Mobilit**y** as a Service in a multimodal European cross-border **Corridor** (**MyCorridor**)

Deliverable 6.3

MyCorridor Impact Assessment

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Abbreviation List

Abbreviation	Definition
AU	Austria
CIA	Core Impact Assessment
CZ	Czech Republic
DRT	Demand Responsive Transport
EC	European Commission
EU	European Union
FOT	Field Operational Test
GR	Greece
ICT	Information and Communication Technologies
IST	Information Society Technologies
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
MaaS	Mobility as a Service
MCA	Multi Criteria Analysis
NL	Netherlands
PC	Project Coordinator
PT	Public Transport
R&I	Research & Innovation
RQ	Research Question
SMCA	Simplified Multi Criteria Analysis
TM	Technical Manager
UK	United Kingdom
WP	Work Package

Executive Summary

The Deliverable 6.3 “MyCorridor impact assessment” reports the results of Activity 6.4 “Impact Assessment” which aimed at capturing the diverse impacts achieved with the introduction and testing of the MyCorridor application during the 2nd round of the evaluation process, which took place in the pilot countries between February and October 2020.

Chapter 1 introduces the purpose of this document, the anticipated interrelations and the target audience. **Chapter 2** summarises the findings of a state-of-the-art review of previous studies investigating the impacts of MaaS as well as of commonly impact assessment methods used for a wide range of ITS projects. While **chapter 3** details the 2-stage impact assessment methodology that was collaboratively co-designed in MyCorridor, **chapters 4** and **5** respectively include the quantitative impact assessment results (i.e., 1st stage of the methodology) and the findings of the stakeholder consultations (i.e., 1st stage of the methodology) carried out during the project. Conclusions and future deployment recommendations for MaaS in chapter 6 conclude the Deliverable.

The impact assessment results presented in this Deliverable are based on an extensive, challenging pilot study which was conducted between February 2020 and October 2020 in the MyCorridor pilot countries, during which a wide a comprehensive data gathering exercise was carried out, consisting in baseline and post-trial questionnaire responses (147 and 107 respectively) as well as mobile application logging data for 934 trips conducted by 160 users. It is particularly noteworthy that a very limited amount of data could be collected for cross-border trips due to the differing levels of travel restrictions applied in the pilot countries during the trial period to contain the spread of COVID-19 virus; therefore, this data was excluded from the overall data sample considered for the impact assessment.

The main finding of the impact assessment is that MyCorridor has the potential to deliver positive impacts for travellers, the environment and society thanks to the estimated reduction of the overall number of trips (in comparison to the baseline situation), to a modal shift in favour of Public Transport and cycling modes, an increase of multimodal trips and a generally improved attitude for travellers toward PT and shared forms of mobility. Whilst positive economic impacts were also observed for diverse business organisations, MyCorridor also contributed to a significant reduction of road-based CO_2 emissions from its operations and provided, in comparison to the baseline situation, unchanged levels in citizens accessibility, general transport comfort, transport trustworthiness, personal safety and transport security.

Thanks to the extensive stakeholder consultations conducted with local transport/MaaS stakeholders representing the business ecosystems of the pilot sites, it can be argued that one of the major stakeholder perceptions of MaaS is that it should aid integration between the different transport modes, and that this may be most achievable in an urban environment where there is a range of existing modes to be orchestrated together. This may be more of a challenge in a rural environment, but here there are perceived to be greater benefits in terms of 'externalities' (e.g., reduction in emissions) and improved experience (e.g., in terms of improving transport safety, accessibility and inclusion, including for rural areas). There are variations between the countries - for example, Austria, Italy and Greece placed more emphasis on the rural setting than stakeholders from the UK, Netherlands and Czech Republic. Overall, however, many views were shared across countries. There is also a view that MaaS is evolving - with concepts such as ‘MaaS of MaaS’ (integration of smaller MaaS schemes) - and moving away from the division between public and private services to a public-private partnership with the backbone of mobility provided by mass transit but supplemented in cooperation with private mobility providers. Data sharing and data privacy were seen as the greatest barriers, and also where policy could make the greatest contribution.

1 Introduction

MaaS represents an invaluable opportunity to access different mobility services in a simple and integrated way using a single digital channel suggesting the best travel solution based on individual needs. MaaS services must be complete, accurate, reliable solutions offering integrated travel planning, booking and payment functionalities and catering for all types of travel and user categories in order to constitute an integrated mobility service of comparable value to the private car ownership.

An effective MaaS solution can be as such considered an extremely powerful tool paving the way to a modal shift toward more sustainable modes of transport, reducing the use of private car-based mobility and ultimately contributing to the reduction of transport externalities.

On the other hand, an opportunity also arises for digital economy companies operating in the transport industry and for decision makers, in light of a possible optimal (re-)organisation of local mobility systems, improved urban planning practices and spatial allocation policies favouring sustainable mobility forms.

MaaS can therefore play a crucial role in delivering key benefits across several dimensions and for a range of actors; however, it is of paramount importance to gather a robust evidence base to raise awareness of key benefits, to formulate data-driven sustainable transport policies and to ultimately trigger suitable policy actions.

1.1 Purpose of the document

MyCorridor WP6 aimed at gathering structured, extensive and meaningful data (both objective and subjective) to assess the impacts generated by the use of the cross-border multimodal MaaS solution developed by MyCorridor (accessed by users via a mobile application), which was deployed and tested in the 5 project pilot countries - Austria, Czech Republic, Greece, Italy and Netherlands.

This Deliverable reports the results of the MyCorridor impact assessment methodology that was designed and applied collaboratively by WP6 partners to capture the diverse impacts achieved by MyCorridor within the 2nd round pilot study, which took place between February and October 2020.

The document is a result of an extensive, iterative cooperation and exchange processes between the Project Coordinator (PC), the Technical Manager (TM), the MyCorridor application development team and WP6 team members working towards the shared adoption of ad-hoc, realistic metrics capable of capturing the heterogeneous impacts arising from using the MyCorridor platform in the pilot environments.

The stakeholder consultations conducted in the pilot countries, as well as in the UK which were not initially foreseen, integrated more qualitative information regarding business impacts and opportunities from MaaS, and required regulatory and policy needs.

1.2 Intended audience

The nature of this Deliverable is public, meaning that it will be (upon approval by the EC) available through the website of the project (http://www.mycorridor.eu/project-library). The intended audience are the following:

- Internally to the project:
  - MyCorridor partners that developed the required tools to achieve the MyCorridor approach (WP3)
  - MyCorridor partners working on the business modelling and legal aspects of the project (WP7)
  - MyCorridor partners involved in piloting and testing activities (WP6)

- Externally to the project:
  - Future research EU R&I projects focusing on MaaS that are interested in further developing the unique and sustainable Mobility Token driven MaaS approach
  - Technology, content and service providers as well as transport operators that are interested in integrating their services into a MaaS solution
  - Policymakers aiming to promote sustainable mobility solutions to users in cities and regional areas
  - Researchers working in transport, mobility, Information and Communication Technologies (ICT) and Intelligent Transport Systems (ITS) sectors dealing with mobility service integration and ticketing (tokens)

1.3 Key interrelations and document structure

The current Deliverable builds upon the work that was carried out in WP6 related to evaluation framework, pilot execution, pilot results consolidation, impact assessment and policy learning issues. Interrelations exist between this Deliverable and several WPs, including *WP1: Defining a disruptive MaaS culture*, *WP3: One stop shop implementation & modules*, *WP4: MyCorridor MaaS (services)*, *WP7: Business models, incentives and legal issues* and *WP9: Ethics manual*.

The remainder of this Deliverable is structured as follows. **Chapter 2** reports the findings of a concise state-of-the-art review of previous studies investigating the impacts of MaaS as well as of commonly impact assessment methods used for a wide range of ITS projects. While **chapter 3** details the overall impact assessment methodology that was collaboratively designed in MyCorridor, **chapters 4** and **5** respectively include quantitative impact assessment results and the findings of the stakeholder consultations carried out during the project. Conclusions and future deployment recommendations for MaaS resulting from findings presented in previous chapters conclude the Deliverable in **chapter 6**.

2 Brief state of the art review

2.1 Common impact assessment approaches

Impact assessments serve a twofold purpose; firstly, they aim to generate knowledge on key benefits associated with a certain mobility solution and ascertain to what extent users may accept and use such services; how technologies should be implemented to unleash their full potential; and what situational conditions may influence the best outcome; on the other hand, impact assessments, coupled with sound cost-benefit assessments, develop a knowledge base to gauge the viability of specific mobility solutions and to ultimately support policy makers in prioritising investment among different alternatives.

Traditionally, impact assessments have been implemented in the form of ex-post evaluations of deployed services, field operational tests (FOTs) and simulation studies. The most consolidated and widely applied impact assessment methodology follows a goals-based approach, whereby impacts are estimated by making use of a set of predefined performance indicators which are deemed to respond to the strategic objectives of the solution to be assessed (Alkins, 2013).

As with any other technology-oriented deployment including ITS, the assessment of a MaaS solution should be based on an approach allowing comparisons between the observed pattern of behaviour to some 'counterfactual' in order to establish what would have happened without the intervention, i.e., the MaaS solution. Therefore, such impacts are simply the result of a comparison between the effects or changes in the outcomes generated with the MaaS solution in place and similar outcomes observed without or before the solution was implemented. To enable such comparison key performance indicators (KPIs) must then be formulated to appreciate differential effects.

To establish a 'counterfactual' or baseline scenario the following estimation approaches are possible (C-ROADS platform, 2019):

- *Before and after approach* consisting in comparing changes in outcomes before and after offering the solution, which requires the collection of baseline data in advance of the service deployment. This is the approach that was adopted in MyCorridor.
- *Simple difference in differences approach* consisting in comparing changes in outcomes measured within the context where the solution is applied to those for other contexts where similar solutions have been applied or for users not equipped with MaaS service within the same context. This necessitates the collection of data from a control group in addition to users provided with the MaaS service.
- *Regression difference in differences* - is similar to simple difference in differences but uses statistical techniques to compare changes in outcomes for users accessing the MaaS solution to those not using it, controlling for a range of other factors.
- *Randomized control trials* - randomly allocating users to either receive the MaaS solution, or into a control group for comparison purposes from which data is collected, but no service is provided.

It should also be mentioned that whenever a mobility-related evaluation is conducted, this evaluation never happens versus static elements, since traffic efficiency (e.g., average speed and travel times) and environmental (e.g., CO_2 emissions) performance metrics constantly change alone without the need of any technology deployment. This holds true especially in the context of MaaS where changes in outcomes derive from travellers changing their mindset and behaviour regarding their mobility choices. Since such change in behaviour can occur for a wide number of reasons, impact evaluation should not be measured against static, but a dynamic baseline development (C-ROADS platform, 2019).

As with other technology-enabled systems deployment and considering the rather small number of impact studies being conducted for MaaS, it is crucial, especially for MyCorridor, to adopt a comprehensive and accurate methodology to evaluate MaaS from different perspective, e.g., travellers, service providers, data/content providers, local and central government bodies.

The methodological principles from which the MyCorridor impact assessment methodology referred to are those from FESTA handbook (CARTRE & FOT-Net, 2018) which provides a framework on how to execute FOTs in general, within which impact assessment is an integrated step of the methodology. The FESTA methodological framework is provided in **Figure 1**.

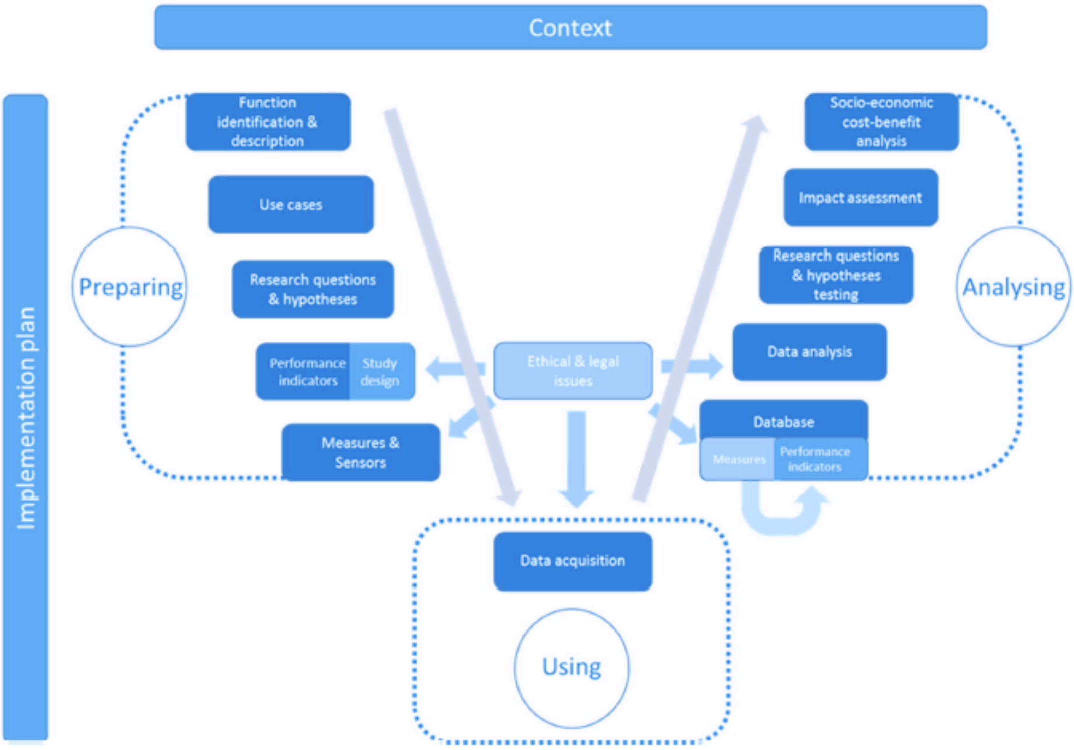


Figure 1: "FESTA V" model diagram (Source: CARTRE & FOT-Net, 2018).

Impact assessment usually refers to aggregated impacts on safety, mobility and environmental performance, which are triggered by behavioural responses and changes that take place on a micro level, i.e., a new service provided to individual travellers. Together with socioeconomic cost-benefit analysis, they typically represent the last steps of the so-called 'V-model', i.e., the upper right of the V-model; additional elements are covered within the FESTA handbook, including how to deal with such changes, how to upscale from individual data to aggregated impacts.

Based on the methodological principles offered by the FESTA methodology, the following approach has been adopted in MyCorridor to structure the development of its impact assessment methodology:

- identification of assessment levels (anticipated to be individual/user level, business/organisational level and societal level) and impact areas (anticipated to be environment, economy, society);
- formulation of research questions per assessment level steering the investigation of impacts for different types of stakeholders;
- selection of assessment level specific KPIs measuring direct effects over the above-mentioned impact areas;
- definition of data requirements, collection tools and estimation methods;

- calculation of KPIs and evaluation of before-after changes in outcomes that could materialise following the introduction of MyCorridor.

2.2 Impact-related findings from previous MaaS pilot studies

MaaS is based on existing technologies but brings a core innovation by the fact that it gives to a MaaS aggregator the opportunity to bring together standard transport operators and infomobility services, using a single access digital platform; the application of this model to transport services will provide meaningful and positive impacts to society, economy, environment and businesses.

Pilot and survey research are often used to make quantitative statements about the impacts of MaaS on travel preferences and travel behaviour, with pilot evaluations typically using various methods, such as comparative analysis, surveys, interviews, travel diaries, in-depth analysis. The remainder of this section briefly summarises the results of pilot studies conducted for MaaS solutions deployed in Sweden (i.e., UbiGo), Austria (i.e., Smile) and Finland (i.e., Whim).

2.2.1 UbiGo

UbiGo (https://www.ubigo.me) is a multimodal service including public transport (PT), carsharing, rental car service, taxi and bicycle hiring; for end-user access to services, UbiGo customers log in a web interface through which users can activate tickets/trips, make/check bookings, and access already activated tickets (e.g., for validation purposes).

Whilst the application does not include pre- or on-trip journey planning or real time PT information, each participant receives 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 PT system in case there is any problem using the UbiGo service. UbiGo also includes a customer service phone line open 24 hours per day, while the business idea is to volume, repackage and deliver an innovative mobility service in a simple way, without having to own a car to travel.

In order to collect relevant data on the use case and for ascertaining key impacts, different information were used during the UbiGo pilot conducted within the Go:Smart project, which had the following characteristics (Karlsson et al., 2017):

- Pilot duration: 6 months (from November 2013)
- Number of pilot participants: 195 people in 83 households
- Amount of survey respondents: 164 before-pilot, 161 during-pilot, 160 end-pilot, 109 6-month follow-up
- Characteristics of the survey respondents: overrepresentation of city centre inhabitants, retired people greatly underrepresented.

Data was collected through surveys (before, during, after), travel diaries (before and during) and personal interviews (after) to UbiGo participants as well as with a sample of non-participants and service providers. **Table 1** summarises the outcomes achieved by the UbiGo pilot study.

Table 1: Outcomes achieved by the UbiGo pilot study, Stockholm.

UbiGo pilot study results
46% reported greater bus/tram use - 5% more tram use (travel diaries); 35% more bus use (travel diaries)
8% reported less local train use (travel diaries).
44% reported less private car use (travel diaries).
51% reported greater carsharing use (travel diaries).
15% reported greater car rental use.
8% reported greater taxi use.
7% reported greater use of bikesharing.
3% reported less use of private bike* note that UbiGo ran during the winter half of the year from November through April.
15% reported more walking (travel diaries)
50% reported a more positive attitude towards bus/tram.
5% reported a more positive attitude towards local train.
20% reported a less positive attitude towards private car.
58% reported a more positive attitude towards carsharing.
17% reported a more positive attitude towards car rental.
12% net reported a more positive attitude towards taxi.
41% net reported a more positive attitude towards bikesharing.
11% reported a more positive attitude towards private bicycle.
14% reported a more positive attitude towards walking.
68% perceived having more alternatives from which to choose.
49% perceived a reduced transportation expenditure.
69% perceived that it became easier to pay and keep track of transportation

2.2.2 SMILE

SMILE (https://smile-einfachmobil.at/index_en.html) is a mobility platform that provides users with access to information about all available city-based means of transport and allows them to book, pay and use them. Based on the results of SMILE project, the Austrian Railway Operator ÖBB created the "ticket shop" and the "WienMobil" application, which integrates private car sharing, bike sharing, taxis, PT, your own car or bike, offering booking, routing, ticketing and payment. The goal of SMILE was to create the platform that will successfully integrate all modes of transport, making it a unified key to urban transport. SMILE customers access the platform, select their destination and receive a number of recommended options to get to it. The customer has access to transport information, schedules, alternative routes and modes of transport and can book their preferred ticket, pay through the platform and use their ticket.

The SMILE pilot study had the following characteristics (Karlsson et al., 2017):

- Pilot duration: 6 months (from November 2014)
- Number of pilot participants: over 1 000
- Amount of survey respondents: around 170 (end-pilot survey)

- Characteristics of the survey respondents: matched the gender and age distribution for early adopters. The average Smile user is male, aged between 20 and 40 and has a high level of education and high income.

Table 2 summarises the outcomes achieved by the SMILE pilot study.

Table 2: Outcomes achieved by the SMILE pilot study, Vienna.

SMILE pilot study results
When choosing the transportation means, the pilot users preferred to be shown in priority the PT routes (80% metro, 77% tram).
In addition, interest was raised for carsharing (21% car sharing, 7% e-car sharing) and bikesharing offers (10% bikesharing and 5% e-bikesharing).
Intermodality was increased: 26% of them confirmed an increased use of PT in combination with their private cars, whilst 20% of them combined PT and bicycle rides more often.
Mostly shared bikes (68%) and private bikes (51%) were combined with PT, followed by private car (51%), carsharing (49%), e-carsharing (8%) and e- bike sharing (5%).
Main motivation for the increase in combinations of PT and car / bike is the quicker alternative that SMILE suggested (69%/74%).
48% stated that their mobility behaviour changed through the use of the smile application.
55% stated that they combine different modes of transport as required.
60% stated that they discovered new routes on their leisure trips with the application.
69% said that suggested routes are faster than the ones they used before.
48% stated that PT is used more often (26% urban PT, 22% regional PT).
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.
60% stated that new routes emerged on leisure trips.
41% stated that new ways emerged on daily routes.
33% registered with new mobility offers.
46% stated that their modal choice on leisure trips changed.

2.2.3 Whim

Whim (https://whimapp.com) is a commercial platform through which customers can book and pay for transport around the city using a wide range of services provided by different operators. It aims to be a more affordable alternative to car ownership offering travel options that taxi, PT, a car service or a bike share. Whim's service model mirrors that one of UbiGo. The application offers pre-purchasable mobility packages (with a monthly quota of mobility points) and a mobile application for journey planning and ICT including a series of transport modes, namely PT, carsharing, rental car service, taxi and a bicycle system. Revenue for Whim is achieved using the monthly subscription model and the pay-as-you-go model, with a Whim points system. Whim points are travel currency which can be used to pay different transport services within the Whim application.

The Whim impact study pilot study had the following characteristics (Ramboll, 2019):

- Pilot duration: 12 months (from November 2017)
- Number of pilot participants: 70 000
- Amount of survey respondents: around 170 (end-pilot survey)
- Characteristics of the survey respondents: fair representation of all age groups.

Table 3 summarises the outcomes achieved by the Whim pilot study.

Table 3: Outcomes achieved by the Whim pilot study, Helsinki.

Whim pilot study results
PT modal share in Helsinki 48%, PT modal share Whim users 73%
Whim users combine taxis 3x more often with PT compared to the typical Helsinki resident
12% of bike trips are taken within 30 minutes before PT trip, 30% of bike trips happen within 90 minutes after PT trip
Whim users travel by taxi 2.4 times more often than the typical Helsinki resident
MaaS users make shorter city bike trips → Whim users 1,9 km; Helsinki resident 2,1 km
Whim users make 3,4 trips per day
68% of all Whim trips occur in areas with the highest PT access

3 MyCorridor impact assessment framework

The aim of this chapter is to detail the impact assessment methodologies that were designed and applied to assess the performances of the MyCorridor one-stop-shop across differing impact areas and user groups.

A two-stage impact assessment methodology was co-designed and implemented in MyCorridor; a semi-quantitative impact assessment, which is referred to as the **Core Impact Assessment (CIA)**, was firstly undertaken to quantify impacts on different areas, namely *environment*, *economy* and *society*, which were achieved only by using data collected during the second evaluation phase.

By proactively engaging all stakeholders of the MyCorridor pilots value chain, a supplemental qualitative assessment, i.e. the **Simplified Multi-Criteria Analysis (SMCA)**, was also conducted to gather governance- and business related impact findings that could not be gathered via means of a purely quantitative analysis; this analysis complemented the semi-quantitative impact assessment and specifically drew upon the results of site-based focus groups and individual stakeholder interviews that were held with stakeholder representatives of the pilot sites. The SMCA results enabled the formulation of evidence-based recommendations for the deployment and transferability of MaaS solutions beyond the MyCorridor project lifecycle.

3.1 Core impact assessment

3.1.1 Methodology

The conceptual sequence of operations through which the CIA methodology was developed, which also corresponds to the topics discussed in the remainder of this chapter, is depicted in **Figure 2** below.

Firstly, the **deployment matrix** (**Table 4**), providing a synthetic overview of five different combinations of mobility products that could constitute a MaaS 'package' in each testing scenario, represents the first input element into the CIA methodology; then, based on the FESTA methodological principles and subsequent conclusions drawn for MyCorridor outlined in section 2.1, relevant research questions and expected impacts are formulated to steer the investigation of impacts generated on specific areas. This is followed by the selection of KPIs concerning different user groups and specifically addressing those research questions.

Subsequently, data requirements and data collection methods are identified; afterwards, estimation methods for impact estimations through the calculation of the predefined set of KPIs (**Table 6**) are defined; notably, the definition of both KPIs, data requirements and data collection methods are jointly summarised in the **evaluation requirement matrices** (**Table 7 – Table 9**)**,** which constitute the output of logical building process of the CIA methodology.

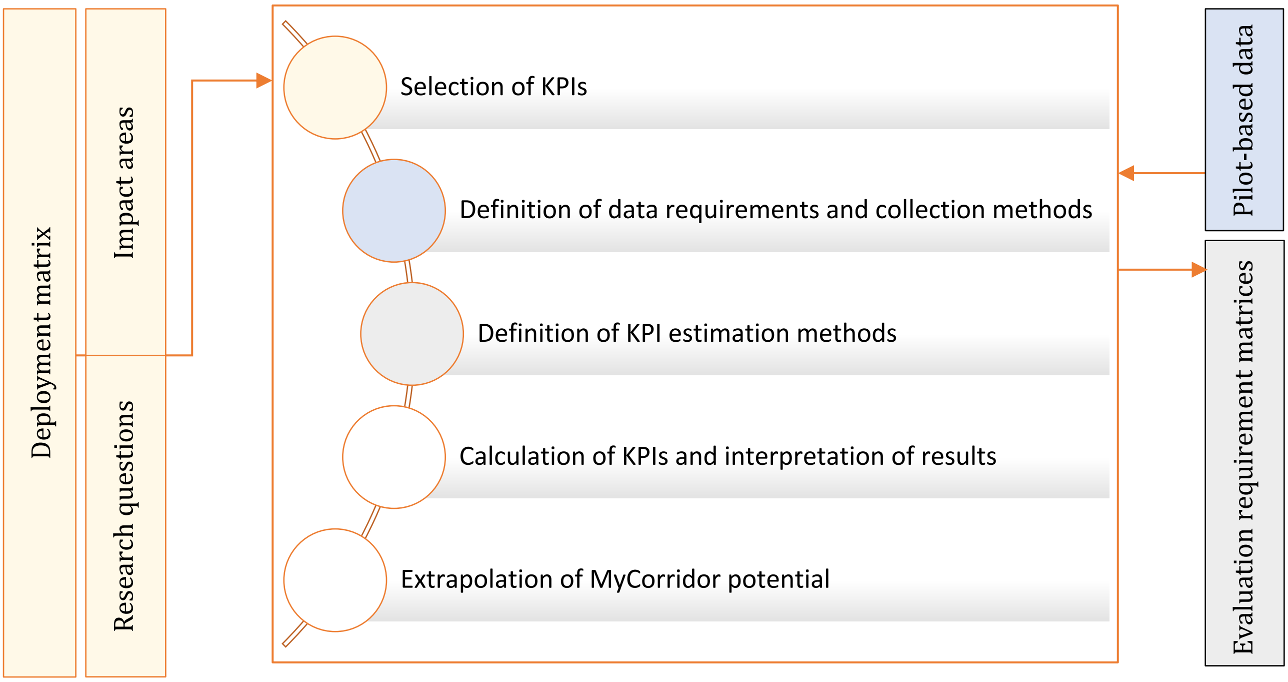


Figure 2: Schematisation of the MyCorridor core impact assessment framework.

Table 4: MyCorridor deployment matrix.

Austria	Czech Republic	Greece	Italy	Netherlands
▪ Advanced multimodal routing ▪ Real time traffic state and forecast ▪ PT e-ticketing ▪ Park and ride information ▪ FCD-based real time traffic state and forecast ▪ Real time traffic flow ▪ On & off-Street parking information ▪ Hybrid Trip planner ▪ Aggregated TM services ▪ Aggregated added value services	▪ Real time information for parking availability ▪ Real-time traffic flow information ▪ PT scheduled information ▪ PT e-ticket purchase ▪ Aggregated added value services	▪ Bus/ interurban service ▪ Hybrid trip planner ▪ Bike sharing ▪ PT ticketing with bike sharing reservation/ticketing ▪ Aggregated added value services	▪ Real time traffic state via route monitoring ▪ Virtual VMS: event management ▪ TLA ▪ On- and off-street parking ▪ Real time traffic flow ▪ Zone access control information ▪ Aggregated TM services ▪ Aggregated added value services	▪ Real time traffic flow ▪ On- and off-street parking ▪ FCD-based real time traffic state and forecast ▪ Static & dynamic parking availability ▪ PT information ▪ Hybrid trip planner ▪ Aggregated TM services ▪ Aggregated added value services

It is worth acknowledging that, whilst impact assessments of ITS and Information Society Technologies (IST) allow to come to a methodological estimation of impacts, the growing accessibility to transport-related technologies, along with the lack of historical empirical evidence of cause-effect mechanisms, also raises concerns about the questionable validity of the impact assessment results over time due to the dynamic changes in travellers' behaviour in response to the introduction of new mobility innovations. Therefore, impact assessment results should be accurately interpreted via a number of possible contributing factors and contextualised in a critical manner within the specificity of the pilot operations.

The following items will be addressed in the remainder of this chapter:

- definition of impact areas, research questions and expected impacts;
- selection of impact area indicators;
- identification of data requirements and collection tools;
- definition of estimation methods; and
- evaluation of extrapolation potential for MyCorridor.

3.1.2 Research questions and expected impacts

A number of research questions and expected impacts were elaborated to study the specific effects MyCorridor produces on the *environment*, the *economy* and *society*.

The identification of relevant impact areas for MaaS, i.e., **environmental**, **economic** and **social impact** areas, was performed by capitalising the work undertaken in the MASSiFiE project (Karlsson et al., 2017), which is summarised below for reference.

According to ISO 14001:2004, as noted by the MASSiFiE project, **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, 1997). These can also include business output or sales volume, personal income, jobs or even simple changes in current practices.

Social impacts have been defined as the effects which characterise and influence the community's social and economic wellbeing. A 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). 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 and Lucas, 2011).

Moreover, MASSiFiE has discerned the impacts and their KPIs on **individual/user level**, **business/organisational level** and **societal level**. These are also kept in MyCorridor and are subsequently referred to as 'assessment levels'.

The specific research questions that were formulated to investigate the effects generated on the above-mentioned assessment levels are given in the following diagrams.

Individual level

Research questions

- RQ1 - Does MyCorridor trigger sustainable travel behaviour mechanisms for individuals?
- RQ2 - Does it associate with positive impacts on the transport system?
- RQ3 - Does it encourage a car-dependant city or does it favour PT modes?

Expected impact

- MyCorridor is expected to have a positive effect on all impact areas via a positive change in the modal split, reduction of trips and through encouraging use of more sustainable forms of transport; particularly traffic efficiency gains as well as positive changes in modal sift and multimodal trips are also facilitated by the advanced traffic management features (i.e., TM2.0) embeddedd in the MyCorridor application, through which, by exploiting a wide range of external traffic data (e.g., from loop, radar and floating car data), users get specific traffic management notifications (e.g. about re-routing directions) along their journey to destination

Data requirem.

- Data on: total number of trips, modal split, number of multimodal trips, attitudes towards PT, sharing mobility, perceived accessibility, travel cost/time

Societal level

Research questions

- RQ4 - Does MyCorridor result in positive societal changes?
- RQ5 - Is the wide general public going to benefit from the intended positive impacts or is it only attractive to a niche group of users?

Expected impact

- MyCorridor is expected to have a positive societal impact for all types of users since it will result in a reduction of CO_2 emissions, improved resource efficiency and enhanced citizens accessibility to transport services as well as comfort and wellbeing. Particularly, CO_2 emissions are expected to be further reduced thanks to the advanced traffic management features provided to car drivers using MyCorridor. Further betterments might result for transport trustworthiness, safety and security levels.

Data requirem.

- Both quantitative and qualitative data were collected in MyCorridor in relation to each of the above-mentioned variables; further details are presented in the next sections.

Business level

Research questions

- RQ6 - Does MyCorridor create equal opportunities for the whole business ecosystem?
- RQ7 - Does MyCorridor give rise to collaboration opportunities within the value chain?
- RQ8 - What type of impacts can be expected for individual company business operations?
- RQ9 - Will there be any need for policy changes and regulatory actions to favour the introduction of MyCorridor-type systems?

Expected impact

- Positive economic impact for all types of businesses might be expected; particularly, service providers are expected to see increases in their customer basis with all traveller clusters being addresses thanks to personalisation features; collaboration opportunity are also expected to arise including those with traffic providers, data providers and navigation services companies. Additional impact may include organisational changes, novel business models and the instauration of data sharing practices.

Data requirem.

- To assess the above impacts, subjective data was collected through focus groups and structured interviews with a wide range of stakeholders representing the local MyCorridor business ecosystems.

3.1.3 Selected impact assessment KPIs

It is particularly noteworthy that the MASSiFiE project, on the basis of some first empirical results of MaaS schemes, and, also, through literature studies and assumptions, has proceeded with some indications of the expected negative and/or positive impacts of MaaS across the aforementioned impact areas (i.e., economic, environmental and social). These qualitative assessment results are reflected through the colour coding in **Table 5**, where the MyCorridor project's elaborations have been added in Italics.

The MASSiFiE categorisation and qualitative assessment approach have been preserved in MyCorridor; however, it should be noted that these only serve as qualitative pre-impact assessment results used as a reference guide to inform the development of the CIA and the selection of the adopted KPIs.

Table 5: Qualitative pre-impact assessment results (Source: MyCorridor project, 2018; adapted from Karlsson et al., 2017).

Overall positive increase/decrease	(green)
Both positive and negative increase/decrease	(yellow)
Overall negative increase/decrease	(orange)
Not possible to assess	

Level	KPIs	Description	Environmental	Economic	Social
Individual/user level	Total 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.	X (yellow)		X (green)
	Modal shift	The KPI refers to a modal shift from private car to other, more sustainable transport modes such as PT, 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. *In the MyCorridor project however, as explained later, this worked out differently given that the specific solution is not excluding vehicle users.*	X (green)		
	Number of multimodal trips	Another possible effect of the introduction of MaaS is that travellers will make use of different modes of transport as well as combine different modes of transport in a way that will result in a more efficient use of available resources. *Particularly, in MyCorridor, the aggregation of TM2.0 services open up the multimodality to a greater group of travellers, as it specifically addresses vehicle users.*	X (green)		
	Attitudes towards PT and shared mobility	MaaS could result in changed attitudes towards different modes of transport providing an increased use of different modes of transport. Indirectly a less positive attitude towards the use of private car use and a more positive attitude towards PT, car- and bikesharing, etc. could result in environmental impacts.	X (green)		

Level	KPIs	Description	Environmental	Economic	Social
		Again, as mentioned above, in MyCorridor, it is one of the crucial aspects to address how the advanced traffic management services impact the use of vehicle, private or shared.			
	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.			X
	Total travel cost per individual/household	MaaS could potentially result in a decrease in the total travel costs per individual and/or household.		X	X
	Total travel time per individual	*The total travel time is conceived as the summation of time consumed for the trip planning (that may be significant, especially in cross-border travels) and the time spent for the travel itself (including waiting times, intermodal time, congestion time, etc.). Through MyCorridor, both are expected to decrease, as the travellers would spend less time in retrieving the optimum for their travel options in advance and would not spend unnecessary time in searching before or during their trip. Also, vehicle users would benefit from advanced traffic management services that will also lead to less time in congestion, optimum routing, etc. This will most probably result in a reduction of environmental resources as well, whereas it is also correlated to decrease of travel costs most probably.*	X	X	X
Business/organisational level	Number of customers	Given a shift from private car to other modes of transport, including PT, car sharing, taxi, etc., service providers could be expected to face an increase in the number of customers which could result in a positive economic impact.		X	
	Customer segments	With a transport service offer that has a less narrow focus on a shift from private car to PT specifically but instead from private car to other modes of transport, i.e., including different modes of transport in the service offer, it is possible 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 result in a positive economic impact. *Especially MyCorridor, throughout is personalisation approach, is expected to contribute significantly to that. MyCorridor aims to address specific traveller clusters (businessmen, commuters, mobility restricted users, elderly, etc.) throughout an all-inclusive approach.*		X	X
	Collaboration/partnership in value chain	With the assumption that MaaS will require further collaboration between transport service providers, public as well as private, it is feasible to assume further collaboration between different stakeholders and (depending upon the business model) possibly new roles in the value chain.		X	

Level	KPIs	Description	Environmental	Economic	Social
		By paving the way for collaboration agreements among key transport and mobility players, MyCorridor enables the conditions for including a wide range of providers and operators to be part of the MaaS offer; these may be both data providers, traffic management services, transport and mobility operators. *Especially in MyCorridor, the value chain is opened up to more providers coming from the traffic management and navigation world (i.e. SWARCO MIZAR, TomTom).*			
	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		X	
	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.		X	
	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.			
	Contribution to standards and novel business models	*MaaS is expected to bring in important changes in business models and roles, while it is not impossible that throughout the new paradigms, the need for new standards or revision of standards may emerge (i.e., regarding security and interoperability). While this possibility has already been elaborated in Deliverable 7.1 'Mobility service aggregator business model', it was also explored during the site-based focus groups and interviews held with a range of transport/MaaS stakeholders.*		X	
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 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. *In addition, in MyCorridor, specific incentivisation will be given in order to promote more environmentally friendly options thanks to the Green Packs product that was implemented which suggests the most environmentally sustainable travel options to desitnations. Also, one of the criteria for selecting and purchasing mobility products*	X		

Level	KPIs	Description	Environmental	Economic	Social
		will be the environmental friendliness itself. Apart from that, MaaS overall is expected to contribute towards a more "eco-friendly" behaviour beyond mobility.			
	Resource efficiency	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 PT, carsharing, and bikesharing, etc. results in an overall increase in resource efficiency. *Specifically, in MyCorridor the traffic management services further contribute towards that, as they specifically target the optimum use of infrastructure resources.*	X	X	
	Citizens' accessibility to transport services	MaaS has been argued to result in an improved or higher accessibility to transport and, provided this improved accessibility to transport, also to a higher accessibility to the different services offered by society. *In MyCorridor, the inclusion of mobility restricted users in the profiling and the provision of the optimum services for them increases the potential of all-inclusive transport and life.*		X	X
	Citizens' overall comfort & well-being	*MaaS and MyCorridor in particular are expected to increase comfort with respect to travelling, which is expected to be even more evident in cross-border travels. In MyCorridor, this was specifically addressed through the personalisation aspects that was put in force but was also extended to vehicle users due to the fact that they will enjoy advanced traffic management services that promote multimodality. Nevertheless, apart from that, comfort of travellers is one of the primary goals of MaaS.*		X	X
	Trustworthiness in transport	*The overall trustworthiness in transport may or may not increase due to MaaS (including MyCorridor) with possible financial implications. This associates to the overall users' service experience with MaaS (both travellers and participating providers/operators).*		X	X
	Security and safety of citizens	*Due to the single access notion of MaaS solutions, including MyCorridor, and the default way of operation, citizens' security and safety may increase as more attention is paid at the liability part of service provision. However, if attention is not paid to data protection rules and security protocols for transactions (with the travellers and the service providers), the outcome may be exactly the opposite.*	X		
	Modification of vehicle fleet	The introduction of MaaS has been argued to facilitate further electrification of vehicle fleets. Also, automated vehicles are frequently mentioned in relation to	X		

Level	KPIs	Description	Environmental	Economic	Social
		MaaS; particularly, the introduction of shared autonomous vehicle systems, as an additional attracting mobility option to users, may further improve MaaS uptake of MaaS while resulting in potentially positive environmental impacts for the whole transport system.			
	Legal and policy modifications	The implementation and dissemination of MaaS must take national as well as international laws and regulations into consideration. Further deployment and dissemination of MaaS may require changes/extensions in laws and regulations and/or policies.	X	X	X

With the above research questions in mind and drawing on the preliminary qualitative assessment results, the selected KPIs that will be employed to estimate the impacts produced by MyCorridor in the pilot sites are those included in **Table 6,** where their matching with assessment levels and associated research questions is also shown.

Table 6: List of KPIs used to perform the core impact assessment.

Level and research question	KPI id	KPI	Level and research question	KPI id	KPI	Level and research question	KPI id	KPI
Individual/user level; RQ1-RQ3	1	Total number of trips made	Business/organisational level; RQ6-RQ9	8	Number of customers	Societal level; RQ4-RQ5	15	CO_2 emissions (from road-based transport activity)
	2	Modal shift		9	Customer segments		16	Resource efficiency
	3	Number of multimodal trips		10	Collaboration/partnership in value chain		17	Citizens accessibility to transport services and beyond
	4	Attitudes towards PT and shared mobility		11	Revenues/turnover		18	Citizens overall comfort & well-being
	5	Perceived accessibility to transport		12	Data sharing		19	Trustworthiness in transport
	6	Total travel cost per individual		13	Organisational changes, changes in responsibilities		20	Security and safety of citizens
	7	Total travel time per individual		14	Contribution to standards and novel business models		21	Modification of vehicle fleet
							22	Legal and policy modifications

3.1.4 Data requirements and collection tools

The data required to estimate the above KPIs (both for the baseline and MyCorridor scenarios to derive a relative before-after change) is gathered at pilot site level through the users' interactions with the MyCorridor platform and via questionnaires administered online to end-users and service providers. While travellers' interaction with and use of the MyCorridor platform reveal factual evidence of the mobility choices made by heterogeneous end-user groups involved in the pilot testing, the latter data collection method, i.e. questionnaires, is generally aimed at collecting additional qualitative information regarding the user's acceptance, willingness to use a specific service, (stated) changes in their habits/attitudes as well as the impacts on society and for local businesses' organisations.

With reference to end users, regardless of the specific category a certain user represents, both the platform-based and the questionnaire-based data collection processes also provide the necessary information needed to characterise the different user profiles; additional data was also collected from users, regarding socio-demographic information and their mobility attitudes/mind-set (e.g., age, gender, education level, living situation, journey purpose of most frequent trips, travel mode choice preference (or preferred combination of transport modes), distance travelled on most frequent trips and number and types of vehicles owned in the household.

In MyCorridor, a considerable amount of data has been collected for reconstructing a solid baseline scenario, through dedicated **baseline questionnaires to travellers** before trips with the MyCorridor application were undertaken, whereas **usage data analytics** based on MyCorridor logged trip data revealed the specific mobility choices made by travellers to get to their destinations; data handling and harmonisation operations were carried out and key metrics based on the raw logged trip dataset were calculated before the impact assessment was conducted. Historic data obtained from Eurostat database was also used.

Additional impact assessment-related data was also collected by means of **post-testing travellers' questionnaires** following the conduction of MyCorridor trips with the specific purpose to further collect qualitative travellers' data regarding the general travel experience, the improved perceived transport accessibility, changes in attitudes towards PT and other shared forms of mobility as well as changes in overall safety, security, comfort and well-being levels. Baseline and post-testing travellers' questionnaires were administered to mainstream and in-depth groups of users, accounting for a total combined 147 (baseline) and 107 (post-testing) users respectively, while a total number of 934 trips were conducted by 160 users across all pilot sites. The extended questions for all questionnaires and their descriptive statistics as well as usage data analytics are fully reported in *Deliverable 6.2: Pilot Results Consolidation*.

Furthermore, **baseline and post-testing data** were also collected from **service providers** through online questionnaires before and after the testing period in order to assess the impacts that a potential ecosystem prototype such as MyCorridor would have on their daily operations; however, since the volume of data gathered for service providers was not deemed sufficient for the impact analysis, similar information were collected from a diversified range of pilot-based stakeholders attending focus groups and individual interviews, which were pivotal to investigate business-related impacts (e.g., generated increases in service providers', customer bases and revenue increases; the need for new data sharing practices, organisational changes, novel standards, business models) as well as required policy and regulatory actions. The results of such stakeholder consultations are fully reported in chapter 5.

The correspondence between the selected KPIs, the data requirements for their calculations under the baseline and MyCorridor scenarios as well as the means of data collection used are reported in the evaluation requirement matrices in **Tables 7 - 9**.

Table 7: Individual/user-level evaluation requirement matrix.

Level	KPI id	KPIs	Data requirement	Means of collection
Individual/user level	1	Total number of trips made	Trips made by each user in the reference period (i.e., length of pilot testing)	Logged trip data and baseline travellers' questionnaire
	2	Modal shift	Number and type of service used in each trip performed by individual users	Logged trip data and baseline travellers' questionnaire
	3	Number of multimodal trips	Derivable from KPIs 1 and 2 requirements	Logged trip data and baseline travellers' questionnaire
	4	Attitudes towards PT and shared mobility	n/a	Baseline and post-testing travellers' questionnaires
	5	Perceived accessibility to transport	n/a	Baseline and post-testing travellers' questionnaires
	6	Travel cost per individual	Individual travel cost of each trip completed successfully by users	Logged trip data and baseline travellers' questionnaire
	7	Travel time per individual	Individual travel time of each trip completed by users	Logged trip data and baseline travellers' questionnaire

Table 8: Business/organisational-level evaluation requirement matrix.

Level	KPI id	KPIs	Data requirement	Means of collection
Business/organisational level	8	Number of customers	Recording the number of users using each individual transport service (other than private car mode)	Logged trip data and travellers' questionnaire
	9	Customer segments	Recording socio-demographic data of users to segment customers	Logged trip data and travellers' questionnaire
	10	Collaboration/partnership in value chain	Service providers that collaborate/work together as a result of MyCorridor.	Site-based focus groups and individual interviews with transport and MaaS stakeholders
	11	Revenues/turnover	Information regarding revenue increase levels achieved by service providers as a result of integrating their services within MyCorridor.	Site-based focus groups and individual interviews with transport and MaaS stakeholders

Level	KPI id	KPIs	Data requirement	Means of collection
	12	Data sharing	This directly links to KPI 10; specific questions were asked to service providers regarding the type, frequency and volume of data to be shared to be part of an ecosystem such as well as what organisational changes should be put in place and how this might affect their daily business operations.	Site-based focus groups and individual interviews with transport and MaaS stakeholders
	13	Organisational changes, changes in responsibilities		
	14	Contribution to standards and novel business models		

Table 9: Societal-level evaluation requirement matrix.

Level	KPI id	KPIs	Data requirement	Means of collection
Societal level	15	Emissions	CO_2 emissions reduction is directly connected to the reduction in vehicle trips or the modal shift achieved (KPI 1, KPI 2). It is computed by applying typical fuel consumption rates (depending on the fuel types) and road-based transport CO_2 emission factors to the total distance travelled by users to derive the amount of road transport fossil fuel emissions in both the baseline and MyCorridor scenarios.	Logged trip data and baseline travellers' questionnaire
	16	Resource efficiency	If MyCorridor results in a reduction of the trips made by private cars and shift towards more sustainable modes including shared mobility options (KPI 1, KPI 2), a decrease in parking demand and a minor use of land space might also derive. This will be quantified by the number of users switching from private car mode to sustainable transport modes.	Baseline and post-testing travellers' questionnaires
	17	Citizens accessibility to transport services and beyond	Qualitative information to be collected through ad-hoc questions.	Baseline and post-testing travellers' questionnaires
	18	Citizens overall comfort & well-being	Qualitative information to be collected through ad-hoc questions.	Baseline and post-testing travellers' questionnaires
	19	Trustworthiness in transport	Qualitative information to be collected through ad-hoc questions.	Baseline and post-testing travellers' questionnaires
	20	Security and safety of citizens	Qualitative information to be collected through ad-hoc questions.	Baseline and post-testing travellers' questionnaires

Level	KPI id	KPIs	Data requirement	Means of collection
	21	Modification of vehicle fleet	This is directly linked to the type of vehicles and services accessed by end-users (KPI 2). MaaS can have in impact on facilitating the transition of the vehicle fleet towards electrified, shared vehicle systems.	Logged trip data and baseline travellers' questionnaire
	22	Legal and policy modifications	This is to assess the role and influence of policymakers and regulators to make MaaS (and its cooperative model) a success at EU level, through ad-hoc questions.	Site-based focus groups and individual interviews with transport and MaaS stakeholders

A comprehensive overview of data items, their collection tools, intended targets and timeframes for each data type are summarised in the **Tables 10 – Table 14**.

Table 10: Characteristics of baseline travellers' data.

Baseline travellers' data	
What	▪ Age; gender, education level, living situation; ▪ location of origin and destination of trips; journey purpose of most frequent trips; ▪ PT accessibility levels, usual travel choices; distance travelled and travel times on most frequent trips; ▪ number of vehicles owned in the household; PT season ticket holders.
When	February 2020 – October 2020
How	Online questionnaires to both mainstream and in-depth users
How many respondents	A total of 147 respondents including mainstream and in-depth users

Table 11: Characteristics of usage data analytics.

Usage data analytics	
What	▪ System back end data was retrieved for calculating the following KPIs: o For user-level KPIs: number and type of users, total number of trips, modal shift, number of multimodal trips, total travel cost, total travel time and distance o For societal-level KPIs: CO_2 emissions (derived from distance and using conventional emission factors per mode), share of sustainable modes used such as shared, electric (derived from specific services selected) o For organisational-level KPIs: no of customers, customer segmentation data
When	February 2020 – October 2020
How	Elaborations based on raw data logged at the MyCorridor system back-end throughout the relevant infrastructure built for this purpose.
How many users	A total of 160 users across all pilot sites conducted an overall number of 934 MyCorridor trips.

Table 12: Characteristics of post-testing travellers' data.

Post-testing travellers' data	
What	▪ Attitude towards PT, sharing modes and general mindsets (KPI 4) ▪ Perceived accessibility to local transport (KPI 5) ▪ Citizens' accessibility to innovative mobility services (KPI 17) ▪ Citizens' perceived overall comfort and wellbeing when using transport services (KPI 18) ▪ Citizens' perceived overall trustworthiness, safety and security when using transport services (KPI 19-20)
When	February 2020 – October 2020
How	Online questionnaires
How many respondents	A total of 107 respondents including mainstream and in-depth users

Table 13: Characteristics of baseline service providers' data.

Baseline service providers' data	
What	▪ Basic organisation data: organization type, ownership structure, business start date ▪ Assets: fleet number and composition, fuel types, etc. ▪ Operation: service provided, coverage area, means of provision, charging policy ▪ Financial: revenue streams, data sharing/cooperation practices
When	February 2020 – October 2020
How	Online questionnaires
How many respondents	Too few and incomplete responses to be considered for the impact assessment.

Table 14: Summary of post-testing service providers' data.

Post-testing service providers' data	
What	▪ Specific topics were addressed at the stakeholder consultations to cover the following aspects: o Collaboration/partnership: number of service providers that collaborate/work together as a result of being within MyCorridor (KPI 10) o Revenues: information regarding revenue increase levels achievable by service providers as a result of being within MyCorridor (KPI 11) o Organisational changes are changes in data sharing practices, in revenue streams, establishment of cooperation frameworks, potential development paths for innovative business models (KPI 12-13-14) o Suggestions on regulatory actions and policy changes for MyCorridor to succeed (KPI21)
When	February 2020 – October 2020
How	Stakeholder focus groups and individual stakeholder interviews
How many consultations	Three stakeholder focus groups in Austria, Greece and Italy; 4 interviews in the Czech Republic, 1 interview in the Netherlands and 8 interviews in the UK (not originally envisaged by the project workplan).

In summary, the CIA methodology made use of different types of data collection tools:

- **Baseline traveller questionnaires** including subjective data, either quantitative or qualitative, that were either used to reconstruct the baseline scenario or to provide additional qualitative information useful for the impact analysis;
- **Post-testing traveller questionnaires** including subjective data collected from users following the use of the MyCorridor application to perform their trips;
- **Logged data from the MyCorridor application back-end** that provide objective quantitative data for the impact analysis;
- **Site-based focus groups and interviews** collecting subjective information from stakeholders of the pilot sites.

3.1.5 Estimation methods

This section describes the calculation methods of the KPIs using logged trip data from the MyCorridor application and the baseline travellers' questionnaires, which altogether allow to calculate changes in the adopted KPIs between the baseline and MyCorridor scenario, thus resulting in a sound before/after comparison of outcomes. As a result, this section does not cover those KPIs related to stakeholders (i.e., KPIs 10-14, 22), which were assessed as part of the stakeholder analysis reported in chapter 5.

3.1.5.1 Individual/user level

3.1.5.1.1 Total number of trips (KPI 1)

It is considered that using a MaaS-type solution such as MyCorridor, the number of trips per person could decrease in a pre-determined reference period given the greater accessibility to mobility services other than the private car mode (Karlsson et al., 2017); on the contrary, having access to sharing mobility services may increase the number of trips by users who had not used them before. Additionally, the possibility to make much more informed mobility choices, as enabled by MaaS in general and MyCorridor in particular, has a positive social component since it could potentially increase the number of trips.

KPI 1 is estimated by recording the number of MyCorridor trips successfully completed by each user, which is then compared to those reported by them in the baseline scenario.

3.1.5.1.2 Modal shift (KPI 2)

One of strongest benefits MyCorridor could bring is the realisation of modal shifts towards more sustainable forms of transport, even though there is very limited evidence to demonstrate that this is always the case for MaaS solutions, which requires long-term deployment of MaaS. To date, empirical evidence has shown that modal shift is mainly towards PT, which is supposed to be the backbone of MaaS; however, MaaS builds on the idea of user-centeredness whereby tailored mobility services are offered based on the situational contexts and specific users' needs.

Therefore, MyCorridor also sought to demonstrate that MaaS can bring positive modal shift not only towards PT, but also towards other private forms of sustainable transport such as carsharing, carpooling, walking and cycling modes.

KPI 2 is estimated by recording all service(s) and transport modes selected by MyCorridor users to perform their trips; the resulting selection is then compared against the previous choices made by them in the baseline scenario to derive a modal shift.

3.1.5.1.3 Number of multimodal trips (KPI 3)

Empirical evidence shows that MaaS could result in more multimodal trips performed by using a combination of transport modes; enabling factors that would allow this choice is the possibility to get real-time travel updates for individual services, as well as the possibility to book and pay for mobility services chosen for individual leg of the multimodal trip.

KPI 3 is estimated from KPI 2 by deducting the number of trips using only one mode of transport.

With reference to the calculation method stated above, it should be noted that not in all pilot sites the KPI can be calculated as the availability and diversity of transport modes may differ across pilot sites significantly; as a result, the concrete possibility to estimate the indicator ultimately depends on the situational or contextual restrictions that can affect the estimations and subsequent inferences.

3.1.5.1.4 Attitudes towards PT, sharing, etc. (KPI 4) & perceived accessibility to transport (KPI 5)

Current use of shared mobility forms, also including PT, and perceived levels of transport access were asked to users via baseline and post-testing questionnaires (based on Likert scale questions) to evaluate potential user benefits resulting from the use of MyCorridor application.

3.1.5.1.5 Total travel cost per individual (KPI 6)

Empirical case studies show that MaaS can result in a decrease of total travel cost for individuals but not for all members of the household. However, this may not only vary in relation to the specific combination of services used, but it is also dependent on the number of services provided to the specific MaaS application, i.e. the greater the size of the service spectrum the greater the travel cost gains that may result for travellers.

A travel cost comparison between trips undertaken in the baseline scenario and with MyCorridor implemented was made; this provided a net change in travel cost per individual over a given period, i.e., the duration of MyCorridor testing operations.

To enable a sound comparison, baseline user questionnaires and logged trip data were pivotal to capture information regarding travel times incurred by users to perform their most frequent trips; the total travel cost per individual was calculated by multiplying average individual travel times by country-specific cost factors (expressed in €/h) associated to the "in-vehicle travel time" experienced by road-based transport users in both the baseline and MyCorridor scenarios. While this calculation method is based on the assumption that most MyCorridor trips used road-based modes, more details on the specific calculation method are given within section 4.1.1.6.

It should also be remarked that, in a real-life operational setting, travel cost changes would also be driven by the competition amongst market players which would potentially translate in a minor cost for travellers; however this could not considered in MyCorridor given the pilot scale of the assessment.

KPI 6 is estimated by applying country-specific hourly travel time cost factors to the amount of in-vehicle travel time experienced by a certain MyCorridor road transport user; these values are then compared to the travel costs incurred by users in the baseline situation to devise a net change.

3.1.5.1.6 Total travel time per individual (KPI 7)

A reduction in total travel time, having both a social, economic and environmental component, might be expected from the operation of MyCorridor. Ad-hoc questions were included in baseline users' questionnaires to determine the travel time spent by users to perform trips before the introduction of MyCorridor; this was compared against the travel time experienced to conduct similar trips using MyCorridor. The total travel time gain per individual is derived from time savings over the whole duration of the testing period.

KPI 7 is calculated through the following steps: 1) the travel time experienced on average by MyCorridor travellers is calculated from the recording of timestamps at both origin and destination locations of each MyCorridor completed trip; b) the resulting average travel time for MyCorridor trips is compared to that experienced on average by users in the baseline scenario to derive a net change.

3.1.5.2 Business/organisational level

3.1.5.2.1 Number of customers (KPI 8)

Given the potential reduction in personal vehicle ownership and use, MyCorridor may generate positive impacts for other service providers who could experience an increase of their customer basis, following the users' shift towards alternative transport modes such as PT, carsharing and active modes (e.g., bike-sharing). To assess the impacts on their business operations, there may be a lack of information needed to establish the baseline conditions (such as the current customer numbers and related revenues) due to privacy and commercial concerns. Therefore, to estimate these impacts, the number of users selecting a specific service (other than the private car) for completing a MyCorridor trip was used. This result was also complemented by questions to service providers (chapter 5) by asking them whether MyCorridor would have resulted in a positive impact to their business (i.e., customers growth level over the testing period).

KPI 8 will be estimated from KPI 2 (i.e. number of users switching from private car to other modes)

3.1.5.2.2 Customer segments (KPI 9)

An interesting point of debate around MaaS is whether the service should target only a specific customer segment or geographic area. In addition to this, MyCorridor is also expected to increase its pontential to promote sustainable travel thanks to the services and the advanced traffic management features specifically provided to car users to optimise their journey to destination.

The ability to attract a diverse range of customers also depends on the efficiency of the booking functionality, the payment model adopted, and the charges made by each service provider. It is worth noting that in the case of UbiGo, on the one hand the minimum monthly subscription fee required made the service less attractive to single-person households and retirees, while on the other hand the flexibility of the system to personalise own subscription contents, and therefore the opportunity to provide transport services based on situational factors and the actual needs of customers, made it attractive to diverse user groups with differing levels of transportation expenditure.

Upon segmenting users according to a range of socio-demographic characteristics measured (i.e. age range, education and living situation), KPI 9 is estimated by reporting the share of users segments using MyCorridor services.

3.1.5.3 Environmental/societal level

3.1.5.3.1 CO_2 emissions (KPI 15)

CO_2 emissions reductions from road-based transport activity are linked to the reduction in vehicle trips or the modal shift achieved (i.e., from private cars to other modes). Several estimation methods have to date been proposed by experts, most of which are based on the application of emission factors (representing the mass of CO_2 per fuel consumed or distance travelled, depending on the type of vehicle, fuel type, vehicle age and speed) to the distance travelled or the fuel consumed (European Environment Agency, 2016); alternative studies adopted a modelling approach to estimate the amount of CO_2 from road transport (Linton et al., 2015).

MyCorridor is likely to result in a reduction of private car-based trips and/or shift of mileage between modes, which may ultimately result in a relative reduction of road-based CO_2 emissions. In addition, MyCorridor also aims to enable a paradigm shift for car users by extending the TM2.0-derived functionalities (e.g., parking availability information; route planning; real time traffic state and forecast) to provide a solution that incorporates multi-modal, seamless, flexible, price-worthy and environmentally sustainable travelling across pilot countries. This results in additional environmental benefits which could not be assessed in MyCorridor with the collected data.

Therefore, to estimate this KPI, a more conventional approach ws used; typical fuel consumption rates and CO_2 emission factors (expressed respectively as grams of fuel per distance travelled and kg of CO_2 per km of fuel), specifically depending on vehicle categories and fuel types, were respectively applied to the distances travelled (by bus and private car) and the total fuel consumed before and after the introduction of MyCorridor to derive the total emitted CO_2.

It should be however noted that the above emissions reduction that is expected from MyCorridor may not always materialise in all pilot sites since there are restrictions to the calculations due to the fact that a semi-real user testing framework with selected routes and services per pilot site is applied.

KPI 15 is computed by applying typical fuel consumption rates and CO_2 emission factors, varying by different vehicles categories and fuel types used, to the travel distances performed by bus and private car modes in both the baseline and MyCorridor scenarios.

3.1.5.3.2 Resource efficiency (KPI 16)

Further to a potential reduction in the overall number of trips made and a shift towards more sustainable modes, a minor land use may be required in cities to meet the lower parking demand. This is also expected to be facilitated through the advanced traffic management features, i.e., TM2.0, by coupling travel demand with parking availability.

KPI 16 could be assessed by calculating the number of car users that in the baseline scenario required a parking space at their origin/destination locations (information derived from the baseline traveller questionnaire) and that, following the introduction of MyCorridor, switch to transport modes other than the private car.

KPI 16 is estimated through KPI 2 (i.e., number of users shifting from car mode to other transport modes that required a parking space at origin/destination locations in the baseline situation).

3.1.5.3.3 KPI 17 to KPI 20

Baseline and post-testing questionnaires (based on Likert scale questions) were used to evaluate potential user benefits resulting from the use of MyCorridor application and regarding the following aspects: citizens accessibility to transport services (KPI 17), citizens' overall comfort and wellbeing (KPI 18), trustworthiness in transport (KPI 19), security and safety of citizens (KPI 20).

3.1.5.3.4 Modification of vehicle fleet (KPI 21)

KPI 21 is directly linked to the type of vehicles and the specific services accessed by travellers. MyCorridor can have a direct positive impact on facilitating the transition towards the use of shared, electrified and autonomous vehicle fleets. This impact can be assessed by calculating the proportion of MyCorridor end-users using such services.

KPI 21 is estimated by deriving the share of travellers accessing shared vehicle services to perform a MyCorridor trip and comparing this to a similar result observed in the baseline situation to derive a net change.

3.2 Simplified Multi-Criteria Analysis

3.2.1 Introduction

In the transport sector, the multi-criteria analysis (MCA) methodology attempts to develop a structural debate among mobility-related stakeholders and come to informed compromises to implement effective policy measures. The adoption of the SMCA in MyCorridor is based on the belief that transport projects quite often bring practical controversies leading sometimes, in extreme cases, to the formation of local action groups challenging the specific transport measure in question; to overcome this, MyCorridor engaged with stakeholders to reach a compromised and balanced solution meeting the needs of all parties.

Drawing on the results obtained through the CIA concerning the diverse impacts MyCorridor may have over different dimensions (i.e. society, economy and the environment) and by relying on structured discussions with representative sample of local stakeholder networks of the pilot sites (in the forms of focus groups and individual interviews), the application of the SMCA methodology aims at conceiving and evaluating the different deployment paths that may be possible for MaaS in general, and MyCorridor in particular, in the short-to-medium term horizon, i.e., 3 to 5 years.

3.2.2 Methodology

The SMCA aims at evaluating the possible deployment paths for MaaS beyond MyCorridor project lifecycle taking into account objectives, criteria and needs of all stakeholder in the value chain in order to come to common informed evaluation of alternatives.

Evidence available from recent MaaS trials across Europe has shown that MaaS not surprisingly developed in areas of dense population where accessibility to transport is generally good. Particularly, the main findings of field operational tests (FOTs) conducted by UbiGo in 2013 were that MaaS was found to be very attractive for people living in the city centres and for those owning a car and living in the city centre (of the UbiGo car owners in the city centre, 73% gave it up during the UbiGo FOTs); furthermore, pilot data analysis showed that, for city centre subscribers, a service such UbiGo is considered to mainly attract households in areas with (i) high availability to PT in terms of routes and frequency and (ii) access to car-sharing within less than approximately 300 m. On the contrary, UbiGo was instead found less attractive for car-owning couples (of the 25% couples being single-vehicle households half of them gave up their cars) and more attractive for families with children (of car-owning families with adult children (67% of such households), 100% gave up their cars) (Karlsson et al., 2017). This is expected to not be the case in MyCorridor, where the TM2.0 feature should also result in MyCorridor being attractive also to car drivers.

In light of this, there is growing interest in the public debate around MaaS in understanding how the MaaS offering can fulfil the needs of populations not well served by PT that still depend on car ownership to execute their daily trips, such as is the case for citizens living in rural or suburban areas. These factors may generate, in general for MaaS, concerns over the commercial viability of MaaS given the often-insufficient level of aggregated demand outside densely populated areas to deliver a viable service; as a reflection of this, substantial public funding injection may be required, such as has very often been the case for community transport and demand-responsive transport systems operating in rural areas. It should be pointed out that the above concernes are expected to be more limited for MyCorridor, given the significant benefits it can offer also to car drivers living and/or working in rural areas by providing traffic management services helping them to optimise their journey to destinations.

In addition, a public-led MaaS implementation presents a potentially transformative approach to achieving socio-economic and environmental policy goals meeting local governments' agenda while pursuing inherent triple bottom-line philosophy, i.e., addressing economic viability as well as social and environmental concerns at once (Ciccarelli et al., 2018). However, whilst factual evidence of the benefits of MaaS on such impact areas have not yet fully developed, there is also a growing concern that MaaS may develop through private sector initiatives, giving rise to the concern that the resulting competitor market would be distorted and that the public sector may need to adapt and regulate accordingly to keep the pace with the private sector.

The WP6 team co-developed and applied the SMCA to explore how MaaS in general, and MyCorridor more specifically, may develop across the two dimensions of Urban/Rural and Public-led/Private-led beyond the project lifespan, these being:

- **Public-led governance** – the MaaS offering is entirely driven by public procurement and government regulation, thus it results more attractive to users, PT and mobility operators, and allows decision makers to realise positive economic, social and environmental impacts;
- **Private-led governance** – the MaaS offering is entirely driven by private organisations, which would be required to form collaboration and partnerships directly with transport operators/authorities; the ultimate goal of this governance model is the maximisation of the revenue potential;
- **Urban scale** – the offering of a number of commercially-viable services, such as personal transport and mass transit systems, is enabled by the high demand density; the focus is on ease of modal of modal interchange among different mobility services;
- **Peri-urban/rural scale** – the number of transport modes and mobility services available to users are limited by the lower demand density to the extent that the focus is placed on mobility solutions more flexible and personalised to individual users' needs, such as community transport systems, demand-response transport solutions and personalised carsharing services.

The application of the SMCA involves 6 steps:

- definition of possible alternatives or scenarios *(step 1)*;
- identification of stakeholder groups *(step 2)*;
- identification of stakeholder criteria and importance rating *(step 3)*;
- scenario evaluation by stakeholder criteria *(step 4)*;
- elaboration of multi-stakeholder evaluation charts of alternatives *(step 5)*;
- formulation of conditions for EU-level MaaS deployment beyond the project lifecycle *(step 6)*.

Four possible deployment scenarios resulting from the combination of the above dimensions will lead to different deployment paths of MyCorridor in the short to medium term horizon, whch were also used in *Deliverable 7.1 Mobility Services Aggregator Business Model* (MyCorridor project, 2020); such scenarios represent the alternatives that will be evaluated with the SMCA methodology in chapter 5, according to stakeholder objectives and criteria (*step 1*). These scenarios are described below.

S1) **MaaS marketplace with many multiple services and limited integration**
There is strong competition among key market players over profitable customer demand segments, which results in multiple systems being made available to users in urban areas; however, a potential low integration of service offerings restricts the large-scale adoption of MaaS.

S2) **MaaS marketplace with high access costs and high car dependence**
The relatively low population density in suburban-rural areas makes users experiment high cost to access MaaS offering, therefore there may be a lack of critical mass limiting the quality of the service (in terms of frequency, waiting times, etc.), thereby users may still be dependent on car ownership.

S3) **Public-led MaaS governance model through procurement systems and minimum requirements**
Public-sector entities govern the MaaS ecosystem, whereby services delivery is heavily driven by procurement systems and minimum requirements, which ensure that the overall MaaS service offering is capable to seamlessly meet the diverse needs of customers.

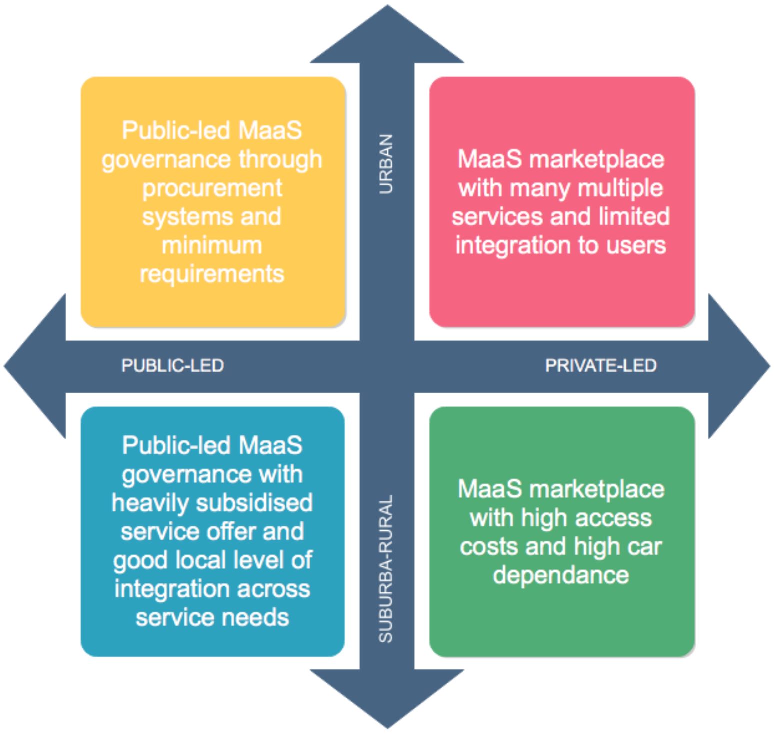


Figure 3 SMCA scenarios. Source: MyCorridor adaptations from IET, 2020.

S4) **Public-led MaaS governance with heavily subsidized service offer**
Public-sector entities govern the MaaS ecosystem, which is constituted by heavily subsidised services that are capable of offering service at no more than satisfying levels. Nevertheless, the public-led nature of service delivery does provide a good level of integration across service needs such as school trips, hospital visits, etc.

The *second step* of the SMCA concerns the identification of stakeholder groups, that is groups of stakeholders with the same objectives; the stakeholders to be considered in MaaS are end-users, transport service providers, PT operators, data providers, IT/ITS developers, local authorities, national and regional government bodies; obviously, the heterogeneity of the stakeholders will result in a methodological challenge to structure the objectives and needs of all actors involved.

The stakeholders involved in a given situation usually work towards different and sometimes conflicting goals, therefore, in order to properly evaluate each of the above scenarios, the full understanding of the criteria by which each stakeholder group judges the different alternatives appears of utmost importance.

By means of an accurate literature review, stakeholders' main objectives and criteria were identified representing what the above stakeholder categories would like to achieve by 2030 in their field of core activities. Adopted criteria to be rated by stakeholder are the following ones: increase revenue/profits; increase passengers/travellers; optimise integration between transport modes; improve customer satisfaction; create possibilities to extend the network and service offering; increase safety and/or security of operations; improve environmental sustainability; improve transport equity and inclusion.

Weights needed to be assigned to criteria to rate the importance that stakeholders attach to each specific criterion; weighting factors were determined through means of online surveys at the stakeholder consultations (*step 3*).

The evaluation of the four possible MaaS deployment scenarios were carried out qualitatively by stakeholders by assigning, for each scenario, a qualitative impact score to all criteria that the specific scenario would have an impact on, thus measuring scenario impacts in terms of their contribution towards reaching stakeholder's criteria (*step 4*); impact scores were given in relation to a baseline scenario representing the existing situation today, since the four alternatives represent all possible future deployment paths of MyCorridor.

Scenario evaluations were also represented through multi-stakeholder impact evaluation charts, where the horizontal axis shows the stakeholders' criteria and the vertical axis being the combined impact evaluation taking into account evaluations from all stakeholders (*step 5*).

Following this, additional questions were also asked to stakeholders in relation to the impact that MaaS would have on the business ecosystem of their region as well as what policy measures and regulatory actions would be needed in order for MaaS to be successful in the medium-term period. Typical questions that were asked are included in **Table 15**, among which potential opportunities arising from COVID-19 were also explored.

Table 15: Additional questions for the local stakeholder consultations.

Typical questions
What benefits do you see for your organisation in being part of an ecosystem such as MyCorridor?
What types of impact would you expect for your organisation in the medium-term period (3 to 5 years) from being part of MyCorridor?
What types of barriers and inhibitors should be overcome to develop a fully functional and widespread MaaS ecosystem?
What do you think will be required to make the most out of MaaS in your city? What policy changes and regulatory actions would be necessary?
What is the most important thing MaaS can offer now that we have COVID-19?

3.2.3 Data requirements

As mentioned before, focus groups and stakeholder interviews were conducted to gather the necessary data to apply the SMCA and ultimately investigate possible future deployment scenarios of MaaS in general (and MyCorridor in particular), as well as to explore additional impacts on business organisations participating to MaaS; key policy and regulatory issues and recommendations to overcome them, thus enabling for a future viable MaaS deployment, were also identified. Chapter 5 of this Deliverable describes the full details on the data collection exercise, including method, participants and results.

4 Core impact assessment results

This section reports the semi-quantitative results of the CIA methodology that has been applied in MyCorridor to assess impacts on society, economy and the environment for end-users, whilst the remaining impact results for other stakeholders will be reported in chapter 5 (i.e., KPIs 11-14, 22).

KPI absolute values are hereinafter given for a specific time reference period (i.e., the whole duration of the second evaluation phase) and provided for both the baseline scenario (i.e., relating to when the MyCorridor solution had not yet been deployed) and a scenario called 'MyCorridor' relating to results obtained by observing and recording traveller choices made using the MyCorridor application to conduct users' trips. In addition, before-after figures are also expressed by the average percentage change to allow a sound before-after comparison of KPI values.

4.1 Individual/user level

4.1.1 KPI results

4.1.1.1 Total number of trips (KPI 1)

KPI 1 was calculated by recording the total trips logged by the MyCorridor application and comparing them to those carried out by travellers in the baseline conditions (i.e., derived from baseline traveller questionnaires) within the same reference period (i.e., the duration of the 2nd round pilot testing period).

Since there were a limited number of trips that could be logged by the MyCorridor application, mainly due to the effects of travel restrictions imposed at EU level to contain the spread of the COVID-19 virus, in order to provide a meaningful before-after comparison basis, baseline trips have been re-calculated by multiplying the average weekly trip frequency for individual countries – as derivable from baseline questionnaires – by the duration of the second testing phase (i.e. 22 weeks) and the number of users (i.e. 147 baseline users); in addition to this, the resulting baseline trips were also factored down by 80% in order to account for the effects of current travel restrictions that affected the operations of the whole user testing period. This assumption appears to be consistent with evidence provided by a recently commissioned European Parliament study on the impacts of COVID-19 on urban mobility (Lozzi et al., 2020).

Table 16 summarises the distribution of users and trips for the baseline situation and MyCorridor scenario respectively.

Table 16: KPI 1 results: total number of trips.

Baseline users	147
MyCorridor users	160 (14 trips/user)
Baseline trips	2088
MyCorridor trips	934 (6 trips per user)
KPI 1 change (MyCorridor vs. Baseline)	-55%

A KPI 1 change of -55% (equating to -57% in terms of the number of trips/user) would result from the above calculations and assumptions, which reflects the potential of MyCorridor to result in a less number of trips performed by travellers with respect to the baseline situation, thus resulting in positive environmental gains. However, it should also be noted that the restrictions imposed in the pilot countries, which resulted in a general drastically lower level of travel demand across Europe, further hindered the conduction of additional MyCorridor trips - under the emergency circumstances an objective difficulty was faced by local pilot teams in recruiting (and retaining) travellers for the trials, i.e. convincing travellers to take part (or continuing to participate) to the trials and conduct trips. This contributed to further reducing the number of MyCorridor trips and therefore increase the negative percentage change.

4.1.1.2 Modal shift (KPI 2)

KPI 2 results are fully reported in **Table 17**, where the sample size in brackets represents the total number of mobility choices made by travellers, thus representing each an individual leg of a user's journey.

Following calculation of modal split based on the full set of observations, including both individual modes and their combinations to perform the trips, uses of individual modes were compared against each other to devise a meaningful change; this means that all mobility choices made for every individual leg of a user's journey were considered to build the overall data samples. Whilst a slight increase in the private car mode use was recorded (+2%), which is considered to be driven by the attractive value of MyCorridor for car drivers (and the subsequent traffic efficiency and environmnental benefits) thanks to the advanced traffic management features, a modal shift favouring both buses and cycling modes was also observed, with respective increases being at +15% and +10%.

Table 17: KPI 2 results: modal shift.

Mode	Baseline modal split (n=401)	MyCorridor modal split (n=756)	Baseline individual modes (n=484)	MyCorridor individual modes (n=553)	KPI 2 change (MyCorridor vs. Baseline)
Walking	16%	0%	14%	0%	-14%
Bus	15%	26%	26%	41%	+15%
Rail	7%	7%	13%	7%	-6%
Car	24%	41%	31%	33%	+2%
Cycling	8%	0%	10%	20%	+10%
Taxi	1%	0%	1%	0%	-1%
Metro	7%	0%	6%	0%	-6%
Car + Rail	4%	0%	-	-	-
Bus + Cycling	3%	25%	-	-	-
Car + Bus	9%	0%	-	-	-
Bus + Rail	4%	1%	-	-	-
Total	**100%**	**100%**	**100%**	**100%**	-

4.1.1.3 Total number of multimodal trips (KPI 3)

An overall increase in the number of multimodal trips conducted by users was recorded with MyCorridor, representing an overall +6% of the total multimodal trips carried out, corresponding to a net before-after difference of 120 multimodal trips. As established earlier, key enabling factors helping materialise an increase in KPI 3 is the possibility to get real-time travel updates for individual services, as well as the booking and payment functionalities for mobility services chosen for individual legs of the multimodal trip.

Nevertheless, it should be noted that this figure is biased by the high number of bicycle trips which were carried out in the Greek pilot site, where the use of the Municipality's bike sharing system and bus services, often used in combination, were the only two travel options chosen by users taking part to the trials. In all other sites, the simultaneous availability of both the private car, buses and rail modes make their relative results more comparable; as a result, taking the "bus + cycling mode" off the overall dataset, a significant decrease in the overall number of multimodal trips would result with respect to the baseline situation, i.e., -24%.

Table 18: KPI 3 results: number of multimodal trips.

Mode	Baseline multimodal trips (n=83)	MyCorridor multimodal trips (n=203)	KPI 3 change (MyCorridor vs. Baseline)
Car + Rail	22%	1%	-21%
Bus + Cycling	17%	93%	76%
Car + Bus	42%	1%	-41%
Bus + Rail	19%	5%	-14%
% of total trips	21%	27%	+6%

4.1.1.4 Attitudes towards PT and other shared modes (KPI 4)

MaaS is a flexible tool that enables a dynamic equilibrium between transport supply and demand to meet the heterogeneous needs of all transport stakeholders. To realise this, the simultaneous increase of the MaaS service coverage and the growing presence of diverse mobility operators, including carsharing, ridesharing, can deliver wide ranging benefits for all types of users offering a concrete, viable alternative to the car ownership paradigm.

To measure users' attitudes towards shared mobility solutions as well as to ascertain the impact generated by MyCorridor in changing the existing travel behaviour, travellers were asked to indicate their level of use, on a Likert scale between 0 (lowest use) and 5 (highest use), of PT and shared mobility services (such as car share and bike share) before and after taking part to the user trials.

Users that participated to the baseline and post-trial surveys add up to a total of respective 147 and 107 travellers; a total of 46% users indicated a medium-to-high level of use of PT (i.e. indicated by 4 and 5 in the chart below) before taking part to the trials, which decreased to a total combined of 36% of users after having used MyCorridor; although this represents a 10% decrease in the number of users reporting a positive attitude toward PT, it should also be remarked that this result may have been triggered by the current pandemic situation and, particularly, by travellers being reluctant to use PT to perform their daily trips during the health emergency crisis. Similarly, access to innovative transport services, such as carsharing and bikesharing, saw a decrease in the share of users showing a positive attitude towards them, albeit the decrease in this case was much more limited, i.e., going from 11% in the baseline situation to 9% with MyCorridor; in addition, a before-after reduction of users (-13%, going from 53% to 40%) declaring lowest use of shared mobility solutions was also recorded.

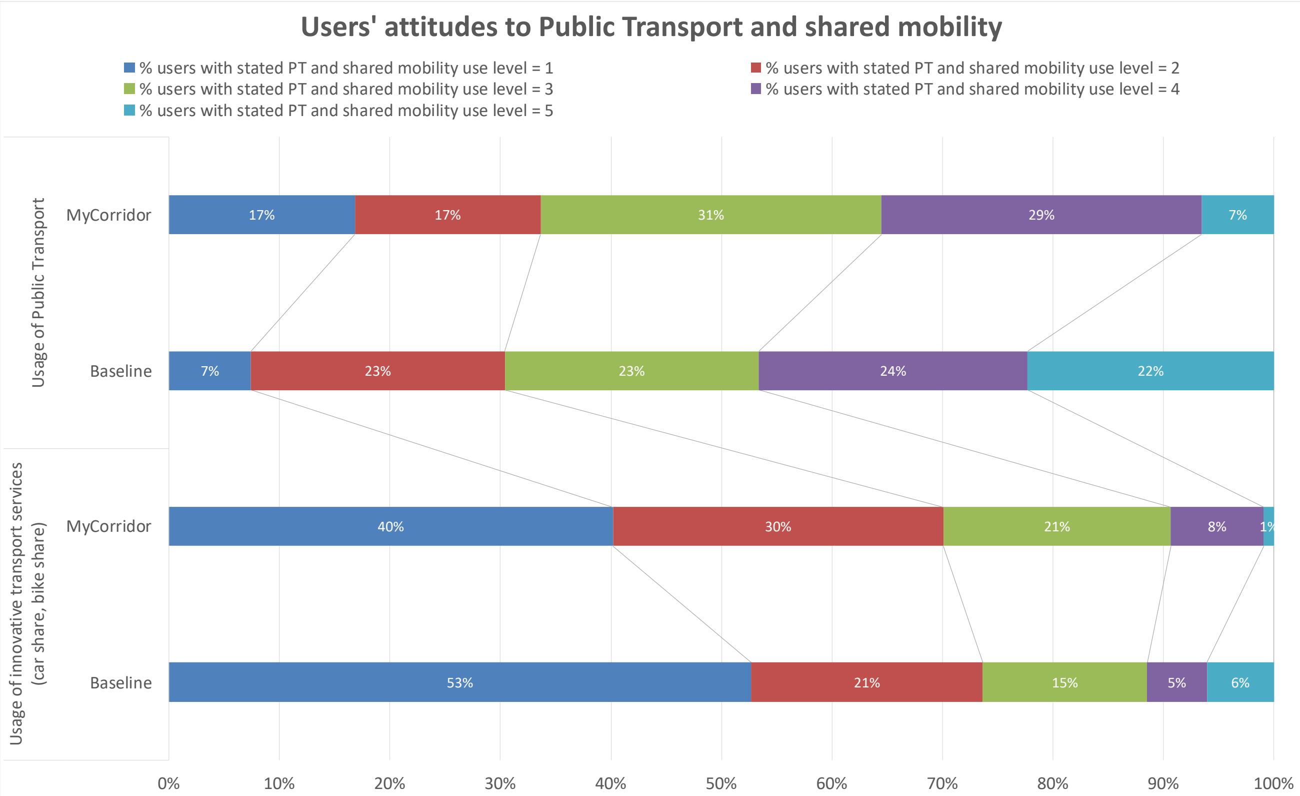


Figure 4: Breakdown of users by attitudes to PT and shared mobility.

The results below, indicate an overall unchanged level of satisfaction (median values) with the use of PT before and after the tests took place; on the other hand, users reported an improved attitude in the use of shared services thanks to MyCorridor, and this is considered to be produced by the added value offered by the advanced traffic management feature in connecting to other transport modes.

Table 19: KPI 4 results: users' attitude levels with PT and shared mobility services.

	Average values		Median values		Modal values	
	Baseline (n=147)	MyCorridor (n=107)	Baseline	MyCorridor	Baseline	MyCorridor
PT	3,3	2,9	3,0	3,0	4,0	3,0
Shared mobility	1,9	2,0	1,0	2,0	1,0	1,0

4.1.1.5 Perceived accessibility to transport (KPI 5)

Similar results to those above were gathered for the perceived overall accessibility to transport services; a larger proportion of MyCorridor users, as opposed to the corresponding baseline user share, perceived a decrease in transport accessibility for services including buses and trains, that is a perceived lower number of alternatives compared to the baseline conditions; this represents a 13% worsening compared to the baseline situation, which once again may have resulted from the same reasons outlined above.

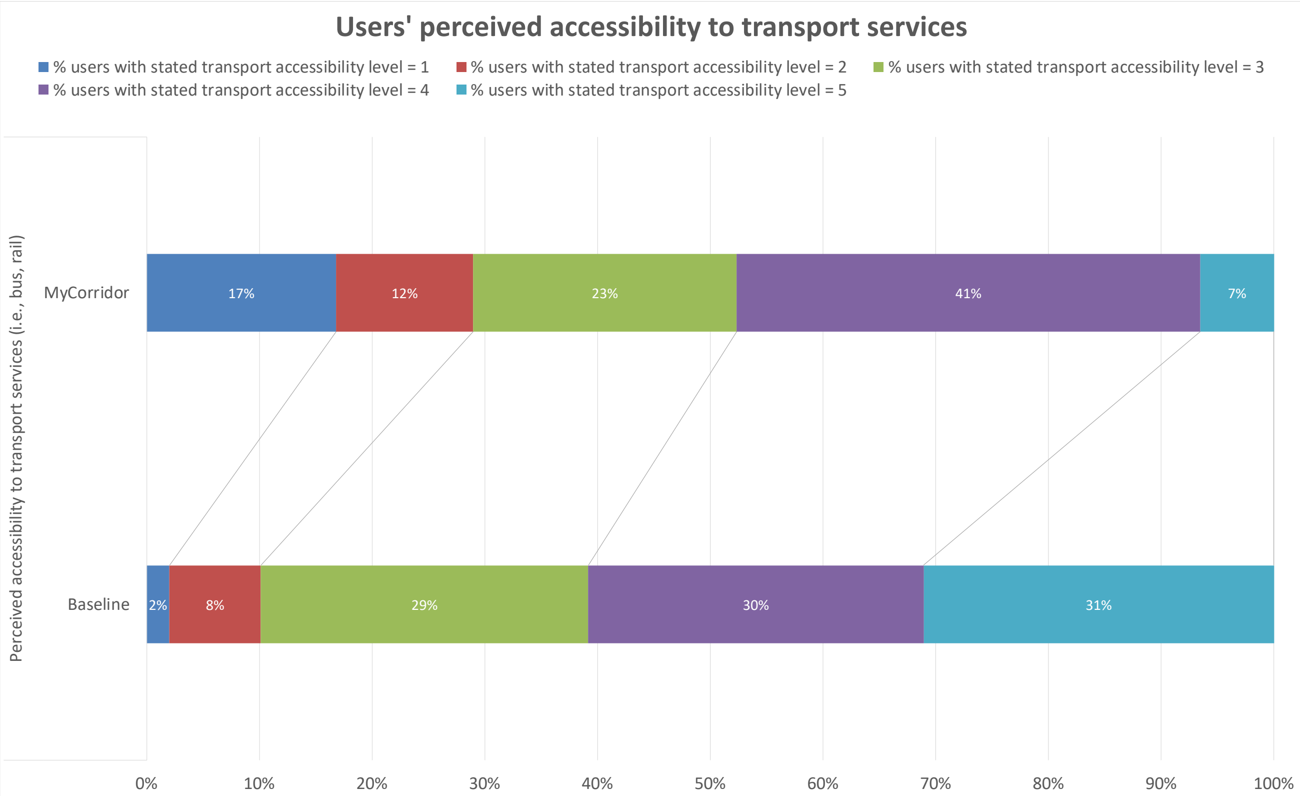


Figure 5: Breakdown of users by perceived overall accessibility to transport services

Table 20: KPI 5 results: users' perceived overall accessibility scores to transport services.

	Average values		Median values		Modal values	
	Baseline (n=147)	MyCorridor (n=107)	Baseline	MyCorridor	Baseline	MyCorridor
Perceived overall accessibility to transport	3,8	3,1	4,0	3,0	5,0	4,0

4.1.1.6 Travel cost per individual (KPI 6)

Due to the limited data available, a travel cost comparison was performed based on the calculation of travel costs arising from in-vehicle travel time experienced by travellers accessing car-based and bus services to execute their daily trips. Country-specific factors for individual hourly travel cost, expressed as €/user/h, were derived from the most extensive meta-analysis of values of time yet conducted (Wardman et al., 2011), covering 3109 monetary valuations assembled from 389 European studies conducted between 1963 and 2011. Such factors relating to the MyCorridor pilot countries are show in **Table 21**.

Table 21: Average of Country-specific cost factors for individual travel time (Source: Wardman et al., 2011).

Country	Cost factor for private car (€/user/h)	Cost factor for rail	Cost factor for buses
Austria	9,8	32,1	6,1
Czech Republic	6,0	19,2	3,8
Greece	6,8	21,4	4,3
Italy	7,7	24,9	4,8
Netherlands	10,3	34,0	6,4
Average	8,1	26,3	5,1

By also taking into account the different car, rail and bus mode shares observed in the respective scenarios, cost factors were applied to the average travel time per individual estimated in both the baseline and MyCorridor scenarios to devise a before-after change. While **Table 22** shows a negligible impact (+5%) in the average individual travel cost that was achieved, it is also considered that such effect might be limited to a minimum with a greater number of baseline observations and a more balanced use of services across pilot sites.

Table 22: KPI 6 results: average individual travel cost per hour (€/user).

	Baseline (n=147)	MyCorridor (n=746)	KPI 6 change (MyCorridor vs. Baseline)
Average individual travel cost per hour	3,9	4,1	+5%

4.1.1.7 Travel time per individual (KPI 7)

By comparing average individual travel times an increase of 18% between the baseline and MyCorridor scenarios derived from the calculations, however this translated in a minimum impact for travellers experiencing on average only an additional 6 minutes to execute their travels; this effect is compensated by the benefit of having a greater access to transport services and an increased level of services accessible on-demand, as demonstrated by evidence shown section 4.1.1.4 reporting an unchanged to improved users' attitude toward PT and shared mobility services.

Table 23: KPI 7 results: average individual travel time (minutes/user).

	Baseline (n=147)	MyCorridor (n=746)	KPI 7 change (MyCorridor vs. Baseline)
Average individual travel time (minutes/user)	32,2	38,0	18%

4.1.2 KPI results summary

The box below summarises the impact results achieved for individual KPIs in qualitative terms, i.e., either positive, negative or negligible impacts, and the associated research questions that were addressed with the analysis. From the evaluation of the impact results achieved within the individual assessment level which were presented in previous sections, it resulted that, from the operation and use of the MyCorridor application in the pilot sites, there is a positive impact on facilitating a positive behaviour towards sustainable travel modes (which answers RQ1 and RQ3); on the other hand, a significantly positive impact on the overall city-wide mobility system could not be demonstrated (which answers RQ2).

KPI description → KPI qualitative result → associated research question

KPI description	KPI qualitative result	associated research question
total number of trips	positive	RQ1
modal shift	positive	RQ1
number of multimodal trips	positive	RQ1
attitude towards PT and sharing	positive	RQ3
Perceived accessibility to transport	negative	RQ3
Travel cost per individual	negligible	RQ2
Travel time per individual	negligible	RQ2

4.2 Business/organisational level

4.2.1 KPI results

4.2.1.1 Number of customers (KPI 8)

The use of MyCorridor application resulted on the one hand in a combined reduction of walking, rail, taxi and metro modes of approximately -27%, while an increase in bus services (+15%) and cycling modes (+10%) was also observed.

This modal shift, resulting from the selection of specific services for any given leg of a traveller's journey, constitutes a customer increase for bus service providers (+101 times bus services were selected to perform a trip leg) and for bike sharing service (+62 times); therefore, providers are expected to have gained a positive economic impact from the operation of MyCorridor.

Table 24: KPI 8 results: number of customers.

Mode	Baseline individual modes (n=484)	MyCorridor individual modes (n=553)	KPI 2 change (MyCorridor vs. Baseline)	KPI 8 change for bus users (MyCorridor vs. Baseline)	KPI 8 change for cycling users (MyCorridor vs. Baseline)
Walking	14%	0%	-14%	101	62
Bus	26%	41%	+15%		
Rail	13%	7%	-6%		
Car	31%	33%	2%		
Cycling	10%	20%	+10%		
Taxi	1%	0%	-1%		
Metro	6%	0%	-6%		
Total	**100%**	**100%**	-		

4.2.1.2 Customer segments (KPI 9)

Considering the highly complex interplay of different factors (i.e., age, gender, education, living condition, transport access levels, household composition, residential location, car ownership) and the required high volume of data to establish cause-effect relationships between situational factors and MyCorridor use, no exact calculation can be made as to how many households could become MyCorridor users or how many households' members may become users of sustainable transport alternatives.

However, customer segments for both baseline and MyCorridor scenarios presented below suggest a major use of the MyCorridor application by males (73%), people aged 26-45 (63%) and those highly educated (82%). Additional descriptive statistics shown in **Table 27** suggest a greater propensity to use the MyCorridor application for family members (66%), either living with partners or with children, who experience a convenient and easy way to access their daily travel options; moreover, there appears that MyCorridor was considered an attractive service not only by frequent PT users (36%), but also by family members with access to at least an own private or shared car (87%), since these may want to explore an alternative paradigm to execute their travels and definitely benefit from MyCorridor advance traffic management services. These findings are in accordance with evidence found by previous research and MaaS impact studies (Karlsson et al., 2017; Durand et al., 2018).

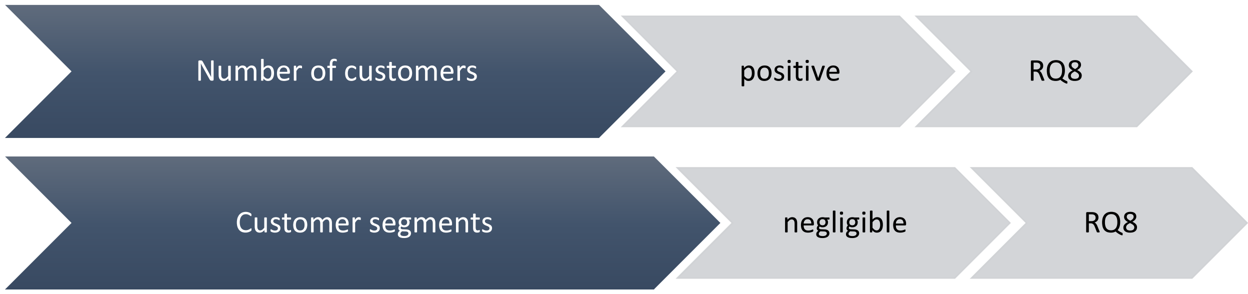
Table 25: MyCorridor customer segmentation.

Customer segments by gender	• Male: 73% • Female: 24% • Prefer not to say: 3%
Customer segments by age	• Under 18: 1% • 18-25: 7% • 26-35: 32% • 36-45: 31% • 46-55: 22% • 56-65: 7% • Above 65: 1%
Customer segments by education	• Elementary: 3% • Secondary: 14% • Higher: 56% • Postgraduate (MSc, PhD): 26% • Other: 1%
Customer segments by living situation	• Alone: 12% • Alone with children: 1% • With family/or friends: 13% • With spouse or partner: 28% • With spouse or partner and children: 38% • Other: 1% • Prefer not to say: 7%
Customer segments by car ownership level	• No car in the household: 13% • One car in the household: 60% • Two or more cars in the household: 27%
Customer segments by car PT use	• Monthly or yearly PT season ticket and no subscription to any other mobility services: 30% • Monthly or yearly PT season ticket and subscription to any of mobility services (bike sharing, car sharing, car rentals, ride sourcing etc.): 6% • No PT season ticket but subscription to any of mobility services: 7% • None of the above: 56%

4.2.2 KPI results summary

The box below summarises the qualitative impact results achieved for organisational KPIs and the associated research questions that could be addressed with the analysis. From the evaluation of impact result achieved within the organisational assessment level, it resulted that, from the operation and use of the MyCorridor application, positive effects were recorded in increasing the number of customers using bus and cycling modes (which answers RQ8); direct relationships between socio-demographic characteristics describing household members participating to the user testing and use of the MyCorridor application could not be established. Remaining RQs were addressed as part of the stakeholder consultations presented in chapter 5.

KPI description → KPI qualitative result → associated research question



4.3 Societal level

4.3.1 KPI results

4.3.1.1 CO_2 emissions reduction (KPI 15)

KPI 15 was computed by applying typical fuel consumption rates and CO_2 emission factors, varying by different vehicles categories and fuel types used, to the travel distances (by bus and private car) and the fuel consumed in the baseline and MyCorridor scenarios.

Particularly, the logical process for calculating road-based transport emissions involved the following operations:

- calculation of the total distance travelled by bus and private car in the baseline situation, which was obtained by multiplying usually travelled distances, stated by baseline survey respondents, for the whole length of the trial (i.e., as key reference period for the assessment of CO_2 emissions), the weekly trip frequency (i.e. usual number of trips performed by users per week), while taking into account a reduction factor taking into account the COVID-related effects in reducing the overall number of baseline trips over the reference period;
- calculation of MyCorridor trip distances by bus and private car based on mobile analytics data;
- typical fuel consumption rates, expressed a g of fuel consumed per unit of distance driven, were applied to the total distance travelled by bus and private car to derive the total amount of fuel consumed under both scenarios; typical consumption rates used are shown in **Table 26** for reference, with values in greyed out cells being those used in the calculations;
- typical CO_2 emission factors, expressed a kg of CO_2 per kg of fuel consumed, were applied to the total fuel consumed to conduct trips by bus and private cars in order to derive the total CO_2 emitted; typical emission factors used are shown in **Table 27** for reference.

With regard to the last two bullets, it was assumed that all buses in the pilots run on diesel fuel[1], while for private cars it was assumed a 50/50 split between petrol and diesel fuelled, which is consistent with 2018 data on the share of passenger cars by fuel type retrieved for the pilots from the Eurostat database.

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[1] *According to service provider data that was collected in MyCorridor hybrid buses are present only in the Netherlands, therefore the assumption is considered to be a good representation of the overall vehicle fleet in the pilot countries.*

Table 26: Typical fuel consumption figures, per km, by category of vehicle (Source: European Environment Agency, 2016).

Vehicle category	Fuel	Typical fuel consumption (g/km)
Passenger cars	Petrol	70,0
	Diesel	60,0
	LPG	57,5
	E85	86,5
	CNG	62,6
LCV	Petrol	100,0
	Diesel	80,0
HDV	Diesel	240,0
	CNG (buses)	500,0
Two-wheel vehicles	Petrol	35,0

Table 27: CO_2 emission factors for different road transport fossil fuels (Source: (Source: European Environment Agency, 2016).

Fuel	kg CO2 per km of fuel
Petrol	3,169
Diesel	3,169
LPG	3,024
CNG (or LNG)	2,743
E5	3,063
E10	2,964
E85	2,026
ETBE11	3,094
ETBE22	3,021

The simultaneous reduction of private vehicle and increase of bus service uses respectively resulted in a reduced environmental impact materialised from road-based transport activities (**Table 28)**).

This level of impact demonstrated that a MaaS service having PT and shared mobility at its core has a potential to substantially reduce pollutant emissions, while guaranteeing a more affordable and convenient access to transport services. It should also be mentioned that the level of bus use was rather limited during the whole duration of the pilot deployments given the current health emergency conditions, hence the impact that could materialise under normal circumstances will be much greater.

Table 28: Before-after comparison of distance travelled and CO2 emissions from road-based transport fuels.

	Baseline (n=147)	MyCorridor (n=746)
Total distance travelled (km)	25852	20597
Travel distance travelled by bus	6623	8437
Travel distance travelled by private car	7905	2751
Total fuel consumption by bus (kg of fuel)	1590	2025
Total fuel consumption by car	1897	660
Total CO_2 emissions (kg) by bus	5037	6417
Total CO_2 emissions by car	6012	2092
KPI 15 change (MyCorridor vs. Baseline)	**-23%**	

4.3.1.2 Resource efficiency (KPI 16)

KP 16 measures a potential land use gain that would result by a lower share of private vehicle use, to which correspond specific parking needs; this gain can be assessed by calculating the number of car users that in the baseline scenario required a parking space at their origin/destination locations (information derived from the baseline traveller questionnaire) and that, following the introduction of MyCorridor, switch to transport modes other than the private car (and therefore do not need that parking space anymore). However, despite the efforts in collecting data to enable such calculations, post-testing modal shift data provides a minor increase in private car use, i.e., by +2%, thereby a potential gain in terms of a more efficient land use could not be demonstrated.

4.3.1.3 Citizens accessibility to transport services (KPI 17)

The amount of both baseline and post-testing questionnaire data collected was not of sufficient volume to argue improvements/impacts for mobility restricted users; however, in MyCorridor, the inclusion of mobility restricted users in the profiling and the provision of the optimum services (e.g. by providing the information about the accessibility level of them) for them increases the potential of all-inclusive transport.

4.3.1.4 KPI 18 to KPI 20

Out of the total users that participated to the baseline survey, 59% indicated a medium-to-high level of satisfaction (i.e., indicated by 4 and 5 in the chart below) with general comfort and wellbeing whilst travelling (KPI 18), which decreased to a total combined of 33% of users after having used MyCorridor application, thus representing a major worsening of 26%. Similar considerations apply for KPI 20a and KPI 20b, i.e., transport safety and security levels. On the other hand, a minor user gain in transport trustworthiness of 8% could be assessed by comparing before and after scores assigned by survey respondents.

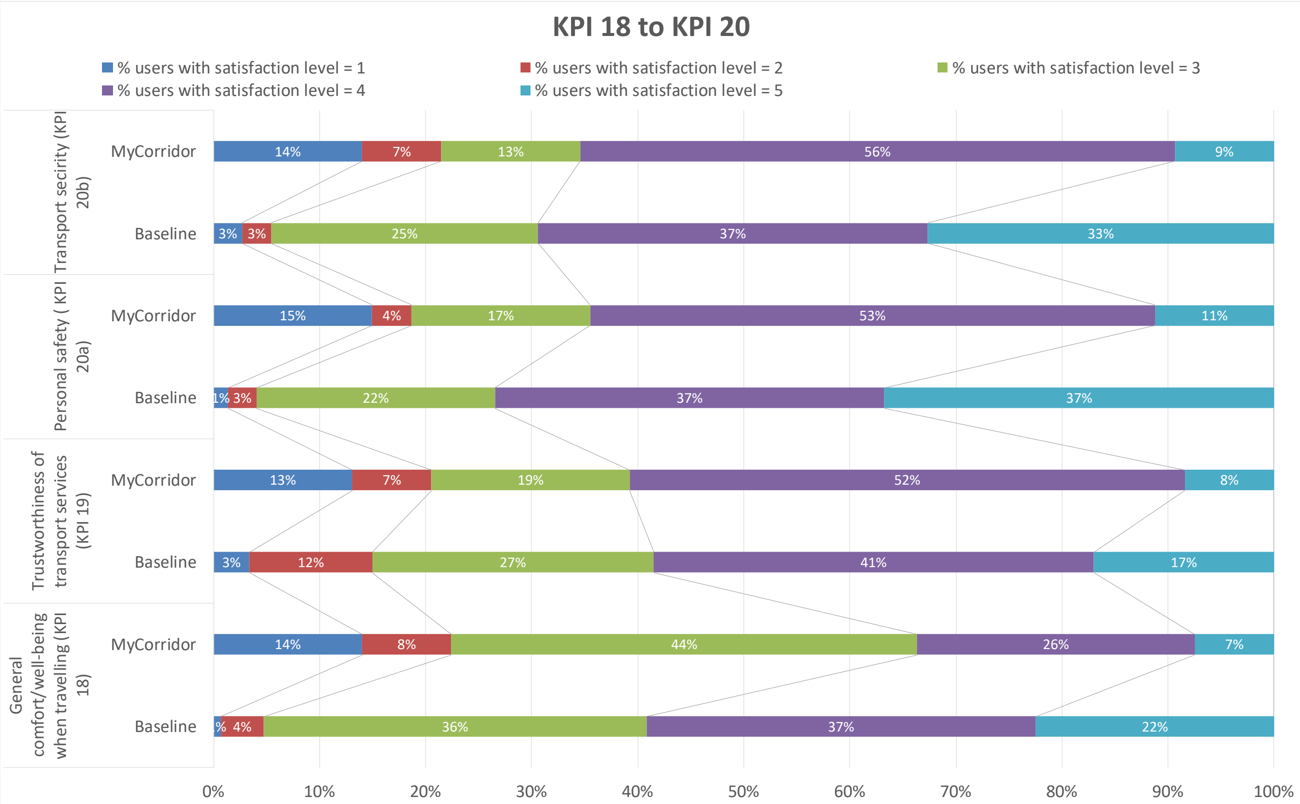

Figure 6: Breakdown of users by satisfaction levels with transport comfort (KPI 18), transport trustworthiness (KPI 19) and transport security and personal safety (KPI 20).

The results below, indicate an unchanged level of satisfaction (median values and modal values) with the general trustworthiness in transport as well as with personal safety and transport security, whereas a decrease in the level of satisfaction with general travel comfort could also be recorded, although this is again considered to be biased by the current travel restriction imposed at EU level.

Table 29: KPI 18 to KPI 20 results: level of satisfaction with general comfort and wellbeing (KPI 18), trustworthiness in transport (KPI 19), personal safety (KPI 20a) and transport security (KPI 20b).

KPI	Average values		Median values		Modal values	
	Baseline (n=147)	MyCorridor (n=107)	Baseline	MyCorridor	Baseline	MyCorridor
General comfort and wellbeing	3,8	3,0	4,0	3,0	4,0	3,0
Transport trustworthiness	3,6	3,4	4,0	4,0	4,0	4,0
Personal safety	4,0	3,4	4,0	4,0	4,0	4,0
Transport security	3,9	3,4	4,0	4,0	4,0	4,0

4.3.1.5 Modification of vehicle fleet (KPI 21)

MaaS has been argued to facilitate the electrification or automation of vehicle fleets, however, this impact could not be entirely demonstrated as MyCorridor used existing vehicle fleets. However, it is considered that MyCorridor also generate such type of impact given the recorded increase in the bike sharing mode;

if such increase usage is realised also by other shared, electrified and automated forms of mobility, and sustained by ad-hoc policies and incentives, the potential of MyCorridor to provide these services and, subsequently, the modification of vehicle fleets would easily materialise in a real-life operational setting.

4.3.2 KPI results summary

The box below summarises the qualitative impact results achieved for societal level KPIs and the associated research questions that could be addressed with the analysis.

KPI description →	KPI qualitative result →	associated research question
CO_2 emissions reduction	positive	RQ4
Resource efficiency	negligible	RQ4
Citizens' accessibility to transport	not addressed	RQ6
General travel comfort & wellbeing	negative	RQ6
Transport trustworthiness	unchanged	RQ6
Transport security and safety	unchanged	RQ6
Modification of vehicle fleet	not addressed	RQ4

4.4 Extrapolated potential

This section recaps the CIA results and provides qualitative considerations on the effects generated by COVID-19 on the deployment of MaaS as well as key solutions to overcome them.

4.4.1 Impact data findings

The application of the CIA methodology assessed the effects that were achieved by MyCorridor on different impact areas (society, economy and environment) and by assessment levels (user-, organisational- and societal level). A number of research questions and expected impacts were formulated, serving as a guide to steer the overall methodology, to which specific KPIs were associated to measure the attainment of such expected impacts. An overall summary of the impact results is shown in **Table 30** for reference.

Table 30: Overview of KPI results

	Assessment level	KPI description	KPI qualitative result
KP1	Individual/user level	Number of trips	
KP2		Modal shift	
KP3		Multimodal trips	
KP4		Attitudes towards PT and shared mobility	
KP5		Perceived accessibility to transport	
KP6		Travel cost	
KP7		Travel time	
KP8	Business/organisational level	No. of customers	
KP9		Customer segments	
K15	Societal level	CO_2 emissions reduction	
K16		Resource efficiency	
K17		Citizens accessibility to transport services	
K18		Citizens' overall comfort & well-being	
K19		Trustworthiness in transport	
K20		Security and safety of citizens	
K21		Modification of the vehicle fleet	

Positive impact	
Negligible impact	
Minimum negative impact	
Not possible to assess	

As presented earlier, positive effects could be demonstrated in relation to the reduction of the overall number of trips (KPI 1), a modal shift towards bus and cycling trips (KPI2), an increase in the number of multimodal trips (KPI 3) and a combined positive attitude towards shared forms of mobility (KPI4). In light of this and bearing in mind that residual effects in travel cost and travel time compared to the baseline situation were estimated to be negligible, all expected impacts belonging to the user level of the assessment (section 3.1.2) could be properly addressed demonstrating that MyCorridor has the potential to trigger a sustainable travel behaviour for individual users which in turn resulted in an overall positive effect on all impact areas.

Whilst these positive effects must be contextualised in a scenario which imposed strong travel restrictions across the EU throughout the operation of the pilots, in a real-life operational environment the materialisation of positive impacts are also considered to be significantly affected by the way in which the MaaS offering is packaged as well as by the specific mechanisms and incentives that can enable a behavioural change in favour of more sustainable travel choices.

The increase in customer numbers (KPI 8) for bus operators and bike sharing services demonstrated that the corresponding expected impact, stated as part of the organisational level of the assessment in section 3.1.2, could be materialised, reflecting in a positive economic impact that will derive from the use of MyCorridor; as a result, all types of businesses will benefit, including service providers who would experience increases in their customer basis with all traveller clusters being addresses thanks to personalisation features. The extent to which users' choices and the overall uptake are influenced by the high number of contributing situational factors (e.g., age, gender, education, living conditions as factors used to segment MyCorridor users) could not be directly established given the limited volume of contextual data and the high interdependencies among such factors. However, high-level findings obtained suggest a major use of MyCorridor application by males, people aged 26-45 and those highly educated (KPI 9); although this outcome may directly be biased by the specific recruitment and engagement strategies that were deployed to achieve the pilot targets, it is also supported by recent studies (Haahtela and Viitamo, 2017; Alonso-González et al., 2017) which showed that young adults and highly educated people are more likely to adopt MaaS.

In addition, MyCorridor application proved to be attractive for family members, living with partners and/or with children, representing more than 60% of the whole customer basis across all sites. To some extent, this result contradicts the evidence established by previous studies (Karlsson et al., 2017; Ho et al., 2017) which found MaaS to be less attractive for families with young children; nonetheless, even considering a lesser attractiveness for this customer segment, MyCorridor can still represent an opportunity to be explored before deciding to invest in a (second) family car as children are often a reason for investing in a family car. It is noted that the remaining expected impacts (e.g., on data sharing practices, collaboration opportunities), pertaining to specific research questions under the organisational level of the assessment, will be fully addressed as part of the results of the stakeholder consultations which are presented in chapter 5.

On the societal level, MyCorridor demonstrated a significant potential to reduce road-based CO2 emissions thanks to the modal shift achieved and the before-after change in vehicle mileage by different modes (KPI 15); moreover, whilst resource efficiency gains and modifications in the vehicles fleets could not be demonstrated given the respective light increase in the use of private car mode and due to the use of existing vehicle fleets by MyCorridor (as opposed to introducing new ones), it can be argued that negligible to minimum negative before-after impacts resulted in relation to a number of aspects, including citizens accessibility (KPI 17), general transport comfort (KPI 18), transport trustworthiness (KPI 19), personal safety and transport security (KPI 20). As a result, the only positive impact that MyCorridor could demonstrate within the societal level of the assessment (among those mentioned in section 3.1.2), consists in the major reduction in CO_2 emissions from road-based transport activity.

4.4.2 COVID-19 impact on MaaS deployment

In the attempt to containing the virus-spread, over the past months several European Countries were forced to reduce citizens' mobility with ever-increasing restrictions, such as the blocking of flights, the ban on inter-municipal travel and even total isolation in our homes during extreme circumstances. Following the gradual restart of the economic activities post-lockdown period, the various production sectors have been gradually adapting their work environments and routines to the safety requirements imposed by this new threat. However, in transport terms, the real challenge is to adapt systems to ensure safe citizens' mobility without losing out on operational efficiency and sacrificing the achievement of sustainable development goals.

These challenges clearly have direct implications on the long-term viability of specific transport solutions, including PT and shared mobility acting as the backbone of MaaS, and ultimately the sustainability of a fully integrated MaaS service encompassing both public and private operators. It is within this context that the impact results presented in this Deliverable should be interpreted since the pandemic scenario seriously affected the normal operations of the MyCorridor pilot testing.

From a demand-side perspective, the pandemic scenario has generated a shift in the criteria that users adopt to make travel choices (McKinsey, 2020); whilst cost and convenience have traditionally represented the key critical choice factors, the risk of infections is currently among the top decision criteria overtaking even destination time in importance. On top of this, as far as the selection of specific travel brands based on the evaluation of their responses to the pandemic is concerned, hygiene and health measures, clear and frequent communications, and flexibility for customers are the top three decision criteria for travellers, which may ultimately represent differentiation factors that further exacerbate competition among market players, thus representing a risk – or an opportunity if seen from the another perspective - for sustainable MaaS implementation. This change in the travel decision criteria currently adopted by users must be fully taken on board by service providers and MaaS integrators to ensure all travellers' needs are satisfactorily met.

From an operational perspective, PT operators have been undergoing serious losses due to the restrictive measures and the negative perception of the potential risk associated with the use of PT services; on the one hand, the travel restrictions not only caused reductions in vehicle capacity up to 25-50% and therefore revenue losses in terms of ticketing, but additional health and hygiene measures also contributed to increased operational expenditures. On the other hand, shared mobility operators were also affected by the crisis, to the extent that some had to diversify their revenue streams by using their passenger vehicles for delivery services. Indeed, despite the overall perception that the use of shared vehicles such as e-scooters, bicycles, mopeds and cars facilitate physical distancing, usage of their services was indeed discouraged by the risk of contagion due to the contact of different users with the same surfaces.

Under this climate of uncertainty, potentially hindering the required cooperation among diverse players within the MaaS paradigm, a recently published EU Parliament TRAN committee's study (Lozzi et al., 2020) identified a number of solutions that would enable overcoming the current challenges faced by service providers; among these are the following measures: PT systems re-establishing trust with their staff and the users through important sanitation measures, by guaranteeing physical distance, obliging passengers to use masks, and by making all cleaning and disinfection operations visible to commuters. More flexible and modern contractual forms should also be included in future tender procedures, such as temporary replacement of some routes with on-demand services; the introduction of more dynamic governance mechanisms to improve "real time" decision making; the inclusion of insurance requirements in the contract to mitigate the financial risk of collapses in demand in the case of crisis; the partial replacement of traditional transport by on-demand services, also in conjunction with shared mobility services, to accelerate and support the deployment of new business and operational models.

These measures can be easily implemented by embracing the MaaS concept at its fullest potential and utilising it as an enabler, which would ensure a more effective use of the resources that operators have at their disposal and allow to re-establish users' trust in public and shared mobility services. MaaS has in fact the potential to be a game changer for everyday mobility ensuring that the transport system is more integrated and resilient and that European cities are less congested and polluted.

5 Simplified multi-criteria analysis

5.1 Objective and scope

In addition to the KPI analysis, direct investigation and enquiry was conducted at pilot sites with relevant MaaS stakeholders (i.e., transport providers, MaaS service providers, ICT providers, policy and advisory bodies) based on the methodology outlined in section 3.2. While this work allowed to address remaining RQs (i.e., RQs 6, 7, 9) and KPIs (i.e., KPIs 10-14 and 22), it aimed at the overall understanding of both the perceived impacts of MaaS and any relevant contextual factors, such as barriers, benefits and policy, that would increase or minimise impact.

Specifically, the work had the following objectives:

1. identifying the overall perceived impact of MaaS;
2. understanding how impact would vary in accordance with business model and deployment setting (public vs private; urban vs rural);
3. identifying contextual factors that shape impact.

The work was conducted as a focus group or interview, structured round an online survey. The structured survey supported quantitative data capture while the discussion in the focus groups / interviews generated qualitative data around perceptions and attitudes that underpinned the data.

The work was conducted at the five pilot site countries. This was complemented by a sixth set of interviews conducted in the UK to broaden the data set and assess whether perceptions were local or global across multiple countries.

5.2 Stakeholder research method

The method for the focus groups was designed with a number of objectives and constraints in mind.

1. It was useful to capture qualitative data (i.e., participant opinions) wherever possible on the reasoning and perceptions of participants.
2. Participants should be from a wide range of stakeholder roles across the five pilot sites.
3. The focus group methodology had to be reproducible across a number of sites. This meant that the presentation of questions had to be consistent, and therefore structured enough to support translation and execution in the local language of the pilot site. Data collection tools also had to be structured to ensure equivalent data were collected across sites (Golightly et al., 2008).
4. The method had to be practical – it had to be easily understood by participants, and the procedure needed to be contained within a maximum of 1,5 hours.
5. The method had to give participants a consistent understanding of MaaS and of MyCorridor. While all participants were expected to have some familiarity with MaaS concepts, it was necessary to make sure that their understanding was broadly aligned with that of the MyCorridor project, though leaving space in the method for participants to highlight discrepancies.
6. Given the constraints of COVID-19, the focus group had to be suitable for running virtually.

To meet these objectives, the following method was developed.

5.2.1 Materials

The primary source of data was through the Mentimeter (www.mentimeter.com) online survey tool which broadly covered the following items:

- stakeholder groups and their criteria;
- rating the importance of criteria by stakeholders;
- stakeholder evaluation of relevance of impact to the four deployment scenarios presented in section 3.2;
- additional questions on MaaS deployment context.

For the Czech Republic, the Netherlands and UK sites, the materials were adapted to facilitate their use in an interview format. This was due to the difficulty in finding suitable times that all participants were able to attend concurrently, and in order to shorten the running time of the method (and thus make it more accessible to participants). This involved adapting the scenario questions to move from 4 presentations by each scenario with each of the 8 criteria presented, to presenting each of the 8 criteria, and asking participants to identify which of the 4 scenarios was relevant to that impact. This proved conceptually easier for participants to understand and allowed for clearer discrimination between criteria.

Mentimeter questions were embedded within a Power Point presentation. This presentation included an introduction to the MaaS concept, introduction to the MyCorridor project, and a description of different MaaS business models. The description of the MyCorridor project also included a short animation about the project.

Other materials included a written script for focus group facilitators to follow. This maintained consistency between the sessions. There was also a data collection template for facilitators to complete after the session in order to rapidly report qualitative results from the session.

Presentation materials were translated to the language of the pilot site, except for Netherlands where the focus group was held in English, thus allowing the participation and facilitation of a representative from UNew.

Typical materials used for the focus groups and interview are included with **Annex A** for information.

5.2.2 Participants

Participants were recruited from the wider stakeholder network from each pilot site. Email invites were sent to stakeholders informing them of the general aims of the focus groups, that they would have visibility of the outputs and of their terms of consent and data anonymity.

Participants were selected where possible from stakeholders directly involved in providing services to MyCorridor, but also included other relevant experts from a number of aspects of MaaS delivery, identified through the project partners' networks.

5.2.3 Procedure

The focus group or interview began with an introduction to the aims of the session, followed by asking all members to indicate which area of transport they worked in. This was followed by the short presentation on MaaS, a description of MyCorridor and the outputs from the project. Participants were asked if they had any concerns or points of disagreement with the description of MaaS.

With reference to the methodology presented in section 3.2, participants were then asked to rate the importance of specific criteria to them (e.g., increase revenue/passengers, improve customer satisfaction, improve environmental sustainability, etc.), before going through the scenario-based questions so as to contextualise the impact results achieved. The session covered the additional impact-related contextual factors (benefits, barriers, and policy).

Finally, participants were asked a question regarding the impact of Covid-19. Specifically, this question was orientated towards potential benefits or opportunities arriving in the aftermath of the pandemic that could be addressed by MaaS.

5.2.4 Analysis

Quantitative response data were collected automatically via Mentimeter and transferred to Excel spreadsheets. This was then collated into a single spreadsheet that covered data from both focus groups and interviews.

Qualitative response data was collected via a template data sheet that each facilitator completed after the focus group. These were then collated into a single harmonised set of comments.

5.3 Stakeholder analysis

5.3.1 Stakeholder demographics

This section presents the demographic makeup of participants. **Table 31** presents the number of participants by category, and **Table 32** presents the number of participants by Country.

Table 31: Participants by stakeholder category.

Stakeholder category	Stakeholder count
PT operator	8
Transport service provider	2
Mobility/MaaS operator	4
MaaS aggregator	2
IT/ITS developer & mobility provider	6
Data provider	1
City and local policy and government	2
Regional and National policy and government	3
Other	3

Table 32: Participants by Country.

Stakeholders' origin country	Stakeholder Count
Austria (AU)	8
Czech Republic (CZ)	4
Greece (GR)	4
Italy (IT)	6
Netherlands (NL)	1
United Kingdom (UK)	8

5.3.1.1 Qualitative data

Participants from transport and mobility providers included rail, bus, coach, light rail / metro, taxi services and micro-mobility. Participants from the ICT / MaaS aggregator community included ICT specialists, MaaS platform developers, 'white label' MaaS integrators and specialist MaaS providers (e.g., for accessible MaaS services).

Even in this aspect of the survey, there were comments from some participants that selecting a category was hard to define. The nature of MaaS means that several participants, particularly in the aggregator or ICT-related categories were of the opinion that they spanned several categories (e.g., that they were both a mobility provider and an ICT provider). This indicates the emerging nature of business roles and competencies for MaaS.

5.3.2 Stakeholder criteria

5.3.2.1 Descriptive statistics

Participants were asked to score eight key criteria to indicate how important these were for them. **Figure 7** presents the scores for each country, and the average score across all countries, for each criterion. The results indicate that optimising integration and improving access are key drivers of MaaS. While increasing passengers is a key impact, this is not reflected in increasing revenue to the same extent.

Analysis was then conducted by stakeholder type as shown in **Figure 8**. Stakeholder types were grouped together as follows:

- Policy = Regional, local and national policy makers (n=5)
- Mobility and transport = PT operators, transport service providers and mobility providers (n=14)
- MaaS ICT and aggregators (n=9)
- Others (n=3)

This analysis helps to understand the discrepancy between increasing passengers and increasing revenue. While all stakeholders value increasing passenger, only those in the private sector value increasing revenue, therefore the overall average of this impact is lower.

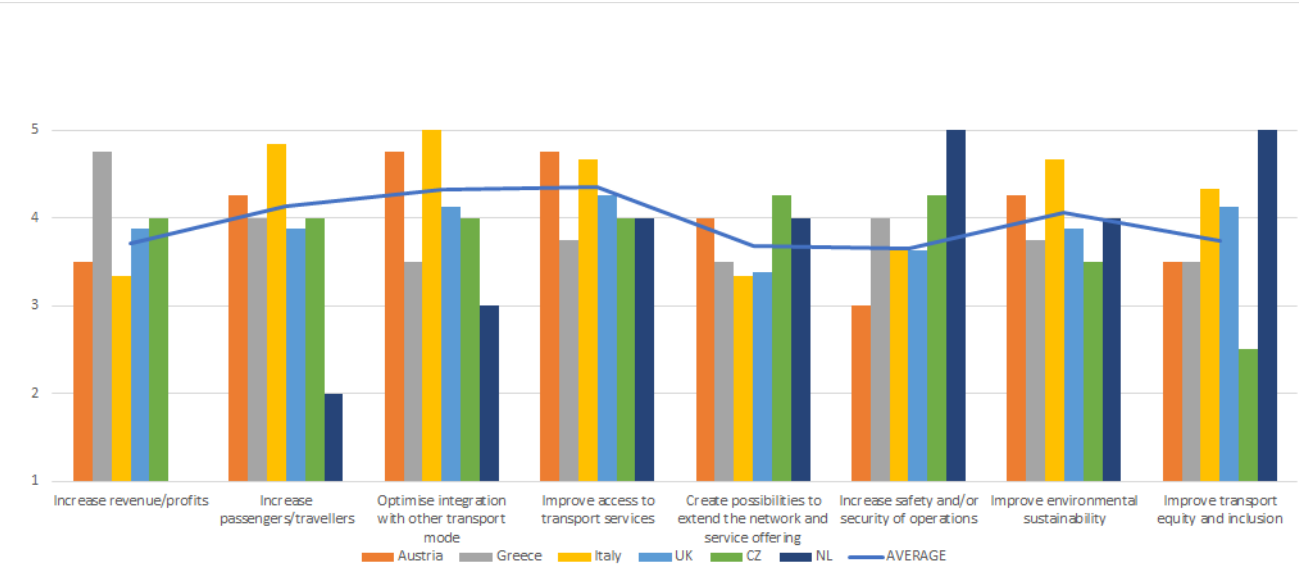

Figure 7: Analysis of stakeholder criteria by country.

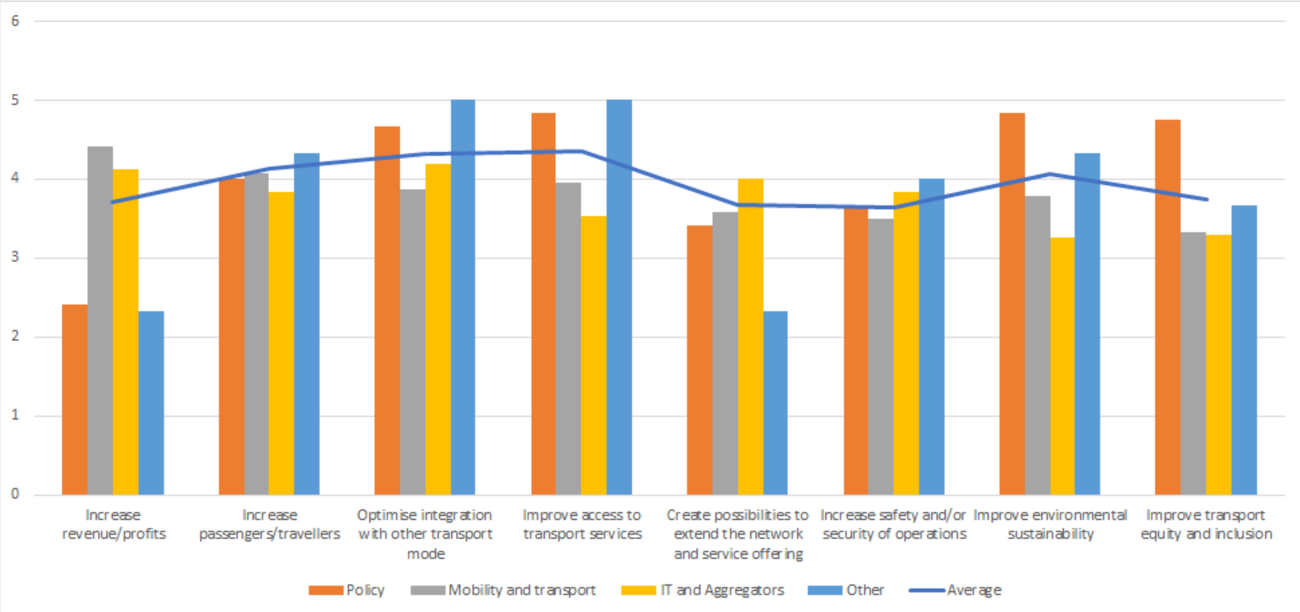

Figure 8: Analysis of criteria by stakeholder type.

5.3.2.2 Qualitative data

It was noted that criteria 1–4 were more in terms of operations and performance, whereas criteria 5-8 were more in terms of quality of service and externalities. Several participants noted the interconnected nature of criteria – that more passengers through MaaS led to better revenue, or that better transport connectivity was key to improving transport equity and inclusion.

Several participants, particularly from a regulatory or public transit background, noted that profit and revenue was not an explicit motivator for them, but rather it was to improve interconnectivity and passenger numbers. If MaaS works well, the increase in numbers would occur by itself. Commercial transport providers (e.g., coach companies) were more directly concerned with generating revenue.

Increasing passenger numbers was also often a significant motivating factor on its own. Instead, MaaS provides a way of delivering a better customer experience, and better integration between the modes in order to simplify journeys.

Several participants highlighted the ambiguity around the concept of customer, and therefore of profit / revenue. For several of the ICT / MaaS solution providers, their customer could also be public transit authorities (for example) who deployed and use their solutions. Several of the ICT / MaaS solution providers operated on either a fixed-cost model, or in terms of a payment per MaaS request. For those stakeholders, profit in terms of passenger revenue was less of a direct impact, but number of passengers (and therefore requests) drove profit. Profit, however, in terms of being able to generate revenue by selling their services to transport providers was a motivation and therefore an important criterion.

5.3.3 Scenario analysis

Participants were then asked to indicate the applicability of each criterion to each of the four deployment scenarios – urban private, urban public, rural private, rural public – in order to evaluate the impact that the specific scenario would have in contributing toward reaching each stakeholders' criterion.

Since consultations were held in different formats, the following harmonisation was applied to progress the analysis presented below:

- Focus groups (who rated each impact between 1 [not relevant] and 7 [very relevant]) – impact scores for each country were aggregated and then calculated as a percentage of applicability, where 100% indicated full applicability of a criterion to that scenario and 0% indicated no applicability.
- Interviews (who only presented a 'yes' or 'no' as to whether a criterion impact was applicable or not for any given scenario) - total number of participants for each country scoring 'yes' was calculated as a percentage of total number of participants for that country, which give a percentage applicability of each criterion for each scenario.

Both focus group and interview percentage scores were then aggregated to give a percentage score of applicability for each impact under each scenario. For each scenario, **Figure 9** through to **Figure 12** present the applicability of each impact by country, with the average across all countries. **Figure 13** presents a single, aggregated, percentage score for all countries for each impact and each scenario, as well as average score across all scenarios for that impact.

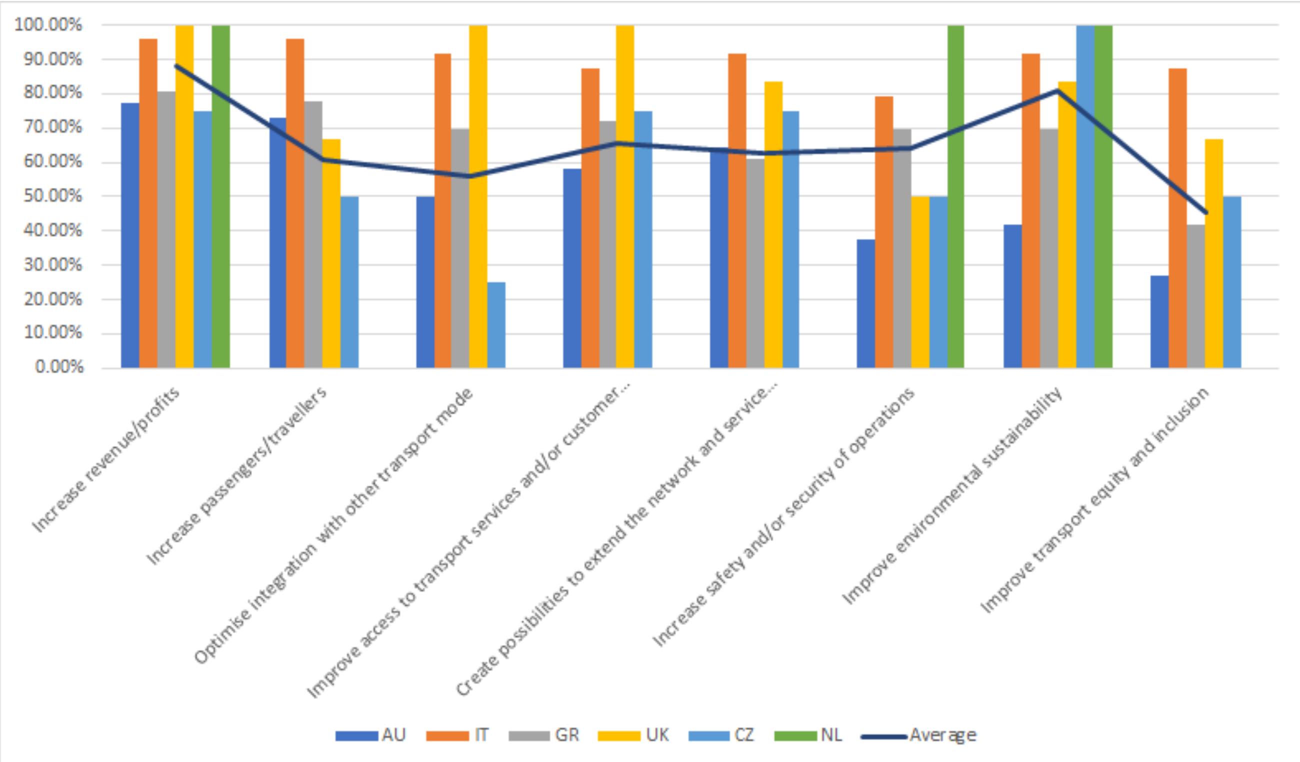

Figure 9: Cross-country comparison of impact for the urban-private scenario.

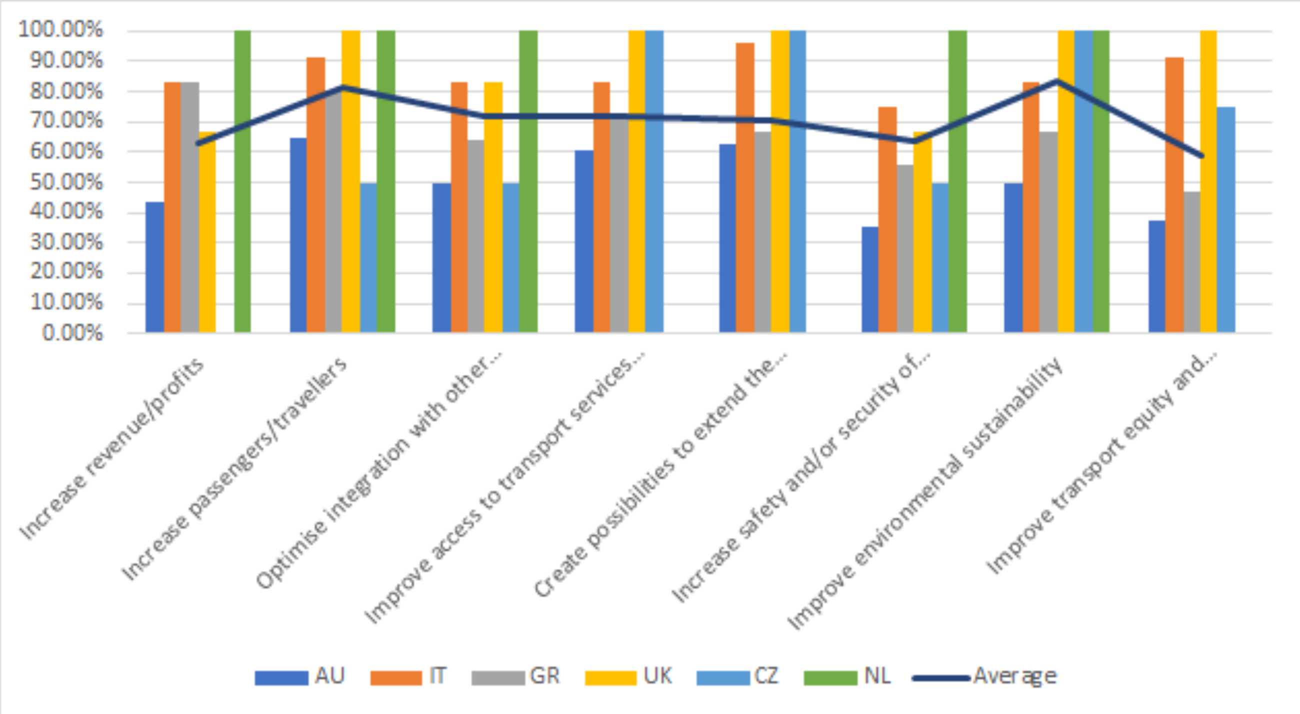

Figure 10: Cross-country comparison of impact for the urban-public scenario.

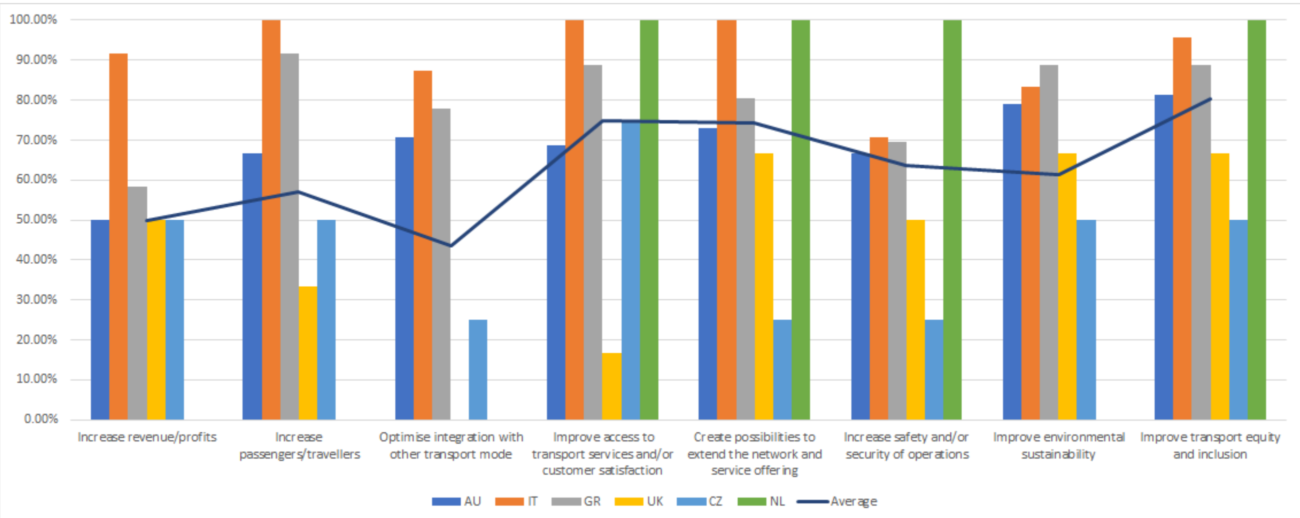

Figure 11: Cross-country comparison of impact for the rural-private scenario.

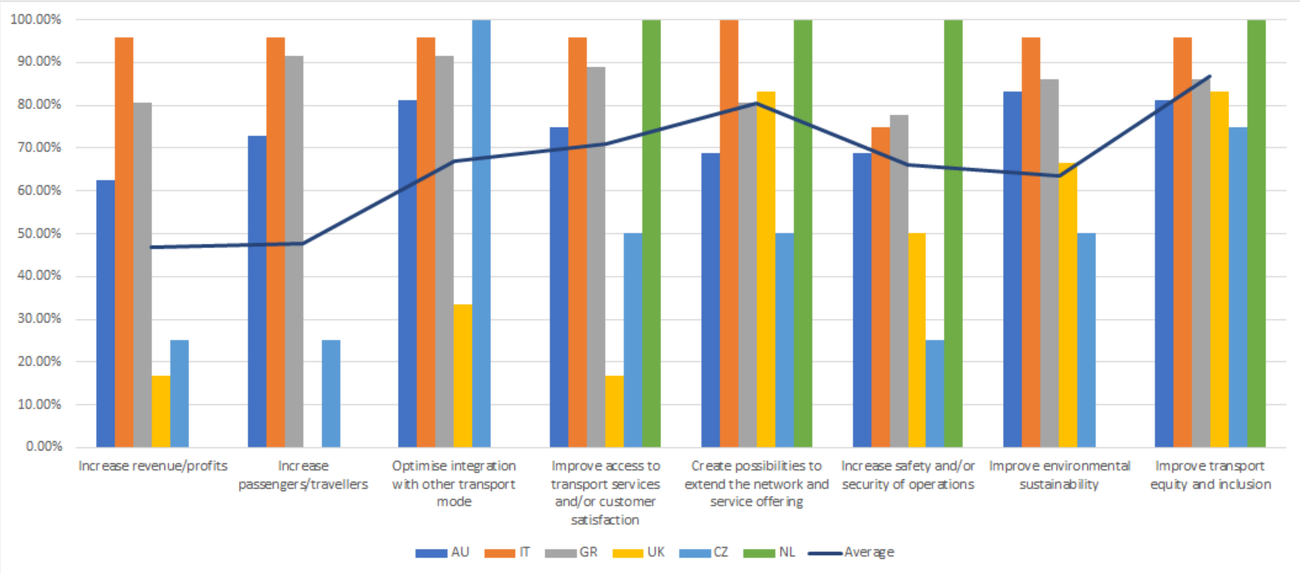

Figure 12: Cross-country comparison of impact for the rural-public scenario.

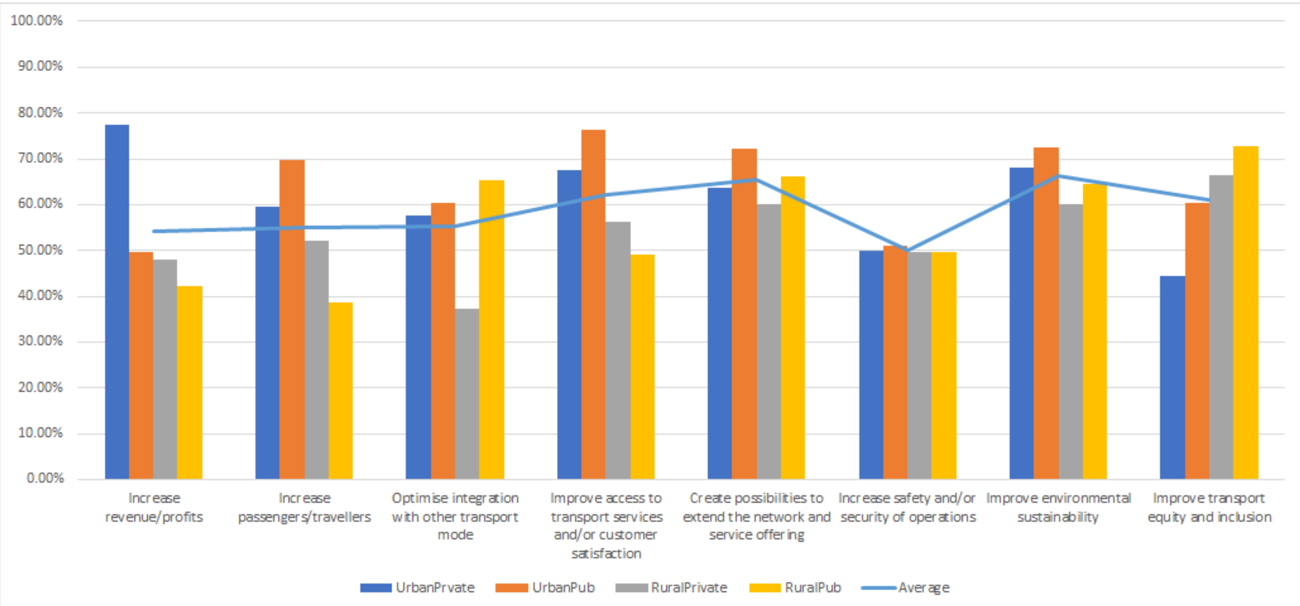

Figure 13: Impact comparison of deployment scenarios (all countries).

Revenue / profit is the key impact for the urban private context. It is notable that revenue is such a significant driver in the rural private context, suggesting it is the combination of both the urban context and the private business model that leads to potential revenue.

Urban public is seen as the greatest potential context for impact, being highest scored in 6 of the 8 impact criteria. Together, the two urban context are highest ranked for most impacts, though the rural environment is important for equity and inclusion.

In comparison to the rating of impacts without context (graph 7 and graph 8) environment and possibilities to extend the network score highly. This may be in part because specific scenarios or contexts elicit the importance of these criteria.

In all contexts, safety is amongst the lowest scoring impact.

5.3.3.1 Qualitative data

As a general comment, several participants either explicitly stated, or implied, that the distinction between private and public business model was inappropriate. The key to successful MaaS was for public governance and operation of transport services to work in *cooperation* with private providers. In this way, the niche private service provider could support the extension of the transport network where it was not viable for the PT operator to offer a service. This was more than just for the provision of the transport service – the public operator would also serve a role as a guarantor and as a well understood 'brand' that passengers (at least in some cities) were aware of had confidence in.

Specific comments for each scenario were as follows:

Urban Private - This environment offered the greatest opportunity for increased revenue, due to the potential size of market. However, there is a risk that this is conducted by competing agencies without delivering a holistic solution, and at the risk of cannibalising public transit solutions. It was felt by many that general conditions must therefore be set by the public sector, though some private provider participants questioned the sector's ability and agility to do this.

Urban Public – This was seen as the most relevant setting for a number of impacts, and particularly for passenger growth and customer satisfaction. The urban environment has the widest pre-existing set of transportation options, while public support and public bodies can act as the prime service providers and arbitrators of MaaS. The public sector is more likely to carry the risk of subscription of MaaS services and offer standardisation and regulation of services and ticketing. This can provide the framework within which private services can flourish. MaaS is also essential in the urban environment *because* of the number of services and transport offerings. MaaS is the means to bring together different modes that might be needed for a single trip, that are otherwise too complicated to be orchestrated by the user, who then opts for the simplicity of the private car.

Rural Private – This was felt to be the most challenging context due to the lack of potential for economic growth, and therefore have limited appeal for providers. However, it was also felt to have some opportunity for niche providers and also the scenario where there was the most to gain in terms of improving interconnectivity, accessibility and environmental performance through the deployment of modes such as Demand Responsive Transit (DRT). One of the challenges for niche providers was that they were not known to tourists (a consideration for Austria). However, there is a tension between the desire to improve equity through niche provision in the rural area, and the sense the inclusion and equity are not priorities for the private sector. However, a smaller number of participants expressed the view that rural private offered the most opportunity for revenue growth as the market was not already saturated.

Rural Public – Public deployment of rural MaaS was felt to be useful as a supporting service provide access to locations such as schools and hospitals, especially if the ticket price is subsidised. Again, this may be through DRT. In specific locations it may have value for tourism and visitors. Public Rural MaaS is a key tool to reduce emissions and discourage car use. As such, rural public had particular relevance to the impact of accessibility and equity, and of reducing the environmental impact of travel, where many travellers currently were forced to use a car because of the sparse nature of public transit.

5.3.4 Business-related impacts, barriers and policy insights

5.3.4.1 Descriptive statistics

Participants were asked to indicate the relevance of a number of potential factors that might affect impact. These were distributed over a number of questions and included:

- benefits of MaaS to their organisation
- impacts of MaaS in the medium term (3-5 years)
- barriers to MaaS
- policy required for MaaS
- potential opportunities or considerations arising from a post-Covid world

Figure 14 through to **Figure 18** gives the responses to each of these questions, by country, with an average score.

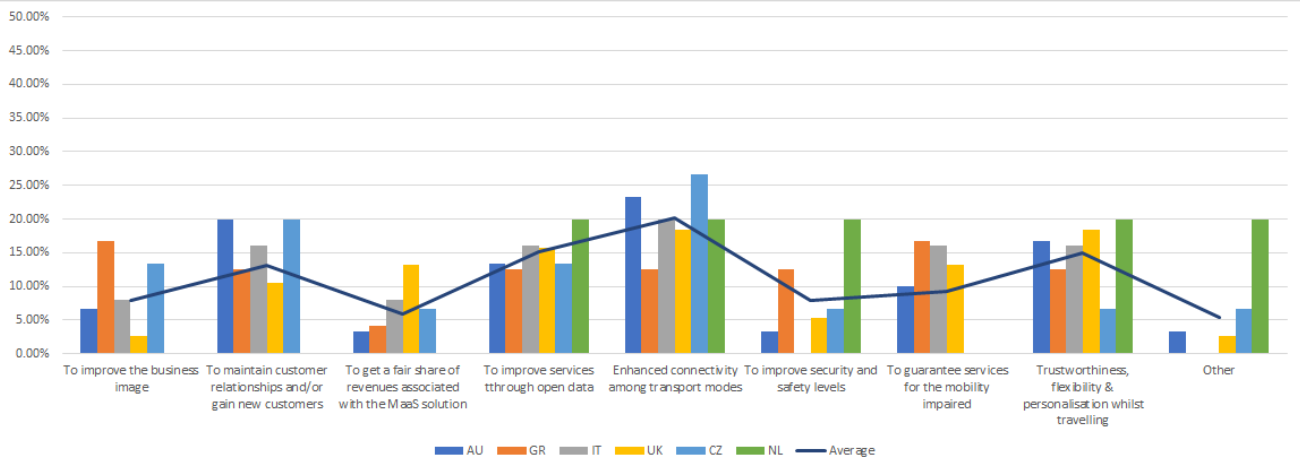

Figure 14: Benefits of MaaS to stakeholder organisations.

In terms of benefits, responses support responses to previous questions on impact. Enhanced connectivity and improved services were key benefits, whereas factors such as safety were not considered to be so relevant. Revenue also scored low. On one hand this fits with scoring that revenue is an impact of limited importance. On the other hand, this does conflict with some of the comments and responses in later questions about setting up processes for the fairness of revenue exchange.

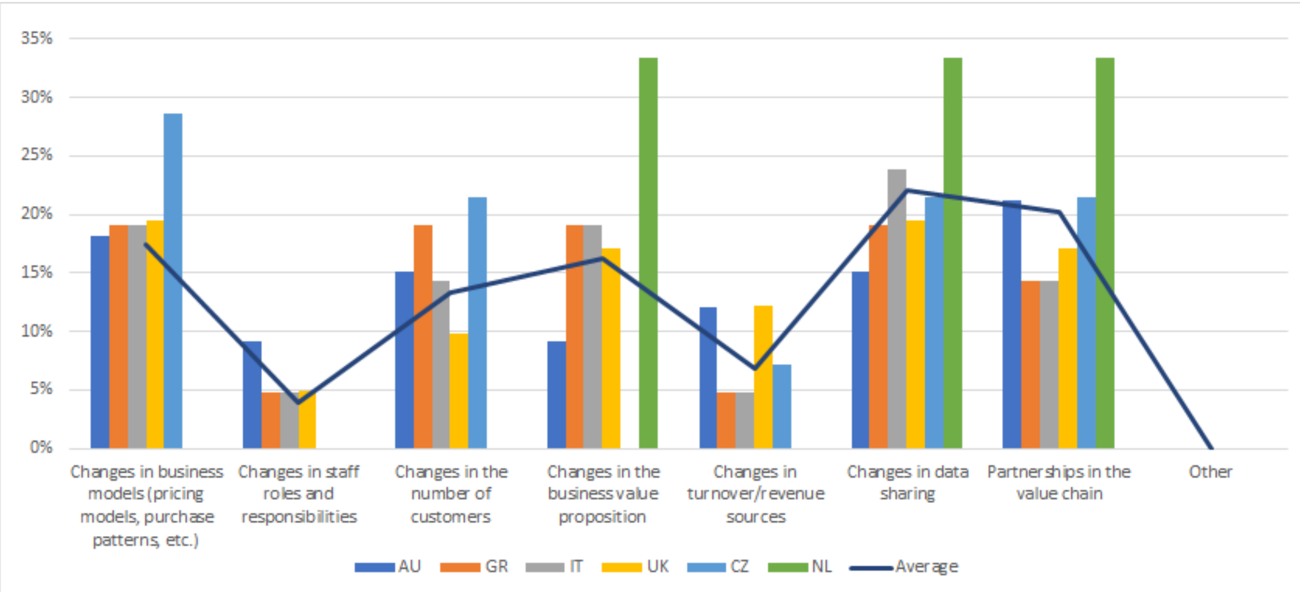

Figure 15: Consequences of MaaS on stakeholder businesses.

For the question on consequences of MaaS on stakeholder businesses, these responses suggest significant changes to how data and revenue is used and exchanged in MaaS, with high scores for changes in the business value proposition, in data sharing, business models and the value chain. On the other hand, this is not seen to affect the actual turnover or revenue sources.

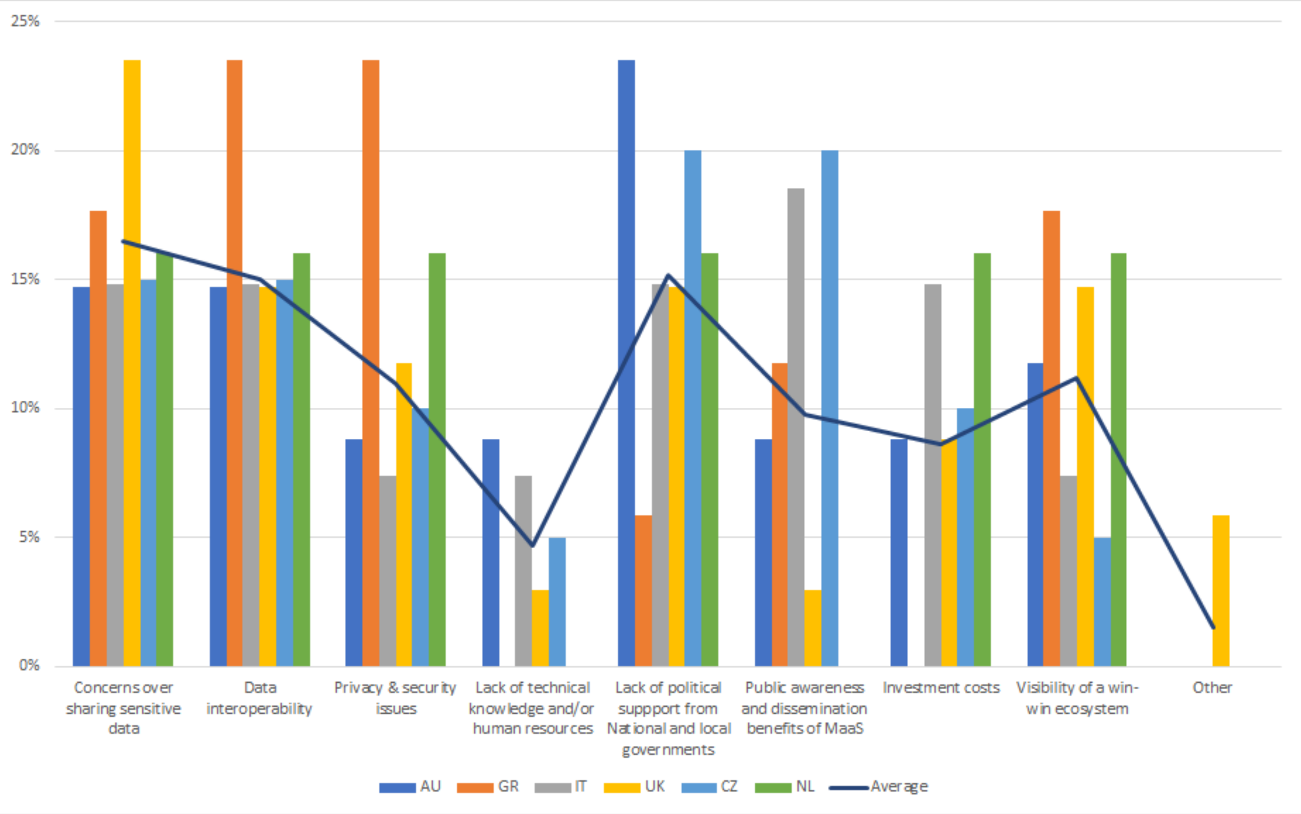

Figure 16: Barriers to MaaS

Data issues form the greatest barriers to MaaS adoption. This includes concerns over sharing data, and interoperability. It is important to note the concerns around sharing data are not just around sharing and privacy (which is identified by fewer participants as a barrier). Lack of policy and governmental support is also identified as a key barrier.

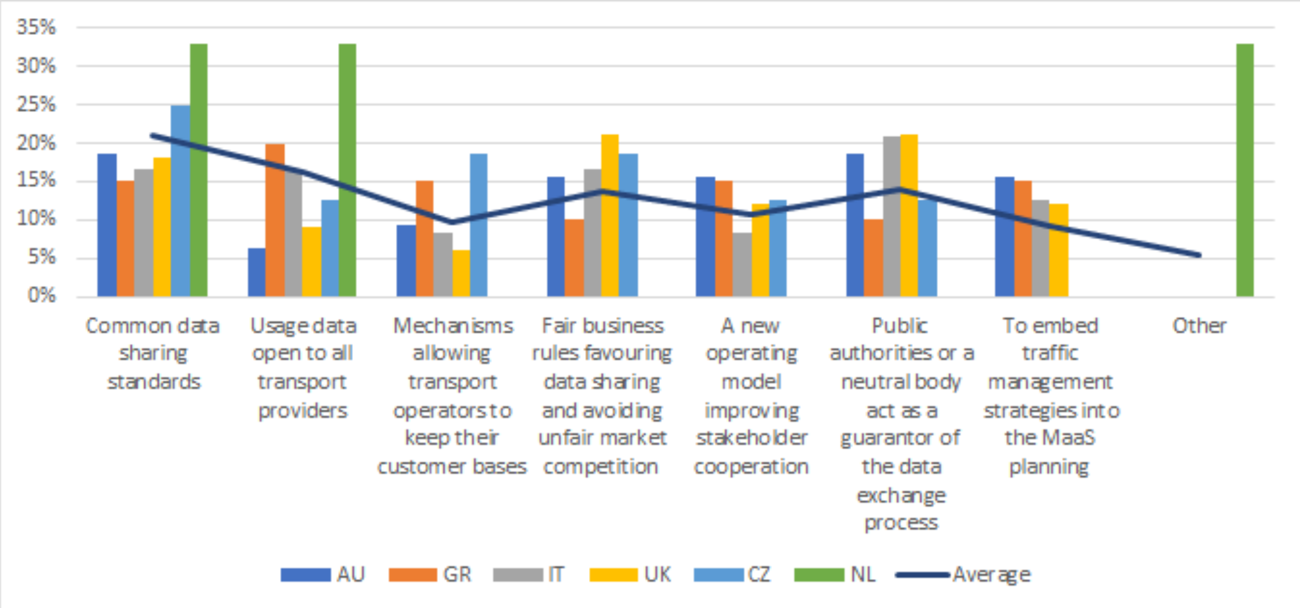

Figure 17: Policy and regulatory changes

More participants identified data changes (common data standards and open data) than any others. Behind that fair business, and public authorities acting as guarantors were the next major areas of concern. This suggests the twin issues of data exchange and fair operations / sharing of revenues to be the major areas for future policy impact.

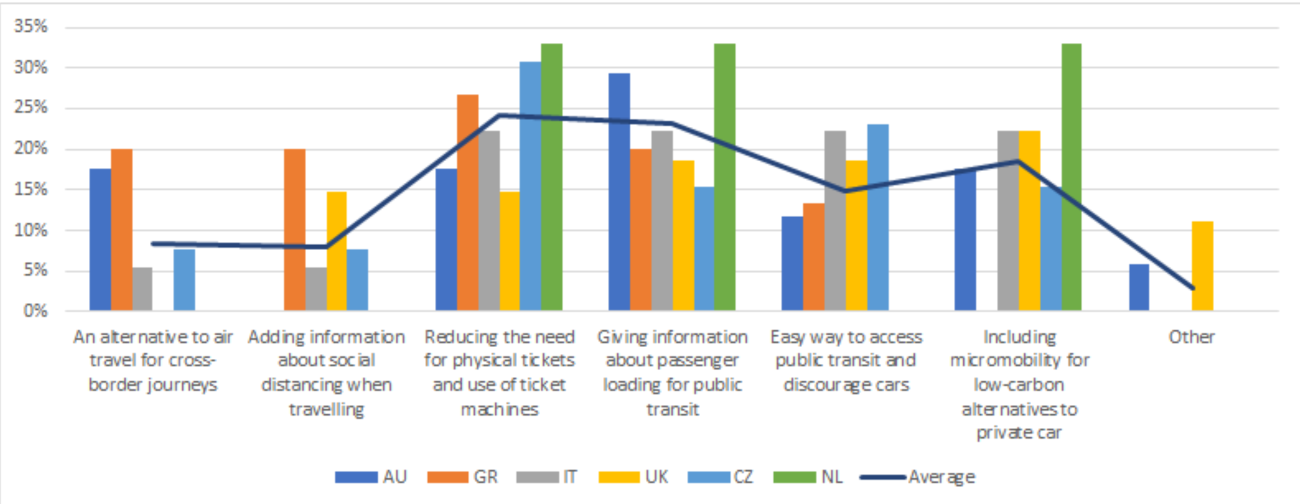

Figure 18: MaaS for post-Covid world

The major opportunity of COVID-19 for MaaS was to improve information provision to passengers on passenger loading and crowding. MaaS also removes the need for physical tickets which can be a vector for COVID-19 transmission. The importance of micro-mobility, and also suggestions for others that covered supporting transitions away from private cars, highlighted the opportunity and need to move people away from the increased number of private car journeys that has been seen during the pandemic.

5.3.4.2 Qualitative data

Benefits of MaaS – Discussion in one of the focus groups highlighted the importance of collaboration, which was both essential for MaaS, and at the same time facilitated by MaaS, moving transport providers away from a competitive mindset. Some interview participants highlighted that all benefits were interconnected, but that connectivity and sharing were the most important. In terms of trustworthiness and flexibility, the ability of MaaS to reconfigure during times of disruption, and to support tailored, personalised journeys were key characteristics, moving transport information and support away from being reactive to proactive, and tailored to different segments and personas.

Medium term consequences of MaaS – Data and changes to data processes were the most pressing consequence of MaaS. Changing public perceptions was perceived as difficult, and not a likely consequence in the short to medium term. There were differing opinions on the timescale of MaaS – some thought it was a long way off (5 years) whereas others believed MaaS was already established, albeit at a a modest scale, and was beginning to evolve to meet larger challenges and markets.

Barriers to MaaS – While not all participants commented on barriers, any comments were mainly related to data aspects and collaboration. It was felt that the fundamentals of the technical solution were in place but building the business models so that data could be exchanged between organisations, and benefits be shared, were still to be addressed. A lack of political and regulatory input was also raised as a barrier, but this was mostly felt to be in the arena of policy to support equitable data sharing and collaboration (i.e., all of the barriers are closely linked).

Policy needs of MaaS – While several participants commented on the need for a neutral body to manage the process of data exchange, it was also stressed that this does not have to be a governmental or independent agency. MaaS providers / aggregators believed they could perform that role, acting independently and with neutrality to share data and revenue between transport service providers. In some cases, participants were also sceptical of public bodies ability to perform the task with neutrality, or that aggregators were more agile than public bodies. Several participants supported the view the traffic management was central to the policy delivery of MaaS. This covered private cars, but also included support for public transit (e.g. buses) to ensure they could operate in a punctual manner and that delays could be rapidly communicated to passengers.

MaaS for Covid and post-Covid – Participants responses were divided in two directions. On one hand, participants commented on the functional and informational support that MaaS could assist with – this included passenger loading information on current occupancy of transport (i.e. how much space is available for social disctancing), contactless and virtual tickets, etc., the inclusion of micromobility (which was perceived as being less exposing to COVID-19 than PT) and information about regulations, as passengers travelled between areas in different levels of lockdown or with different levels of restriction. There was, however, a second and complimentary view that COVID-19 offered an opportunity to the mobility sector, in that it had fundamentally changed the mobility landscape. COVID-19 had seen an increase in the number of people switching from public transit to private car use. This trend could be reversed through MaaS. COVID-19 will also continue to change travel patterns in the short to medium-term, and this makes travellers amenable to new concepts and new ways of travelling that can be addressed by MaaS.

5.3.5 Additional qualitative insights

Across the focus groups and interviews a number of more general or cross-cutting points were raised. A recurrent view was that work in MaaS needs to be positioned against the simplicity and ease-of-use of the car. While this was not universal (either for people or locations), it needs to be considered against any level of simplicity offered by a MaaS service. A MaaS service should be simple, proactive (in that it needs to personalise to the user) and flexible, particularly during disruption to travel services.

Also, there was a range of views on the maturity of MaaS. While some felt that MaaS was still emerging, others felt the technical development of MaaS was already mature. What is missing is maturity in market and the policy processes for MaaS. This was particularly with regard to fair business models for data and revenue sharing.

There were a number of differences in perceptions and comments received depending on location (i.e., country). In particular, Austria and Italy raised the importance of regional areas, reflecting their local geography or, for Salzburg in specific, the importance of tourism for their mobility market. For other locations (UK), rural was seen as a less important market, and a more challenging market, assuming that urban centres should rather be the highest priority.

Across a number of questions, safety was not seen as a significant concern or, it was thought that it should be taken as a given and implicit characteristic of mobility that should apply to all situations and scenarios. That said, it was occasionally noted that there is a safety benefit from moving people out of cars to lower risk forms of transport (train, light rail, etc.). Also, safety is multi-dimensional. There is the inherent safety risk of any given mobility mode (e.g. the private car is less safe than public transit), but there are also safety risks waiting for connections at public transit or walking between modes. All safety considerations should be factored in for each different mobility option, whilst also alternative travel combinations and options offered by MaaS could alleviate those risks (e.g., making demand responsive transit available to eliminate waiting time at stations late at night).

Several participants identified the need to take a flexible and long-term view of MaaS adoption. The aim of MaaS schemes and deployments should not be to replace the car but, at least at first, offer an occasional alternative to the car or place car users in the MaaS cooperative context. This has implications for expected usage, business models and ticketing of MaaS. A gradual shift to mass means users may want to experiment with conventional ticket purchasing and pay as you go before embarking on more novel mobility packages.

5.4 Summary of multi-stakeholder evaluation findings

5.4.1 Deployment and transferability conditions

The major interpretation of the interviews and focus groups is that the responses are relatively consistent across categories, questions and stakeholder group (by both type and country). Generally, the potentials of integrating various mobility services and improving access to transport were the most frequent and important impacts both in terms of quantitative data and qualitative comments. Impacts such as passenger numbers and revenue were deemed less important. This was driven by the divergence in the stakeholder groups. Private operators were typically more interested in revenue, while policy makers rated this as a minor impact. The effect of this spread of perceptions was to lower the average impact score. Similarly, private operators were less concerned with passenger numbers unlike public transit and policy makers for whom this was a significant impact.

The urban context is generally felt to be most relevant or of the highest priority for the deployment of MaaS, with both the greatest range of pre-existing services to pool into a MaaS provision, and the most sizeable market, particularly for private providers. The rural market would appear to be challenging in many aspects for the deployment of MaaS. There is limited appeal in the rural context for the private market, and limited current provision of services for the public market. This is, however, the context where there are significant perceived benefits to be found in terms of improving accessibility and where there may be significant environmental benefits. As such, the rural context may well turn out to be a priority in future; at least for public transport. DRT is likely to play a key role here.

We note the blurred line between public and private stakeholders. Whereas previous work has emphasised the importance of public transit as the backbone of MaaS, this is usually to support interconnectivity with PT modes (bus, light metro etc.). The results of this analysis highlight that the integration and role of public transit is more than just this capacity, but lies also (a) as a trusted brand for users (b) as the stakeholder in the best position to understand the scope of local travel needs and to organise transport in an integrated manner.

While results were relatively consistent across different geographical locations that stakeholders originated from, there were some regional variations. Italy, and to a lesser extent, Austria saw value and potential in the rural context, whereas in the UK this was seen to be either a difficult context to deploy or one with limited opportunities. However, the relatively low number of participants makes it inappropriate to draw firm conclusions regarding regional differences.

Across a number of different questions regarding context, a series of factors emerged that would shape successful impact. The two major areas currently inhibiting MaaS success were highlighted to be the exchange of data and the business environment that supported equitable and fair exchange of revenue, while ensuring profitability for all participating private transit providers and service providers (e.g., MaaS issuers/ aggregators). We also noted the complexity of range and type of stakeholders involved in MaaS; this is more than just mobility providers, MaaS providers, and regulators. Particularly, the MaaS provider market involves a range of evolving abilities, services and business models. Some of the MaaS providers also felt they provided the mobility service itself, while other purely provided the ICT element; some operated across the MaaS playing fields, whereas others had specific aims (e.g., to provide MaaS for users with accessibility / disability needs).

Traffic management was discussed in the interviews and focus groups. Overall, only a limited number of participants thought this was relevant to MaaS delivery, but this is likely due to the number of participants who were more focussed on public transit provision. Those participants who were positive of traffic management noted that cars are still likely to form an important part of multi-modal journeys, particularly in rural and peri-urban journeys, and therefore improving the quality of car journeys to transport hubs was a key part of delivering an end-to-end high quality journey. Additionally, participants noted the importance of traffic management for public transit as a means to ensure the reliability of the service, particularly in urban areas. This would apply to buses, but also to modes such as DRT.

5.4.2 Key recommendations for policy changes and regulatory actions

The overwhelming perception was that the major area for policy lies in data governance regulations and standards. Putting appropriate policy in place would support a common European approach to data, and would support fairness in the MaaS ecosystem, thus supporting fair ticketing and revenue management.

Policy needs to take a harmonised approach to support both private and public sectors. Also, support for the public sector needs to extend beyond simply funding the provision of PT modes, to enabling PT to act as the orchestrator and arbitrator within the MaaS ecosystem, and thus have appropriate authorisation and support for MaaS procurement and interaction with MaaS aggregator providers.

As noted above, the rural mobility context is challenging; yet offers significant benefits and opportunities for a future successful MaaS deployment. Therefore, policy and regulatory actions need embrace acknowledge of those barriers and embrace benefits to support the rural context. This involves both initial funding of deployments and ongoing subsidy to support services where revenues may always be low due to low population density. In time, however, subsidy can be reduced or stopped altogether as niche private providers find ways to maximise revenue streams.

Another key conclusion emerging was that what is mostly challenging nowadays is not the technical developments in MaaS, but rather the business and regulatory aspects that will turn it into a success. As such, funding offers should be towards this direction.

Finally, the post-covid environment is more than just a challenge that will need ongoing financial support from government. It is a critical juncture to encourage to align with fundamental shifts in travel patterns, take advantage of new modes of mobility, and push ahead with the MaaS agenda. Nevertheless, MaaS in alignment with connected and autonomous vehicles may prove to be the greatest game changers in the post-COVID era.

6 Conclusions

An effective MaaS solution providing citizens with simplified access to multiple mobility options can be a powerful tool enabling a modal shift towards more sustainable modes of transport, reducing the use of private car-based mobility and improving transport externalities. Previous research has established direct positive effects for business organisations participating to MaaS (i.e., who may for instance accrue and/or retain their customer bases, improve customer satisfaction and establish new partnerships), whilst, on the other hand, key implications for them would also lie in the need for changing their value proposition and existing data sharing practises, and a potential re-organisation of staff responsibilities. Given the lack of robust, extensive evidence that is currently available on cross-sector impacts generated by MaaS, it appears of utmost importance to establish new knowledge in this area in order to ultimately gather an informative basis driving awareness, uptake and political commitment for MaaS.

To this end, MyCorridor applied a multi-sector semi-quantitative impact assessment methodology to investigate impacts for the economy, the environment and society as a whole by taking into account the specificities of different assessment dimensions, i.e., the users, the organisations and society. Assessment level-specific KPIs were therefore used to quantify such impacts consisting in before-after changes in outcomes from transport activities.

The methodology is fed by extensive data from the second phase pilot study conducted in the MyCorridor pilot countries between February 2020 and October 2020, during which baseline and post-trial questionnaire responses (147 and 107 respectively) as well as logged mobile application data for 934 trips conducted by 160 users were collected. It is particularly noteworthy that a very limited amount of data could be collected for cross-border trips due to the differing levels of travel restrictions applied in the pilot countries during the trial period to contain the spread of COVID-19 virus; therefore, this data was excluded from the overall data sample considered for the impact assessment.

From the extensive analysis of travellers' questionnaires and the MyCorridor mobile application logging data, it can be concluded that MyCorridor has the potential to reduce the overall number of trips, to deliver a modal shift in favour of bus and cycling modes, and to increase the number of multimodal trips, also by relying on a more positive travellers' attitude toward PT and shared forms of mobility. This is found to be in accordance with the results of previous pilot studies presented in this Deliverable; particularly, travellers pariticipating to all pilot studies stated, to a different extent, an increased use and attitude toward PT and shared mobility, with the Whim pilot study reporting the highest usage increase for PT (i.e. from 48% to 73%), although a total of 68% of all Whim trips (i.e. 70 000) were conducted in areas with the highest PT access. This type of impact was also confirmed to a certain degree in MyCorridor, where on the one hand users reported a lower propensity to use PT and shared mobility but, on the other hand, an overall modal shift in favour of PT (i.e., +15% compared to the baseline situation) and bikesharing (i.e., +20%) was also observed. Across all pilot studies, including the MyCorridor trial, an increased number of multimodal trips, specifically combining cycling (either through own bikes or bikesharing), was recorded.

In addition to these positive impacts, it should also be remarked that a worsening of the overall accessibility to transport services (i.e., bus, rail) perceived by MyCorridor users was estimated, which may have been triggered by the current pandemic situation and, particularly, by travellers being reluctant to use PT to perform their daily trips during the health emergency crisis, unless the trip was strictly necessary. Moreover, although no travel time gains could be demonstrated at individual level, it was assessed that the residual effects in travel cost and travel time compared to the baseline situation are negligible; particularly, a minor increase of the total travel cost on average (+6 minutes per user) was estimated.

In accordance with previous evidence, it can be argued that, whilst major use of the MyCorridor application was recorded for males, people aged 26-45 and those highly educated, it also proved to be attractive for family members, living with partners and/or with children, representing more than 60% of the whole customer bases across all sites. Therefore, positive travellers' impacts would enable a sustainable travel behaviour, thus resulting in positive effects, particularly for the environment and society as a whole.

The modal shift achieved also delivers an increase in customer numbers for bus and bike sharing modes, reflecting a positive economic impact for transport operators that joined MyCorridor; as a result, all types of businesses, particularly service providers, will experience increases in their customer basis with all traveller clusters being addressed thanks to personalisation features.

MyCorridor also demonstrated a significant reduction in CO_2 emissions from road-based transport activity and negligible to minimum negative before-after impacts also resulted for citizens accessibility, general transport comfort, transport trustworthiness, personal safety and transport security. Particularly, the decrease in the level of users' satisfaction with general travel comfort that was recorded is considered to having been biased by the current travel restriction imposed at EU level.

A combination of stakeholder focus groups and interviews with 31 participants from 6 countries and multiple roles (transport providers, MaaS providers / aggregators, policy makers) were also used in MyCorridor to access perceptions of the major areas of MaaS impact, and of potential barriers and contextual factors that influence success. Transport accessibility and transport integration were seen as the major areas of impact. While other impacts were rated as less important, this was in part due to them being more relevant to specific contexts – revenue was more important to private MaaS deployment, while passenger numbers were more relevant to policy makers and to the public setting, particularly in the urban environment. While the rural mobility context was seen as more challenging, particularly for private MaaS, there were benefits found with regard to transport inclusivity and equity, and a reduced environmental footprint. There were some regional differences, particularly where there was a touristic dimension (e.g., Austria). The results of the focus groups and interviews also highlighted the importance of data standards and regulations as well as of niche business models and roles. On the other hand, the technology was felt to be reasonably mature and less of a concern.

Despite the challenges that still exist, the above findings confirmed that MyCorridor has a very valuable use and even more promising future potential for both travellers and other stakeholders, and can ultimately generate a change in existing travel patterns enabling for a shift towards more sustainable and less polluting mobility, while offereing considerable value to car drivers and subsequent traffic efficiency and environmental gains through the advance traffic management functionality.

However, also considering the objective difficulties and the very peculiar (pandemic related) conditions MyCorridor was forced to operate, its overall impact magnitude must be further consolidated at the EU level; additional evidence from large scale deployment under "normal" mobility and life circumstances would definitely allow to validate the findings herein presented and ultimately demonstrate whether MyCorridor can be of value and what would be the size of it in specific for travellers, business entities and other stakeholders and society as a whole.

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Annexes

Annex A – Materials used for stakeholder consultations

Typical agenda for the stakeholder focus groups and interviews

Topic & date	MyCorridor project – Italian stakeholder focus group, [Date]
Venue	Virtual meeting
Meeting joining link	[Link]
Contact	Gennaro Ciccarelli (TTS) gennaro.ciccarelli@ttsitalia.it

Agenda

[Date]

Time	*Topic*
09:00 – 09:10	Welcome, objectives & participants' introductions
09:10 – 09:20	Mobility as a Service and MyCorridor
09:20 – 10:05	**Introduction of future deployment scenarios for sustainable MaaS**: urban-private-led, urban-public-led, suburban-private-led, suburban-public-led **First interactive Mentimeter polling session** – Impacts of MaaS deployment scenarios towards reaching stakeholder criteria (increase revenues, improve environmental/social sustainability, etc.)
10:05 – 10:55	**Second interactive Mentimeter polling session** – Business-oriented implications, policy and regulatory recommendations for a sustainable growth of MaaS
10:55 – 11:00	Wrap up & end of focus group

Typical support presentation and surveys for stakeholder focus groups and interviews

MyCorridor

Stakeholder focus group, Italy

Virtual meeting, 25th September 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636626"

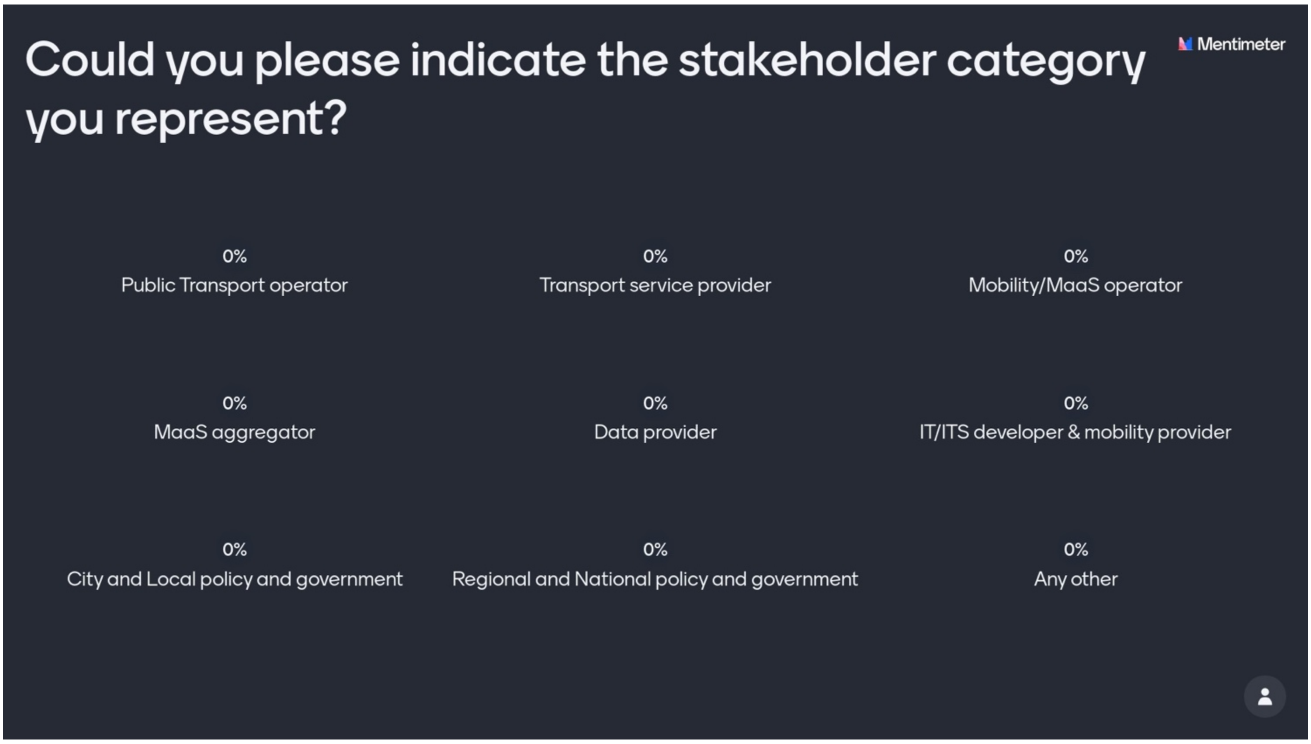
Objectives of the day

- **Objectives:**
  - gather stakeholders needs and views about possible future deployment conditions for MaaS in Europe
  - investigate expected MaaS impacts for stakeholders
  - explore key policy and regulatory barriers hindering the widespread of sustainable MaaS
- **Activities:**
  - Round table of introductions
  - MaaS & MyCorridor
  - Interactive sessions on impacts & policies

Agenda

Time	*Topic*
11:00 – 11:10	Welcome, objectives & participants' introductions
11:10 – 11:20	Mobility as a Service and MyCorridor
11:20 – 12:05	Introduction of future deployment scenarios for sustainable MaaS: urban-private-led, urban-public-led, suburban-private-led, suburban-public-led First interactive Mentimeter polling session – Impacts of MaaS deployment scenarios towards reaching stakeholder criteria (increase revenues, improve environmental/social sustainability, etc.)
12:05 – 12:55	Second interactive Mentimeter polling session – Business-oriented implications, policy and regulatory recommendations for a sustainable growth of MaaS
12:55 – 13:00	Wrap up & end of focus group

Participants' introduction poll


Could you please indicate the stakeholder category you represent?
Mentimeter
0%
Public Transport operator
0%
Transport service provider
0%
Mobility/MaaS operator
0%
MaaS aggregator
0%
Data provider
0%
IT/ITS developer & mobility provider
0%
City and Local policy and government
0%
Regional and National policy and government
0%
Any other


How important are these criteria to you?
Mentimeter
Increase revenue / profits
Increase passengers / travellers
Optimise integration with other transport modes
Improve customer satisfaction
Create possibilities to extend the network and service offering
Increase safety and/or security of operations
Improve environmental sustainability
Improve transport equity and inclusion
0.0

Mobility as a Service and MyCorridor

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636626"

What are the problems?

- Complex journeys
- Multiple stages that are difficult to coordinate
- Multiple tickets
- A lack of resilience during disruption
- For short journeys
  - Private car, urban gridlock
- For longer journeys
  - Use of short haul air travel

New capabilities

- Mobile devices
  - Power
  - Location
- Multi-modal routing algorithms
- Shared mobility
- Micro mobility
- Ticket bundling and pricing
- Computing (e.g. cloud) architecture

Google Maps

BlaBlaCar

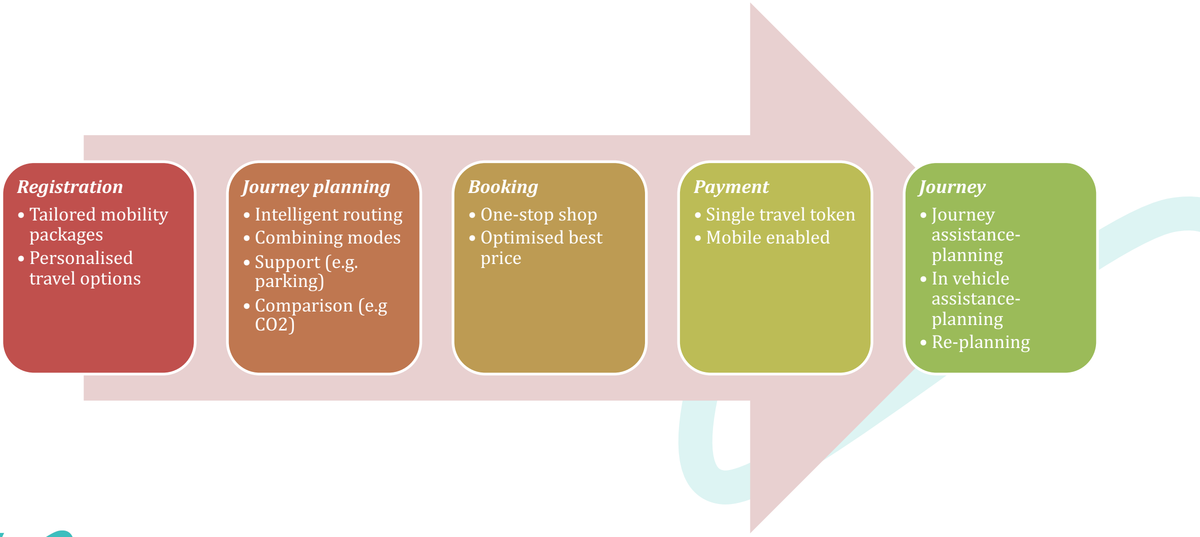
Lime

aws

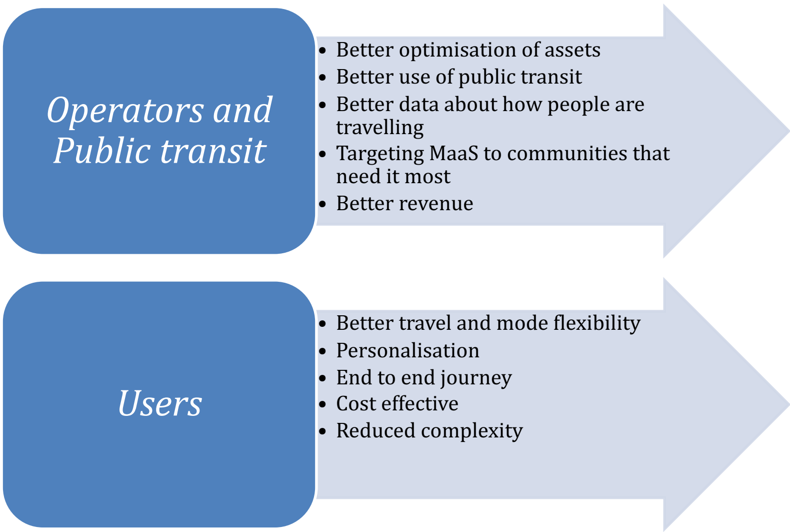
A definition of Mobility as a Service

- MaaS
  - combines different transport modes, in end-to-end journeys
  - offers a tailored mobility package (e.g. pay monthly for all travel, or pay-per-trip)
  - includes other complementary services, such as trip planning, reservation, and payments, through a single interface
  - can include micro-mobility and shared travel modes
  - a shift away from the existing ownership-based transport system toward an access-based one
  - a tailored hyper-convenient mobility solution, promising perspective to substitute the private car

MaaS process



Benefits



MyCorridor – brief introduction

- **Mobility as a Service in a multimodal European cross-border corridor**
- **Starting 1st of June 2017 to last 3 years**

Coordinator

Technical & Innovation Manager

Industrial Partners

Mobility Market SME's

Mobility Agency

ITS Association

Research

Legal firm

Liaison to MaaS Alliance

The mission

To facilitate ***sustainable travel in urban & interurban areas & across borders***

replace private vehicle ownership by private vehicle use,

- one element in an ***integrated/multi-modal MaaS chain***,
- provision of an ***innovative one-stop-shop platform***
- combine connected traffic management, ITS and multi modal mobility, infomobility and added value services
- thus facilitate modal shift.

Innovation: a ***technological and business MaaS solution***

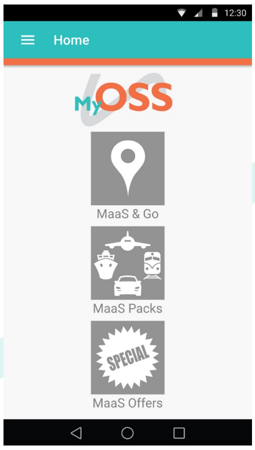
cater for interoperability, open data sharing, while tackling the legislative, business related and travel-behavior adaptation barriers enabling the emergence of a ***new business actor*** across Europe; the one of a ***Mobility Services Aggregator.***

What are we doing?

- Building a **one-stop-shop** for MaaS! → *Integrate several types of services to offer in a MaaS pattern.*

Services (multimodal):
- ✓ Mobility services
- ✓ Infomobility services
- ✓ Traffic management services (TM2.0 → TM2.1)
- ✓ Added value services (cultural, sports, etc.)

Products:
- ✓ **"MaaS & Go"**: MaaS coupled with trip planning
- ✓ **"MaaS Packs"**: MaaS supported via multicriteria search
- ✓ **"MaaS offers"**: Ready to use mobility packages



Our Unique Selling Points

- **Cross-border seamless service provision**
  - If necessary, an automatic shift to the authorised local aggregator will be made.
- **One Mobility Token**
  - Validation tickets for all mobility products purchased in one digital form.
- **Traffic Management services**
  - TM2.0 services will be offered as a new paradigm in MaaS (towards TM2.1).
- **Hybrid Trip Planner**
  - Individual trip leg mapping of available products through a user-centric matchmaking process.
- **Personalisation**
  - Static & dynamic feedback from traveller trips, providing an all-inclusive experience.

First interactive session (Mentimeter)

Future deployment scenarios for sustainable MaaS

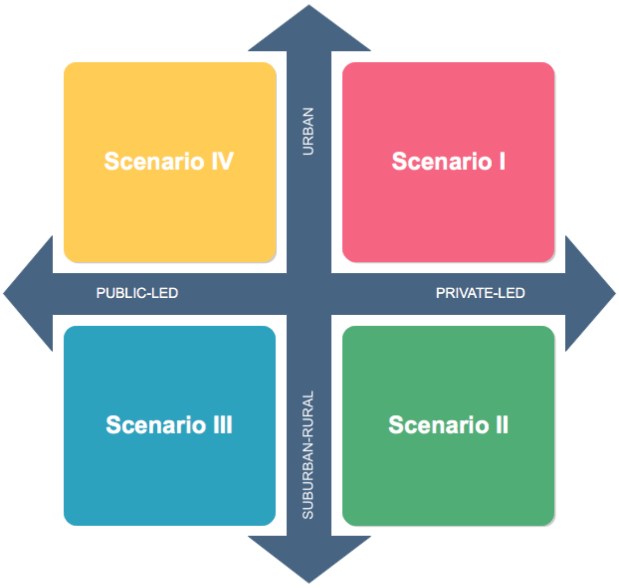
Objectives

- **Facts:**
  - Both public and private organisations are beginning to develop MaaS resulting in a diverse range of partial and full offerings
  - MaaS attractive for people living in urban areas and for those owning a car and living in city centres
  - Main drivers are high availability and accessibility to PT and (car-) sharing services

- **Explore together possible ways for delivering new models and forms of transport**
  1. *how can MaaS meet the needs of low population density areas not well served by public transport?*
  2. *public-led MaaS or through private-sector initiatives?*

Deployment scenarios for MaaS

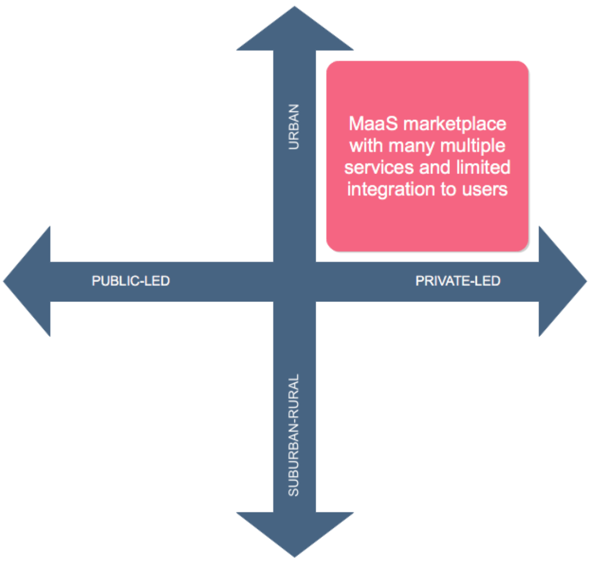
- **Public-led governance** - MaaS driven by public procurement and/or government regulation allowing decision makers to achieve ***societal goals (potentially)***
- **Private-led governance** – MaaS by private organisations, partnerships with transport operators/authorities; ***revenue potential*** is key
- **Urban scale** – presence of several commercially-viable services, such as personal transport and mass transit systems, enabled by the high demand density; ***ease of modal interchange*** among services is key
- **Suburban/rural scale** – limited number of services available to users; focus is ***flexible and personalised solutions***, such as community transport systems, personalised carsharing services, etc.

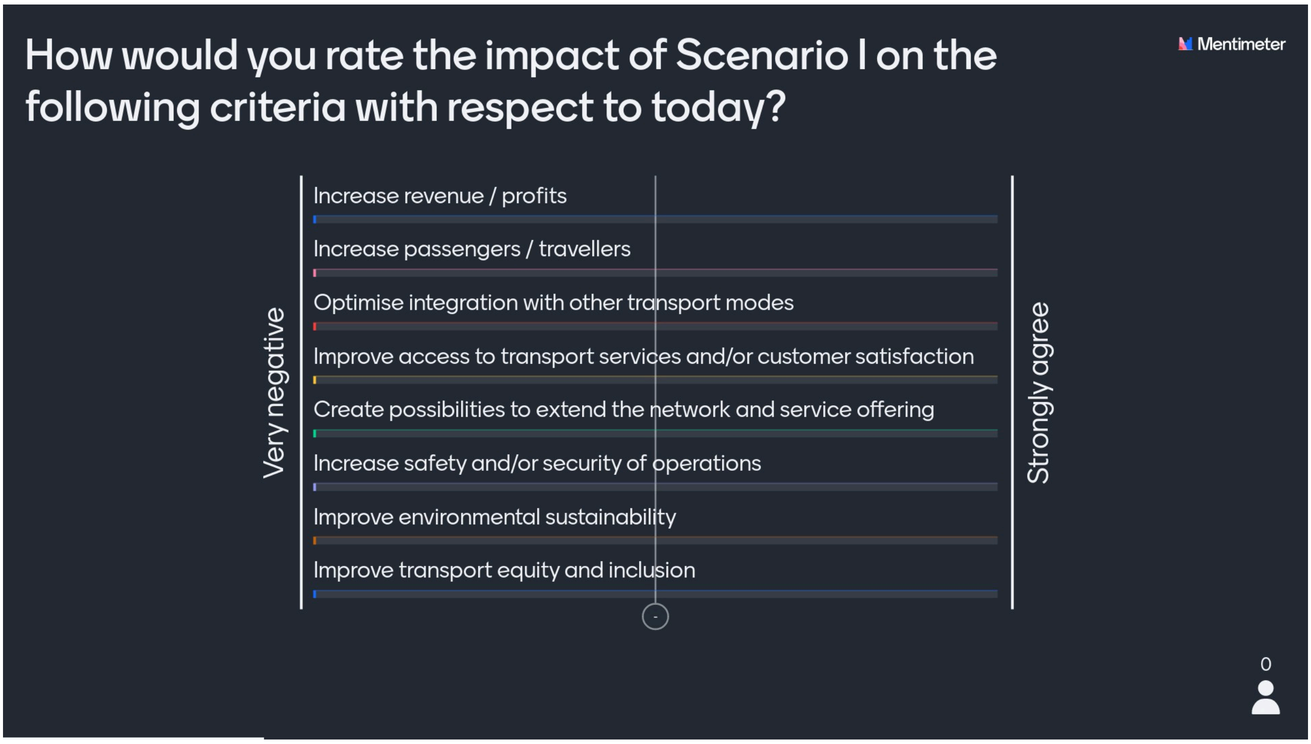


Scenario I – urban-private-led MaaS

MaaS marketplace with many multiple services and limited integration:

- Strong competition among market players over profitable customer demand segments
- Proliferation of fragmented services
- Services integration potentially low restricting large-scale adoption of MaaS

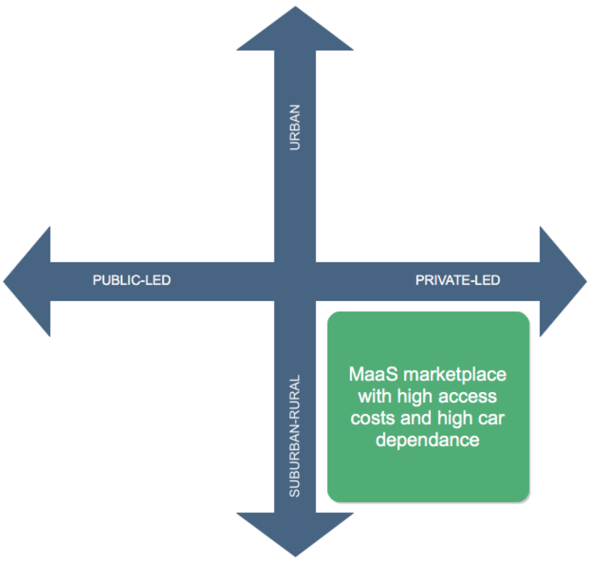


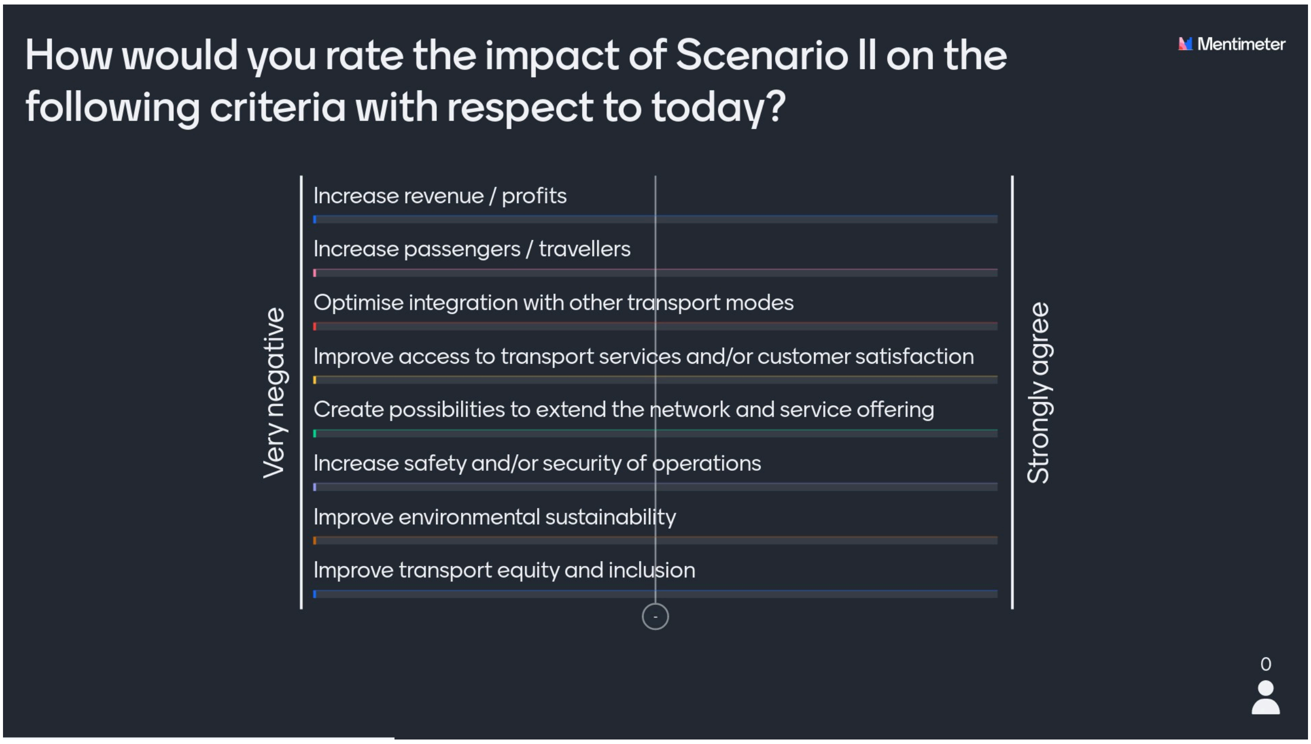


Scenario II – suburban-private-led MaaS

MaaS marketplace with high access costs and dependence from car ownership:

- Low population density resulting in high access cost to MaaS
- Lack of critical mass produces low QoS
- Moderate to high dependency on private car results in negative environmental impacts

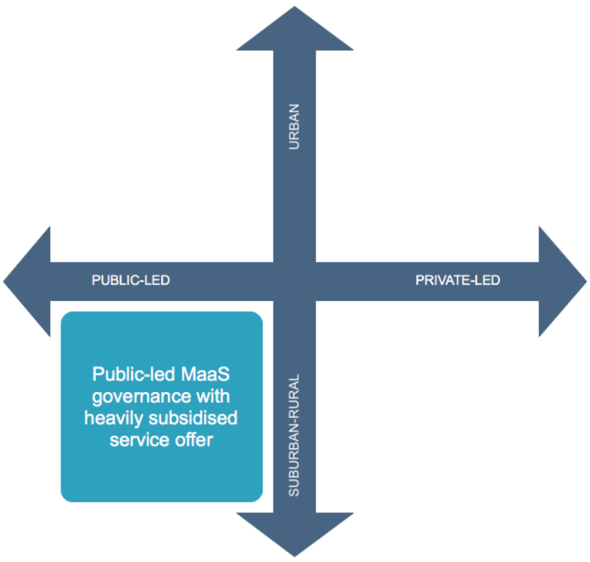


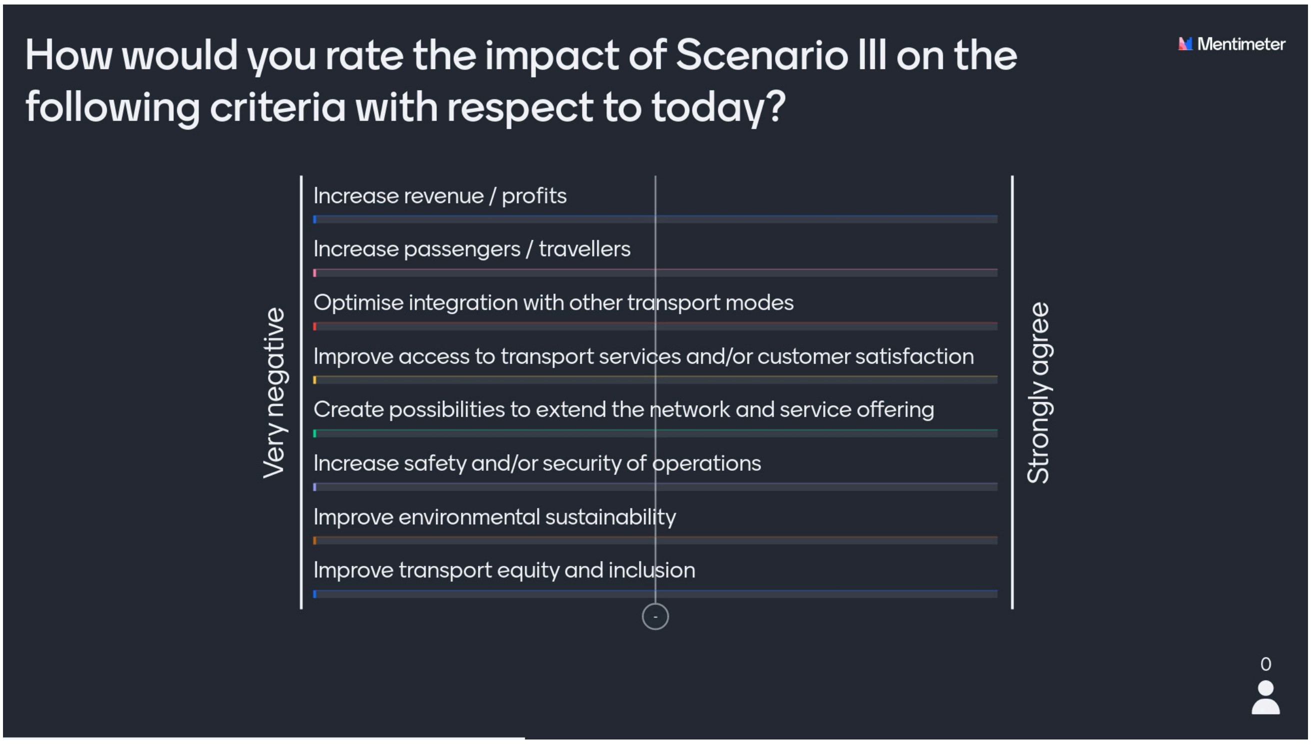


Scenario III – suburban-public-led MaaS

Public-led MaaS with heavily subsidised service offer:

- Heavily subsidised services that are capable of offering service at no more than satisfying levels
- Public-led nature of service delivery provide a good level of integration across service needs such as school trips, hospital visits, etc

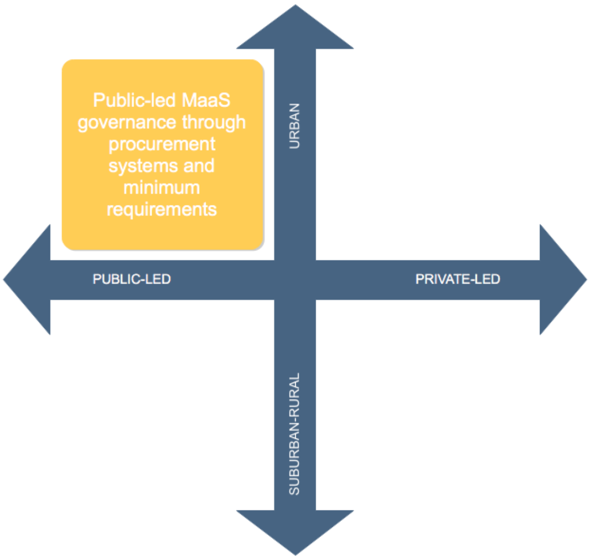


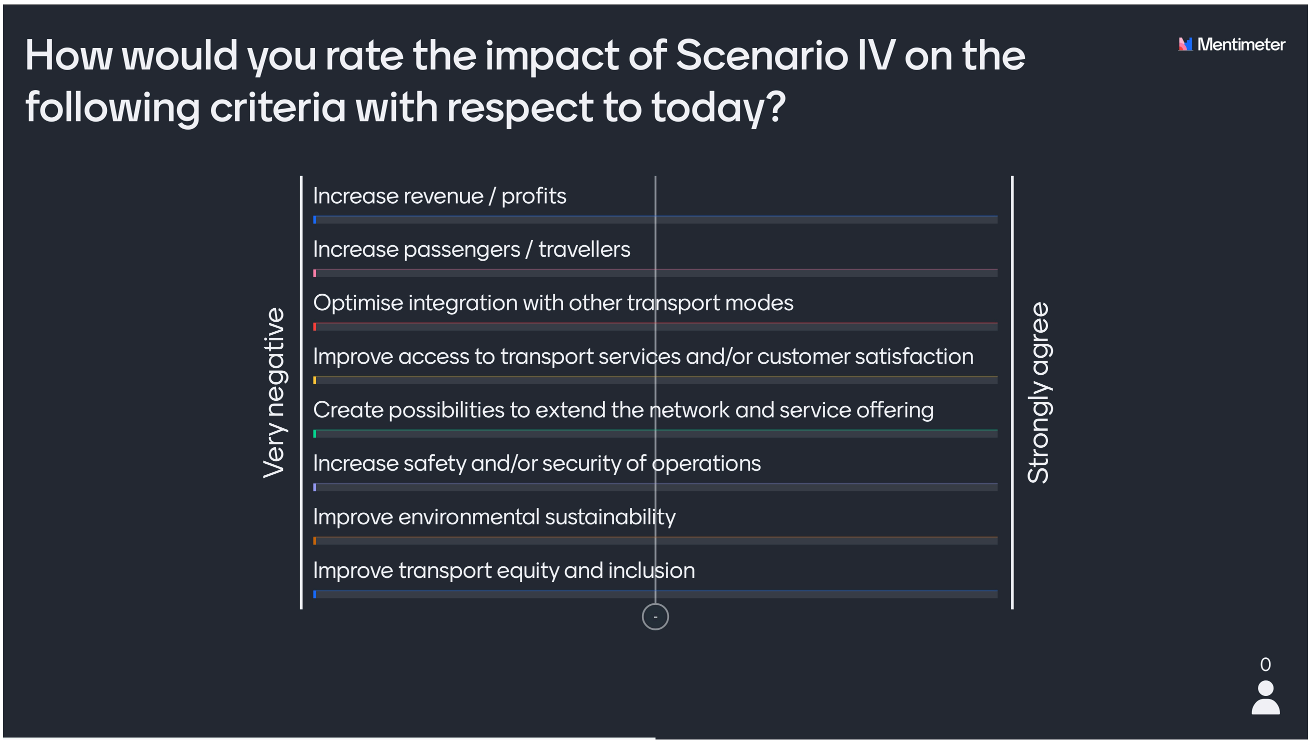


Scenario IV – urban-public-led MaaS

Public-led MaaS with heavily subsidised service offer:

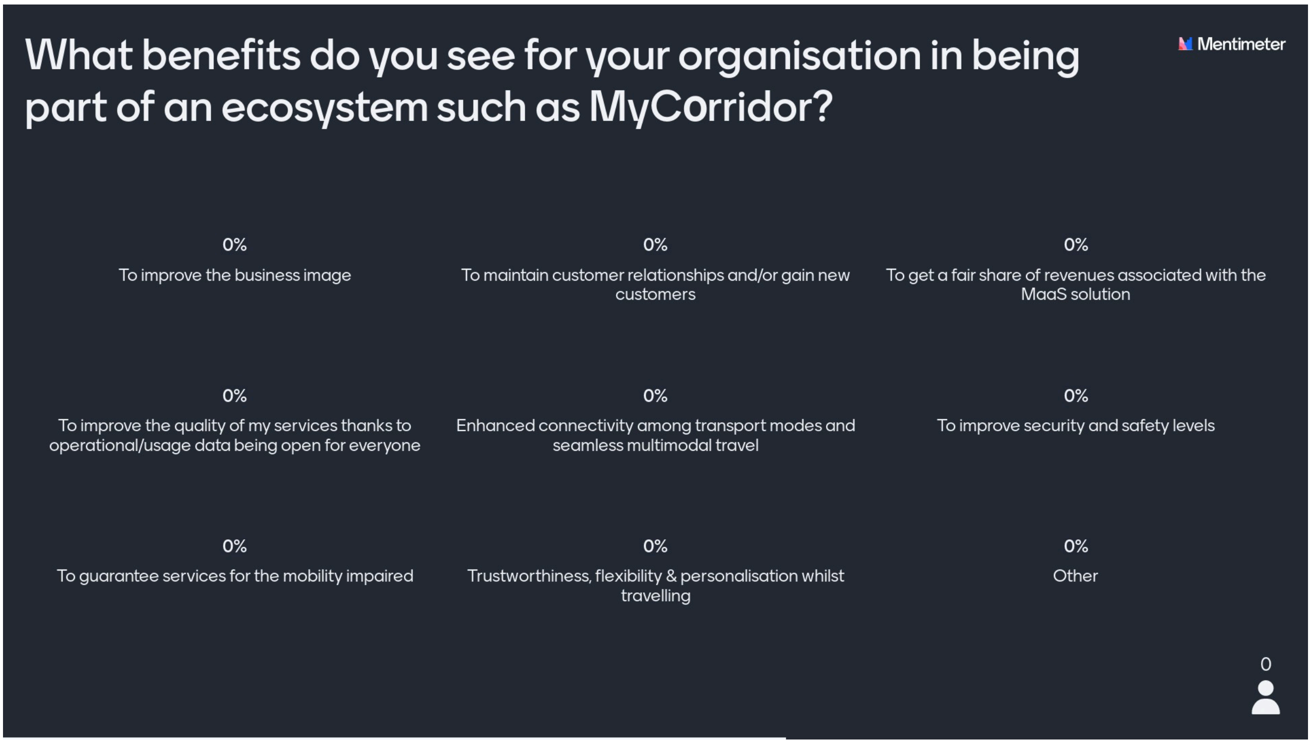
- Service delivery is heavily driven by procurement systems and minimum requirements
- Potentially high level of service integration
- MaaS offer seamlessly meeting diverse needs of customers

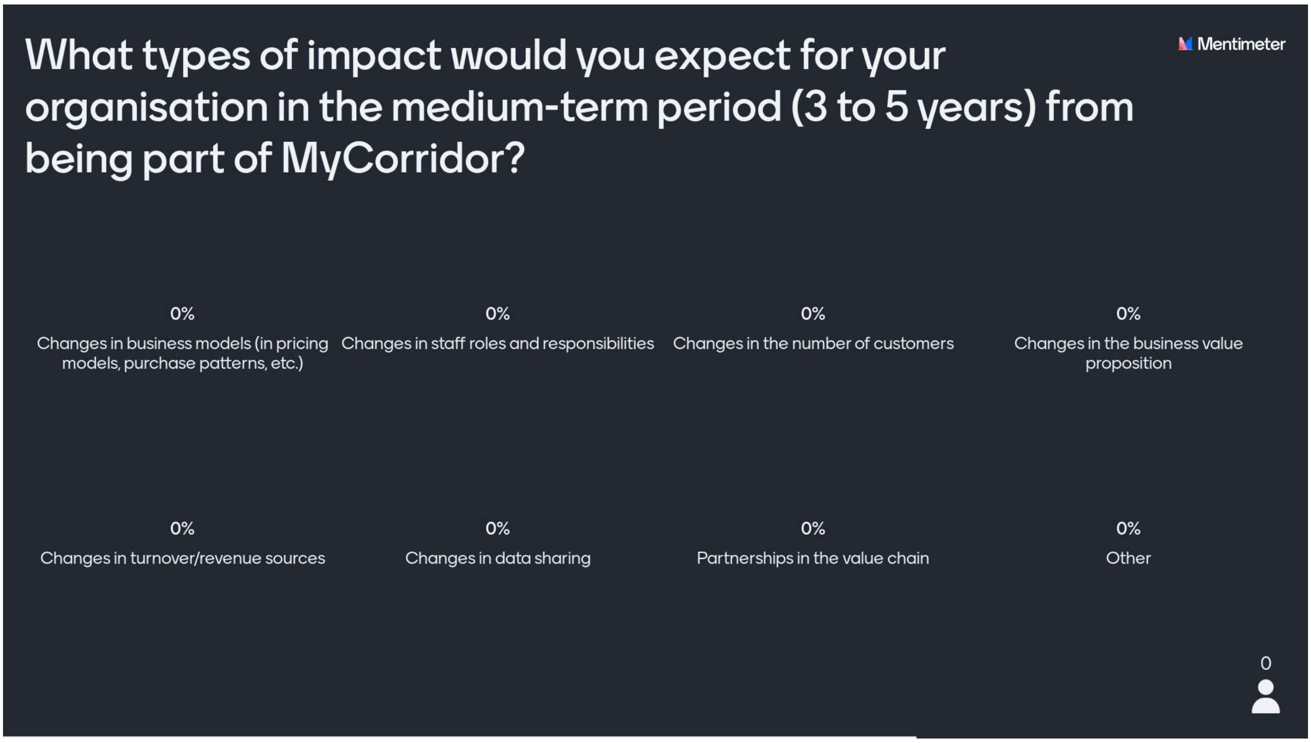




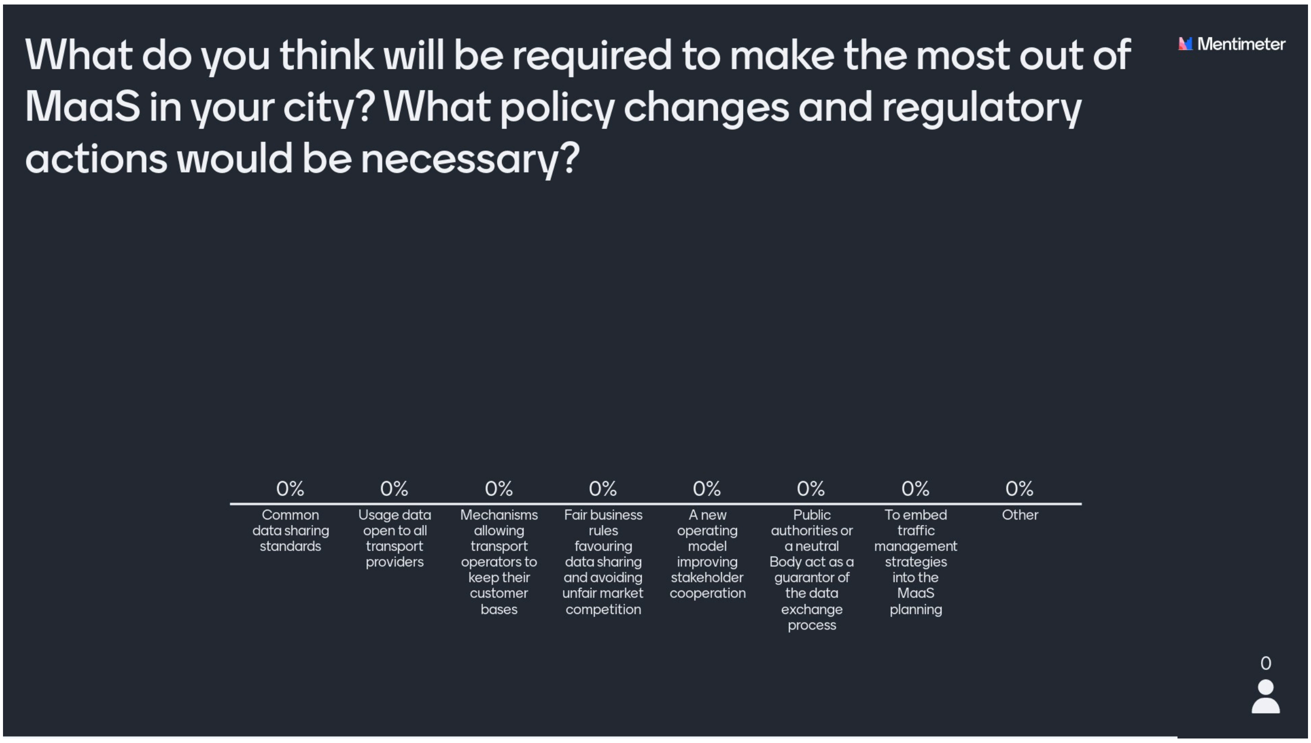
Second interactive session (Mentimeter)

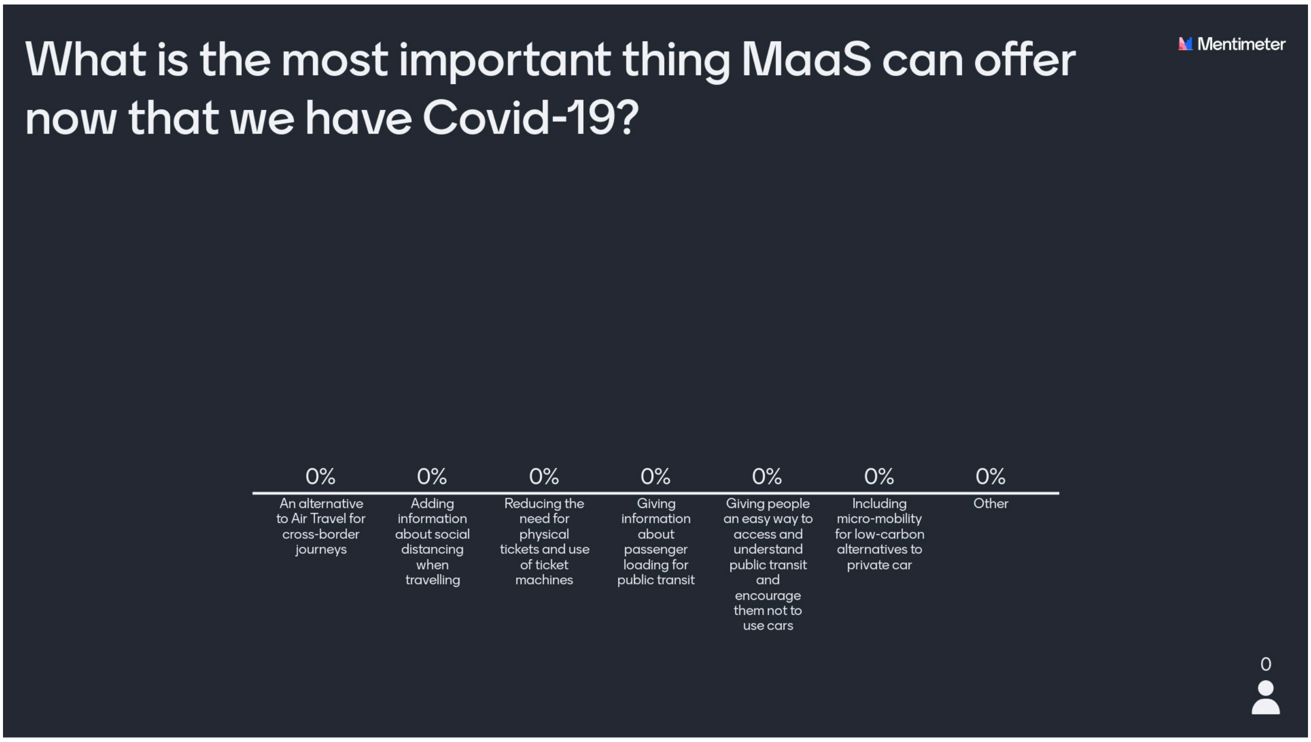
Business-oriented implications, policy and regulatory recommendations for a sustainable MaaS


What benefits do you see for your organisation in being part of an ecosystem such as MyCorridor?
Mentimeter
0%
To improve the business image
0%
To maintain customer relationships and/or gain new customers
0%
To get a fair share of revenues associated with the MaaS solution
0%
To improve the quality of my services thanks to operational/usage data being open for everyone
0%
Enhanced connectivity among transport modes and seamless multimodal travel
0%
To improve security and safety levels
0%
To guarantee services for the mobility impaired
0%
Trustworthiness, flexibility & personalisation whilst travelling
0%
Other
0


What types of impact would you expect for your organisation in the medium-term period (3 to 5 years) from being part of MyCorridor?
Mentimeter
0%
Changes in business models (in pricing models, purchase patterns, etc.)
0%
Changes in staff roles and responsibilities
0%
Changes in the number of customers
0%
Changes in the business value proposition
0%
Changes in turnover/revenue sources
0%
Changes in data sharing
0%
Partnerships in the value chain
0%
Other
0


In your opinion, what types of barriers and inhibitors should be overcome to develop a fully functional and widespread MaaS ecosystem?
Mentimeter
0%
Concerns over sharing organisational/commercially sensitive data
0%
Data interoperability
0%
Privacy & security issues
0%
Lack of technical knowledge and / or human resources
0%
Lack of political support from National and local governments
0%
To raise public awareness and dissemination of socio-economic benefits of MaaS
0%
Investment costs
0%
Visibility of a win-win ecosystem
0%
Other
0


What do you think will be required to make the most out of MaaS in your city? What policy changes and regulatory actions would be necessary?
Mentimeter
0%
Common data sharing standards
0%
Usage data open to all transport providers
0%
Mechanisms allowing transport operators to keep their customer bases
0%
Fair business rules favouring data sharing and avoiding unfair market competition
0%
A new operating model improving stakeholder cooperation
0%
Public authorities or a neutral Body act as a guarantor of the data exchange process
0%
To embed traffic management strategies into the MaaS planning
0%
Other
0



Wrap-up & end of focus group

Is there anything that we did not talk about today that you feel is important?