

# POLITECNICO DI TORINO

Master's Degree in ICT for Smart Societies



**Politecnico  
di Torino**

Master's Degree Thesis

## **Mobility as a Service: state of the art overview, criticalities, Italian proposals and analysis of people's opinions and behaviour**

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## Abstract

Carbon neutrality is more than ever a crucial topic in today's world, with cities being more and more polluted each year. Private transport is surely part of the problem, with cities congestion a direct consequence of the non-sustainable individual usage of car vehicles. Mobility as a Service is a new concept that gained a lot of interest in the last ten years, with the goal of finding new paradigms of urban transport leading to a less polluting and less congested cities. In these years in fact, a big amount of research and studies have been carried out to analyse the strength and weaknesses of this concept, with different pilot projects all over the world. These projects have shown how MaaS implementation is not straightforward and can be conducted with very different visions, from architecture to business models and services offered to the users. Thus, MaaS realization is still an open question, with several partial answers but not a standardized efficient one. Italy has published its own guidelines for MaaS realization, but still, these are not sufficient for implementing a successful project, needing each participating Italy's region to implement their own solution. This research aims to provide an overview of the MaaS concept, analysing its structure, criticalities, and success factors through literature review, considering European and Italian projects. For this purpose, a literature review of studies around MaaS and analysis of Italian proposals are conducted, to highlight strength and weaknesses of this controversial mobility paradigm. Italian council of ministers have published the official notice for implementing MaaS in Italy thanks to the PNRR investments, thus it will be examined to understand what the Italian vision of mobility as a service is. Then proposals from Turin and Milan will be analysed, observing the vision of these two cities about this topic. Moreover, to investigate users' perception and consideration of mobility as a service, a survey has been conceived and a questionnaire designed. Thanks to the survey it is possible to understand what the actual mobility choices of interviewees are and what are their opinions regarding the new way of thinking urban mobility represented by MaaS, understanding which are the limitations of this mobility concept from a user perspective. MaaS, in fact, should offer a lot of value to change users' habits and attract population to participate, but still bringing this value at a fair price. Population, and a wide portion of car users, have not a clear overview of the costs of owning a car, perceiving alternative transport modes as more expensive instead, thus, MaaS objective is to be able of offering a wide variety of services maintaining prices sufficiently low to attract a large number of people, in order to reach social goals like greener and more sustainable society, energy consumption saving and reduce overall pollution. Nevertheless, from the conducted analysis it merged that, even though people is interested in Mobility

as a Service and see its potential, still is hesitant in considering it as a complete alternative to private transportation and thus car owning. However, MaaS shows all its potential and gains trust when it is considered as an alternative option to buying a second car.





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# Acronyms

**LPT**

Local Public Transport

**MaaS**

Mobility as a Service

**B2B**

Business to Business

**B2C**

Business to Consumer

**FOT**

Field operational test

**PNRR**

Piano Nazionale di Rimesa e Resilienza (National Recovery and Resilience Plan)

**DSSRF**

Data Sharing and Service Repository Facilities

**NAP**

National Access Point

**RAP**

Regional Access Point

**PV**

Piattaforme di Vendita (Sales Platforms)

**CEN**

Comité Européen de Normalisation

# Chapter 1

## Introduction

The car is arguably the most comfortable mode of transport in the world. It ensures flexibility, freedom, and comfort; then, there are different types of car for different needs, nevertheless, it is not free from drawbacks.

According to Inrix traffic scorecard [1], Italian cities are among the more congested in Europe and all over the world, being Rome 1<sup>st</sup> in Italy and 7<sup>th</sup> in the world, Palermo 2<sup>nd</sup> in Italy and 9<sup>th</sup> in the world, and Turin 3<sup>rd</sup> in Italy and 17<sup>th</sup> in the world. The same study found out that 109 are the hours lost yearly while commuting in Palermo, while 93 are lost in Turin.

Moreover, it is evident how cars are not used with their full capabilities, since it is noticeable how in most of the cars there is only one person, leading to extremely high polluted and congested cities.

Traffic does not only affect our daily life in a time-consuming way, it also drastically affects the world we live in due to the massive CO2 emissions.

It must be said however that private transport alone is not the only contributor to the climate change; however, it is evident that in the transport sector it is the mode with the bigger impact (Fig 1.1).

Due to all these considerations, it is reasonable to think that the car-based transport model as it is, is not suitable for our societies and must undergo some drastic rework. For these reasons the aim of this thesis is to investigate if Mobility as a Service can be a possible solution.

Today, mobility is a system which is quite close and surely lacks interoperability.

Each mobility service inside urban areas and wider areas stands on its own. Who possesses its own car it is not inclined to use public transport, while who it is already subscribed to LPT (Local Public Transport) is not interested in subscribing to other services.

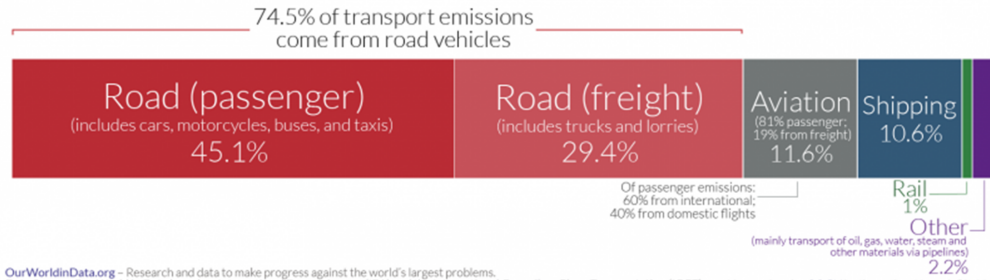
It is evident that to reduce pollution, congestion, and letting our cities be more efficient from a mobility perspective, public transport and other services must play a more central role in our mobility decisions.



## Global CO<sub>2</sub> emissions from transport

This is based on global transport emissions in 2018, which totalled 8 billion tonnes CO<sub>2</sub>.  
Transport accounts for 24% of CO<sub>2</sub> emissions from energy.

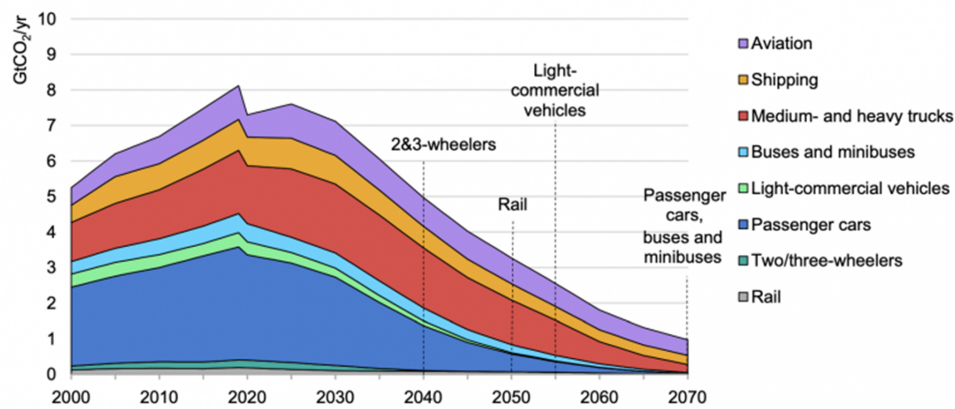
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Data Source: Our World in Data based on International Energy Agency (IEA) and the International Council on Clean Transportation (ICCT).

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**Figure 3.16 Global CO<sub>2</sub> emissions in transport by mode in the Sustainable Development Scenario, 2000-70**



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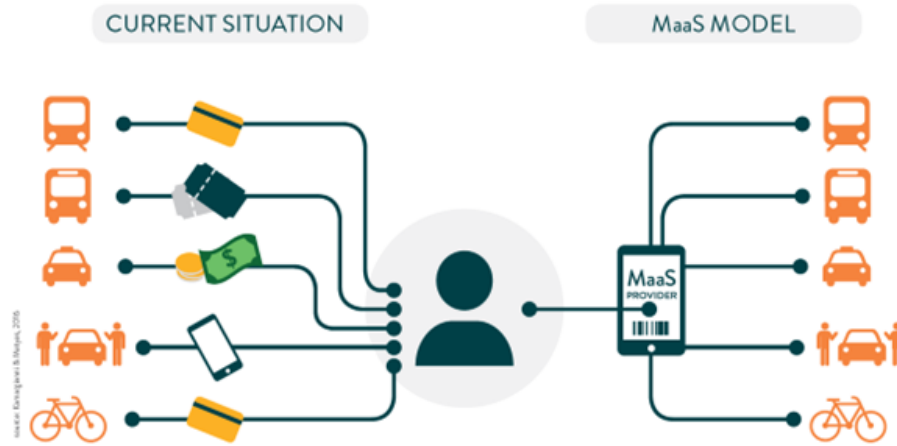
Notes: Dotted lines indicate the year in which various transport modes have largely stopped consuming fossil fuels and hence no longer contribute to direct emissions of CO<sub>2</sub> from fossil fuel combustion. Residual emissions in transport are compensated by negative emissions technologies, such as BECCS and DAC, in the power and other energy transformation sectors.

**Figure 1.1: Global CO<sub>2</sub> emission in transport sector**

Mobility as a Service (MaaS) objective is exactly this: create more transport opportunities with the services that cities already offer, reducing the overall usage and impact of private cars.

The reduction in the usage of private cars can have multiple positive aspects because the big part of the population travelling with this mode will be spread across all other mode of transport, resulting into a more efficient engineering of roads, cycling paths and pedestrian areas.

In addition, a better optimization of shared services with respect to single person car usage will inevitably reduce pollution and congestion (Fig1.2).



**Figure 1.2:** MaaS model

According to Istat 2019-2020 data [2], the total amount of money spent in Italy for private car use is around:

- €107,600 billion for usage and maintenance;
- €32,738 billion for purchasing a car;
- €8,886 billions for extraordinary maintenance.

The cost items covering the bigger percentage of the usage and maintenance cost are related to fuel (33,6%), ordinary maintenance (14%), R.C.A. insurance (13%) and interests on the invested money (12,5%).

However, it must be pointed out that the fraction of cars bought brand new versus those bought second-hand is severely unbalanced in favour of the latter, with only 30% of cars bought as new.

Moreover, it is interesting to note that when buying new cars, the market is seeing a particularly optimistic shift from gasoline and diesel cars to electric or hybrid, as can be seen in Fig 1.3

In the whole picture, in Italy there are 39.717.814 private cars, with 9.630.891 motorcycles, leading to 49.348.705 vehicles for private transport. This number must not be compared with the Italian population of 59 million of people, but with the number of persons that have a driving license, which in 2021 are 38.358.460, resulting in 1,29 vehicles per person.

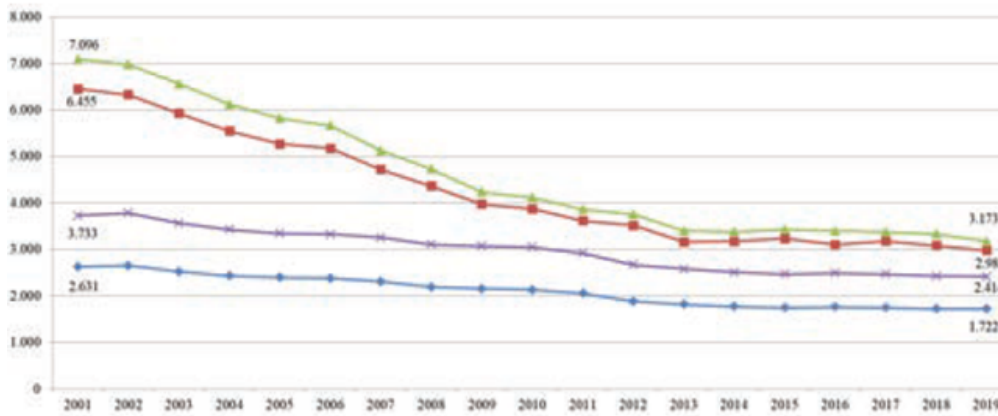
In addition, not everyone owning a driving license have their private vehicle.

Talking about safety, in the period 2001-2019 car accidents have decreased, together with overall injured and dead people. However, these data take into

| Anno | Benzina | Diesel    | Elettrica | Dual fuel | Metano | Ibride/Altro | Totale    |
|------|---------|-----------|-----------|-----------|--------|--------------|-----------|
| 2010 | 711.548 | 901.279   | 112       | 341.207   | 3.170  | 4.925        | 1.962.241 |
| 2011 | 684.459 | 965.668   | 306       | 91.196    | 2.691  | 5224         | 1.749.544 |
| 2012 | 467.596 | 745.437   | 524       | 177.147   | 5.373  | 6.926        | 1.403.003 |
| 2013 | 401.830 | 702.753   | 864       | 172.004   | 11.964 | 15.158       | 1.304.573 |
| 2014 | 394.060 | 746.917   | 1.099     | 185.021   | 11.826 | 21.628       | 1.360.551 |
| 2015 | 491.782 | 872.595   | 1.451     | 175.354   | 8.313  | 26.170       | 1.575.665 |
| 2016 | 599.314 | 1.040.621 | 1.377     | 139.647   | 5.893  | 38.828       | 1.825.680 |
| 2017 | 628.648 | 1.112.653 | 1.969     | 155.385   | 5.757  | 66.694       | 1.971.106 |
| 2018 | 677.995 | 978.316   | 4.995     | 155.175   | 7.026  | 86.662       | 1.910.169 |
| 2019 | 851.968 | 762.916   | 10.664    | 135.736   | 30.363 | 125.005      | 1.916.652 |
| 2020 | 522.393 | 452.056   | 33.191    | 96.424    | 28.000 | 249.581      | 1.381.645 |

**Figure 1.3:** Number of new cars per fuel type

account that cars' manufacturer have improved safety condition of vehicles, thus this injury reduction is related to both less car accidents and more secure vehicles (Fig 1.4).



**Figure 1.4:** Data on accidents: blue - accidents, red - deadly accidents, purple - injured, green - deaths

Regarding emissions, transport sector in 2019 contributed for 11,6% of the total national PM10 emissions, with 64,2% caused by auto vehicles only, with diesel emitting more than twice the amount of pollutant than gasoline vehicles.

In 2019 61,3% of trips were made by car, with only the 8,5% as a passenger, showing how bad optimized is car usage, while intermodality, where Local Public Transport (LPT) has a central role, stands at 5,5%. Audimob showed a particular trend due to the COVID-19 pandemic. The possibility of walking towards the nearest shops increased people willingness to walk inside their neighbourhood. In fact, in 2019 trips made by walking were only 6%, while during pandemic they

raised to 17%, to stabilize at 10% after the lockdown. This is interesting in showing that habits play a fundamental role in mobility.

In conclusion, Istat reports that the great delay that Italy is facing with respect to other European countries into improving mobility and implementing new sustainable modes of transport will have heavy repercussions not only in urban environment quality or in the citizens' ordinary life, but also in the capacity of our cities to attract investments.

This research aims at providing an overview of the current state of the art regarding MaaS, analysing what are the challenges to face in promoting and implementing this new solution.

To this end, a preliminary state-of-the-art analysis is conducted in section 2, considering not only pilot projects but the overall factors to consider when proposing a MaaS solution concerning its structure, with emphasis on the actors, business models, and Italy's PNRR guidelines.

Moreover, the second objective is to investigate people's opinions regarding MaaS' new urban mobility paradigm; to this end, both quantitative and qualitative surveys are proposed and depicted in section 3.

The results of the proposed analysis are examined in section 4, with the study of the Italian pilots and proposals, and the analysis of the results of the two surveys conducted, providing insights on MaaS' interest and the criticalities it has to face to succeed in our society.

## Chapter 2

# State of the art

In this section, the results of the literature review on MaaS will be provided. State-of-the-art analysis gave interesting results with respect to current pilot projects and general MaaS implementation aspects, but a more in depth analysis was also done considering Italian MaaS vision.

Our world is constantly changing and evolving, and technology makes every day big steps towards new horizons and opportunities. This trend is evident when looking at the huge progress in electric and autonomous vehicles development and deployment, nevertheless, private car is from decades the dominant mode of transport, with no changes towards the overall urban mobility approach.

Since they were invented, in fact, private cars are the emblem of freedom and the must-have transport mode when seeking autonomy, flexibility and freedom, while transport modes based on sharing (e.g., bike sharing or car sharing) are not considered a viable option, also being perceived expensive with respect to owning a car.

Many car owners do not have the full cost overview of possessing a private car [3, Turrentine and Kurani, 2006]. Many perceive the cost of using the car as only the cost for gas, not considering the high purchase price, but also ordinary and extraordinary maintenance costs derived from the usage of the vehicle itself, thus, being less sensitive to the long-term costs of owning a car and perceiving the running costs of car sharing as higher [4, Scott and Axhausen, 2006].

As previously said, already existing transport mode lack interoperability: MaaS has interoperability as a milestone for all its implementations.

The first comprehensive definition of MaaS is offered by Hietanen (2014)[5]. He describes MaaS as a mobility distribution model that deliver users' transport needs through a single interface of a service provider. It combines different transport modes to offer a tailored mobility package, like a monthly mobile phone contract.

Most likely, MaaS users will be those who already use LPT or tourists, since these people already travel using various modes of transport [6, Gandia et al.,

2021].

MaaS is considered a tool by transport operators to improve customer loyalty and provide better value for money. The inclusion of rental cars and rental bikes promote the door-to-door trip. MaaS is therefore associated with a shift from ownership as the need to own vehicles decrease as easy access to shared and rental vehicles increases [7, Ajit, 2020]

MaaS can be implemented and offered to customers in different ways. More basic MaaS platforms allow to plan, book, and pay for each trip in the pay-per-use formula, while more complex implementations rely on subscriptions.

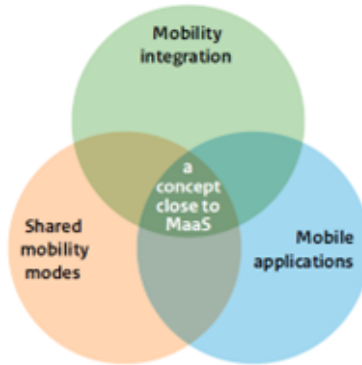
In these more complete implementations, each citizen has the possibility to define its own mobility package, which is simply the set of services provided by its city that he/she intends to use. An example of a mobility package can comprise LPT (bus, tram and metro), bike sharing and car sharing, discount on taxi rides etc. This mobility package enables the possibility to use LPT (coherently upgraded to satisfy the new demand), without renounce to the freedom offered by bikes and cars.

Differently to the current status quo, all these services will be accessible thanks to a single app, increasing simplicity and accessibility to those services, which up to now require to register to each service provider to use them.

Mobility as a Service plays a key role in integrating new mobility opportunities. To do so it exploits ICT (Fig (2.1).

MaaS ICT application in fact wants to be a single application from which it is possible to manage multimodal trips.

With MaaS, the idea of signing into every mobility service offered by the city is now obsolete, since one of the core factors of MaaS is data integration.



**Figure 2.1:** MaaS concept

According to the different integration level of the MaaS application developed, users can have access to different possibilities.

In Fig 1.2, Sochor et al. (2017) [8] explain clearly how the different levels of integration of MaaS change the shape of the service.

|   |                                                                                   |                                                       |
|---|-----------------------------------------------------------------------------------|-------------------------------------------------------|
| 4 | <b>Integration of societal goals</b><br>Policies, incentives, etc.                |                                                       |
| 3 | <b>Integration of the service offer</b><br>Bundling/subscription, contracts, etc. | UbiGo<br>whim                                         |
| 2 | <b>Integration of booking &amp; payments</b><br>Single trip – find, book and pay  | GVH   Hannover mobil<br>smi)e simply mobile<br>moovit |
| 1 | <b>Integration of information</b><br>Multimodal travel planner, price information | Qixxit Google<br>Transport for London Lyft            |
| 0 | <b>No integration</b>                                                             | Hertz sunfleet                                        |

**Figure 2.2:** Levels of integration

Level 1 is the simplest integration level for MaaS, which only includes multimodal trip planning information and prices. This kind of integration however is far from the real MaaS objective of reducing private car usage. As researched from Pronello et al. (2017) [9], Advanced Traveller Information Systems are not sufficient to lead a significant decrease of private cars in favour of a more sustainable approach thanks to LPT or shared mobility.

Moreover, it must be remarked that literature reviews reveal a generally low willingness to pay for information provided via information systems, especially for PT information. There are currently plenty of systems providing information for free, but people may be willing to pay if the system is perceived to add sufficient value and functions faultlessly [9, Pronello et al., 2017]. Today however most travelers view information integration as a basic prerequisite and care more about higher integration levels [10, Chowdhury et al., 2018].

Level 2 MaaS lies on the concept of pay-per-use, meaning that the users can plan, book, and pay for their trip inside the MaaS application. Key aspects of this level of integration are ticket and payment integration, thanks to the use of a single ticket for each multimodal trip made of more services.

This integration paradigm shows occasional reductions in travel costs, leading also to more freedom of choice of transport mode [11, Abrate et al., 2009]; [12, Blythe e Holm, 2002].

Level 3 provides MaaS as it was designed and intended. Thanks to this level of

integration, users can purchase mobility packages or bundles. Subscribing only to the MaaS application, and not to the single services, users can choose which mode of transport to include in their subscription among those offered by the MaaS providers, using either pay-per-use, monthly or annual subscriptions. Personalization and customization is now a part of the MaaS application, allowing the service to be more suited to everyone. Level 4 comes with the idea of including some policies and benefits to attract people to use MaaS, nevertheless, implementation remains difficult, and impact assessments of such integration on travellers remain limited [13, Candel, 2017]; [14, Preston, 2010].

Already existing MaaS projects are introduced in Fig 2.3, also showing their level of integration [15, Durand et al., 2018].



| Name of the initiative                                                                 | Place                                           | Status                                                    | Modes                                                                                                              | Type of mobility integration                                                   |
|----------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| moovel                                                                                 | Hamburg and Stuttgart, Germany                  | Operational (2015-)                                       | Car sharing, taxi, urban PT, regional PT.                                                                          | Level 2 (partial, payment integration).                                        |
| myGicero                                                                               | Italy                                           | Operational (2015-)                                       | Urban PT, regional PT, international PT, parking, permit for urban congestion charging zones.                      | Level 2 (partial, payment integration).                                        |
| NaviGoGo                                                                               | Dundee and North East Fife region, Scotland, UK | Operational (2017-)                                       | Car sharing, taxi, urban PT, regional PT.                                                                          | Level 2 (partial, payment integration).                                        |
| IDPASS                                                                                 | France                                          | Operational (2017-)                                       | Car renting, taxi, valet parking.                                                                                  | Level 2 (partial, payment integration).                                        |
| Tuup                                                                                   | Turku region, Finland                           | Operational (2016-)                                       | Car sharing, bike sharing, taxi, urban PT, DRT.                                                                    | Level 2 (partial, payment integration, ticketing integration to come in 2018). |
| Hannovermobil                                                                          | Hannover, Germany                               | Operational (2014-)                                       | Car sharing, taxi, urban PT, regional PT.                                                                          | Level 2.                                                                       |
| EMMA (TaM)                                                                             | Montpellier, France                             | Operational (2014-)                                       | Bike sharing, car sharing, urban PT, parking.                                                                      | Level 2.                                                                       |
| Business travellers cards: NS Business Card, MobilityMixx, Radluz Total Mobility, etc. | The Netherlands                                 | Operational (national coverage of these cards since 2013) | (Car sharing, parking, tank filling, electric car loading, taxi, car rental), bike sharing, urban PT, regional PT. | Level 2 (Business to Business), partial Level 1.                               |
| Smile                                                                                  | Vienna, Austria                                 | Pilot (2014-2015)                                         | Bike sharing, car sharing, taxi, urban PT, regional PT, parking.                                                   | Level 2.                                                                       |
| WienMobil Lab                                                                          | Vienna, Austria                                 | Operational (2017-)                                       | Bike sharing, car sharing, taxi, urban PT, parking.                                                                | Level 2.                                                                       |
| SHIFT                                                                                  | Las Vegas, USA                                  | Planned (2013-2015)                                       | Bike sharing, car sharing, taxi, collective DRT, valet parking.                                                    | Level 3.                                                                       |
| UbiGo                                                                                  | Göteborg, Sweden                                | Pilot (2013-2014), version 2.0 in preparation             | Bike sharing, car sharing, car renting, taxi, urban PT.                                                            | Level 3.                                                                       |
| Whim                                                                                   | Helsinki, Finland                               | Operational (2016-)                                       | Bike sharing (car sharing to come), car renting, taxi, urban PT, regional PT.                                      | Level 3.                                                                       |

Figure 2.3: MaaS projects

MaaS development and success relies also on habits and psychological factors. Thørgersen and Møller (2008) [16], provide an interesting aspect of the impact of mobility as a service introduction in communities. According to their research, timing is fundamental in order to break car owners' habits in favor of an increased usage of LPT.

Following Verplanken and Aarts (1999) [17], a habit is defined as a learned sequence of acts that has become an automatic response to specific cues and is

functional in obtaining certain goals or end-states. With repetition, each step in the execution of the behaviour can be done with less effort and less conscious awareness [18, Ouellette and Wood, 1998]; [19, Thørgersen and Ölander 2006].

The key to changing habitual behaviour is to create conditions that make the automatic execution of the habit impossible or at least unattractive [20, Ronis et al. 1989] and which give individuals sufficient motivation to make a deliberate choice [21, Fazio 1990]. Specifically, with regard to travel mode choice, it has been suggested that people's car-driving habits can more easily be influenced when they have recently changed residence [22, Bamberg 2006].

However, as highlighted by Thørgersen and Møller (2008) [16], the effect of the free travel card was limited only to those people who did not experience major life changes.

## 2.1 MaaS structure: the integration layer problem

Even though there are different possible MaaS implementations, all of them share a common factor, which is data sharing.

This is a crucial aspect of MaaS success, since the more transport operators share their data, the more services can be offered to users, enabling MaaS in its overall and complexity. In the Fig 2.4 are explained the nine core characteristics of MaaS platforms according to Jittrapirom et al. (2017) [23]

| Core Characteristic               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Integration of transport modes | A goal of MaaS schemes is to encourage the use of public transport services, by bringing together multi-modal transportation and allowing the users to choose and facilitating them in their intermodal trips. Following transport modes may be included: public transport, taxi, car-sharing, ride-sharing, bike-sharing, car-rental, on-demand bus services. Envisioning a service beyond the urban boundaries, it will embrace also long-distance buses and trains, flights, and ferries.    |
| 2. Tariff option                  | MaaS platform offers users two types of tariffs in accessing its mobility services: "mobility package" and "pay-as-you-go". The package offers bundles of various transport modes and includes a certain amount of km/minutes/points that can be utilized in exchange for a monthly payment. The pay-as-you-go charges users according to the effective use of the service.                                                                                                                     |
| 3. One platform                   | MaaS relies on a digital platform (mobile app or web page) through which the end-users can access to all the necessary services for their trips: trip planning, booking, ticketing, payment, and real-time information. Users might also access to other useful services, such as weather forecasting, synchronization with personal activity calendar, travel history report, invoicing, and feedback.                                                                                         |
| 4. Multiple actors                | MaaS ecosystem is built on interactions between different groups of actors through a digital platform: demanders of mobility (e.g. private customer or business customer), a supplier of transport services (e.g. public or private) and platform owners (e.g. third party, PT provider, authority). Other actors can also cooperate to enable the functioning of the service and improve its efficiency: local authorities, payment clearing, telecommunication and data management companies. |
| 5. Use of technologies            | Different technologies are combined to enable MaaS: devices, such as mobile computers and smartphones; a reliable mobile internet network (WiFi, 3G, 4G, LTE); GPS; e-ticketing and e-payment system; database management system and integrated infrastructure of technologies (i.e. IoT).                                                                                                                                                                                                      |
| 6. Demand orientation             | MaaS is a user-centric paradigm. It seeks to offer a transport solution that is best from customer's perspective to be made via multimodal trip planning feature and inclusion of demand-responsive services, such as taxi.                                                                                                                                                                                                                                                                     |
| 7. Registration requirement       | The end-user is required to join the platform to access available services. An account can be valid for a single individual or, in certain cases, an entire household. The subscription not only facilitates the use of the services but also enables the service personalisation.                                                                                                                                                                                                              |
| 8. Personalisation                | Personalisation ensures end users' requirements and expectations are met more effectively and efficiently by considering the uniqueness of each customer. The system provides the end-user with specific recommendations and tailor-made solutions on the basis of her/his profile, expressed preferences, and past behaviors (e.g. travel history). Additionally, they may connect their social network profiles with their MaaS account.                                                      |
| 9. Customisation                  | Customisation enables end users to modify the offered service option in according to their preferences. This can increase MaaS' attractiveness among travelers and its customers' satisfaction and loyalty. They may freely compose a specified chained trip or build their mobility package with a different volume of usage of certain transport modes to better achieve their preferred travel experiences.                                                                                  |

Figure 2.4: MaaS characteristics

Core elements of MaaS are instead [24, (Fishman T., 2017)]:

- infrastructure;
- data providers;
- transport operators;
- trusted mobility advisors;

*Infrastructure:* MaaS is a data driven, user-centred paradigm powered by the growth of smartphones. It relies on high level of connectivity, secure, dynamic up-to-date information on travel options. Thus, the need for a diverse range of actors such as mobility management players, payment processors, public and private transport providers, and local authorities with responsibility for transport and city planning.

*Data providers:* these are one of the intermediary layers between the multiple service providers, providing the application programming interface (API) gateways and analytics on usage, demand, and planning. Because individual service providers are not likely to share their app data, having a third-party involved can remove some of the barriers to cooperation that would otherwise arise.

*Transport operators:* demand to expand service delivery have driven many transport agencies to introduce new modes of travel such bike-sharing, e-scooter, or car-sharing. Typically, each operator requires its own app, with a separate interface and payment mechanism, while MaaS integrates all of them.

*Trusted mobility advisor:* this is the third-party aggregator, which links the services of the various private and public operators facilitating payments through a single gateway.

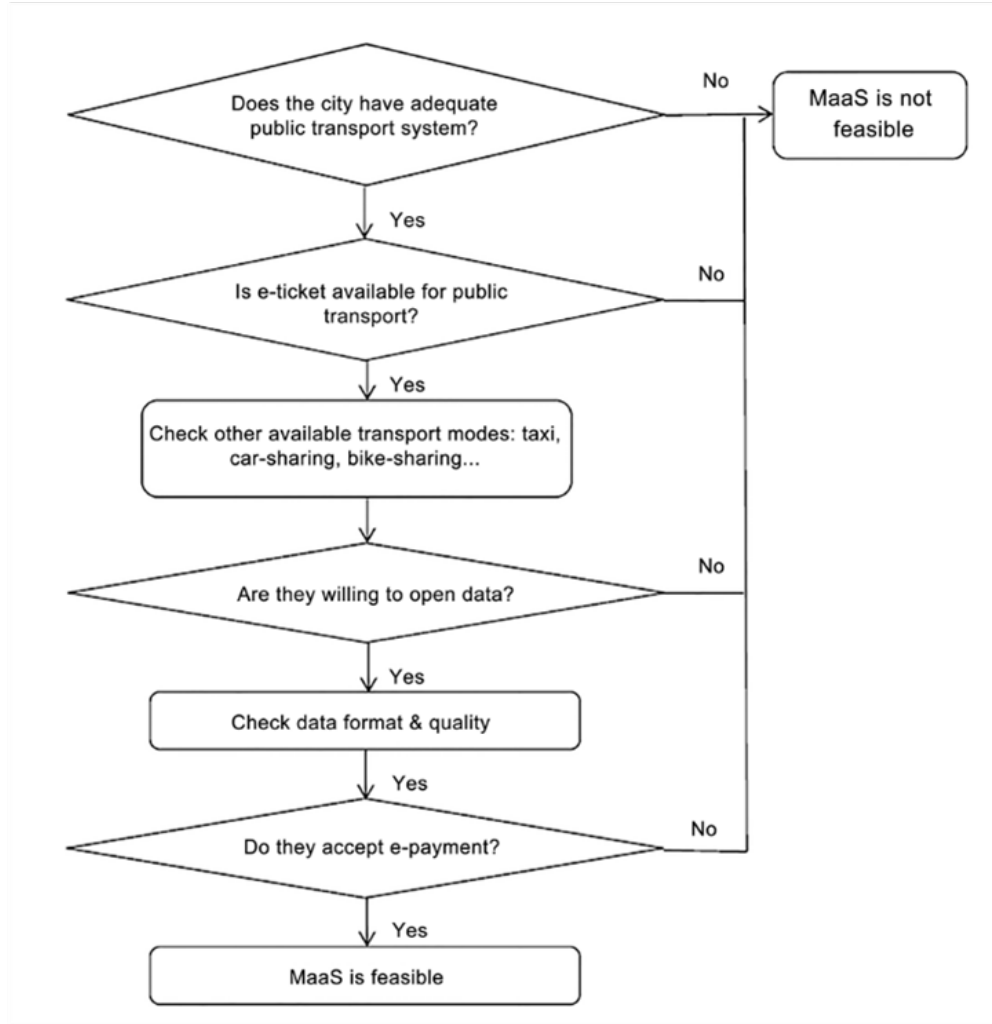
Fig 2.5 summarizes in a flow chart the main aspects that must be considered when implementing MaaS.

Mobility as a Service implementation is not a straightforward process: it involves different actors that can play different roles, with cooperation being the key to the success of the project.

Of course, key actors for the success of the MaaS are the end users and the service operators that offer their services to the MaaS provider, but most challenges occur at the integrator layer.

It is required that some actor takes the responsibility of unifying all the services, collecting data from all of them and providing them to the users. That is the role of the integrator.

The integrator is responsible for the integration of data from multiple transport operators and infrastructure, and then the MaaS provider builds the solution on top of the integrated layer. The integrator could be different from the MaaS provider, but sometimes these roles are taken by the same actor. The key doubt regarding



**Figure 2.5:** MaaS requirements

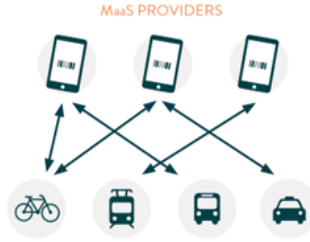
MaaS implementation is about the MaaS provider entity. But the key question is rather who can attract the maximum customers to produce the maximum benefits for sustainable and affordable mobility. Therefore, the role of the integrator is to make MaaS successful. Only having happy customers and happy business partners will lead MaaS providers to be able to scale and create maximum benefits for sustainable mobility.

The roles of the MaaS provider and integrator could be taken by different actors such as the public transport authority, the public transport operator, any mobility service operator, a tech firm, a MaaS company or any other actor from the banking or the telecommunications sectors. This would depend on the local context, thus considering many factors such as the strength of established mobility services, the

readiness of the travelers, the institutional organization and legal framework for the transport services, to name a few.

MaaS can be implemented in different ways according to the roles covered by the actors and according to whom takes the integrator role [25]

**Commercial integrator** With this model, multiple MaaS providers are present in the area of interest, however there is no cooperation in data sharing and all remains separated and in conflict. This inevitably results in competitive and unregulated market, thus the need for a marketplace with agreements between MaaS providers and transport system (2.6). Nevertheless, since the basis for the success of MaaS is collaboration and not competition, there are strong doubt that this implementation would be suitable, since competition will lead to exclusive services for some providers, not giving the users a complete urban transport experience. In this scenario, the resulting platform is non-regulated and not effective towards increasing ridership of public transport, moreover, there is no data sharing with any public authorities.

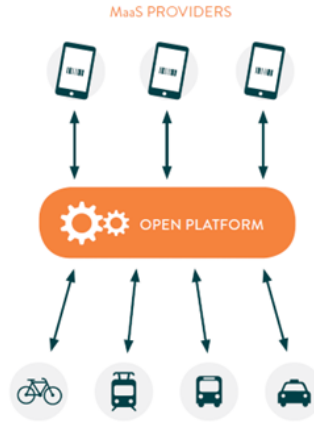


**Figure 2.6:** Commercial integrator

**Open back-end platform** Having an open back-end platform there is free sharing of data through open API's. This is set up by a public entity with rules determined by the public authority. In this scenario all services must open their API's MaaS solutions, in order to succeed, must be user-centred, thus providing a different experience to each customer.

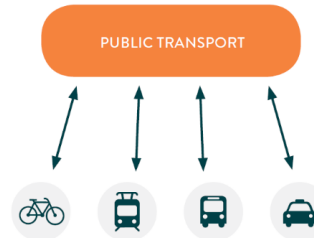
This scenario comes with a standardized back-end MaaS platform, however, there is still competition on the front side and cost of maintenance of the infrastructure needs to be evaluated. Standardization is key in the success of this implementation, needing common standards for letting all transport operators sharing their data in a common way, allowing all MaaS providers to have access to them.

Moreover, the presence of an open back-end platform handled by a third party actor will encourage small transport operators to join the project (Fig 2.7).



**Figure 2.7:** Open back-end platform

**Public transport as integrator** In this solution, MaaS is run by public transport with selected mobility services, where rules are set by the public transport, while other mobility services providers may have to open up their APIs to participate. Public transport already has the largest customer data base and is the backbone of sustainable urban mobility. It is perceived as being able to achieve the highest increase in sustainable mobility, be socially inclusive, however can lead to a less customer-oriented experience (Fig 2.8).

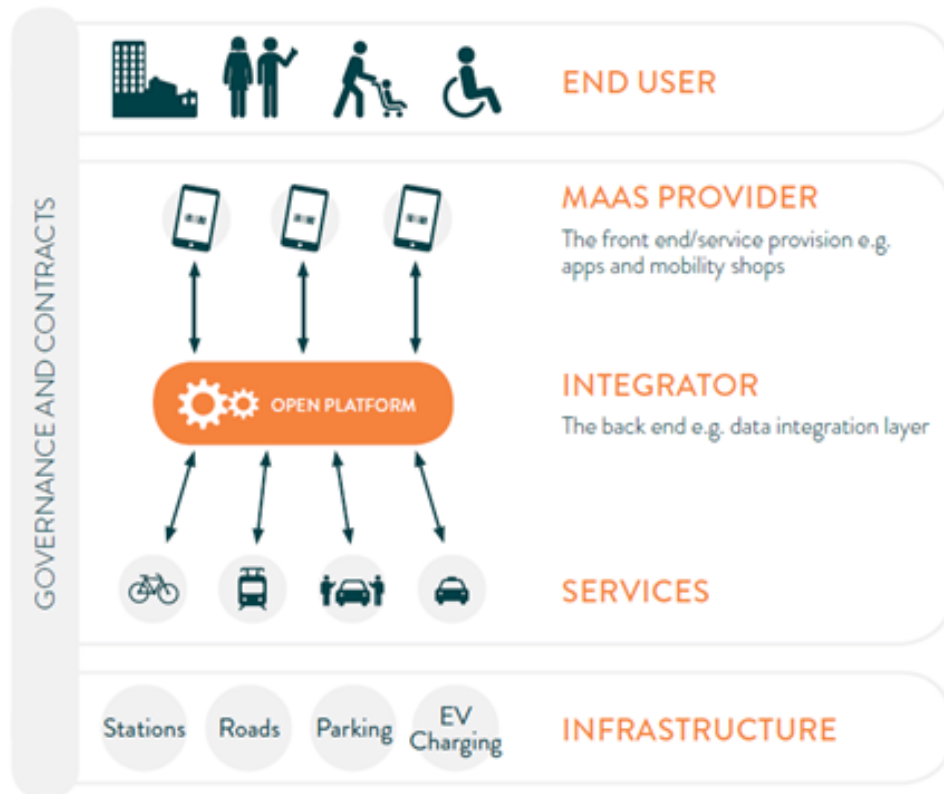


**Figure 2.8:** Public transport as integrator

Considering MaaS structure, the one that best suits the scope of MaaS is depicted in 2.9. Users' need for personalization and customization certainly leads to the choice of competition at the front-side of the implementation, seeing concurrency among MaaS providers. However, cooperation is needed on the back-end side of MaaS structure. The importance of a back-end platform is undeniable, nevertheless, it is not yet sure which the best actor that manages it should be.

Since there is competition on the front-side, the most reasonable solution is that LPT takes the charge of acting also as integrator of services, this is eased also from the fact that LPT is the one that has the most data and is able to extract the most

value from it. The only concern regards the investments into the implementation of this digital platform.



**Figure 2.9:** MaaS structure



Increasing demand for more personalized and interoperable transport services has created a market space for MaaS. Its development necessarily relies on the following factors [7, Ajit, 2020]:

- access and openness of data;
- availability of open API's and more flexibly transport and mobility regulations;
- multiple transport modes;
- one single application;
- mobility subscriptions (mobility packages);
- integration of real-time data;
- payment integration.

Regarding personalized and user-centered aspects, key elements of a well-constructed MaaS implementation are trustworthiness, simplicity, impartiality, and flexibility (Fig 2.10).

To do so, data management is a critical point when creating the service.

Privacy and security are mandatory elements in information and communication technologies. The system security attributes are:

- confidentiality: data and services that process such data cannot be accessed by unauthorized entities;
- integrity: data and services that process such data cannot be modified in an unauthorized or undetected manner;
- availability: access to data and services that process such data is always granted in a comprehensible and processable manner;
- unlinkability: data cannot be linked across domains that are constituted by a common purpose and context;
- transparency: data processing can be understood and reconstructed at any time;
- intervenability: intervention is possible concerning all ongoing or planned privacy-relevant data processing.

Nevertheless, all these aspects go in contrast with each other.

Confidentiality goes against availability since the former aims to ensure that there is no external access to data, while availability wants full access to data and services for everybody.



**Figure 2.10:** Key elements with respect to users

Integrity goes against intervenability since integrity wants no change in shared data, while intervenability aims to have all types of changes and full process flexibility.

Finally, unlinkability and transparency go against each other because unlinkability requires that data cannot be linked across multiple platforms, while the latter wants openness and reproducibility.

It is thus evident how data management is tricky and requires a lot of attention. In addition to data security and privacy, the main issues related to data handling

are related to the presence of multiple data providers and that those data are stored and shared with different data formats and protocols, mining integration and interoperability.

Lots of data are needed to create a MaaS platform:

- transport data: real-time data on the availability of the mobility service, accessible through secure APIs;
- ticketing data: data to resell access to the mobility service, online booking, and mobile ticketing, through secure APIs;
- traveler data: personal data useful to shape the service for each customer;
- infrastructure data: parking spaces, availability of EV charging stations

All these data are owned and managed by transport operators, which are multiple, all with their standardization processes and rules. Thus, it is not easy to use those data in a common way, due to the lack of standards among the different actors.

The quality and consistency of shared data and the data format are essential for MaaS. It must be easy for all transport operators, large and small players, to plug in the MaaS solution. A standard to share data should be set up, to which every actor could adapt voluntarily. Forcing transport operators to open their booking and/or ticketing via regulation will not necessarily address the above-mentioned risks. There needs to be a collaborative approach as setting up a MaaS solution is all about cooperation.

MaaS platforms must interface via APIs with each operator, and these operators will potentially have different repositories and data structures. Problem is that some of the public transport companies still do not will abandoning their own data formats. Nonetheless, as Google Transit Feed Specifications (GTFS) becomes a global standard, many transport operators decided to supply their data, wanting their services to be included in Google map, which enjoys a dominant position in the market [7, Ajit, 2020].

Stakeholders often refrain from sharing the data due to cybersecurity fears and fear about any leak in data that can break the system in general. However, this seems not to be a problem when considering the final users, since they are more inclined in sharing their personal data in order to have a better and personalized service, as everyone give permission to Google services and others in their everyday life.

The CEN (European Standard Public Transport Reference Data Model), defined standard models and protocols to ease the process of sharing data. Those that are mainly used in Europe are the Transmodel, which defines the structure of the messages and the entities involved, and NeTEx and SIRI as information exchange standards

**Transmodel** Public transport services rely increasingly on information system to ensure reliable, efficient operation and accurate passenger information. These systems are used for a range of specific purposes like setting schedules and timetables, manage vehicle fleet, issuing tickets and receipt or provide real time information.

Transmodel, the CEN , improves a number of features of public transport information and service management. The Transmodel standard provides a framework for defining and agreeing data models, covering the whole public transport operations area. Thanks to it, it is possible for operators, authorities and software suppliers to work together much more easily towards integrated systems. There are many organizations involved in the provision of transport data that must interact with each other in order to provide services. Transmodel provides matching definition, structures and semantics for PT data allowing the design of coherent, precise and efficient data exchange, also considering additional concepts to simplify the link between LPT and alternate modes of transport. As example, Public Transport involves different transport modes, with travellers boarding or alighting at specific stop places. These, for timetable construction purposes, are represented as scheduled stop points. A journey pattern is a sequence of scheduled stop points.

Thanks to the Transmodel, data from different organizations can be combined into a unified view, allowing to be used for many different purposes by many systems.

**NeTEx** NeTEx is a CEN Technical Standard for exchanging Public Transport schedules and related data and it is divided into six functional parts [26]:

- part 1 describes the Public Transport Network topology;
- part 2 describes Scheduled Timetables;
- part 3 covers Fare information;
- part 4 describes the European Passenger Information Profile ;
- part 5 describes Alternative modes exchange format ;
- part 6 describes the European Passenger Information Accessibility Profile.

Many NeTEx concepts like definitions and explanation are directly taken from Transmodel, being sometimes adapted to fit the NeTEx context. It consider all mass public transport modes, considering also airports and thus air journeys, and the data exchange is possible either through dedicated web services, data file exchange or thanks to SIRI exchange protocol.

Regarding fares the purposes are multiple. Among them, it is stated that it describes many various possible fare structures (e.g. flat, time dependent, zonal

etc), fare products that may be purchased and describe if particular conditions are related to them. Moreover, it allows price data to be exchanged, without specifying algorithms for calculating fares, and finally present fares and their conditions to users and public.

**SIRI** Service Interface for Real Time Information [27] is a European standard to exchange information on transport services, created with initial participation of equipment suppliers, transport authorities, transport operators and transport consultants from Germany, France, Norway, Sweden, Finland and United Kingdom. It covers a wide range of functions, from timetable data exchange to information on vehicle activity. SIRI concepts are defined in a XML schema and are congruent with Transmodel definitions, moreover, all SIRI services can be provided via both Request/Response and Publish/Subscribe paradigms. The former is a synchronous communication paradigm, in which a user requests information that are immediately provided by a server, while the latter enables asynchronous communication. This is done allowing users to subscribe to a certain topic and receive the information as it is published on the topic. SIRI is modular, meaning that for any particular application only a subset of services requires to be implemented, thus letting users to start with only few services and implement more in the future. This modularised, pluggable nature eases automated testing also. The services offered by SIRI are:

- Production Timetable service: information about expect operation of a transport network per day;
- Estimated Timetable service: real time deviation from scheduled timetables and control actions related to it;
- Stop Timetable and Stop Monitoring services: those provide information about vehicle arrivals and departures at a certain stop or monitoring point;
- Vehicle Monitoring service: information about location and activities of a particular vehicle;
- Connection Timetable and Connection Monitoring services: it enables information change between feeder and distributor vehicles at connection points, for example they let passengers on a delayed train know that a local bus service will wait for them;
- General Messaging: structured way to exchange arbitrary information.

To exchange information between servers, SIRI exploits eXtensible Markup Language (XML), with a careful separation between Transport and Payload, so that SIRI messages can be sent as XML documents via HTTP POST or using Simple

Object Access Protocol (SOAP). Finally, SIRS supports two common patterns of delivery, being Direct Delivery or Fetched Delivery. The former follows the classic client-server paradigm, while the latter always first notify the client and then deliver the data.

Another main concern about the success of MaaS, is the business model. Traditionally, economic margins in transport have always been low, with companies needing to be subsidized by local authorities in order to continue providing services to the citizens. In the case of MaaS, multiple operators must collaborate and share their resources, together with the implementation of a back-layer platform, and the joining of a new actor: the MaaS provider.

It is evident that in this scenario the margins shrink more and more. For these reasons, the main question is if there are sufficient margins to allow MaaS providers to obtain revenue, after distributing to transport operators what is due to them. Unfortunately, there is no clear answer to this at the moment, so in this phase, it is interesting to analyze what is the current business model and what are the possibilities around MaaS from a business model perspective. Two main types of business models can be indicated:

- Business-to-Business (including local authorities and government) (B2B);
- Business-to-Consumer (B2C).

#### **Business-to-Business (B2B)**

In this approach, companies with a B2B approach are the ones that provide APIs or a White-Label solution to other transport companies. These actors are the MaaS providers.

The revenue model of this approach may vary according to the type of Business-to-Business implemented: [7, Ajit, 2020]

- MaaS White label solutions: a monthly/annual license fee + per service provider integration cost;
- MaaS API+ SDK providers: a monthly/annual license fee (per transaction-based cost/per API call cost) + Setup cost (per service provider integration cost) + one-time fixed cost per country (optional).

#### **Business-to-Consumer (B2C)**

Companies with a B2C business model are typically platforms and apps that provide a MaaS solution directly to passengers and users. They build their own tech from scratch, or they use one of the B2B companies as their technology service providers. In this case, the revenue models are generally:

- pre-paid discounts: pre-paid bulk purchases of services directly from the transport operators with volume discounts;

- commission model: the B2C platforms earn from the commission selected by operators for reselling their services;
- pay per click: the transport operators pay per click or pay per invoice;
- monthly subscriptions: B2C platforms bundle the mobility offers into monthly packages, thereby benefitting from the bulk offers;
- service fees: end user pays a service fee for aggregated billing.

The business model is clearly a key factor in the success of MaaS since MaaS providers must have revenues to continue providing services to customers.

## Chapter 3

# Objective and methodology

The aim of this research is multiple:

- to analyse already existing MaaS projects and their findings;
- to analyse what are the criticalities into implementing MaaS solutions;
- to describe business models proposals for MaaS
- to investigate how the actual mobility offer is perceived in two different Italian cities, Palermo and Turin, being them the 2<sup>nd</sup> and 3<sup>rd</sup> most congested of the country;
- to investigate how people living in those cities would receive MaaS;
- to investigate the possible differences between citizens from the two different cities, given that Palermo and Turin have different topography and mobility offers;
- finally, to investigate if a cultural gap exists between the two cities in approaching new unconventional solutions.

To this end, a methodology has been set up, articulated in to steps: firstly, a literature review of MaaS pilots is conducted, together with the analysis of what are the proposals ongoing in Italy. MaaS implementation in fact is not easy and need to be standardised. To do so, a lot of pilots have been conducted in order to come up with possible solutions suitable for the aims of this mobility paradigm; secondly, to analyse citizens' opinions, a mixed method including both a quantitative and a qualitative survey is chosen, to understand how people currently travel and what are their opinions about Mobility as a Service.

MaaS is today at the centre of research and experiments; several experimentations and projects have been carried out in the last 10 years, all leading to quite successful



results. However, being lots of them already in progress, the literature is not rich and insights of implementation are missing. Those results however not always remain in time, with some users abandoning the new habits to return to the old ones.

As MaaS goals, structure and criticalities are studied, a questionnaire was proposed to users to investigate what they think about MaaS and what are their travel habits.

To this end, quantitative and qualitative surveys are both needed to investigate how and why users travel in the way they do, and to understand their position with respect to MaaS and to a more sustainable way of urban transport.

Surveys can in fact being carried out in two ways, depending on the sample and on the goal of the investigation. In this case, not only is important to investigate how people perceive mobility, but also why they make their choices.

Quantitative surveys are used when the researchers are interested in behavioural aspects, attitudes and opinions of groups or populations. Thus, the necessity to use a structured method is of utmost importance.

Qualitative surveys instead are preferred when the aim of the research is to study the psyche of the persons or to deepen the motives of certain behaviours, thus the need for an instrument that allows for the expressiveness of the interviewees.

### **3.1 State of the art**

MaaS is a relatively new concept, with research and experimentation ongoing for the last ten years. However, a lot of pilot projects results are not available online to be studied and analysed, since MaaS still has various criticalities and service providers are not willing to share their business models, revenues, and general approach to the whole community.

The state-of-the-art review referred to the current literature, together with more general research regarding MaaS related to general and travel habits. Moreover, analysis of Italian notice and Turin and Milan proposal was possible thanks to Comune di Torino's effort and disposability, which provided the documents needed to conduct research on Italian MaaS state of the art.

This state-of-the-art research allowed to better construct the surveys, giving the possibility to investigate people's opinion regarding ongoing pilots and experimentations, and allowing a more in-depth investigation thanks to the focus group, where suggestions for improving these pilots can arise.

## 3.2 Survey design

To reach our objectives and investigate users' behaviour, a mixed method using quantitative and qualitative surveys is chosen.

Surveys can be carried out with different methods, depending on the purpose of the research. Quantitative surveys are used when the researchers are interested in behavioural aspects, attitudes, and opinions of groups or populations. Qualitative surveys instead are preferred when the aim of the research is to study the psyche of the persons or to deepen the motives of certain behaviours, thus an instrument that allows for the expressiveness of the interviewees is needed.

### 3.2.1 Quantitative survey

The quantitative survey allows to understand how people perceive mobility in general, what are their habits, and what are their opinions on different themes like LPT or private mobility. It is in fact fundamental to understand which trips people do in their routine and which mode of transport they prefer. In a quantitative survey, it is also possible to understand the “why” of some habits and decisions, although those are better exposed during the qualitative surveys thanks to the focus groups. Moreover, it is important to know the socioeconomic characteristics of the respondents in order to understand patterns and correlations between those factors and daily choices.

Strengths of this kind of survey are the statistical representativeness and the formalization of complex relationships since each piece of information can be codifiable. Nevertheless, statistics can be dangerous, since they can lead to illusions due to any kind of issues with the sample taking the survey. In addition, behaviour is inevitably averaged, potentially reducing the overall knowledge and information gained from the survey.

To efficiently create a survey, a work of project and design of the questionnaire must be carried out. Questions must be presented in a standardised form, and the design of the overall questionnaire must involve linguistic and intuitive skills; precisely, it is needed to collect documents related to the problem under consideration and contact people interested in the survey to get suggestions and consensus, examine the results and method of previous surveys on the same area to avoid past mistakes and prepare the necessary statistical documentation. Normally, each questionnaire should be made of two parts:

- knowledge of the general, physical, and socioeconomic factors of the subjects;
- main information about the studied phenomenon.

Emphasis is then put into analysing the relationship between the phenomenon studied and the general characteristics of the subjects. The questionnaire should

be complete, but still, the number of questions should be limited to avoid costs and fatigue for the respondents, avoiding unnecessary questions that will not be analysed. Moreover, before including a question it is fundamental to foresee the way in which the answers will be analysed and how the results will be presented.

Questions should be written with clarity and precision, using simple terms avoiding technical words, but also precise terms avoiding possible wrong interpretations by the respondent. Also, questions whose answers would lead to moral or legal standards doubts should be avoided, since the respondent suffers from social desirability bias.

Finally, no question should have as answer options “true” or “false”, since this can lead the respondent to believe that there are right or wrong answers. Another important aspect of the success of the survey is the correct definition of the respondent sample. It must ensure a good representation of the population and respect the quotas as much as possible. The procedure that leads to the definition of the sample is called the sampling plan.

**Questionnaire design** The questionnaire is articulated in four sections;

**trips in a typical week.** This is the first section of the questionnaire. In this introductory part, the aim is to analyse the actual behaviour with respect to urban mobility of the respondents, thus understanding which is their actual usage of mobility transport services. While the first two questions are related to all kinds of trips one can do during its typical week and which modes of transport are used for each of them, all the others are related only to the most important mode.

Referring to the most important trip, several questions are asked, investigating how people travel inside their municipality and asking if they are generally satisfied with the amount of time that their trip takes. Attention is put also on the arrival time of the respondents. Such a time can be variable for multiple reasons, depending not only on the transport mode used but also on factors such as traffic.

Those who walk or take the bicycle for their most important trip are likely to arrive always at the same time, not experiencing differences in the arrival time, since these transport modes do not suffer from traffic or strike of course.

Those who take LPT instead are more prone to experience delays related to strikes, or the buses can experience some delays or can even arrive earlier to the station, so that one can lose the ride, making LPT not really reliable for the arriving time.

For those who take the car or the motorbike, it can happen that they leave earlier than they could in order to avoid traffic in the peak hours.

It is also important to investigate the level of satisfaction as regards different aspects concerning the mode of transport the respondent uses; for example, comfort,

safety and cost perception, since not all car users have the right perception of the cost of the transport mode they use, considering only gasoline as the cost for their trip;

**alternative modes of transport and intermodality.** In this section, attitudes towards mobility and new modes of transport are analysed and more precise questions about modes of transport perception are asked. In particular, the first question of the section asks what the respondents think it is the price for different services, like single-ride tickets with LPT, monthly LPT subscription, or annual bike-sharing subscription.

With these questions, it is possible to understand if the respondents know the services their city provides. If their answers are far from reality, it is possible to think that their perception of mobility is biased, considering shared mobility and LPT as more expensive or cheaper than they are. Thus, the fact that the respondent has little knowledge of the LPT is a flag that shows how information and communication are key to attract new users that do not use LPT not because they have some particular impeding reason, but because they are simply not informed.

Moreover, respondents are asked what they think are their expenses related to mobility and transport during a month. With this in fact it is possible to understand if someone has a clear overview of the cost that he/she undertakes with the used mode of transport, and also if some biases are present when people think about their transport mode with respect to others;

**Mobility as a Service.** This is the most important section of the questionnaire. After a brief explanation of what Mobility as a Service is, questions regarding willingness to use other transport modes are asked, like for example car sharing, investigating the limiting factors for those who indicate that they do not use this service. More precise questions regarding MaaS follow. In this questionnaire, different levels of MaaS integration are considered being those level 2, level 3, and one question regarding level 4, in order to investigate how people will react to a complete MaaS service. The aim of the questionnaire is in fact to inspect what people think about MaaS at its peak with mobility bundles, but also on pay-per-use usage. The section can be seen as composed of three parts:

- questions regarding what would lead people to travel with different transport modes;
- compose the respondent's own mobility package;
- questions regarding already existing MaaS services.

First, limiting factors of LPT usage are investigated. Then, all other questions are proposed based on the assumption that LPT has a sufficient quality standard for the customers, in order to normalize answers with no biases related to it.

Pay-per-use MaaS implementation is considered in the next questions, where it is asked if users would find useful an app that works as an integrator of different mobility operators, gaining access to all mobility operators' vehicles through one single app.

After, it is asked questioned to users if they would pay an extra fee of 50 cents per ride in order to use this aggregator app. This can give insights on the success or limit of certain business models.

Moreover, the gamification process is considered. Gamification is a process that aims at involving users to keep using the platform promising some rewards. This can also have a role in attracting new people, depending on the attractiveness of the offered reward.

Then, respondents are asked to compose their mobility package by selecting among different services:

- unlimited rides on LPT;
- unlimited rides with bike-sharing, e-scooter;
- unlimited rides with car-sharing;
- discounts on regional trains;
- discount on personal taxi rides;
- shared taxi.

A shared taxi is a service that, upon booking, allow users to share taxi rides with other persons with a similar route. This will drop costs in taxi usage, and also reduce the number of private cars in our cities. However, unlimited rides with car-sharing are quite utopian, while discounts on their price is a more realistic scenario. For this reason, it is again asked to respondents to create their own mobility package considering a discount of 50% of the cost-per-minute of car-sharing, thus leading to an interesting analysis in people's choice changes when an extra price is put for car usage.

As previously said, there is also one question to investigate which kind of service would increase the participation in MaaS, considering a possible level 4 implementation where some discounts to services external to mobility is added. In this case, it is asked if respondents already perceive MaaS as a good option, or if they would need bonuses like discounts to cinemas or cultural events promoted by the municipality.

Before analysing already existing MaaS solutions, respondents are asked some questions about prices and costs. In the first one, respondents must specify how much they think the mobility package they created would cost. Thanks to this question, it is possible to investigate the user cost perception of the services offered by the Municipality. It is possible to compare the answers to this question to the price of already existing services provided by the Municipality, but also with others MaaS services around the world.

Then, respondents are asked to specify what price they would pay to access to the services provided in their mobility package. It is expected that the prices specified in this question will be lower than those of the previous one since it is reasonable to think that people are always willing to pay less than the value attributed to certain products, especially if a product, MaaS in this case, implies drastic changes in habits. The difference between the two specified costs will be analysed, to understand which is the bias between what cost of the service people perceive and how much they would be willing to pay.

Moreover, a specific cost perception question is asked. It is asked if users think that spending the price they are willing to pay for their mobility package would lead in their opinion to money saving.

Finally, some questions about already existing MaaS platforms are asked. In particular, questions regarding Whim unlimited service not considering its price are proposed, analysing if the Whim unlimited offer is perceived as valuable. Only after these questions, it is asked how much respondents think this service costs, and if they still find it valuable at its real price.

The last two questions instead are related to “Buoni mobilità” Turin MaaS pilot, and Cambio car-sharing prices;

**Socioeconomic factors.** This is the last section of the questionnaire, where socioeconomic factors-related questions are asked to respondents. These are needed in order to weigh the answers given in the previous sections, analyse the differences between people with different instruction levels or incomes, or if a gender or age gap exists in mobility perception and MaaS acceptance.

**Data analysis design** Questionnaire responses are easily downloaded from LimeSurvey [28], which can return them in different formats like HTML, PDF, CSV or via Excel file. The latter is the one chosen for the analysis.

The excel file provides every response to the questionnaire organized per row. Each row contain all the answers to all the questions and sub questions, which are organized in columns. Thanks to this organization, it is possible to easily filter the desired answers to some questions to investigate how different groups of respondents answer, so to have a more focused and precise look at the data rather

than a general one. Moreover, Microsoft Excel allows one to easily display data with the aid of graphs and statistics.

### **3.2.2 Qualitative survey**

To better investigate the “why” and the reasons behind respondent choices and habits, deeper research must be conducted. To do so, qualitative surveys are employed thanks to focus groups. Focus groups are meetings with a selected set of people with different and possibly diametrically opposite ways of thinking.

These surveys do not aim to change people’s minds; the scope of these is to let people argue what are their thoughts and through cooperation construct a productive dialogue. No opinion is correct among the others, however, thanks to the willingness of the participants to know new things and approaches, it may happen that someone will change his mind about some habit or daily choice.

The focus group is coordinated by an interviewer who leads and moderates the conversation, letting people expose their thoughts and highlight the positives and negatives of all positions. In any case, the interviewer should never highlight some of the arguments as the correct one, his/her role is only to coordinate the conversation.

For this research, interest is put into MaaS, thus, the focus group will concentrate on the pros and cons of this new mobility concept.

The focus group has been held via video conference and lasted around one hour and a half.

Eight persons have been selected among volunteers, forming a group of heterogeneous attitudes towards mobility, including people from those who would be happy to participate in the MaaS project, to those who almost certainly would never use it.

Focus group interviews have a predefined structure to follow, however, once some considerations arise, it is necessary that the interviewer correctly moderates the conversation according to the topic that arises, stimulating participation.

The interview started assessing general considerations regarding the proposed questionnaire, and also to understand if there is the need for more clarification around certain topics.

After this introductory part, everyone has been asked to what they think about MaaS, if they think it is a successful concept or not, and why, giving everyone a couple of minutes to explain their reasons and highlight the pillars of their thoughts.

The aim of the focus group and of the interviewer is not to change people’s minds even though, it is a great success if some persons start to doubt their reasons and re-think their choices thanks to others’ opinions,

# Chapter 4

## Results

In this section, results from the state-of-the-art analysis and from both quantitative and qualitative surveys are reported.

### 4.1 State of the art

MaaS' state-of-the-art research gave multiple hints on the advantages and challenges around it. It can be implemented in several ways, being pay-per-use and mobility packages the two most popular; however, the more customization requires more implementation complexity.

Different implementation levels pilots are present, for example, myCicero as level 2, UbiGo, and Whim as level 3, with the latter having reached more interest with respect to myCicero. This is maybe due to the fact that myCicero services are already quite offered by other platforms, with Google Maps leader in the integration of information, and other apps allowing to pay for parking. Moreover, as will be depicted in 4.3, myCicero is not so popular among respondents.

Level 3 implementation instead attract customers thanks also to curiosity, since they surely provide an innovative service.

Regarding the structure of the MaaS implementation, it is evident how important is the role of the aggregator and the presence of a back-end platform, accessible from all transport operators; however, it still remains unclear who will take the effort of the implementation, having also repercussions on the business models to be adopted.

For what concerns the B2B approach, the possible key problem is to let MaaS provider and transport operator communicate with each other. MaaS providers, in order to deliver services to customers, must have access to transport services' APIs to gain information about those services like vehicle availability, timetables, etc. Moreover, there is the need to open the ticketing APIs on the transport operator



side, but many operators have no willingness into changing and opening their APIs for some services that they have no guarantee that will work and provide profits.

Finally, even if these changes happen, what are the revenues? Transport operators of course need to be paid for the service they gave to the users, but also MaaS providers deliver some service to the customers.

It will be somehow reasonable to increase the prices of the single tickets, or to charge up a commission for the use of the MaaS platforms, but it is obvious that customers are not likely to pay more for services they already can access for free. It is fundamental to individuate some value that the MaaS provider has to offer to users in order to justify extra expenses. Also, in order to be a viable revenue model for MaaS providers, there is the need to attract a huge volume of customers.

Regarding B2C instead, this requires a direct link from MaaS providers to the payment APIs of the transport operators to allow payments. However, given that the business model is based on commissions and pre-paid bulks, there is again the need to attract a very large portion of users, which is most likely to not happen if the aggregator is not a public entity. Being services acquired in stocks by the B2C companies, the concept of personalization and customization misses, thus even less customers are attracted in the services.

These, combined with the low willingness from the transport operators to share their data and open their APIs contribute to slow down the rise of this solution. As for the local public transport sector, it is reasonable to think that cities authorities will and must take the lead role in implementing B2B MaaS platforms. Public authorities do have the bandwidth to make the necessary investment and are capable of promoting the right conditions for the deployment of MaaS, having at disposal the bigger amount of data, both personal and of services, centralized information systems, open ticketing systems, etc., while B2C applications must be further analyzed. As it is depicted in the qualitative survey analysis, there may be space for this business model to arise in pay-per-use implementations.

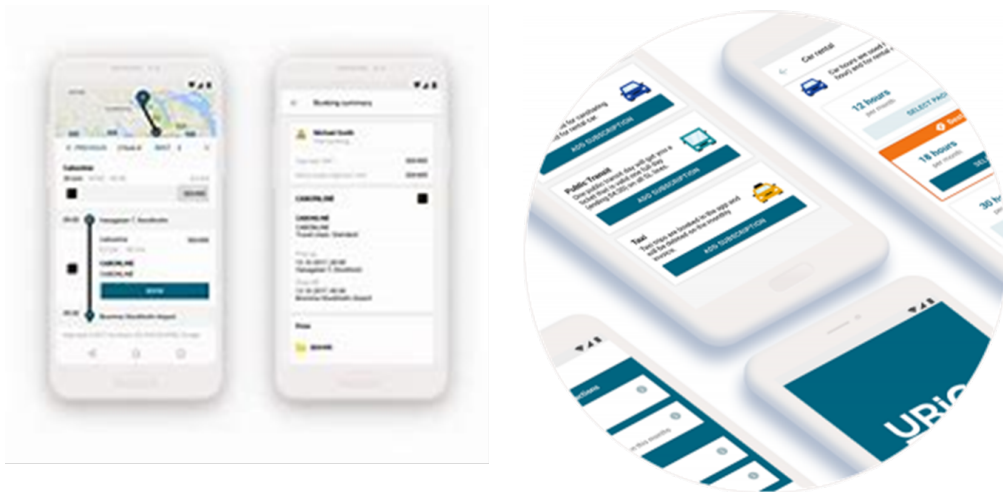
### 4.1.1 UbiGo

One of the most popular MaaS platforms is UbiGo (Fig 4.1, Fig 4.2), which operates in Sweden, [29].



**Figure 4.1:** UbiGo logo

The mobility app UbiGo combines public transport, car sharing, rental car services, and taxi in one app. The MaaS service is based on a flexible monthly subscription with an account shared by all members of a household. Every end user searches and books routes via the app. For the payment, the customer chooses a mobility subscription that is linked to a mobility account, e.g. of the family. The company has started operations in Stockholm in 2019. Within the first year of operation, it demonstrated the feasibility of bundling mobility options into packages, offering these via subscriptions has proven to be crucial for user acceptance



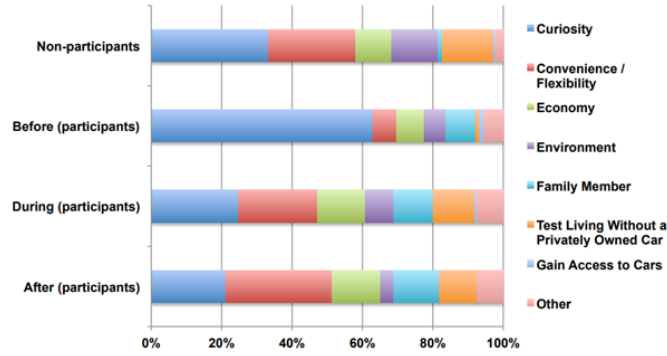
**Figure 4.2:** UbiGo app mockup

UbiGo service was built around subscriptions and credits. Participants had to exchange money for in-app credits to access the service. During the trial, the minimum limit for prepaid credit was set at 1200 SEK/month (as of February 2014 approximately €135/\$185). If the household ran out of credit for a particular travel service during the month, additional credit could easily be purchased through the app. If all the monthly credit for a particular travel service was not used up, the credit rolled over to the next month (or was refunded at the end of the FOT (Field

Operational Test)). The subscription could also be modified on a monthly basis. [30, Sochor et al., 2015]

The goodness of UbiGo approach was noticeable already in the early stages, with 44% of participants that decreases their car usage after the end of the trial (Karlsson et al., 2017 [31]). It is interesting to notice that 25% of participants accept to relinquish their car before the trial receiving a financial compensation, and for 88% of them that was the only car of their household. (Karlsson et al., 2016 [32]).

In Fig 4.3 it is noticeable how the attitude towards MaaS changed over time.



**Figure 4.3:** UbiGo opinions

With respect to Fig 4.3, Sochor et al. (2015) [30] state the following: *"of great interest is how the participants' primary motives changed over time, as curiosity is something that fades away with experience. From the "during" questionnaire results (third row), we can see that curiosity lost its dominant position (from 62.8% to 24.8%), while convenience/flexibility (22.4%) and economy (13.7%) increased as motivators for why one continued to be a customer. The "after" questionnaire (fourth row) revealed that convenience/flexibility became the dominant motivator (30.0%), followed by curiosity. Throughout the entire FOT, environment was rarely viewed as the primary motivator. Interview results revealed that participants were first attracted to the concept of UbiGo and felt that it was an added bonus if it meant potentially more environmentally friendly travel as well"*.

Four participant subgroups were identified: Car shredders, Car accessors, Simplifiers, and Economizers. A qualitative analysis revealed that the subgroups had different reasons to join the service and different expectations of the change that would occur based on the altered preconditions offered by the service (Strömberg et al., 2018 [33]).

To better understand Fig 4.4, these subgroups must be better explained.

- Car shredders are those who want to try to live without owning a car;

- Car accessors are those who want to gain access to a car without having to purchase one;
- Simplifiers saw UbiGo as a smarter way to handle their use of mobility services;
- Economizers saw UbiGo as a way to save money on LPT.

Looking closer at reported mode use changes, the overall trends are that all subgroups used car less and walked more. The two car-owning subgroups reduced their private car use; 95% of Car shedders and 53% of Economizers reported using their car considerably more rarely than before the trial (4.4b).

The Car shedders appear to have spread their former car trips across all other available modes, while the Economizers primarily used more LPT (60%), which may be due to their joining to get access to cheaper LPT. They also used more carsharing and walked more, but less private bicycling.

A large proportion of the Car accessors increased their use of carsharing (78%) as well as rental cars (30%) but reduced private car use (37%), a result of not borrowing cars from friends and family anymore. At the same time, many of them increased their use of LPT (41%), walking (18%), bicycle-sharing (28%), and private bicycles (17%), even if some participants reported less use of these active modes.

Simplifiers is the most split subgroup in the sense that they changed behaviour but not in a uniform way; one share increased their use of most modes while another share decreased their use [33](Strömberg et al., 2018).

This research also reports that car shredders stated: “not having one (a car) gives you different opportunities . . . moving your body a bit more and so, bicycling, walking, and public transport too, for that matter.” Another explanation was that this subgroup came to realize how well the LPT system actually worked and they discovered that it covered trips for which they initially believed they needed a car.

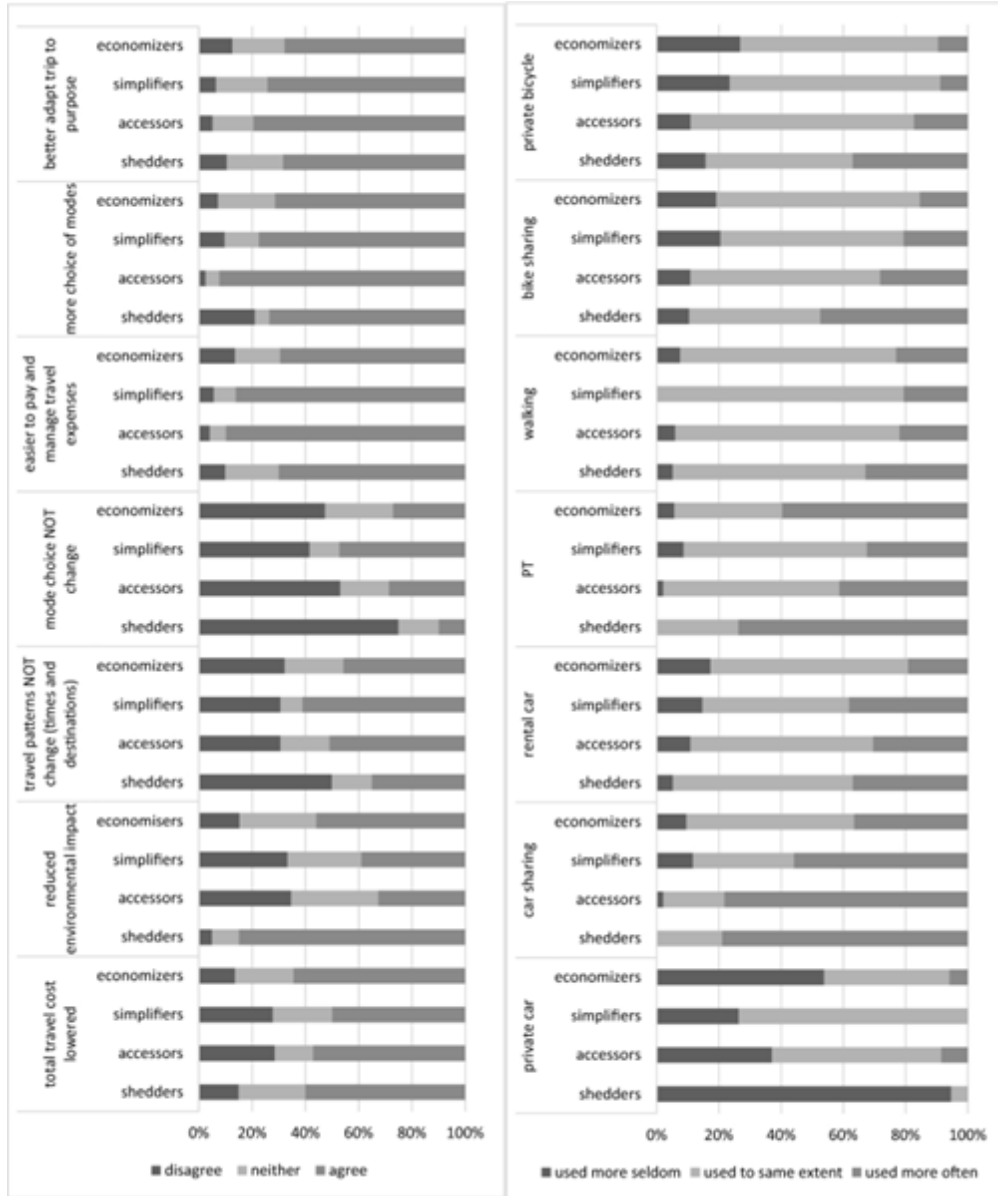


Figure 4.4: a) before using UbiGo, b) after using UbiGo

#### 4.1.2 myCicero

MyCicero [34] is a MaaS platform operating in Italy since 2015 (Fig 4.5).

It is a Level 2 platform providing a suite of different services involving transport services not only related to Italian territory, as it is shown in Fig 4.6.

Thanks to myCicero app it is possible to:



Figure 4.5: myCicero logo

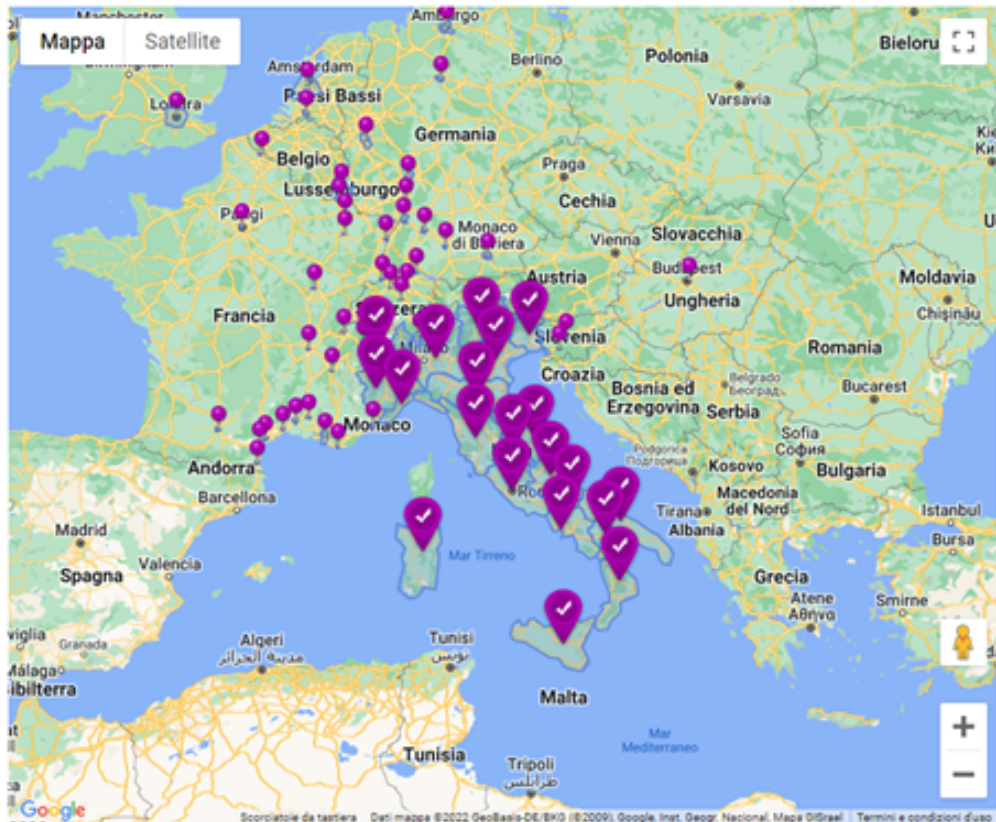
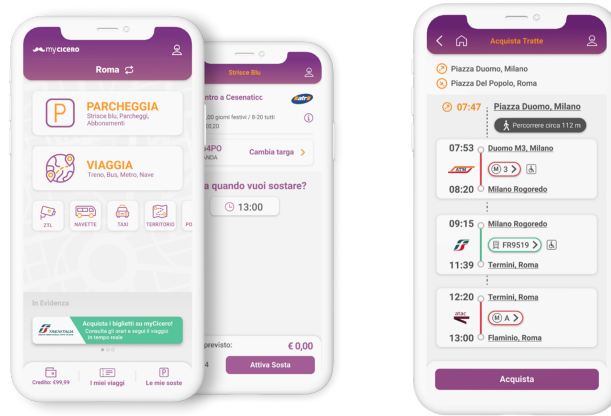


Figure 4.6: myCicero Europe map

- discover combined trip solutions;
- pay for your private car parking slot;
- utilize the single myCicero account to book and pay for all the services present in the platform;
- manage your in-app credit usable to pay for all the services.

myCicero allow users to pay only for the effective minutes for which their car is parked, but also to monitor, plan and book train, bus, and metro tickets. Without

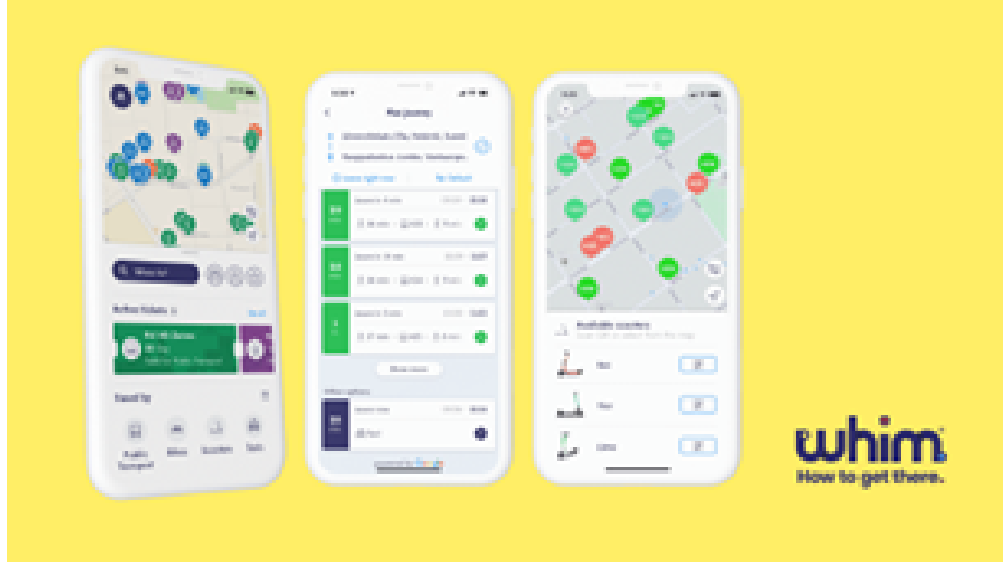
myCicero, in order to pay for the parking slot, people have to go to the special column to buy the parking ticket. To do so, spare coins and the a priori knowledge of how much time one will spend in that location are required. The MaaS platform instead let people to pay only for the effective minutes used, allowing them to activate, extend and terminate the stop from the app using digital currency. To do so, the users must previously print and place a coupon into the car, so that the officers will know they must scan the car plate in order to obtain the information about the parking. The app interface is shown in Fig. 4.7.



**Figure 4.7:** myCicero app interface

### 4.1.3 Whim

Whim [35] is a Mobility as a Service provider operating in different locations such as Helsinki and Turku in Finland, Antwerp in Belgium, Greater Tokyo in Japan, Vienna in Austria, West Midlands in UK and in Switzerland (Fig 4.8).



**Figure 4.8:** Whim

Thanks to Whim it is possible to plan your trip and pay for those services that you need for your trip with a pay-per-use formula. With Whim users can access to LPT, bike sharing, and e-scooter sharing. It is also possible to buy seasonal tickets (Fig 4.9) for LPT of the duration of 30 or 60 days, pre-buy 30 or 60 minutes of e-scooter sharing or buy an annual subscription to the bike-sharing service. Once the users gain access to one of Whim’s offers, he/she can benefit from Whim bonuses, which are discounts on car rental, 1 free shared ride per month, and also an unlimited number of taxi journeys discounted by 35% (Fig 4.10).

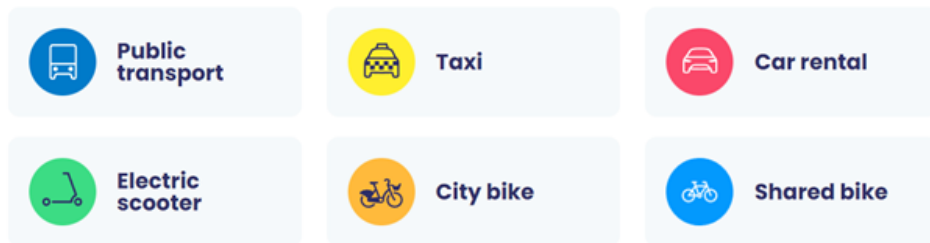
For those who travel a lot during a month, Whim offers the “Unlimited” service. This is a quite expensive subscription, costing €699 per month, but offering free LPT and 80 free taxi rides for trips under 5km, plus the possibility to rent a car for up to 30 days.

In overall, Whim offers a variety of options to join MaaS, from pay-per-use to Unlimited, providing also the possibility to buy annual bike-sharing subscriptions. Despite Whim seasonal tickets offer good value for their price, especially for students, the offer that implements MaaS in its most complex and complete form is Whim Unlimited. However, this kind of subscription is more of a premium-end bundle, providing value mainly for those who already use taxis every day. Being expensive,





**Figure 4.9:** Whim seasonal tickets



**Figure 4.10:** Modes of transport included with Whim

this service will not provide the right population inclusion, which is one of MaaS' pillars. Moreover, even if some may find this a good offer, being actually cheaper than paying singularly for each of those services, it is unclear how this mobility package contributes to reduce pollution since taxi rides are at the heart of the subscription together with car rental. Research must be conducted in order to evaluate the percentage of Whim Unlimited users that take advantage of the LPT.

#### 4.1.4 Cambio

Cambio [36] is a MaaS provider focused on car sharing operating in Brussels since 2003, and by July the 1<sup>st</sup> 2017 its network consisted of 150 stations, and 450 cars in all 19 municipalities of the Brussels-Capital-Region, with 60.957 users joining the service.

Thanks to Cambio, users have the possibility to use a car without owning one, potentially saving lots of money. Moreover, not possessing a personal car may stimulate users to take other modes of transport for shorter trips, like LPT, bicycle, or even walking to their destination. For this reason, even if Cambio itself does not provide sustainable modes of transport, it may create a partial shift for short trips. Finally, when Cambio's fleet will be made of only electric vehicles, surely the City will benefit from fewer emissions and pollution.

To use Cambio services of course users need to register. Cambio services can be accessed through a laptop or a smartphone, increasing accessibility to the service. In order to gain access to a car it is in fact needed to book it; with a smartphone this process is always immediate and user-friendly.

Cars can be booked 24/7, long time before or last minute. Once booked, each car must be picked up and returned at a predefined station, that in the case of electric vehicles is the charging station. Speaking of offers, there are three possible tariffs all with a one-time contribution of €35, and all offering different types of cars, with different prices. Moreover, each tariff comes with two different cost items: cost per hour and cost per kilometer. The tariffs are Start, Bonus, and Comfort. Thus, the rental cost depends both on the time spent during the rental and the total distance traveled.

In Tables 4.1, 4.2, 4.3 all costs for Start, Bonus, and Comfort tariff options are shown. Start tariff 4.1 comes with a monthly fee of €4 and it is suggested for those who travel up to 50km per month.

**Table 4.1:** Start option fares

| Start                   | Class S (city car) | Class M | Class L | Class XL (van) |
|-------------------------|--------------------|---------|---------|----------------|
| €/hour from 6am to 00pm | €2.2               | €2.8    | €3.4    | €4.6           |
| €/hour from 00pm to 6am | €0.5               | €0.5    | €1      | €1             |
| €/km (km<100)           | €0.37              | €0.38   | €0.4    | €0.45          |
| €/km (km>100)           | €0.25              | €0.26   | €0.26   | €0.3           |
| €/day                   | €25.5              | €33     | €40     | €46            |

Bonus tariff 4.2 is suggested instead for those who travel more than 50km but

less than 300km a month.

**Table 4.2:** Bonus option fares

| Bonus                   | Class S (city car) | Class M | Class L | Class XL (van) |
|-------------------------|--------------------|---------|---------|----------------|
| €/hour from 6am to 00pm | €1.95              | €2.3    | €2.7    | €3.9           |
| €/hour from 00pm to 6am | €0.5               | €0.5    | €1      | €1             |
| €/km (km<100)           | €0.28              | €0.29   | €0.35   | €0.4           |
| €/km (km>100)           | €0.24              | €0.25   | €0.25   | €0.29          |
| €/day                   | €23                | €27.5   | €32     | €38.5          |

Comfort tariff 4.3 is suitable for people who need to travel more than 300km a month, offering the lowest fares at a higher monthly price.

**Table 4.3:** Comfort option fares

| Comfort                 | Class S (city car) | Class M | Class L | Class XL (van) |
|-------------------------|--------------------|---------|---------|----------------|
| €/hour from 6am to 00pm | €1.7               | €2.1    | €2.4    | €3.1           |
| €/hour from 00pm to 6am | €0.5               | €0.5    | €1      | €1             |
| €/km (km<100)           | €0.25              | €0.26   | €0.27   | €0.33          |
| €/km (km>100)           | €0.2               | €0.21   | €0.21   | €0.25          |
| €/day                   | €19.5              | €24     | €29     | €31.5          |

Payment is done at the end of the month, receiving a detailed bill of what has been consumed and thus must be paid. Moreover, all tariffs include basically all kinds of expenses that come with car-owning such as fuel, free parking, maintenance, cleaning, and insurance.

Cambio is not actually a MaaS provider, however it recently implemented also e-cargo bike sharing in Brussels, thus starting to implement different modes of transport to customers and preparing for a shift towards MaaS, even though the e-cargo bike fleet is still poor. Nevertheless, Cambio provides a non-expensive way to have access to a car. This can stimulate people to not buy their own car, walk for the trips that can be made inside their neighbour, and use the car only when really needed, thus following the social and environmental pillars of MaaS, as opposite to Whim Unlimited.

As example, consider a student whose trips are home-university 5 times per

week and home-gym 3 times per week. Consider each ride takes 20 minutes of time, for one week there are 5+3 round-trip rides, leading to a total of 16 rides of 20 minutes each, for a total of 320 minutes per week, leading to a total of 1280 minutes per month resulting in 21 hours and 20 minutes. Considering also that each ride is 4km long, there is a total of 64km per week, leading to 256km per month.

Considering all daytime rides, the cost incurred for each month for the cheapest car is:

- start: €46.9 related to hours and €76 related to kilometres for a total of €122.9 plus the €4 monthly fee results in €126.9;
- bonus: €41.6 related to hours and €65.44 related to kilometres for a total of €107 plus the €8 monthly fee results in €115;
- comfort: €36.3 related to hours and €56.2 related to kilometres for a total of €92.5 plus the €22 monthly fee results in €114.5

Basically, this service let you travel for less than the price of a car bought in instalments, considering also that other monthly rides like groceries, visiting friends are at the discounted price given that the 100km monthly goal is reached.

Moreover, it is noticeable that in this case that almost reaches 300km there is a difference between Start and Bonus offers' prices, but Comfort results the cheapest, and it will surely be if more rides are added since it is the tariff with the lowest fares. A Volkswagen Up! Has a 35 litres tank, which considering 15km/l, can provide a 525km of autonomy. Considering the cost of gas of €1.7, filling the tank will cost 59.5€.

With Cambio, this amount of kilometres, not considering the hourly price, will cost €110 with the Comfort tariff, for a total of €132 considering the monthly fee. Doing a proportion to evaluate the time spent into the car considering that for 256km 21 hours and 20 minutes are spent, the results is 43 hours and 45 minutes, leading to a total monthly cost of €207.48.

Thus, if €59.5 are subtracted from €207.48, it is will obtain how much is needed to spend monthly at maximum for our private car in order to spend less than using Cambio. This results in €148, which must be spread in parking, insurance also for accidents, ordinary and extraordinary maintenance, cleaning, and of course the cost of the car itself, which can be easily reached and overpassed.

Cambio is very similar in its offer to Palermo Amigo car-sharing service [37]. Palermo's service however is more expensive. Amigo has two possible ride options, round-trip and one-way. Round-trip is of-course the most affordable of the two, nevertheless being still more expensive than Cambio, where the Amigo Class S car cost €2.4 per hour in the 7-22 range, and €0.54 per km for less than 100km. Moreover, there is no option for 1-day rental. Both services however have as a drawback of the need to return the car to a predefined station.

This aspect drastically limits the spread and impact of these services, with flexibility not at the centre of the user experience; ioGuido service in Italy went bankrupt since this prevents users from willing to use the service. Moreover, it must be said that with the previous calculation, Cambio service will cost €24.000 in ten years, which is the cost of buying a medium-sized car. However, a car usually lasts at least other 5 years, which in are other €12.000 using Cambio, leading to a total over 15 years of €36.000.

Thus, a careful cost analysis must be performed when thinking of Cambio as a good alternative to buying a car, with it being a surely good deal when comparing it to buying a second car for the family. It is indeed clear that Cambio offers good value in proposing a smarter way of access to a car. Moreover, it is evident that Cambio itself is not actually a MaaS provider since it offers only one mode of transport. Recently it launched also the e-cargo bike, a bicycle with a wagon space to carry your kids for example to take them to school, starting to resemble to an actual MaaS provider.

As previously said, Cambio itself does not promote more sustainable modes of transport. However, it may lead users to prefer to walk or take a bike for shorter trips, using the car only when needed. It would be extremely interesting though to think of ways to introduce inside Cambio the possibility to have access to LPT at least, or even bike sharing, maintaining the fair prices it now has.

A good car sharing may in fact be the perfect starting point to allow shifts in modes of transport's choices, leading users into the MaaS ecosystem thanks to the attractiveness of cars but allowing them to use also more sustainable modes of transport. Being car sharing the main service offered by this hypothetical Cambio 2.0 it would surely attract those people who want to reduce their car usage, creating a link between the actual car usage and future and more complex MaaS implementation.

People do not want to lose their “free” access to their car (by “free” it is intended the possibility to use their own car when they want as they want), with MaaS implementation being not perceived as useful and as a good value offer, thus Cambio has the potential to change people's habits and lead the shift towards MaaS.

## 4.2 MaaS for Italy

Italian ministry for digital transition (MITD), together with the department for digital transformation and the ministry of infrastructure and sustainable mobility (MIMS), have activated the sub-investment 1.4.6 of PNRR “Mobility as a Service for Italy” [38, 39, 40].

This defines the guidelines that Italian regions and municipalities must follow when proposing their own MaaS solution. The milestone is to have each proposed project open to a minimum of 1000 users, that can access it voluntary and at their own expense, giving a personal evaluation of the service, and having the possibility to choose and buy mobility services among those available on the platform.

The goal of MaaS is to suggest to citizens the best mobility solution according to their needs, thanks to the integration between different service providers, in order to optimize the trip experience in terms of planning, booking, and payments.

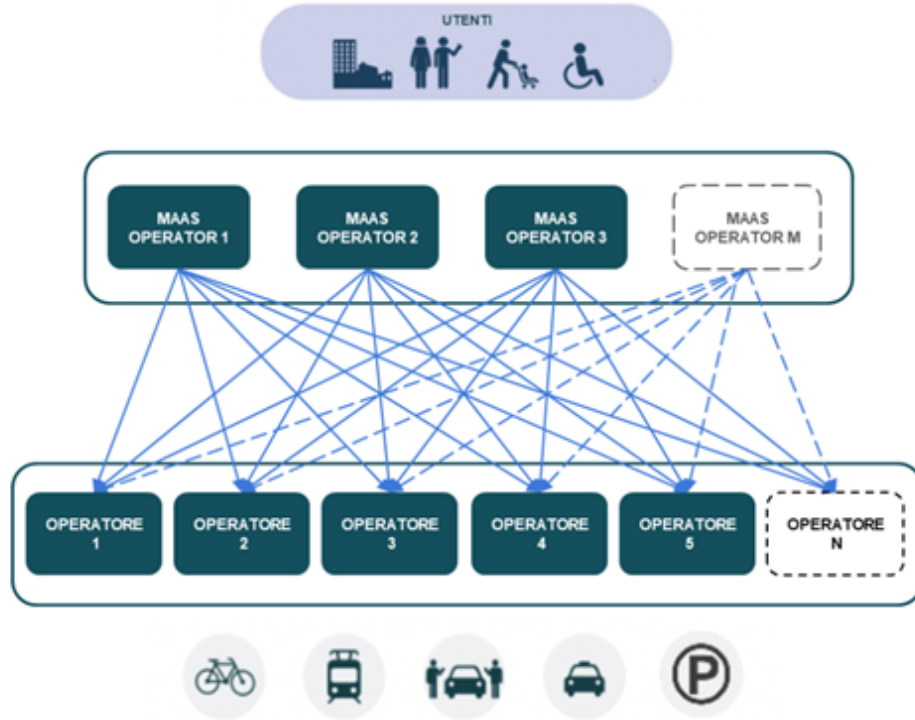
From a Public Administration point of view, an effective MaaS gives to citizens simplified access to a variety of transport modes for every need, favoring a modal shift in favor of more sustainable modes of transport, rationalizing the usage of individual cars, and reducing congestion and pollution. MaaS must not be seen only as a software applications integration, but as a driver in changing urban mobility, using digital platforms able to have an influence on human behaviour.

For this reason, it is extremely relevant the importance of politics and governance to promote a socially including service, together with promoting economic development, since MaaS is also an opportunity for those digital companies operating in innovative transport services.

The MaaS vision proposed for Italy wants to give nondiscriminant access to the MaaS paradigm for all operators working in mobility, promoting competition in a regulated and supervised market. The proposed intervention aims at giving value to already done investments on territories by local entities and economic operators, allowing easy access for other actors. The proposed vision relies on the assumption that data availability regarding transport play a key and central role in the MaaS contest.

Data availability is in fact an essential condition for the deployment and development of MaaS. Thus, advanced skills in digital technologies and new opportunities to satisfy the mobility demand are required. The architectural scheme is represented in Fig 4.11.

In this scheme, each MaaS provider must collaborate with those transport operators that may best fit their target. This kind of market needs regulation and standardization since a dominant position can arise. Moreover, it must be considered that this experimentation must provide a valid architectural proposal for a national realization, thus MaaS providers cannot work at their own pace, but standards must be introduced. MaaS for Italy in fact aims at defining guidelines



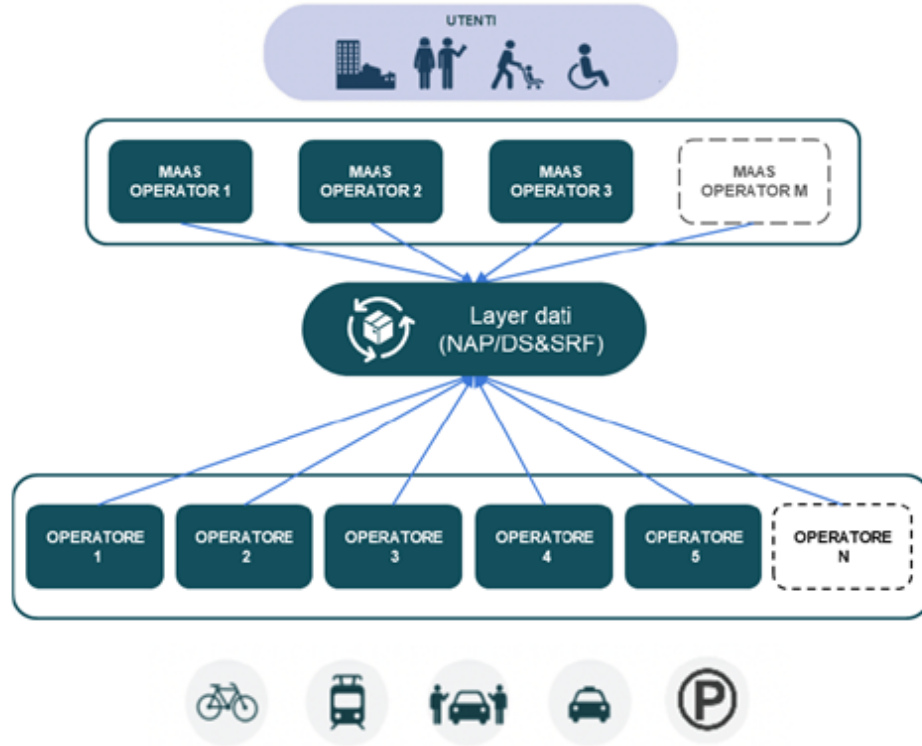
**Figure 4.11:** MaaS basic scheme

that regions and municipalities participating must follow in order to develop their own proposal. Then, after each experiment is done, Italy will look at all pilots with their strengths and weaknesses to depict the characteristics that will lead to a successful MaaS.

To overcome these criticalities, a B2B approach with a common data integration layer is to be preferred. In MaaS for Italy project, the public sector is the one in charge of this part of the architecture, defining rules, dues, norms, and standards for actors' interaction. This kind of standardization however is not already existing; the pilot projects with their experimentation will show the best road for the implementation of the back-end platform.

The open platform must ensure an efficient sharing of transport sector data, with each nation being forced by a European norm to create a unique access point for all available data, called National Access Point (NAP). The definition and creation of the NAP opens the road for the creation of a standard integration layer between the operators, called Data Sharing and Service Repository Facilities (DS&SRF, Fig 4.12).

The DS&SRF is the direct evolution of the NAP being deployed purposely for the MaaS implementation. It provides a national data access point and a



**Figure 4.12:** MaaS architecture with DS&SRF

repository of services needed for MaaS functioning, together with an API gateway. Also, it ensures that also small companies can participate into MaaS project, since it reduces the architectural complexity that MaaS providers must meet. Thus, it enables market opening, allowing easier contacts between transport operators and MaaS providers. Communications with this entity must be done using the transmodel as model for data sharing, and NeTEX and SIRI as communication protocols.

DS&SRF is an access point for all registered operators to the data shared among transport operators and MaaS providers in order to distribute services, plus a set of basic functions to make them usable in a regulated manner, enabling booking and payments through proper channels to the platform using those services. The platform will be realized incrementally until December 31<sup>st</sup>, 2024. DS&SRF will enable different actions:

- exposure to static and dynamic data;
- access to transport operator services' data;
- trips composition and identification of agreements between transport operators;



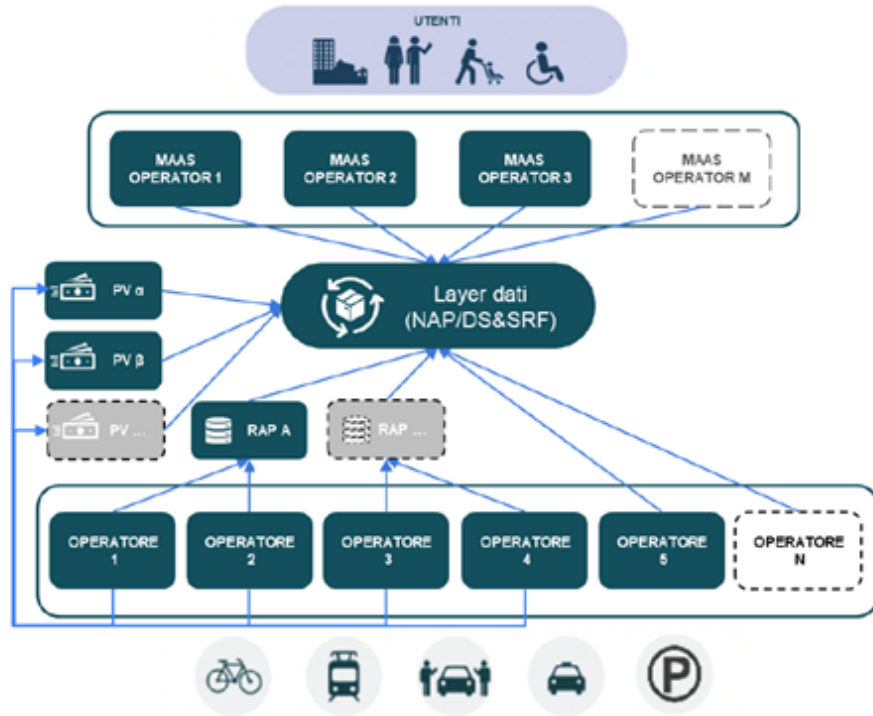
- data registration on agreed trips;
- making of statistics;

while the main actors and figures that populate and use the DS&SRF are:

- transport and mobility operators;
- territory services aggregators and integrators;
- MaaS operators;
- touristic or passenger information operators;
- local or national authorities.

The platform will be realized with open-source components based on a microservices approach, moreover, its development must be technically neutral to do not create any competitive advantages for any operator involved. All will be compliant with standard ISO/IEC 27001. The service allows for each MaaS provider to handle at least 5.000 travelers simultaneously for each city/territory with response times not exceeding 1 second.

MaaS for Italy implementation involves also other actors, in particular, integrators/aggregators: RAP and PV. RAP are Regional Access Points whose aim is to alleviate NAP complexity at a regional level, promoting transport operators' participation locally. Piattaforme di Vendita (PV, sales platforms) are actors in charge of the transaction to be made when using MaaS. Transport operators, in fact, expose their ticketing services on the DS&SRF using these third-party platforms, which are able to integrate more operators. These platforms are those in charge of the correct partition of the revenues between all transport operators (Fig 4.13).



**Figure 4.13:** MaaS definitive scheme proposed for MaaS4Italy

#### 4.2.1 Turin "Buoni Mobilità project"

“Buoni mobilità” is a MaaS experimentation ran from October 2021 till September 2022, tested by 100 users between those who requested to participate [41]. Each tester has the possibility to choose each month a new mobility package among those available, thanks to a dedicated app allowing for the usage of e-scooters and taxi, while LPT is accessible through the BIP electronic card and car sharing and electric motorbike sharing are accessible thanks to vouchers usable directly into transport operators’ app.

Each mobility package had a cost of €150, and they are composed as follows:

- single: unlimited LPT, 100 minutes of bike / e-scooter sharing, 120 minutes of electric motorbike sharing, €25 voucher for car sharing and €25 voucher for car rental;
- couple: unlimited LPT, 100 minutes of bike / e-scooter sharing, €30 voucher for taxi, €25 voucher for car sharing and €25 voucher for car rental;
- family: unlimited LPT, 100 minutes of bike / e-scooter sharing, two €25 voucher for car sharing and one €30 voucher for car rental;

- exclusive: €50 voucher for taxi, 50€ voucher for car sharing and €50 voucher for car rental.

All packages but the single package of course can be shared with household members, enlarging the number of users from 100 to 152, uniformly divided in male and females, while the age ranged from 20 to 60 years, with a mean of 37 years. The most selected mobility packages were “couple” and “family”.

Unfortunately, at the date of writing of this research, the full report of this MaaS project is not available yet, since it is still being produced. However, preliminary data show that LPT was used by 65% of users that had access to it, being the preferred mode of transport among those available.

Moreover, e-scooter sharing showed a loyalty process since its usage changed over time: during colder months the number of used reduced, but those who continued to use it increased the number of rides with this mode of transport. Electric motorbike instead was the most used service among those available in the “single” package, with a peak usage in the early months of testing, stabilizing between December and February. Taxi usage instead was not uniform, being used less as months passed, showing a general preference for other modes of transport.

Car rental and car sharing instead were the two modes of transport less used, with car rental having a poor success maybe due to the fact that the access to this service was not digitalized, while car sharing was used constantly but was not a relevant mobility choice. However from these first results emerges positivity among users, with the support service finding a good and a proactive climate of collaboration, where users have interest into improving the experimentation. Thus, with this project it is evident that there is a slice of population that is interested in MaaS and is willing to contribute into the development of more mature platforms.

### 4.2.2 MaaS for Italy - Turin

City of Turin MaaS proposal “TorinoMaaS4Italy” is quite interesting and detailed ([42]). Starting from the objectives, the aim is to realize MaaS solutions according to different users’ categories, thus the idea of realizing two different MaaS solutions: Corporate MaaS and Consumer MaaS. The former will involve important companies in the metropolitan area of Turin, which will offer MaaS solutions to their employees not only for home-work and work-work trips, but also for their free time, with the companies themselves promoting MaaS usage with subsidies. The companies involved are 9 and are: Politecnico di Torino, Leonardo, Punch, Italdesign, BASICITALIA, Free2Move, IVECO, CNH and 5T. Moreover, there is the willingness to improve LPT digitalization to better integrating them into the MaaS project, create public politics to incentive sustainable modes of transport in order to reach social goals through discounts, voucher, cashback, in order to change users’ habits, thanks also to a Level 4 MaaS integration, giving local authorities a central role in attracting people and promoting the services.

Finally, there is the willingness to experiment different business model to investigate which is the most suitable in the long run. Agreements have been already subscribed between City of Turin and transport operators working on different services, like LPT, parking, trains, e-scooter, car-sharing, car-pooling, taxi and also electric vehicle charging stations.

TorinoMaaS4Italy pilot will be divided in 2 phases:

- wave-1: experimentation of 2 MaaS services for both Corporate and Consumer involving at least 1.000 users;
- wave-2: moving from experimentation to a more stable version of the project, with the possibility of involving other transport operators.

Wave-2 is expected to be launched in 2024, thanks to a progressive development of DS&SRF and the deployment of the regional platform “BIPforMaaS”. Moreover in 2024 “SmartBIP” Platform will be launched, allowing regional smart-ticketing for the entire LPT and its full integration into the MaaS ecosystem.

TorinoMaaS4Italy will take advantage of all the funds disposed from the ministry, but also from regional funds. All expenses are listed below:

- €2.500.000 from the ministry for MaaS experimentation, including €600.000 for incentivize users through cashback, vouchers and discounts;
- €950.000 from Piedmont region for MaaS ecosystem project (BIPforMaaS);
- €1.300.000 from Piedmont region for MaaS regional platform implementation;
- €800.000 from City of Turin to develop a tool for demand analysis and implementing politics to attract users;

- €430.000 already founded by Piedmont region for SmartBIP design;
- €2.830.000 approved by Piedmont region for SmartBIP implementation.

Corporate MaaS will adopt a B2B business model since it is designed for business users. Companies will offer mobility solutions for home-work, work-work and even free time trips, providing a better employment of company's fleet and giving subsidies to those who participate. Consumer MaaS will instead adopt a B2C business model, created ad-hoc from the MaaS provider for each target, experiment incentives to reach social, economic and environmental goals, promoting modes of transport with the least environmental impact. Knowledge and expertise acquired during TorinoMaaS4Italy project will be put at disposal to followers and subjects interested. Not only reports will be produced, but also workshops will be organized in order to share TorinoMaaS4Italy experience and being of support to secondary projects.

Moreover, it will be organized a "MaaS Academy" for training and leading research on MaaS, involving public entities and students, that with the coordination of 5T company will be a Centre of Excellence.

5T is the company in charge of the overall management of the activity, together with the help of advisors, legal specialist, a service specialised in finding the right KPIs to track the project performance, and a community management that will promote the project.

### 4.2.3 MaaS for Italy - Milan

Milan was the first city, together with Rome and Napoli to win the contract, with Turin winning the second notice published, thus receiving €2.500.00 for MaaS realization, €800.000 for digitalization of LPT, and €7.000.000 for the realization of the Living Lab [43].

Milan municipality has defined and proposed a project which aims at finding one or more entities willing to become MaaS providers, developing a multimodal offer that must involve LPT and at least 3 other modes of transport. To incentive the rise of the service, Milan municipality promotes discounts and vouchers to different population groups or more sustainable modes of transport ([44, 45, 46, 47, 48])

MaaS providers must use DS&SRF to distribute their services, and must have access to the prices of transport operators' offer, in order to re-sell those services. Thus, DS&SRF will contain all static and dynamic data like routes, timetables, and prices.

Here, phases and their deadlines are showed:

- from April 11<sup>th</sup> 2022 to June 10<sup>th</sup> 2022: the first phase of the realization of Milan MaaS is the signing of the agreement, In this phase all milestones must be defined and consolidated and allows the correct allocation of the resources;
- after, the MaaS providers must be found, thanks to a public notice between May 4<sup>th</sup> 2022 and October 26<sup>th</sup> 2022. In this phase it is time to individuate the MaaS providers that will be in charge of creating the platform and services to deploy MaaS in Milan. All selected operators will enjoy subsidies from the municipality together with the possibility to have a promotional campaign done from the municipality and the possibility of using Milan city logo for their own campaign;
- then the development of the MaaS platforms will take from October 27<sup>th</sup> 2022 until April 26<sup>th</sup> 2023. In this phase MaaS providers must secure commercial agreements with transport operators, and developing their platform;
- from June 13<sup>th</sup> 2022 to March 24<sup>th</sup> 2023 the DS&SRF platform will be implemented from the ministry;
- from July 11<sup>th</sup> 2022 to April 14<sup>th</sup> 2023 the Milan data platform and the integration with DSSRF will be implemented;
- from February 23<sup>rd</sup> 2023 to August 23<sup>rd</sup> 2023 the launch campaign will be handled, both digitally and physically;
- from October 27<sup>th</sup> 2022 to October 27<sup>th</sup> 2023 there will be the experimentation management. The experimentation must last for at least 6 months, while this

part of the project lasts 1 year, since the 27<sup>th</sup> October 2022 is the first day after the MaaS providers' notice winners announcement, thus there is still time before the actual start of the experiment. Milan municipality aims at involving students already owning an annual subscription to ATM (LPT), city users with Trenord annual subscription, city users with age below 26 years using at least two modes of transport between 7 a.m. and 9.30 a.m., disabled persons and workers from neighbours surrounding the city;

- from December 12<sup>th</sup> 2022 to October 25<sup>th</sup> 2023 the experimentation will be monitored, to evaluate also eventual macro-displacement from the proposal. It is important to identify and correctly analyze non foreseen phenomena, to introduce actions to counteract them for a better success of the experimentation. In this phase, KPI will be measured, like:
  - number of MaaS providers involved;
  - number of users involved;
  - coverage area of the service and number of users per area;
  - users subdivision in clusters;
  - usage of modes of transports per hours;
  - percentage of users involved in MaaS with respect to people using mobility options without participating in the MaaS project;
  - improvement of urban accessibility;
  - reduction of private vehicle usage;
  - improvement in health conditions of the users;
  - improvement in environmental sustainability of modes of transport;
  - improvements from an efficiency and economic point of view of transports in general.
- finally, until June 2023 LPT services will be digitalized.

### 4.3 Quantitative survey analysis

The questionnaire has collected a decent number of answers, being them over two-hundreds, however, only half of the respondents answered to all the questions, with the remaining half leaving after the first section of the questionnaire.

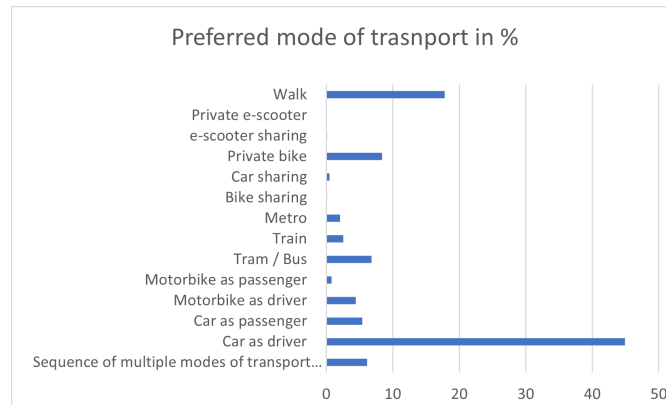
This indicates one of the downsides of snowball sampling plan. Despite this sampling plan is useful to reach many respondents in a fast, easy and cheap way, their behaviour still remains unclear and unpredictable. Moreover, this behaviour may be due to the fact that people who is not really interested in the object of the questionnaire may find it annoying, thus leaving without completing it.

Despite this criticality, interest findings are obtained.

In order to better focus and understand the answers, it is needed to start describing the context, thus the socioeconomic variables of the respondents.

The gender rate was perfectly balanced with half of the respondents being male and half female, with only a few identifying as "other". Regarding social status, the respondents were mainly students (42%) or employees (31%), with a smaller part of freelance (9%). The level of education among participants is high, with 18% of people having a high school diploma, 30% a bachelor's degree, and 44% a master's degree.

The car is the preferred mode of transport (44%), walking is the second (18%), while LPT and private bikes share both around 8% (Fig. 4.14). Even if the car is the most used mode of transport, it is evident that cars are used by only one person. In fact, only 6% of respondents admit using the car as a passenger for their mobility.



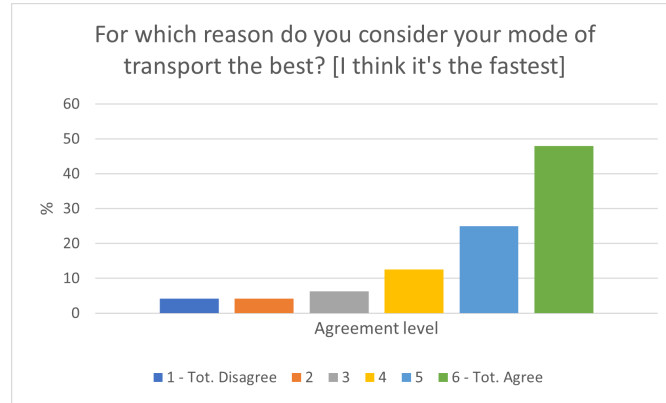
**Figure 4.14:** Preferred modes of transport during the week

The average round-trip distance for the most important trip is around 25km, being reasonable that the most used mode of transport is the car, since at that distance from the city, PT can be insufficient and unreliable.

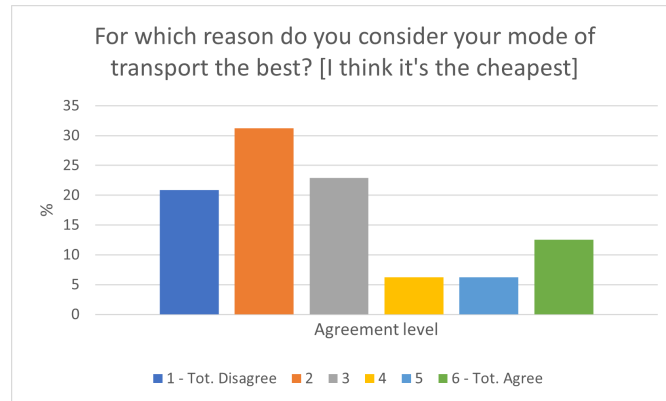


Then, the dataset was split among those who use the car and those who use the LPT for their most important trip.

Car users reported that they prefer this mode of transport as it is the fastest one (Fig. 4.15); regarding costs, even though the majority admits that it is not a cheap mode of transport, 12% think that the car is the cheapest mode of transport (Fig. 4.16).



**Figure 4.15:** Car users' opinion regarding their mode of transport velocity

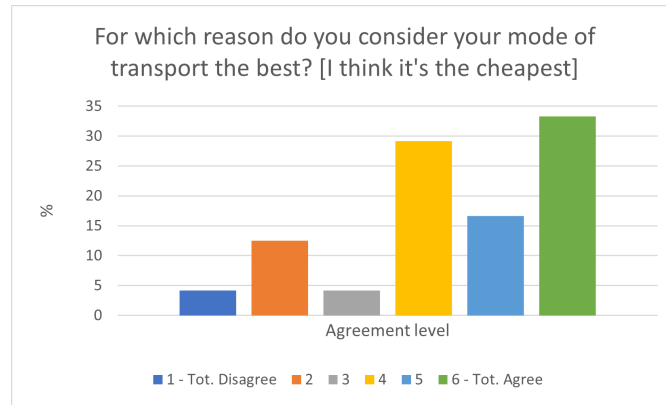


**Figure 4.16:** Car users' opinion regarding their mode of transport's cost

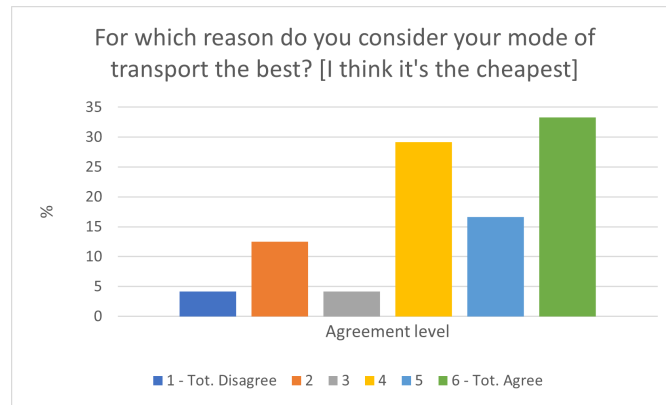
On the contrary, LPT users are aware that LPT is cheaper than private transport, even if 12% of people does not consider it so cheap. Regarding speed instead, even though a 20% of respondents consider LPT the fastest option, it is mainly considered a not-so-fast solution (Fig. 4.17 and Fig. 4.18).

In the overall, LPT users like their mode of transport (Fig. 4.19)

Once the knowledge of people habits regarding mobility is established, it is possible to analyse their opinions regarding other modes of transport and MaaS.



**Figure 4.17:** LPT users' opinion regarding their mode of transport's cost

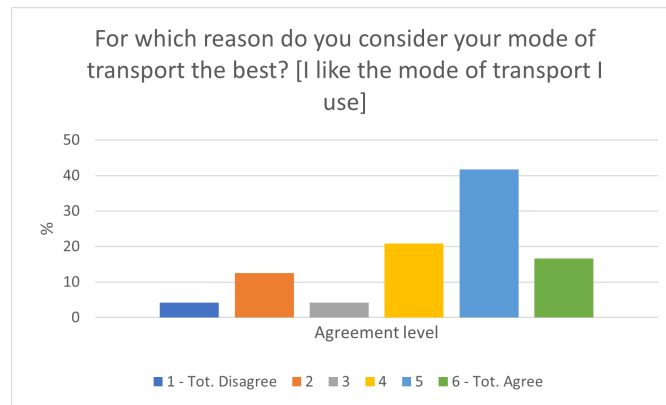


**Figure 4.18:** LPT users' opinion regarding their mode of transport's velocity

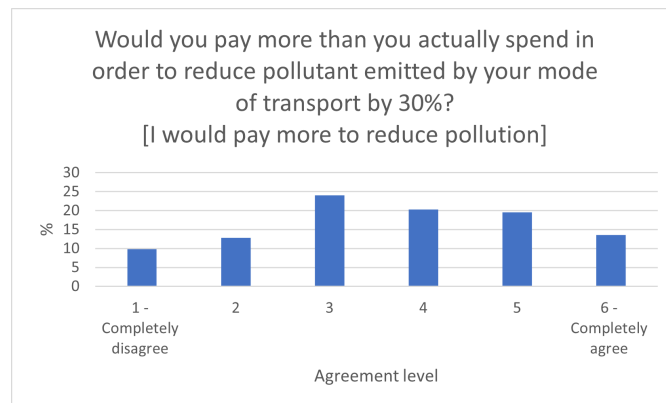
It is extremely interesting to observe that when asked to think at the percentage of trains that arrived on time, the average answer is only 62%. The national Italian average is 92%, while the average for Piedmont and Sicily are respectively 90% and 85% ([49]).

In order to analyse attitudes towards sustainability and "green" topics, it is asked to respondents if they would like to spend more than they actually do in order to reduce emissions by 30%. While the extra expenses are not specified, a 30% emission reduction is quite huge. Nevertheless, this seems not to be relevant, as it is noticeable from Fig. 4.20.

The car-sharing analysis is also interesting; around 80% of people admit to not use this service, but this is not due to car-sharing prices. The main reasons behind this low usage are a lack of information from the user's side and, most importantly, the fact that generally people admit that they do not like the service. This, however, has nothing to do with costs or even hygiene, as one could suppose Probably, and



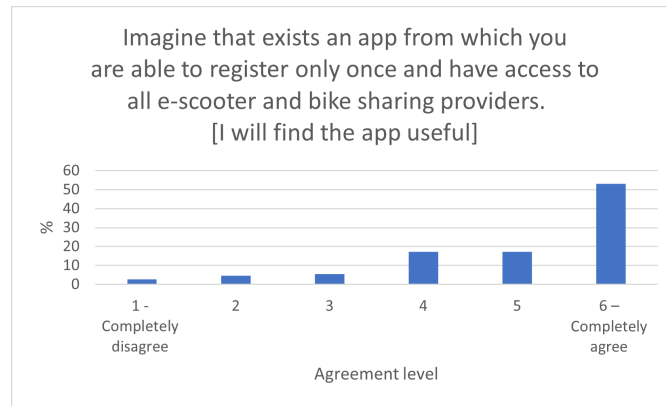
**Figure 4.19:** LPT users' like their mode of transport



**Figure 4.20:** Opinions on paying more to reduce emission by 30%

as the qualitative survey confirms, people do not consider subscribing or renting something that they can possess, and generally prefer to pay more in order to possess the good instead of paying as they need it.

**MaaS opinions** Starting from Level 2 implementations, and thus pay-per-use applications, results are encouraging. As depicted in Fig. 4.21, people would find extremely useful an app that works as an aggregator for micro-mobility providers. However, when considering an extra fee for each ride for using this app, opinions drastically change, and the overall interest decreases (Fig. 4.22). Finally, gamification seems to be able to attract users since over three times the number of respondents were in favor of a gamification solution. For gamification is intended a mechanism that takes statistics from micro-mobility usage to give rewards in the form of discounts to those who spent more time using these mobility patterns, promoting a shift towards more sustainable modes of transport.



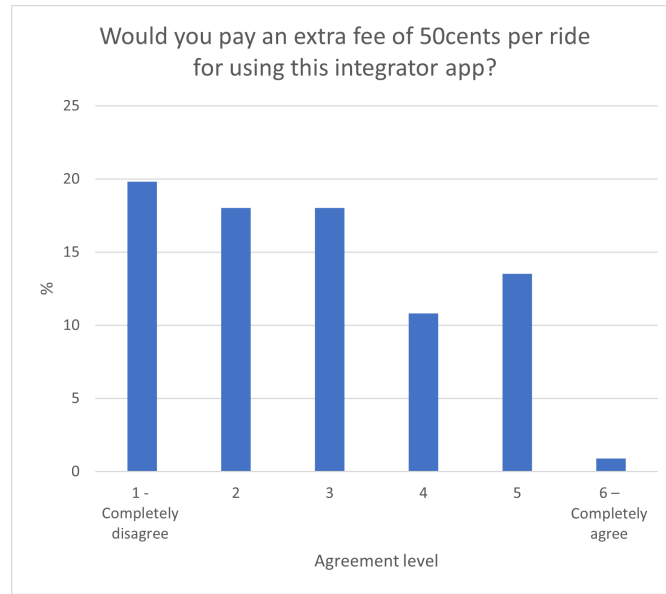
**Figure 4.21:** Opinions on pay-per-use

Another interesting aspect, that links with the previous analysis regarding car-sharing is related to the mobility packages composition. This question was proposed in two steps: first including unlimited car-sharing rides and then proposing a 50% discount on car-sharing fees.

Results show that in both cases, the three most picked options are LPT, bike sharing and discounts on regional trains. Car sharing is the 4<sup>th</sup> most selected solution; however, it shares scores similar to the least selected solutions. Moreover, the scores of all modes of transport do not change between the two questions, in case unlimited car-sharing is available or if it is discounted by 50%.

This result can mean two things: the 50% discount is excellent since it does not scares people that previously accept unlimited rides or car-sharing is a variable so that it has no influence on mobility packages. The second option is the most probable, since it is already stated that the majority of respondents do not use car-sharing service, and also it is not among the three most selected modes of transport.

Considering the mobility packages created by respondents, they think that the price for these services should be around €60 per month, while the price that



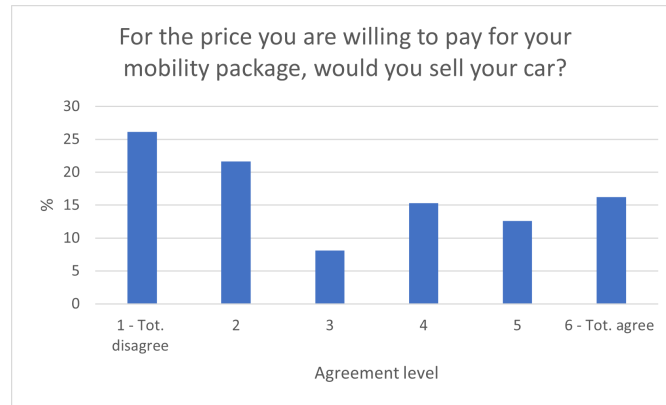
**Figure 4.22:** Opinions on extra-fee

they are willing to pay is around €55. As expected, the price that people are willing to pay is lower than the price that they attribute to the services, but other considerations arise.

In fact, when an approximation of the monthly expenses related to transport is asked, the average among all participants is €69, while the average expenses estimated by those who use the car is higher equal to €93.

From the above results, we understand that people always seek money saving and thus, when considering a MaaS mobility package, attribute to it a price which make them saving money with respect to their current expenses.

Moreover, people admit that a mobility package would be a valid alternative to private car usage and admit that mobility packages would lead to money savings; nevertheless, they still are not so inclined in selling their car. Opinions about this topic are spread, as it is shown in Fig. 4.23, with still a slight majority of those who prefer not to sell their car.



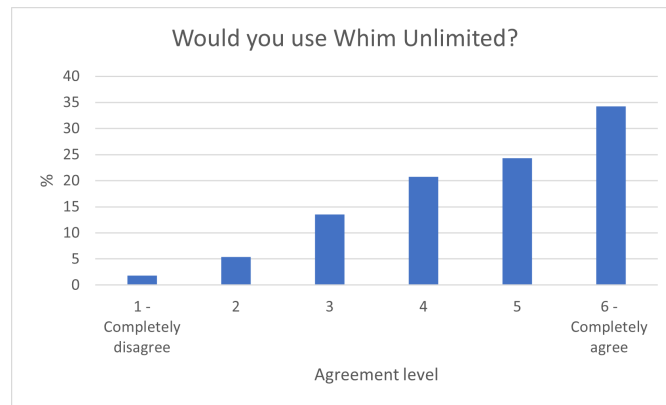
**Figure 4.23:** Sell the car in favor of MaaS

**Whim Unlimited** The last questions in the Maas section of the questionnaire regard Whim Unlimited offer. Again, Whim Unlimited includes free LPT, up to 30 days of car rental (with distance limits that, once exceeded require extra payments for some car-rental operators) and up to 80 taxi rides per month which are free if under 5km.

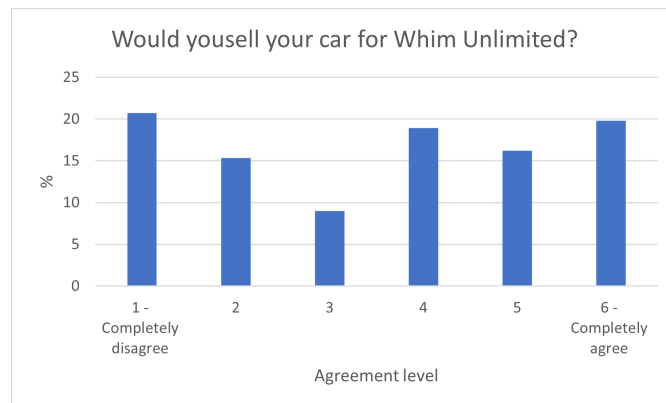
Respondents think that on average this service would cost €151, which of course is extremely low when considering how much Whim Unlimited offers. Even if it does not include any package for micro-mobility or discounts on car-sharing, it still includes a huge portion of car rental and almost 3 taxi rides per day which can be free if the ride does not exceed 5km.

To confirm the goodness of Whim Unlimited offer, people say that they would like to use this service if it was available in Italy, as it is shown in Fig. 4.24. However, even if Whim Unlimited offers a lot for urban mobility, people still do not agree in sell their car, with opinions spread across this topic. This may be because more and more people work outside the city and thus need for rides that exceed the 5km threshold, reducing the advantage of Whim unlimited (Fig. 4.25).

Finally, when the real price of whim Unlimited of €699 is shown to respondents, their interest in the service drastically decreases, because bringing value implies a payment proportional to it (Fig. 4.26).

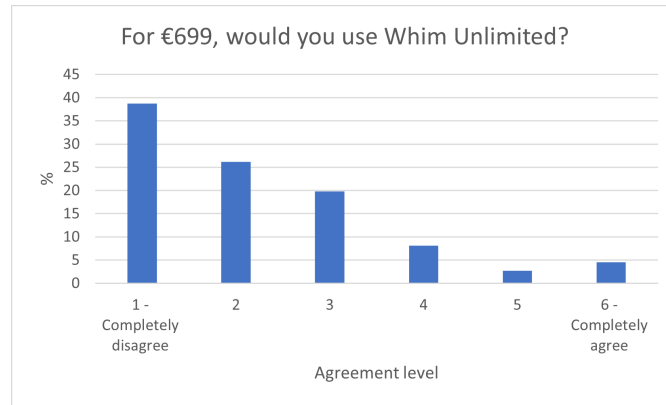


**Figure 4.24:** Whim interest

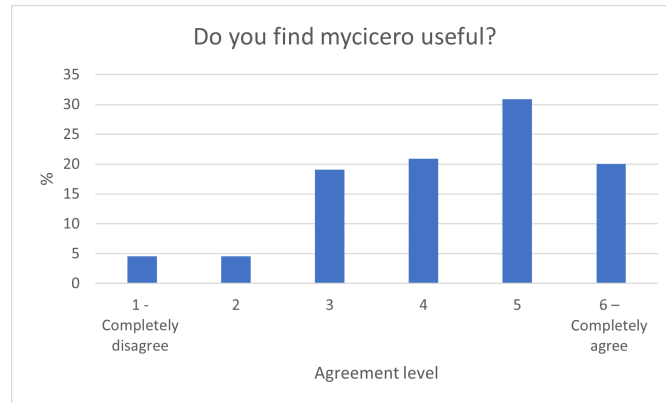


**Figure 4.25:** Sell the car in favor of Whim

**myCicero** myCicero is an Italian service, nevertheless, the great majority of respondents do not know it (more than 85%). When myCicero services are explained to interviewees, the service gained success; Fig. 4.27 shows how many people find it interesting and useful. This is a sign that communication has a key role in promoting services that people may like and use.



**Figure 4.26:** People's interest knowing that Whim Unlimited costs €699



**Figure 4.27:** Perception of usefulness of myCicero

## 4.4 Qualitative survey

The qualitative survey was conducted through a focus group, involving eight people with different opinions about MaaS. Participants included people who do not see any success possibility for MaaS, people who see the goodness in it and people who see potential in this mobility paradigm but still notice criticalities and problems that, in their opinion, drastically limit and prevent MaaS development.

The focus group had a duration of one hour and a half, giving to all the participants the possibility to expose their reasons, resulting as an extremely productive tool because it reached one of its main goals: it allowed people to doubt their position, question their reasoning, and engage in arguments to find solutions to the problems they raised.

Problems and criticalities were those who emerged the most during the activity, with topics concerning mainly:



- infrastructure;
- availability;
- environmental sustainability;
- mobility packages flexibility;
- family needs;
- emergencies.

Finally, interviewees proposed some ideas related to what they think a successful business model could be.

**Infrastructure and availability** The main concern regarding Mobility as a Service is related to infrastructure and vehicle availability. Mobility packages which include LPT and micro-mobility heavily suffer from weather conditions. Rain forces users to abandon micro-mobility modes in favour of LPT, reducing the range of mobility options and thus leading to waste money as paid services included in the subscription are no more comfortable and viable.

Moreover, if a user plans a round-trip journey, he/she wants to have the certainty of finding a vehicle to return home in his/her proximity, with no fear of someone taking their vehicle as their doing commissions. It is indeed possible in these cases to return home with LPT but again there is the need for a reliable infrastructure and high availability. If returning from grocery there are no vehicles available and the nearest bus stop is distant, it may be difficult for some people to reach it without fatigue, not considering weather constraints.

However, it must be remarked that, when considering the possibility offered by Cambio of "blocking" the vehicle for around €2 per hour, all respondent considered this as a fair price to have guaranteed access to the car as they terminated their commission, as for the case of groceries.

Finally, the group agreed that the maximum time they are willing to spend to reach the nearest available vehicle is no more than 5 minutes, that is the same maximum time indicated to reach the nearest bus stop.

**Environmental sustainability** The largest percentage of participants consider MaaS only if comprehensive of cars. Thus, reaching a higher environmental sustainability level is not perceived as playing a key role in their involvement in the MaaS project. Moreover, they all agreed that is it preferable to introduce other habits into everyday life to reach a more sustainable society instead of trading the comfort and speed of cars for that reason, thus confirming UbiGo pilot in which participants participated for other reasons than for environmental concerns.

This certainly does not cope well with the fact that private transport is the most polluting mode of transport, and shows how social goals like environment sustainability take a back seat with respect to overall comfort and everyday needs, with people preferring to change already existing and introducing new habits in their life for environmental friendliness instead of modifying the urban transport concept.

**Mobility packages flexibility** The freedom that a car offers is undeniable. For this reason, interviewees when facing the possibility of buying a mobility package looked for the maximum flexibility and wanted to have access to LPT, micro-mobility, and also car-sharing. It was agreed by all participants that if pre-built mobility packages are offered by the MaaS provider, those must be flexible, with a wide range of options, fully customizable letting each person choose which modes of transport to include and pay accordingly. Some people may prefer more access to micro-mobility while others living far from the city centre will not take great advantage of micro-mobility, thus they will not pay for a service that is not needed. Finally, the group agreed that it is better to pay more to have access to the widest range of services to always have a wide mobility option for their day-to-day use, rather than to pay less and have less options or time included. Running out of minutes for a given mobility option is a big concern since it is a problem that is not faced using a private car unless it is not reliable.

**Family needs and emergencies** Private cars give access to a ready-to-use mode of transport for every kind of emergency. This aspect is strictly related to concerns about not having a private car in favour of mobility packages since different emergencies can arise during everyday life. In these cases, it is perceived as risky and extremely uncomfortable to not possess a private car, leading to searching for a shared vehicle nearby or even using LPT. Health reasons were the main concern agreed from the totality of the participants, which feel not safe not having a private vehicle in the case of rushing to the hospital.

**Remarks** In the overall, MaaS is not perceived as a way of saving money, since to reach comfort and flexibility the most expensive options would be preferred. Moreover, participants agreed that it is better to pay more for owning a private car than pay less to access MaaS. Existing infrastructure is considered an extremely limiting factor in MaaS applicability, and money-saving is not sufficient in providing the shift needed for MaaS success, with people wanting to pay more for all the comforts that a private car can bring. As an example, in most Palermo roads and in some of Turin's ones, LPT suffers from traffic equally as cars, thus not offering time savings to the users.

These considerations however turn in favor of MaaS when considering it as a substitute for the second car in a household. With this solution, people still can benefit from the comfort and reliability of their private car, but benefit from all MaaS positive aspects such as money-saving and environment friendliness. When considering MaaS as opposed to owning a second car all participants were happy to announce that they would be extremely more likely to consider MaaS solutions for their needs. This is due to the fact that when talking about car and mobility habits people prefer to possess the good and not to have access to it based on a subscription, which can be limiting, resulting in not altering daily habits due to external causes such running out of credits for their subscription.

Moreover, participants noted how Whim model is not suitable in Italy. With Finland's life cost being higher by 30% with respect to Italy, it means that Whim Unlimited should cost €468 per month in this country. Nevertheless, with that price, even less depending on the car type, it is possible to access Leasys services which are long-term rentals, and thus perceived as a better alternative to a service subscription, given that once rented, the car is only for private use. It must be remarked that Whim offer does not include micro-mobility.

Regarding pure car-sharing services, 25% of the participants admitted being interested in Amigo car-sharing in Palermo, but not subscribing to it given the non-convenient price. In this regard, Amigo is surely not convenient when compared with Cambio, thus Cambio prices were proposed to respondents, which all agreed that those were a good deal. For this reason, all admit that they would find interesting a MaaS service built around Cambio, at a higher price of course, but including also LPT and micro-mobility, giving the freedom of choosing between different modes of transport depending on the needs.

Finally, participants gave some hints on the possible business models of MaaS platforms, considering the pay-per-use approach. In particular, respondents were asked if they would accept an extra fee for using a single aggregator platform to have information and access to all micro-mobility vehicles present in their territory. To this question, everyone agreed that instead of paying an extra commission, they would prefer to watch a video advertisement when accessing a vehicle. Moreover, it must be remarked that in-app advertisement presence would be not perceived as a negative aspect if it prevents an extra commission.

This approach can also open up a path to a monthly subscription for a *premium* package with no advertisement, following Spotify's business model.

The qualitative analysis thus revealed itself as a fundamental instrument in support of the quantitative survey, giving the possibility for future customers to explain their reasons and opinions in order to implement services better suited to their needs.

## 4.5 Comparison between Turin and Palermo

In this section, some parameters are considered in order to analyse if differences in modes of transport perception are present between Turin and Palermo. Italy, in fact, has a non-negligible infrastructure gap between the north where Turin is located, and the south, especially the islands, since Palermo is in Sicily.

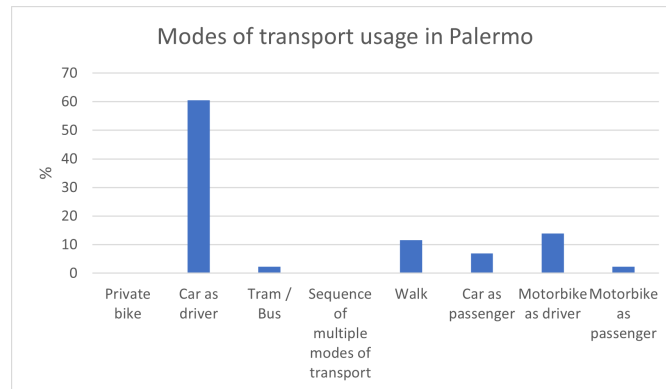
For this reason, the chosen parameters for this comparison are the punctuality perception of trains, the generally preferred mode of transport, and the mobility package composition.

From the analysis of the questionnaire, by filtering from the city of origin of the respondents, it is evident that this perception gap does exist. When asked to estimate the percentage of on-time trains on the Italian territory, the results given by Palermo's respondent were lower. With the average of Turin's respondents arriving at 62%, which is also the average of all respondents, Palermo's interviewees estimated that only 56% of trains arrive on time at the stations.

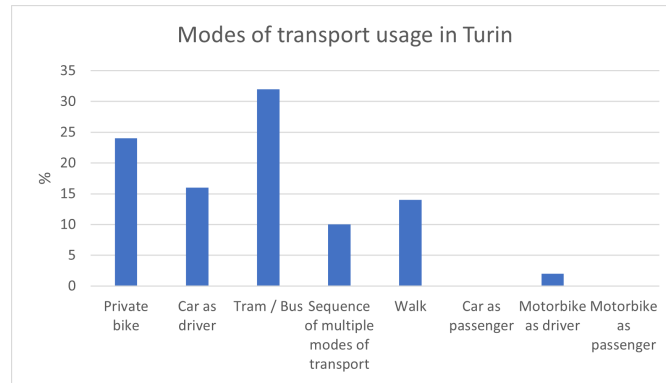
This data denotes high dissatisfaction and dejection when thinking at LPT and regional connection through railways. On the other side, it must be remarked that this dejection is motivated by the fact that the railway infrastructure in Sicily is not in step with time, since high-velocity trains like Trenitalia FrecciaBianca are not present, thus relegating Sicilian passengers to generally slow railway's solutions.

LPT problems are not only related to railways though. When analysing the preferred modes of transport it is evident an extreme prevalence for the car, while modes of transport that do not include a car or a motorbike only sum up to 14% (Fig. 4.28).

The situation is very different when analysing Turin's data (Fig. 4.29), however, it must be said that Turin's respondents were more students than workers.



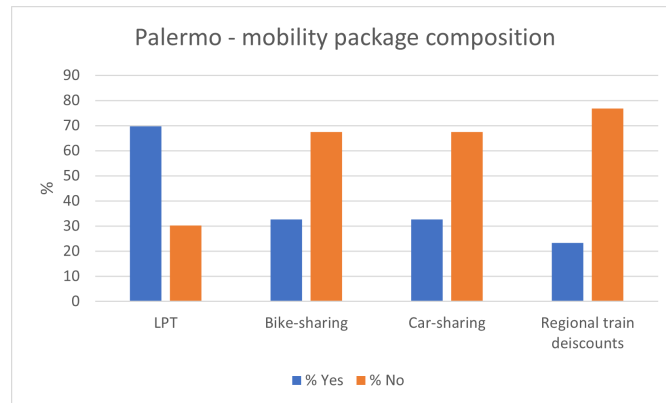
**Figure 4.28:** Preferred modes of transport in Palermo



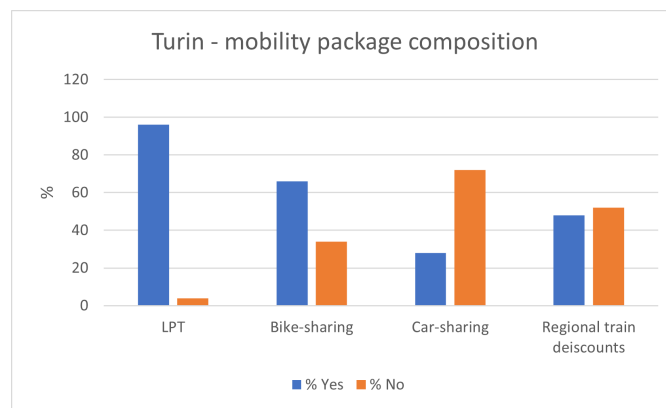
**Figure 4.29:** Preferred modes of transport in Turin

Similar considerations can be done when looking at the mobility package composition. Palermo's respondents does not seem so interested in mobility packages, since besides 70% who choose LPT, the other transport modes do not exceed 30% (Fig. 4.30).

Differently when looking at Turin's data, it is noticeable a considerable interest into bike sharing, followed by a 45% of interest in discounts on regional trains, while this service was the least selected by Palermo's users. It is also interesting that LPT interest reaches almost 100% in Turin, while is 70% in Palermo (Fig. 4.31).



**Figure 4.30:** Mobility package choices - Palermo



**Figure 4.31:** Mobility package choices - Turin

## Chapter 5

# Conclusions

Mobility as a Service comes with the noble aim of transforming our cities with smarter solutions in order to achieve environmental sustainability, reducing emissions and consumption, thanks to a smarter usage of modes of transport.

MaaS requires strong efforts from all actors involved, from the transport operators to the MaaS providers, integrators and, most importantly, from users. Users' psychology, behaviour, and ease to adopt new habits and solutions for everyday mobility are key to MaaS success; nevertheless, there is the need to provide adequate infrastructure and quality of the available services in order to attract and enhance users' loyalty.

The ongoing experimentations, demonstrate that this new mobility paradigm can succeed when the right conditions are met. In particular, as it emerged from the qualitative analysis, different criticalities arise when thinking about MaaS implementation, differing for each different mode of transport. LPT, in order to attract users, needs consistent improvement in the overall quality concerning waiting time and reliability with respect to the time spent on a given route; micro-mobility is perceived as a valuable mode of transport, however, users have concerns regarding its limited use because they consider that it is usually not comprehensive of a great number of minutes; car-sharing instead faces the problem of having the fear that no cars are available in the neighbourhood, or that the coverage area of the service is not big enough to satisfy users' needs.

Opinions regarding MaaS are not so enthusiastic when considered as a complete alternative to the private car, nevertheless the situation drastically changes when considering MaaS as an alternative to the purchase of a second or third car.

From the quantitative analysis in fact emerged that for an average of three persons per household there are more than two cars; MaaS can play a fundamental role in preventing the purchase of a not-so-necessary second car per household, allowing huge money saving and social goals like environmental sustainability and less overall consumption.

For these reasons, and since people today are not so happy when thinking of abandoning the freedom of having a car, it can be useful if MaaS could be an extension of an extremely good car-sharing service. As stated in 4.1.4, it is evident how Cambio is convenient in everyday use, thus it is perfectly suitable to be the foundation of a successful MaaS platform operating in Italy. Moreover, participants to the qualitative survey were surprised when noticed that Cambio prices were comprehensive of fuel.

Mobility as a Service is an ambitious project that aims to revolutionize the mobility landscape. It is difficult to imagine a drastic change without a smoothed transition; each country comes with its level of infrastructure and predisposition to new habits and no solution is good for everyone.

Thus, for MaaS to succeed there is the need to implement a smoothed-out solution that must be personalized in order to satisfy a wide range of users.

This research aimed at providing an overview on what is the actual perception of the MaaS solution, but more can be done. More data always come in handy, especially when analysing something as complex as MaaS; moreover, the research can be further improved with more advanced analysis tools in order to better understand market segmentation and to foresee and predict mobility behaviours.



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