per individual/household	n.a.	
Business level	Number of customers	(↑)	1,000 pilot users
	Customer segments (men/women, young/old, ...)		Around 79% of the respondents were male and 22% female. Most of the participants were from Vienna (74%) followed by those from Other Austrian federal states (26 %). 51 % of the respondents are between 20 and 40 years old, 21 % are between 50 and 60 years old and 14 % are older than 60 years. The average smile user has a high level of education and income and is male. The average user was male, from Vienna, between 20 and 40 years old with a high level of education and income.

	Collaboration/partnerships in value chain	↑	PT, Austrian Federal railway (OEBB), carsharing, bikesharing organisations
	Revenues/turnover	n.a.	
	Data sharing	n.a.	
	Organisational changes, changes in responsibilities	n.a.	
Societal level	Emissions	n.a.	
	Resource efficiency (roads, vehicles, land use, ...)	n.a.	
	Citizens accessibility to transport services	n.a.	
	Modification of vehicle fleet (electrification, automation)	n.a.	
	Legal and policy modifications	n.a.	

4. Assessment of additional MaaS and MaaS-related services

According to the plan for the MAASiFiE project, two case studies were to provide the material for evaluating the consequences introducing MaaS concepts on a broader scale from an individual (user), organisational, and societal perspective respectively. These have been presented in Chapter 3. However, a broader basis was desired for the impact assessment why an additional sample of primarily MaaS-related services were analysed. The aim was to find more empirical evidence of actual impacts.

4.1 Approach

D3 'Business and Operator Models for MaaS' provides short descriptions of a sample of MaaS and MaaS-related services from a business model perspective. These same services have been further investigated in order to elicit information and possible empirical evidence of impacts. Several data sources have been used, including existing evaluation reports, interviews with representatives of service providers, and the results from workshops run within the MAASiFiE project. Only those examples were information has been available regarding the KPIs and/or impacts have been included (see Table 4.1).

Table 4.1. Overview of information sources used

Case	Evaluation report/documentation available	Other information sources used
Carsharing		
ZipCar	Yes	-
Car2go	Yes	-
Bikesharing	Yes	-
Multimodal services		
Kutsuplus	Yes	-
Tuup	(Yes, websites)	Presentation, public material
Ylläs Around	No	Workshop
SMILE	(Yes, websites)	-
Hannovermobil	(Yes, website)	-

4.2 Results

4.2.1 Carsharing and bikesharing

Due to the lack of multimodality, carsharing and bikesharing services are part of MaaS ecosystem even though they are not considered as MaaS according to the definition adopted in the MAASiFiE project. Nevertheless, from an impact assessment perspective, they may add insight.

ZipCar[2]

ZipCar is a roundtrip carsharing system, where members begin and end a trip at the same vehicle location. Zipcar currently offers over 10,000 vehicles in five countries across North America and Europe. In North America, Zipcar offers three program types: Zipcar for Everyone, Zipcar for Business, and Zipcar for Universities. The university-specific carsharing program typically houses carsharing vehicles on or near college campuses and gives students, staff, and faculty the opportunity to join a fleet of shared vehicles at locations in and around campus (Stocker et al., 2015).

An impact analysis by Stocker et al. (2015) is based on survey data from 10,040 college/university Zipcar customers from across North America. The analysis finds that 5.2% of customers sell a private car or suppress purchasing a private car due to the Zipcar service, which outweighs any additional driving with Zipcar vehicles. Reduction in vehicle kilometers travelled (VKT) ranges from 1-5%, translating into a 0.1-2.6% reduction in greenhouse gases (GHG). These impacts are not as large as in other carsharing studies (see e.g. car2go), as many students do not own vehicles, and may have reduced travel needs (distance and frequency) compared to other demographic groups. The service also has a positive impact on accessibility, flexibility, and other quality of life aspects, as well as on transportation expenditure and future intentions to purchase a car.

car2go[3]

car2go is a one-way carsharing service provider with, primarily, a free-floating operational model. It is currently the largest carsharing operator in the world, with a presence in nine countries and nearly 30 cities. It operates as a one-way, instant access, carsharing system within a pre-defined urban zone. Members can find an unoccupied parked vehicle, access it immediately, and use it to meet their local travel needs. As long as the vehicle is parked within the operating zone, users only pay for the time that they drive. As a one-way system, car2go provides flexibility to the user (Martin & Shaheen, 2016).

An impact analysis by Martin and Shaheen (2016) is based on survey data from 9,497 car2go customers from five North American cities. The analysis finds that car2go reduces and suppresses vehicle ownership, reduces VKT and GHG emissions, and both substitutes and complements public transportation and other active transport modes. Most respondents had not changed their public transport use, but of those who did change their use, a greater number used it less frequently than more frequently (with some exceptions). More respondents reported walking more frequently than less frequently; there was a mixed effect on bicycling; and respondents reported a reduced use of taxis and the analysis concludes that car2go directly competes with that mode.

Vienna carsharing[4]

Vienna carsharing services include several different services: DriveNow, Car2Go, zipcar, and Flinkster.

Bikesharing

Public bikesharing — the shared use of a bicycle set — is an innovative transportation strategy that has recently emerged in major cities around the world. Information technology (IT)-based bikesharing systems typically position bicycles throughout an urban environment, among a network of docking stations, for immediate access. Trips can be one-way, round-trip, or both, depending on the operator. Bikesharing can serve as a first-and-last mile

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[2] http://zipcar.com

[3] https://www.car2go.com/US/en/

[4] http://carsharing-wien.net

connector to other modes, as well as for both short and long distance destinations (Shaheen, et al., 2014).

An impact analysis by Shaheen et al. (2014) is based on two surveys: one online member survey of bikesharing operators in five North American cities – Montreal and Toronto, Canada; Salt Lake City and Minneapolis-St. Paul, USA; and Mexico City, Mexico – with 6,168 complete responses; and one on-street survey in three U.S. cities – Boston, Salt Lake City, and San Antonio – with 205 responses. The analysis finds that bikesharing causes diverse mode shifts across the cities, e.g. for rail use in the eight cities, respondents reported increased use in two cities, decreased use in three cities, and no change in three cities. (See table 4.2. for more information.) The report concludes that this is likely due to differences in public transport networks in the various cities. Respondents reporting reduced public transport use gave reasons such as “faster travel and lower cost” compared to public transport. The analysis also found that bikesharing did reduce driving (private cars) by large margins in all cities, with very few respondents reporting increased driving. In Minneapolis, where the survey data could be overlaid with activity data, those who used bikesharing to substitute other modes used bikesharing more frequently, taking more trips (on average) than those who used bikesharing to complement to other modes. This result cut across all reported mode shifts by respondents, suggesting that, when bikesharing is used as a substitute, it is substituting many or most other modes.

Summary
Table 4.2. provides a summary of identified changes.

Table 4.2. Changes as a consequence of carsharing. **(↑)** *= increase,* **(↓)** *= decrease, 0 = no change, n.a. = no information available.*

Level	KPI	Services			
		ZipCar for Universities[5]	***Car2Go***[6]	***Car sharing in Vienna***[7]	***Bikesharing***[8]
User level	Total number of trips made (increase/decrease)	n.a.	n.a.	n.a. *7,000 daily trips* *40% of stationary car sharing users use the carsharing at least once every 6 months and 30% use it at least once per week.* *39% of free floating carsharing users use the car sharing at least 1-3 days per week.*	n.a.
	Modal shift (from car to PT, to sharing, to...)	**↑ carsharing** **↓ uber/lyft** *24% net report less frequent use (34% less frequent and 10% more frequent)* **↓ public transport (PT)** *9% net report less frequent use (25% less frequent and 16% more frequent)*	**↑ carsharing** **↓ taxi** **↓ public transport** **↑ ↓ bicycling** **↑ walking**	*Stationary car sharing:* **↓ car** *13% use a car more often, 42% use it less, 13% use it as often as before and 26% don't use it at all* **↓ taxi** *15% state that taxis are used more often; 26% there is no difference, 31% use taxis less*	**↑ ↓ bus** *a greater number of respondents report less than more bus use in four of five cities; vice versa in one of five cities* **↑ ↓ rail** *a greater number of respondents report less than report more rail use in three of five cities;*

[5] Stocker, et al., 2015

[6] Martin & Shaheen, 2016

[7] http://carsharing-wien.net

[8] Shaheen, et al. (2014)

		↓ **bicycling** *7% net report less frequent use (20% less frequent and 13% more frequent)* ↑ **walking** *11% net report more frequent use (22% more frequent and 11% less frequent)*		↑ **public transport** *40% state that they use PT more often, 45% state there is no difference. 11% use it less often* ↑ **bicycling** *23% of car sharing users state that they use bicycles more, 42% state there is no difference, 7% use it less* ↑ **walking** *35% of car sharing users state that they walk more often since they use car sharing, 56% state there is no change, 3% use walking less often* *<u>Free-floating carsharing:</u>* ↑ **walking** *22% walk more often, 60% use the same way, 12% use it less* ↑ ↓ **bicycling** *10% use a bicycle more often, 42% see no change, 9% less often* ↓ **public transport** 17% use PT more often, 40% the same way, 34% use it less often ↓ **taxi** 3% use taxis more often, 16% use it the same way, 55% use it less	*vice versa in two of five cities* ↑ ↓ **walking** *a greater number of respondents report more than report less walking in three of five cities; vice versa in two of five cities* ↓ **driving (car)** *reported reductions in driving by large margins in all cities*

				↓ **private car** 3% use cars more often, 23% the same way, 45% use it less often	
	Combining different modes of transport	n.a.	n.a.	n.a.	*some respondents use bikesharing to complement other modes, while others use it to substitute other modes*
	Attitudes towards PT, sharing, etc.	*42% less likely to purchase a car in the next few years*	n.a.	n.a.	n.a.
	Perceived accessibility to transport	*4.99 of 7 rating of impact on accessibility*	n.a.	n.a.	↑ *A majority of those who reported increased bus use gave reasons such as improved access to and/or from the bus line. The same for those who reported increased rail use.*
	Total travel cost per individual/household	↓ *17 USD/month savings (range 9-36)* *4.60 of 7 rating of impact on financial control and predictability;* *4.41 of 7 rating of impact on money/income*	n.a.	n.a.	↓ Of those who reported decreased bus use, 25-53% in four of five cities reported the reason lower cost or the reason lower cost and faster travel. Of those who reported decreased rail use, 7-57% in four of five cities reported the

					reason lower cost or the reason lower cost and faster travel.
Business level	Number of customers	↑	↑	n.a.	↑
	Customer segments (men/women, young/old, ...)	college/university students and faculty/staff; 81% non-car owners	urban	<u>*Stationary car sharing:*</u> predominantly male, 36-49 years, high level of education, 20% own a car <u>*Free-floating car sharing:*</u> 36% are 26-35 years old, high level of education, 64% own a car ¾ of car sharing users has an annual ticket for PT	urban; *a majority of casual (short-term) users. The respondents were more likely be male, Caucasian, wealthier, younger, and have attained higher educational degrees than the general population in which a given bikesharing program resides.*
	Collaboration/partnerships in value chain	n.a.	n.a.	*Some but not all carsharing schemes offer a cooperation with the national Austrian train operator & Viennese PT*	*Many bikesharing operators stated that establishing partnerships within local government and with community stakeholders is imperative to successful bikesharing operations*
	Revenues/turnover	n.a.	n.a.	n.a.	n.a.
	Data sharing	n.a.	n.a.	n.a.	n.a.

	Organisational changes, changes in responsibilities	n.a.	n.a.	n.a.	n.a.
Societal level	Emissions	↓ due to reduced VKT; 1-5% reduction in VKT with a 0.1-2.6% reduction in GHG emissions 4.48 of 7 rating of impact on environmental quality	↓ due to reduced VKT; 6-16% reduction in VKT per car2go household; 4-18% reduction in GHG emissions per car2go household	n.a.	↓ reported reductions in driving by large margins in all cities
	Resource efficiency (roads, vehicles, land use, ...)	↑ car ownership reduced (0.6%) and suppressed (4.6%);	↑ car ownership reduced and suppressed; 7-11 private vehicles removed from the road per car2go vehicle (aggregate ~28,000 vehicles)	↑ car sharing has a positive impact on urban mobility, because the private car ownership can be reduced without personal disadvantages.	↑ reported reductions in driving by large margins in all cities
	Citizens accessibility to transport services	n.a.	n.a.	n.a.	*Two programs with experience in low-income neighborhoods reported lack of early adoption, but use picked up after a year.* *Two programs removed debit/credit card deposits to improve access in low-income communities. Two did not require such deposits from low-*

					income users. Other programs are testing other solutions to improve economic access. *Three programs conducted special outreach events targeting minority communities. Seven programs had multi-lingual kiosks, and one provided bi-lingual marketing materials.*
	Modification of vehicle fleet (electrification, automation)	n.a.	n.a.	n.a.	n.a.
	Legal and policy modifications	n.a.	n.a.	n.a.	*One city revoked its compulsory helmet law due to poor performance of bikesharing programs subject to such laws. (Interviewed experts generally agreed that legal exemptions to helmet laws would encourage bikesharing use if helmet dispensing options are unavailable or not provided.)*

4.2.2 Multimodal services

Services integrating several modes of transport comply with the definition of MaaS to a higher degree than do carsharing and bikesharing services. However, not all multimodal services comply completely with the definition but may still provide important insight into the preconditions for as well as outcomes of MaaS.

Kutsuplus[9,10]

Kutsuplus was an intermediate form of public transport and taxi, complementing other public transport services (bus, local train, tram, metro) in the metropolitan area of Helsinki. The service was an alternative to multiple-transfer trips and private car trips, using a network of nine-seat minibuses. The trial started with three vehicles but a year later it was increased to 15 vehicles. The trial ran from 2012 to 2015 when the service was shut down because it was too expensive for Helsinki Region Transport (HSL). By the end of 2015 there were 32,193 registered users.

Kutsuplus' features and services included:

- Individual search and selection of trips
- Ride from (virtual) bus stop to (virtual) bus stop
- Driver's instructions in real-time
- Rides can be ordered online or via SMS minimum 45 min in advance to a bus stop
- Different service classes, group discount, happy hour
- People going in the same direction can be efficiently collected in the same vehicle
- Walking route from the bus stop to the final destination will be provided on a map in the kutsuplus.fi account
- Advance payment, using the Trip Wallet, enables fast pick-up and delivery

As a pilot, Kutsuplus was a success in terms of technology and customer satisfaction. The service was the world's first fully automated, real-time demand-responsive public transport service. The system worked well, the efficiency in combining trips grew as expected, and the subsidizing level of transport decreased as the vehicular capacity was increased in late 2013.

Already in the beginning of the service, it was apparent that with a fleet of 15 vehicles, the service would call for heavy subsidies. Getting the subsidies to a level comparable with other public transport, would require a large-scale expansion of the number of vehicles. The same is true for the profitability of the service. It is evident that a service, like Kutsuplus, providing flexibility and considering individual customer needs, will create more customer value than a service offering one single service level that does not take individual customer needs into account.

In addition to HSL, the participants of the trial included the software developer Split Finland OY (previously known as Ajelo Oy), Aalto University and Finnish Transport Agency.

[9] www.hsl.fi, https://www.hsl.fi/sites/default/files/uploads/8_2016_kutsuplus_finalreport_english.pdf

[10] KutsuPlus (2016) Final Report. https://www.hsl.fi/sites/default/files/uploads/8_2016_kutsuplus_finalreport_english.pdf

Tuup[11]

Tuup is a Finnish service providing access for users to all the transportation options through one mobile application. It offers users information on the prices, routes and timetables of all kinds of transportation, be it public transportation, taxis, rental cars, bicycles or a combination of these. The Turku Region Traffic, also known as Föli, was the first mobility service to offer purchasing via Tuup.

Tuup mobile application has been available since April 2016 and currently the service includes the following features:

- A comprehensive route planner with access to all mobility modes and service, and travel time, price and emission rate estimates
- Integrated finding, paying and using of mobility services:
  - Föli, Turku Regional Traffic
  - Taxi
  - City Car Club (sharing)
  - Ekorent (shared electric vehicles in Helsinki)
  - 24rent (car rental: passenger cars, vans, minibusses, minivans)
  - Helsinki Regional Transport, HRT
  - PiggyBaggy (Ride Sharing for goods)
- Daily travel plan optimized according to a personal agenda, schedule and preferences
- Effects and statics of mobility choices (distance, cost, emissions)
- Other features:
  - Reminds when it is time to leave
  - Provides alternatives when deviations occur
  - Real-time traffic information
  - Shows pick-up locations of rental cars and shared cars

Ylläs Around pilot

Ylläs Around is a MaaS pilot launched in spring 2016 in the Ylläs ski resort area in Northern Finland. The pilot continues until spring 2017. The project financial partners include the Finnish Transport Agency, Kolari municipality and Ylläs Travel Association. The MaaS service is operated by Telia Company and other main stakeholders are local transport operators, municipality of Kolari and Ylläs Travel Association. Ylläs Around offers transport services within the Ylläs area and between Ylläs and Kittilä airport and Kolari railway station. The modes included are buses, taxis and shared taxis, as well as their combinations. Ylläs Around use a mobile application for mobile payment and ticketing.

A workshop on Ylläs Around service pilot impacts was organised in September 2016 with participation from the MaaS operator, users, transport operators (bus and taxi), municipality of Kolari and Ylläs Travel Information. According to the workshop results, the pilot was considered very positive by all the stakeholders. A defined area (in Ylläs area + train from Kolari + Kittilä Airport) facilitated the testing of new concepts. Also, communication between different actors worked well. The main advantages were the digitalization of transport data and mobile payment. Users found mobile payment convenient because it eliminated the need to use cash. Also, the transport operators considered electronic payment and ticketing positive, because it sped up the operation as no fare collection was needed. Advance information about the number of passengers facilitated the use and optimization of equipment. In addition, shared taxis were seen to have clear potential. From the municipality point of view the main advantage was digitized transport data. In addition, when the bus

[11] http://tuup.fi/en/

routes were combined into one service, it was realised how many routes and transport services that actually were available.

The main challenges were related to delayed launch of the pilot and addresses/names of bus stops. As the pilot started later than planned (after the main skiing season), the number of users in 2016 was lower than expected and marketing was not sufficient. The Ylläs area has potential for MaaS services due to one million annual visitors. However, the route and the direction of the bus were not always evident when using the service. The service required good local knowledge at the street address level as the bus stops were named accordingly, which was challenging for travellers.

Hannovermobil

The combo package HANNOVERmobil has been available since 2004, as a pilot project until 2007 and as a regular service since then. It integrates an annual public transport ticket with (for an additional monthly fee) access to carsharing, as well as discounts at Deutsche Bahn, a taxi company, a car rental agency, and a bicycle parking garage in the city centre. All combo card transactions are cashless and combined into a single monthly 'mobility bill'.

After five years, the following results have been documented:

- The number of customers who has bought a combo packages exceeds 1000;
- Approximately 1/3 of the customers have gotten rid of a car or have decided against a car purchase;
- 4/5 of the customers were not previously users of carsharing services.

Summary

Table 4.3. provides a summary of identified changes.

Table 4.3. Changes as a consequence of multimodal services. **(↑)** *= increase,* **(↓)** *= decrease,* 0 *= no change, n.a. = no information available.*

Level	KPI	Service			
		Kutsuplus	***TUUP***	***YlläsAround Pilot***	***Hannover-mobil***[12]
User level	Total number of trips made	↑ increases in trips made)	↑ increase in trips made)	n.a.	n.a.
	Modal shift (from car to PT, to sharing, to...)	↑	↑	↑	↑ 4/5 of customers were not previously users of car sharing services
	Combining different modes of transport	0	↑	↑	n.a.
	Attitudes towards PT, sharing, etc.	n.a.	↑	↑	1/3 of customers abolished a private car or renounced a planned car
	Perceived accessibility to transport	↑	n.a.	↑	n.a.
	Total travel cost per individual/household	↓	n.a.	n.a.	n.a.
Business level	Number of customers	↑	↑	↑	1,300 customers.
	Customer segments (men/women, young/old, ...)	Men 56%, Women 44%; 54% 30-44 years old	n.a.	n.a	n.a.
	Collaboration/partner-ships in value chain	0	↑	↑	Cooperation with the national German train operator, discounts for taxis and car sharing in Hannover

[12] http://www.carsharing.de/images/stories/pdf_dateien/factsheet_2_e_mobility_packages.pdf

	Revenues/turnover	↓ (revenues)/ ↑ (turnover)	n.a.	n.a.	↑ 65 € per year and customer contribution margin
	Data sharing	0	↑	↑	n.a.
	Organisational changes, changes in responsibilities	n.a.	n.a.	n.a.	n.a.
Societal level	Emissions	↓	↓	↓	↓
	Resource efficiency (roads, vehicles, land use, ...)	↑	↑	↑	n.a.
	Citizens accessibility to transport services	↑	↑	↑	n.a.
	Modification of vehicle fleet (electrification, automation)	0	↑	0	n.a.
	Legal and policy issues	n.a.	n.a.	n.a.	n.a.

5. Impact Assessment

As MaaS is still a new concept, there is a general lack of generally available information on actual impacts of MaaS and the same is true of MaaS-related services. Services which appear to have undergone more thorough evaluations include well-established mobility services, such as carsharing and bicycling schemes, whereas other services, most of which are pilot projects and/or recently introduced services, have not been exposed to the same process (as yet). Furthermore, when evaluations have been undertaken they appear to have focused on those impacts that relate to users' behaviour in terms of, for example modal shifts and possible consequences on emissions, i.e. on a societal level, whereas impacts on a business level have not been addressed or the information is not generally available.

5.1 *Approach*

Available data does not support a quantitative assessment of possible impacts of the introduction of MaaS. Hence, a qualitative assessment has been made of possible impacts of MaaS taking into consideration the results presented in Chapter 3 and Chapter 4, reflected against additional literature.

5.2 *Results*

Table 5.1. Overview of anticipated impacts

Level	KPI	Impacts		
		Environmental	Economic	Social
Individual /user level	Total number of trips made	x		x
	Modal shift (from car to PT, to sharing, to ...)	x		
	Number of multimodal trips (combining different modes of transport)	x		
	Attitudes towards PT, sharing, etc.	x		
	Perceived accessibility to transport			x
	Total travel cost per individual/household		x	x
Business/ organisational level	Number of customers		x	
	Customer segments (men/women, young/old, ...)		x	x
	Collaboration/partnerships in value chain		x	
	Revenues/turnover		x	
	Data sharing		x	
	Organisational changes, changes in responsibilities		x	
Societal level	Emissions	x		
	Resource efficiency (roads, vehicles, land use, ...)	x	x	
	Citizens accessibility to transport services			x
	Modification of vehicle fleet (electrification, automation, etc.)	x		
	Legal and policy modifications	x	x	x

Overall positive increase/decrease	
Both positive and negative increase/decrease	
Overall negative increase/decrease	
Not possible to assess	

Overall, the assessment suggests that a broader introduction of MaaS could result in overall positive impacts, in terms for instance of a modal shift and an increase in perceived accessibility to the transport system (Table 5.1). However, a few consequences are anticipated to result in positive and/or negative impacts depending. In addition, some conflicts between impacts on different levels have been identified.

5.2.1 Individual level

Total number of trips

MaaS could result in a reduction of the number of trips made which could have a positive effect on emissions and hence on the environment. The empirical evidence is however limited. There are some indications that not having access to a private car may result in less short, spontaneous trips being made (Sochor et al. 2016a; Strömberg, 2015) but being provided with easy access to carsharing has been shown to result in an increased car use for those who have earlier not used a car for trips. Furthermore, the introduction of MaaS has potential to increase people's accessibility to transport which could result in an increase in the number of trips undertaken. This could have positive social impacts but is contradictive to overall environmental goals.

Modal shift

One of the strongest arguments for MaaS is that it will result in a modal shift. The empirical data shows that MaaS could, indeed, contribute to such a shift. However, whereas most solutions focusing on modal shifts have assumed a shift from private cars to using public transport (i.e. bus, tram, train, ...), MaaS builds on the idea of user-centredness and on satisfying the customers' need for transport – offering "tailored, situation-specific mobility for the user's needs" (Hietanen, 2014). The argument is that MaaS could, using new technology including data analytics, offer more flexible services (cf. also Burrows et al, 2015) than is, for instance, the case with present public transport. Even though public transport will be 'the backbone' of MaaS, other mobility services, including cars, will be used based on situational needs and contexts. This flexibility and the possibility to choose the most appropriate solution for the specific situation has been found to be one of the particular strengths of MaaS (Sochor et al., 2016a). It has also been suggested that a MaaS model could use different incentives to move users from one mode of transport to another if the latter was reaching capacity at a peak time (Burrows et al, 2015) but as yet there is no empirical evidence of the possible impact of such incentives.

Number of multimodal trips (combining different modes of transport)

The introduction of MaaS should provide users with a 'smörgåsbord' of different modes. Empirical evaluations show that this 'smörgåsbord' has potential to ensure that MaaS can offer users what is perceived to be the most appropriate solution for the specific situation (Sochor et al., 2016a; Strömberg, 2015). There is also some empirical data to show that MaaS could result in users combining different modes of transport in one and the same trip to a higher degree than is the case today.[13] A prerequisite for enabling users to combine different modes of transport in one and the same trip-chain is, however, access to accurate, real-time multimodal information with bookings and payments managed collectively for all legs of the trip (which among other things in turn relies on sharing of data between service providers).

[13] http://smile-einfachmobil.at/pilotbetrieb_en.html

Attitudes (towards different modes of transport)

Research on travel behaviour and the choice of transport mode has to a large extent relied on attitude as an explanatory factor. Even though more recent studies argue, for instance habits and practice as equally or even more important, attitudes are still considered as an aspect to consider. Attitudes towards car ownership is argued to be changing, in particular among younger people (Catapult, 2016). The empirical data illustrates that MaaS can results in changed attitudes towards different modes of transport (Sochor et al. 2015a; Sochor et al. 2016a; Stocker, et al., 2015), i.e. an increased use of public transport, public bikes, carsharing etc. can result in a more positive attitude towards these modes of transport – and vice versa. However, this means that further effort is needed to maintain and/or improve the quality of the respective services in terms of network/routes, frequency/timetables, vehicles, etc. An overall more positive attitude could be an important impact in order to reach a more sustainable use of different modes of transport.

(Perceived) Accessibility to transport

MaaS has been argued to result in an increased accessibility to transport as well as, given this increased accessibility to transport, also an increased accessibility to the different services offered by society. The empirical data supports this assumption (Sochor et al. 2015a; 2016a; Strömberg, 2015;) with MaaS offering a 'smörgåsbord' of transport options, rather than only one alternative. However, voices have been raised regarding the impact of MaaS on social inclusions/exclusion, one argument being that MaaS will not be an economically feasible alternative for all individuals/households (depending for example on the type of subscriptions or packages offered). There are also concerns that a commercial perspective on MaaS results in MaaS being primarily an urban phenomenon and that rural areas will not benefit from the ideas of MaaS (see also 5.3.4). Burrows et al. (2015) argue instead that MaaS could result in "... improving social inclusion by providing new mobility opportunities for the elderly or isolated areas or other users with specific requirements that cannot be easily met by traditional transport interventions."

Total travel cost per individual/household

In general cars are unused for over 90% of the time. In addition, the cost of owning and driving a private car varies depending upon type of car, how many km driven, parking costs, etc. but a feasible sum is approximately 75,000 SEK/year (or 7330 Euro/year) with a driving distance of 15,000 km. With most probably increasing costs for fuel, parking, and additional taxes this sum can be expected to increase over the next few years. In comparison, a yearly subscription to public transport in the municipality of Gothenburg amounts to approx. 5,700 SEK (or 550 Euro/year) per adult. Burrows et al. (2015) draw the conclusions that "Mobility expenditure channelled through the MaaS provider, may provide cost saving for the customer" (p.17). A MaaS model may offer consumers better value than the car ownership model (Catapult, 2016). The empirical case studies show that MaaS could, indeed, result in a decrease in total travel costs – but not necessarily for all individuals and/or households. For an adult, whose travel needs are almost or completely covered by the existing public transport service (and a cost of 550 Euro/year), a subscription of for example 1000 Euro/year will probably not be a feasible option, for a student or a retired person with possibilities for discounts even less. For a family with two cars who can, with access to MaaS, sell one of these cars, the economic outcome is completely different.

Table 5.2. Summary of impact on an individual level

KPI	Increase/decrease (↑ ;↓)	Positive/negative impact (+/-)
Number of trips made	↑ ; ↓	+/-
Modal shift	↑	+
Number of multimodal trips	↑	+
Attitudes	↑	+
(Perceived) accessibility to transport	↑	+
Total travel cost per individual/household	↓	+

5.2.2 Business/organisational level

As mentioned earlier, impacts on a business level are not typically addressed in analyses or the information is not generally available, despite the active discussion in MaaS professional networks and transportation conferences about the need to identify business and collaboration models, roles and responsibilities of various stakeholders, etc., i.e. how to sustainably operationalize the concept of MaaS. Also, in the web-survey, business models, partnerships in the value chain, and data sharing were considered as highly relevant to address in impact analyses, and changes in such were predicted as some of the major impacts of MaaS.

Number of customers

The number of customers was considered highly relevant to address in impacts of MaaS for private and public organisations/businesses. Given a shift from private car to other modes of transport, including public transport, car sharing, taxi, etc., such service providers could expect an increase in the number of customers as customers use non-private car modes to substitute for previous private car trips. Results from evaluations of unimodal schemes such as carsharing or bikesharing are difficult to directly apply to MaaS, as unimodal schemes are less likely to offer a comprehensive alternative to car ownership compared to a multimodal MaaS offer such as UbiGo, for example, which saw significantly higher rates of private cars taken off the road during the FOT compared to the carsharing analyses. Thus, although there are indications that carsharing on its own can reduce and suppress car ownership (Martin & Shaheen, 2016; Stocker et al., 2015), and that bikesharing on its own can both complement and substitute other modes (Shaheen et al., 2014), the potential benefits of single modes could likely be leveraged if the modes are instead offered as part of a multimodal MaaS service. However, building this multimodal offer will depend on if the unimodal non-private car service providers view and interact with each other as competitors, or if they view themselves collectively as a competitor to private car ownership, each mode with different benefits to offer different customers for different types of trips. As already pointed out, MaaS' flexibility and the possibility to choose the most appropriate solution for the specific situation has been found to be one of the particular strengths of MaaS (Sochor et al., 2016a).

Customer segmentation

With a transport service offer that has a less narrow focus on a shift from private car to public transport specifically but instead from private car to other modes of transport, i.e. including different modes of transport, it is feasible that MaaS will attract new and other customer segments. This, however, will depend on the payment model, such as pre-paid packages with or without credit rolled over, pay-as-you-go, minimum subscription levels, etc.; the relative prices of the modes; and other perhaps less discussed customer service aspects such as the availability of one or more child seats for families with small children who, according to UbiGo interviews, often feel pressure to purchase a private car. Furthermore, a point of debate arising from the different perspectives of public and private transport providers is equity – should and can MaaS be made available to all, or is it a service targeting a specific customer segment or geographic area, as in the case of UbiG targeting urban car ownership (reduction but also suppression) by offering a comprehensive alternative to private car ownership. In the case of UbiGo, the minimum monthly subscription levels made the service less attractive to single-person households and retirees, although its flexibility in being able to personalize one’s own subscription content, thus offering a possibility to better choose the most appropriate solution for the specific situation, meant that it attracted and held a diverse range of households with a certain level of monthly transportation expenditure (single-persons, couples, families with minors, families with adult children) and with varying backgrounds of car ownership and carsharing experience (Sochor et al., 2014; 2015a; 2016a).

Revenues/turnover

‘Revenues/turnover’ was considered quite relevant to address in impact assessments of private organisations/businesses in the web-survey. From the individual/customer perspective, the potential for revenue/turnover is highly related to the above discussions of attracting new customers and customer segments, as well as travel cost per individual/household, i.e. if MaaS and transport providers can capture part of the large piece of the “mobility expenditure pie” currently used for car ownership.

Related to revenue is the opportunity to use incentives or rewards to encourage certain behaviours, which could lead to more effective operations and reduce costs. For example, incentives such as dynamic pricing could be deployed to encourage users to avoid peak time services and spread demand over a wider period of time (Burrows et al., 2015, p.25) for a more effective use of infrastructure or capacity, or even rebalance loads of shared vehicles. Burrows et al. (2015) also identifies the potential for organisations and businesses to build partnerships to enable opportunities and benefits across sectors, "such as local shops benefiting from their location next to a bus interchange to offer live benefits to nearby customers" (Burrows et al., 2015, p.30).

Data sharing

A further implementation and dissemination of MaaS relies on the collection and processing of data from different service providers, and hence on data sharing from the service providers to the MaaS provider. However, service providers to MaaS will also likely expect some level of data sharing from the MaaS provider regarding the MaaS service as a whole and/or related to certain modes, e.g. mode split, in order to further refine their own offer and and/or effectivise their operations and service. Furthermore, if for example public funders and/or regulators require evaluation against various KPIs, such as mode shift and emissions, this may also require some at least aggregated level of data sharing from the MaaS provider. In theory, multimodal MaaS service data could be used to better plot how mobility is used, how well it works, how efficiently the network is being managed, how to plan for improvements and consequently how to prioritise work and, crucially, funding (Burrows et al., 2015, p.25). Data sharing was, in the web-survey, considered highly important to address in impact assessments as well as one of the predicted major impacts of MaaS.

Collaboration/partnerships in value chain

MaaS relies on cooperation and collaboration, on the notion of a co-operative and interconnected transport system (including services, infrastructure, information, and payment), where boundaries between not only transport modes are blurred but also between public and private operators (Heitanen, 2014). Thus, MaaS, as a new way of organising and integrating transport, will require new types of and more extensive collaboration between transport service providers, public as well as private, and other stakeholders. Bikesharing operators have, for example, stated that establishing partnerships within local government and with community stakeholders is imperative to successful bikesharing operations (Shaheen et al., 2014) and this is certainly true for MaaS as well. As such, it is perhaps not surprising that 'Partnerships in the value chain' was considered highly important to address in impact assessments (for public organisations in particular) and was one of the predicted major impacts of MaaS. It is also reasonable to assume that new service providers will enter the scene, both unimodal providers such as the recent emergence of TNCs like Lyft and Uber, and multimodal MaaS providers or travel brokers like UbiGo or MaaS Global. However, *"... decisions are often mainly based on 'public actions' and do not sufficiently address interfaces with the private sector and what contribution it could make to the achievement of urban mobility goals*" (van Audenhove, 2014, p.26). Furthermore, "establishing sustainable urban mobility policies requires cities to develop a political vision and urban mobility objectives based on strategic alignment between all key public and private stakeholders of the extended mobility ecosystem. This should inform a visionary urban mobility strategy (priorities and investments to achieve mobility objectives), which ensures the right balance between stretch and achievability" (van Audenhove, 2014, p.7). Without some degree of alignment, it will likely be difficult to achieve MaaS, as in the case of UbiGo, which was discontinued after the pilot ended, mainly due to difficulties in finding a cooperative (business) model that worked for both the region/PT-provider and UbiGo as an emerging private, commercial service (Sochor et al. 2015a; 2015b; 2016a).

Organisational changes and changes in responsibilities

With the assumption that MaaS will require further collaboration between transport service providers, public as well as private, it is feasible to assume that organisational changes will be one result of a further implementation of MaaS. Although organisational changes are not typically addressed in analyses or the information is not generally available, it was predicted as one of the major impacts of MaaS (particularly for public organisations/businesses). Organisational changes are indeed already occurring in the market even outside of full-scale MaaS with OEM's such as car manufacturers attempting to shift towards offering mobility instead of transport, or service instead of ownership, via acquiring or partnering with other providers of transport, information, and/or payment, or offering add-on services such as Volvo's In-Car Delivery[14] for delivering goods directly to the trunk of your parked car. Organisational changes can and will occur within transport providers to a MaaS service as well; in the MAASiFiE workshop on impacts in Gothenburg, transport service providers shared how the UbiGo FOT had triggered and/or hastened internal, strategic discussions and actions regarding the (future) mobility market and their position in it.

According to Burrows et al. (2015), MaaS "is also providing new opportunities that are lowering the barriers for businesses and innovators to enter the transport sector" (p.28). However, in order to provide more integrated, customer-focused transport services (i.e. MaaS), Burrows et al. (2015, p.29) predicts that the transport sector will split, creating a distinction between customer-facing service businesses and the infrastructure and hardware

[14] https://incardelivery.volvocars.com/

providers supplying the capacity. This is similar to the model of utility businesses, where customers might have a monthly service contract with company A, who may or may not be the actual provider of the service but is purchasing capacity separately from companies B, C and D as required. In other words, the transport system itself could be seen as the equivalent of the national electricity grid with non-customer-facing businesses providing the supply of capacity and services (i.e. transport providers); while customer-facing businesses detach themselves from service provision and instead focus on meeting the customer demand effectively and innovatively (i.e. MaaS providers). Whether or not this occurs remains to be seen, although changes in roles and responsibilities are of clear concern within the mobility sector, and related to MaaS in particular (Sochor et al., 2016b).

Table 5.3. Summary of impact on a business/organisational level

KPI	Increase/decrease (↑ ;↓)	Positive/negative impact (+/-)
Number of customers	↑ ; ↓	+/-
Customer segments	↑	+
Revenues/turnover	↑ ; ↓	+/-
Data sharing	↑	+
Collaboration/partnerships in value chain	↑	+
Organisational changes, changes in responsibilities	↑	+

5.2.3 Societal level

Emissions

A reduction in emissions relies on a reduction in trips made and/or reduction in km travelled, and/or a modal shift from petrol/diesel fuelled car to other modes of transport. If MaaS results in a modal shift, from trips made by more to trips made by less energy using modes of transport, a reduction in emissions is feasible. If MaaS also results in a reduction in the overall number of trips made, a further positive effect on the emissions resulting from transport could be expected. However, as explained earlier, it is not evident that MaaS will result in a reduction in the total number of trips made, or in the kilometres travelled. In fact, MaaS providing easy access to the transport system may well result in an increased number of trips.

Resource efficiency (roads, vehicles, land use, ...)

Provided that MaaS results in a reduction in number of trips made with (private) cars, a wide dissemination of MaaS could possibly result in a reduction in congestion. If MaaS contributes to a reduction in the ownership and use of private cars, also a reduction in the need for parking spaces can be anticipated. Furthermore, a further use of shared resources in terms of public transport, carsharing, and bikesharing, etc. results in an overall increase in resource efficiency. Burrows et al. (2015) suggest that while transport has provided a fixed level of supply (e.g. road, rail capacity) to meet a forecast of demand, MaaS could provide an opportunity to track user demand in real-time and hereby match demand dynamically with the available capacity on the network (p.24).

Modification of vehicle fleet

The introduction of MaaS has been argued to facilitate a further electrification of the vehicle fleet: shared vehicles are used more intensively, improving the economics of ownership. There is also some empirical evidence that access to car- and bicycle sharing offering electric vehicles (EVs) could result in an increased use of EVs. A shift from fossil fuelled vehicles to electric vehicles would have positive consequences on emissions and hence on the environment but not necessarily on congestion.

Fully automated vehicles are not yet generally available but nearly every auto manufacturer is currently working on prototypes and plans to introduce market ready solutions within the next few years. Autonomous vehicles are even so intensively discussed in relation to MaaS, where a fleet of autonomous cars is argued to provide the desired flexibiity. It should be recognized that the introduction of autonomous vehicles may, in the long run, have radical consequences on public transport, as well as taxi services as we know it today. Also, exchanging the private car with an autonomous car may not result in the, from a societal perspective, desired reductions of vehicles with implications for congestion etc.

Citizens' accessibility to transport services

Accessibility, defined as the capacity of a location to be reached by, or to reach different locations, is considered higher in high-density areas (i.e. cities) compared to low-density (rural) areas: distances to reach goods, services and activities are shorter, public transport more frequent and public transport network more dense. MaaS has been argued to result in an increased accessibility to transport as well as, provided this increased accessibility to transport, also an increased accessibility to the different services offered by society. However, voices have been raised regarding the impact of MaaS on social inclusions/exclusion and there are concerns that a purely commercial perspective on MaaS may result in MaaS being primarily an urban phenomenon and that rural areas will not benefit from the ideas of MaaS, i.e. MaaS will contribute to improving some citizens' but not other categories' accessibility to transport services. On the other hand, improving transport services and making them affordable and accessible addresses social exclusion. MaaS could be an economically feasible alternative to owning a car but still providing access to a car (as well as other modes of transport) if needed. However, it must also be recognised that those with low incomes may be less able to take advantage of MaaS models based on pre-paid subscriptions as the may not be able to pay large sums in advance.

Legal and policy issues

The implementation and dissemination of MaaS must take place taking national and international laws and regulation into considerations. Further implementation and dissemination of MaaS may however require changes in laws and regulations and/or policy. The outcome of the UbiGo pilot illustrates how difficulties in finding a cooperative model that worked for both the region/PT-provider and UbiGo as an emerging private, commercial service, resulted in a discontinuation of the service, although well received and highly appreciated by the users. One part of the problem was, in this case, that PT is partly subsidised by taxes. According to Catapult (2016), "getting the regulatory framework right" is a key issue for a wider dissemination of MaaS. This provides a challenge to be addressed by policy makers.

Table 5.4. Summary of impact on a societal level

KPI	Increase/decrease (↑ ; ↓)	Positive/negative impact (+/-)
Emissions	↓	+
Resource efficiency (roads, vehicles, land use, ...):	↑	+
Composition of vehicle fleet (electrification, automation)	↑ (electrification and automation over time)	+
Citizens' accessibility to transport services	↑	+
Legal and policy modifications	? (can be assumed)	?

6. Discussion and implications

With the continued global trend of urbanization and increased demand for transportation with related issues of emissions, noise, congestion, etc., urban mobility is a major challenge for the future. Many attempts have been made to bring about sustainable changes in individuals' mode choices and travel behaviours including: information and education campaigns to raise commuters' awareness and change attitudes, mainly targeting a shift from private car to public transport and active modes; competitions and handing out free public transport passes and increasing the attractiveness of public transport via new vehicle designs and improved traveller information. Nevertheless, further efforts are needed in order to solve the problems.

Mobility-as-a-service (MaaS) is considered to be part of the solution, supported by several but in particular two major societal trends:

- the ongoing shift in individuals' attitudes and values in a more environmentally conscious direction, and the trends towards joint/shared ownership or no ownership at all – including car- and bikesharing – open up new possibilities for new types of travel offers or services;
- advances in and the dissemination of mobile ICT: The technological developments in the field of Information and Communication Technology (ICT) as well as the dissemination of mobile ICT has made it increasingly possible to create and test new types of offers.

These are trends that are believed to continue and be further established, providing a stable basis for the further development and implementation of MaaS.

Several analyses of the feasibility of introducing MaaS in different contexts have been presented, most of which argue positive consequences. Also the assessment completed as part of the MAASiFiE project suggests that a broader introduction of MaaS could result in overall positive impacts, in terms for instance of a modal shift and an increase in perceived accessibility to the transport system. However, some consequences have been identified as positive or negative depending, and furthermore have conflicts between impacts on different levels been identified where, for instance increased accessibility to the transport system (a desired impact on an individual and societal level) may result in an increase in the number of trips made (possibly a desired impact on an individual level but an undesired impact on a societal level with negative implications for emissions as well as congestion). When planning for a further introduction of MaaS from a societal perspective, such conflicts must be acknowledged and addressed.

Although not generally addressed in impact assessments, this analysis emphasises the importance of understanding impacts on a business level. The introduction of MaaS will require new business models, increased data sharing, and further collaboration between public and private service providers with possible implications also for legal and policy issues on a societal level. Without a functioning business model and, for instance without data sharing between service providers, the MaaS model and offer will not result in the expected positive impacts on an individual level, and hence not in the desired behavioural changes. The MAASiFiE project has in D3 'Business and operator models for Mobility as a Service (MaaS)', presented different business models and the deliverable from WP5 will address technological prerequisites for a functioning service. Nevertheless, in order to fully understand the consequences of different business models and the economic impacts, more empirical data is needed.

A fundamental issue for feasibility studies in general and the assessment of possible impacts which has been part of the present project, is the lack of empirical evidence. The argued impacts of MaaS, positive and/or negative, are to a large extent based on informed assumptions and experts' opinions. The case of UbiGo is an exception but it is important to recognize that the design of the UbiGo service as well as the outcome of the field trial are the consequence of context, time as well as place. Hence, it is important that different trials are initiated, with the intention to be developed into a fully functioning service, in order to provide further evidence of the possible impacts of an implementation of MaaS. Resources must therefore be allocated to address and evaluate different types of impacts (economic, environmental, and social) on different levels (individual, business and societal). However, in order to allow for a comparison between, for instance, different levels of integration (cf. König et al. 2016) and/or different business models, a common assessment framework would be beneficial.

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Appendix I – Online Questionnaire

INTRODUCTION

Mobility-as-a-Service (MaaS) can be defined as "multimodal and sustainable mobility services addressing customers' transport needs by integrating planning and payment on a one-stop-shop principle" (MAASiFiE project). The dissemination of Mobility-as-a-Service (MaaS) is expected to have impact on individuals, organisations/businesses, as well as society. However, there is as yet no comprehensive evaluation framework for MaaS.

The project MAASiFiE (Mobility as a Service for Linking Europe) - funded by CEDR with project partners VTT, Chalmers University of Technology and AustriaTech - attempts to develop a roadmap for MaaS in Europe and impact evaluation is a vital piece of this work. As input for such a framework, this questionnaire investigates what you consider to be the most relevant impacts on individuals, business (private and public), and society respectively. As a valuable stakeholder, your contribution is greatly appreciated.

It will take approximately 15 minutes to complete the questionnaire. Your participation is completely voluntary and the questionnaire data will only be reported in the aggregate.

If you have any questions, please contact Jana Sochor, jana.sochor@chalmers.se Thank you very much for your time and support.

BACKGROUND

* 1. In what country do you work?

* 2. In what type of organisation do you work?

- University/research institute
- Public administration/authority/government
- Public transport operator/organisation
- Private transport service provider
- ICT service provider
- Interest organisation (e.g. ITS national organisation)
- Consultancy
- Other (please specify)

* 3. For how long have you worked in the area of transportation?

- Less than 1 year
- 1-5 years
- 6-10 years
- More than 10 years

IMPACT ASSESSMENT - **INDIVIDUAL / USER** PERSPECTIVE

* 4. If you consider the impacts on the **individual / user** of MaaS, how relevant do you think the following impacts are to address in an evaluation of MaaS?

	No relevance	Little relevance	Moderate relevance	High relevance	No opinion
The number of trips made (increase/decrease)					
Distances travelled (increase/decrease)					
Use of private car(s) (increase/decrease)					
Use of car sharing (increase/decrease)					
Use of taxi services (increase/decrease)					
Use of car pooling (increase/decrease)					
Use of public transport (increase/decrease)					
Use of public bicycles (increase/decrease)					
Use of private bicycles (increase/decrease)					
Use of walking (increase/decrease)					
Combining different modes of transport (increase/decrease)					
Use of electronic information services, e.g. via apps and websites (increase/decrease)					
Use of electronic payment methods (increase/decrease)					
Total travel cost (per individual and month) (increase/decrease)					
Average travel times (increase/decrease)					
Perceived stress associated with travelling (increase/decrease)					
Perception of access to different transport modes (better/worse)					
Overall satisfaction with transport solution (increase/decrease)					
Attitude towards driving private cars (better/worse)					
Attitude towards car sharing (better/worse)					
Attitude towards using taxi services (better/worse)					
Attitude towards car pooling (better/worse)					
Attitude towards using public transport (better/worse)					
Attitude towards bicycling (better/worse)					
Attitude towards walking (better/worse)					
General health/wellbeing (better/worse)					
Internet shopping/home deliveries (increase/decrease)					

5. Additional suggestions for impacts and their relevance levels

IMPACT ASSESSMENT - **BUSINESS / ORGANISATIONAL** PERSPECTIVE (1/2)

* 6. If you consider the impacts on the **private** organisations and/or businesses that are to provide (part of) the services, how relevant do you think the following impacts are to address in an evaluation of MaaS?

	No relevance	Little relevance	Moderate relevance	High relevance	No opinion
Business model(s)	◯	◯	◯	◯	◯
Business value proposition	◯	◯	◯	◯	◯
Brand identity / company image (change)	◯	◯	◯	◯	◯
Customer segments (change)	◯	◯	◯	◯	◯
Number of customers (increase/decrease)	◯	◯	◯	◯	◯
Customer relationships (change)	◯	◯	◯	◯	◯
Channels for reaching customers (new, other than today)	◯	◯	◯	◯	◯
Revenues/turnover (increase/decrease)	◯	◯	◯	◯	◯
Revenue sources (new, other than today)	◯	◯	◯	◯	◯
Financial (re)sources (new, other than today)	◯	◯	◯	◯	◯
Distribution of costs (change)	◯	◯	◯	◯	◯
Need for investments (e.g., in technology, infrastructure, vehicles)	◯	◯	◯	◯	◯
Competence/skill (need for new/other competences and/or skills, technological knowhow)	◯	◯	◯	◯	◯
Number of employees/jobs (increase/decrease)	◯	◯	◯	◯	◯
Organisational changes (e.g. new ways of working within the organisation, change in work tasks)	◯	◯	◯	◯	◯
Partnerships in the value chain (new, other than today)	◯	◯	◯	◯	◯
Data sharing (among partners)	◯	◯	◯	◯	◯
Traffic management responsibilities (change of allocation between private and public organisations)	◯	◯	◯	◯	◯

7. Additional suggestions for organisational impacts and their relevance levels

IMPACT ASSESSMENT - **BUSINESS / ORGANISATIONAL** PERSPECTIVE (2/2)

* 8. If you consider the impacts on the **public** (transport) organisations that are to provide (part of) the services, how relevant do you think the following impacts are to address in an evaluation of MaaS?

	No relevance	Little relevance	Moderate relevance	High relevance	No opinion
Business model(s)	◯	◯	◯	◯	◯
Business value proposition	◯	◯	◯	◯	◯
Brand identity / company image (change)	◯	◯	◯	◯	◯
Customer segments (change)	◯	◯	◯	◯	◯
Number of customers (increase/decrease)	◯	◯	◯	◯	◯
Customer relationships (change)	◯	◯	◯	◯	◯
Channels for reaching customers (new, other than today)	◯	◯	◯	◯	◯
Revenues/turnover (increase/decrease)	◯	◯	◯	◯	◯
Revenue sources (new, other than today)	◯	◯	◯	◯	◯
Financial (re)sources (new, other than today)	◯	◯	◯	◯	◯
Distribution of costs (change)	◯	◯	◯	◯	◯
Need for investments (e.g., in technology, infrastructure, vehicles)	◯	◯	◯	◯	◯
Competence/skill (need for new/other competences and/or skills, technological knowhow)	◯	◯	◯	◯	◯
Number of employees/jobs (increase/decrease)	◯	◯	◯	◯	◯
Organisational changes (e.g. new ways of working within the organisation, change in work tasks)	◯	◯	◯	◯	◯
Partnerships in the value chain (new, other than today)	◯	◯	◯	◯	◯
Data sharing (among partners)	◯	◯	◯	◯	◯
Traffic management responsibilities (change of allocation between private and public organisations)	◯	◯	◯	◯	◯

9. Additional suggestions for organisational impacts and their relevance levels

IMPACT ASSESSMENT - **SOCIETAL** PERSPECTIVE

* 10. If you consider the impacts on a **societal** level, how relevant do you think the following impacts are to address in an evaluation of MaaS?

	No relevance	Little relevance	Moderate relevance	High relevance	No opinion
Emissions (Co2, NOX, etc.) (increase/decrease)	◯	◯	◯	◯	◯
Congestion (increase/decrease)	◯	◯	◯	◯	◯
Land use (more efficient/less efficient)	◯	◯	◯	◯	◯
Public health (better/worse)	◯	◯	◯	◯	◯
Public investments in e.g. infrastructure (increase/decrease)	◯	◯	◯	◯	◯
Access to mobility solutions for citizens (increase/decrease)	◯	◯	◯	◯	◯
Number of parking spaces (increase/decrease)	◯	◯	◯	◯	◯
Occupancy rate of vehicles (increase/decrease)	◯	◯	◯	◯	◯
Utilization rate of vehicles (increase/decrease)	◯	◯	◯	◯	◯
Vehicle types in use, incl. EV-fleets, hybrids etc. (changes in)	◯	◯	◯	◯	◯
Traffic safety (increase/decrease)	◯	◯	◯	◯	◯
Laws and regulations, e.g. re procurement etc. (changes)	◯	◯	◯	◯	◯

11. Additional suggestions for societal impacts and their relevance levels

IMPACT ASSESSMENT - EXPECTED IMPACTS FOR THE **INDIVIDUAL / USER**

* 12. Assuming MaaS is implemented on a broad scale, which do you think will be the greatest impacts of MaaS on the level of the **individual / user** (maximum three)?

- [ ] The number of trips made (increase/decrease)
- [ ] Distances travelled (increase/decrease)
- [ ] Use of private car(s) (increase/decrease)
- [ ] Use of car sharing (increase/decrease)
- [ ] Use of taxi services (increase/decrease)
- [ ] Use of car pooling (increase/decrease)
- [ ] Use of public transport (increase/decrease)
- [ ] Use of public bicycles (increase/decrease)
- [ ] Use of private bicycles (increase/decrease)
- [ ] Use of walking (increase/decrease)
- [ ] Combining different modes of transport (increase/decrease)
- [ ] Use of electronic information services, e.g. via apps and websites (increase/decrease)
- [ ] Use of electronic payment methods (increase/decrease)
- [ ] Total travel cost (per individual and month) (increase/decrease)
- [ ] Average travel times (increase/decrease)
- [ ] Perceived stress associated with travelling (increase/decrease)
- [ ] Perception of access to different transport modes (better/worse)
- [ ] Overall satisfaction with transport solution (increase/decrease)
- [ ] Attitude towards driving private cars (better/worse)
- [ ] Attitude towards car sharing (better/worse)
- [ ] Attitude towards using taxi services (better/worse)
- [ ] Attitude towards car pooling (better/worse)
- [ ] Attitude towards using public transport (better/worse)
- [ ] Attitude towards bicycling (better/worse)
- [ ] Attitude towards walking (better/worse)
- [ ] General health/wellbeing (better/worse)
- [ ] Internet shopping/home deliveries (increase/decrease)
- [ ] Other (please specify)

IMPACT ASSESSMENT - EXPECTED IMPACTS FOR **PRIVATE** BUSINESSES / ORGANISATIONS

* 13. Assuming MaaS is implemented on a broad scale, which do you think will be the greatest impacts of MaaS on the level of the **private** organisations and/or businesses that are to provide (part of) the MaaS services (maximum three)?

- [ ] Business model(s)
- [ ] Business value proposition
- [ ] Brand identity / company image (change)
- [ ] Customer segments (change)
- [ ] Number of customers (increase/decrease)
- [ ] Customer relationships (change)
- [ ] Channels for reaching customers (new, other than today)
- [ ] Revenues/turnover (increase/decrease)
- [ ] Revenue sources (new, other than today)
- [ ] Financial (re)sources (new, other than today)
- [ ] Distribution of costs (change)
- [ ] Need for investments (e.g., in technology, infrastructure, vehicles)
- [ ] Competence/skill (need for new/other competences and/or skills, technological knowhow)
- [ ] Number of employees (increase/decrease)
- [ ] Organisational changes (e.g. new ways of working within the organisation, change in work tasks)
- [ ] Partnerships in the value chain (new, other than today)
- [ ] Data sharing (among partners)
- [ ] Traffic management responsibilities (change of allocation between private and public organisations)
- [ ] Other (please specify)

IMPACT ASSESSMENT - EXPECTED IMPACTS FOR **PUBLIC** (TRANSPORT) ORGANISATIONS

* 14. Assuming MaaS is implemented on a broad scale, which do you think will be the greatest impacts of MaaS on the level of the **public** organisations and/or businesses that are to provide (part of) the MaaS services (maximum three)?

- ☐ Business model(s)
- ☐ Business value proposition
- ☐ Brand identity / company image (change)
- ☐ Customer segments (change)
- ☐ Number of customers (increase/decrease)
- ☐ Customer relationships (change)
- ☐ Channels for reaching customers (new, other than today)
- ☐ Revenues/turnover (increase/decrease)
- ☐ Revenue sources (new, other than today)
- ☐ Financial (re)sources (new, other than today)
- ☐ Distribution of costs (change)
- ☐ Need for investments (e.g., in technology, infrastructure, vehicles)
- ☐ Competence/skill (need for new/other competences and/or skills, technological knowhow)
- ☐ Number of employees (increase/decrease)
- ☐ Organisational changes (e.g. new ways of working within the organisation, change in work tasks)
- ☐ Partnerships in the value chain (new, other than today)
- ☐ Data sharing (among partners)
- ☐ Traffic management responsibilities (change of allocation between private and public organisations)
- ☐ Other (please specify)

IMPACT ASSESSMENT - EXPECTED IMPACTS FOR **SOCIETY**

* 15. Assuming MaaS is implemented on a broad scale, which do you think will be the greatest impacts of MaaS on the **societal** level (maximum three)?

- [ ] Emissions (Co2, NOX, etc.) (increase/decrease)
- [ ] Congestion (increase/decrease)
- [ ] Land use (more efficient/less efficient)
- [ ] Public health (better/worse)
- [ ] Public investments in e.g. infrastructure (increase/decrease)
- [ ] Access to mobility solutions for citizens (increase/decrease)
- [ ] Number of parking spaces (increase/decrease)
- [ ] Occupancy rate of vehicles (increase/decrease)
- [ ] Utilization rate of vehicles (increase/decrease)
- [ ] Vehicle types in use, incl. EV-fleets, hybrids etc. (changes in)
- [ ] Traffic safety (increase/decrease)
- [ ] Laws and regulations, e.g. re procurement etc. (changes)
- [ ] Other (please specify)

16. If you have any other comments or input on MaaS impacts, or MaaS in general, please share them here.

THANK YOU!

Thank you very much for your time and support of our project.

Mobility as a Service for Linking Europe (MAASiFiE) is a two-year project that investigates the prerequisites for organizing user-oriented and ecological mobility services in order to provide consumers with flexible, efficient and user-friendly services covering multiple modes of transport on a one-stop-shop principle. In addition, the project examines the opportunities of combining passenger and freight transport operations, especially with respect to urban delivery and distribution in rural areas.

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