TECNOLOGIE TELEMATICHE TRASPORTI TRAFFICO TORINO

CITTA' DI TORINO

MOBILITY VOUCHERS PROJECT

FINAL REPORT

March 2023

MINISTERO DELLA TRANSIZIONE ECOLOGICA

Introduction

The "Mobility Vouchers" project is led by the City of Turin, run in collaboration with 5T S.r.l., which aimed to test level 4 of the "Mobility as a Service" (MaaS) paradigm in the urban area of Turin and with "real" users.

The project was co-funded by the Ministry of the Environment and Energy Security within the framework of the "Funding Program for Improving Air Quality in Urban Areas and Enhancing Public Transport".

What is Mobility as a Service (MaaS)

MaaS is a new concept of mobility, involving the integration of multiple public and private transport services into a single service, accessible via smartphone, capable of responding in a customised manner to all specific mobility needs and offering a real alternative to the private car. All in one app.

The MaaS service is delivered through the implementation of a single technological platform, capable of suggesting to the citizen-user the best travel solution based on individual needs or preferences, exploiting the integration between the different mobility options (local public transport, ride-sharing, car-sharing, bike-sharing, scooter-sharing, taxi, car rental, etc.), both in terms of travel planning (intermodal route planner, real-time information on travel times and distances) and in terms of use (booking, payment and use of services).

The project

The City of Turin, building on the experience gained from its participation in the European projects SOLEZ[1] and IMOVE[2], wanted to deepen the MaaS experience through the "Mobility Vouchers" project.

As already mentioned, the project aimed to fully test the MaaS model and its functionalities, making it operational and accessible in a real context and with the direct involvement of citizens.

The selection of the "citizen-testers" took place on a voluntary basis and through a public call for applications issued by the City of Turin, which foresaw for the first 100 participants the possibility of using "vouchers" or "coupons" to spend on mobility services, fully financed by the city administration. Moreover, the "vouchers" also offered the possibility of being used by other members of the participants' households, effectively extending the number of testers to 152 users.

To participate in the project's call for proposals, interested parties had to meet certain requirements: an ISEE[3] certification of less than €50,000; not to be in possession, in the entire household, of any car or, alternatively, having scrapped a car in the household during 2020 or 2021 (on the date of joining the competition); being the owner of an electronic/digital payment

[1] http://www.comune.torino.it/ucstampa/2017/article_650.shtml
[2] http://www.comune.torino.it/relint/francese/progetti/programmi1420/imove.shtml
[3] Equivalent Financial Situation Indicator

system; the availability of a smartphone with an Android (from version 6) or iOS (from version 10) operating system with data traffic coverage.

The trial lasted one year, from 1st October 2021 to 30th September 2022.

Through the MaaS platform "Mobility Vouchers" (specifically created for the trial), users were provided with the following mobility services, accessible through a dedicated app: local public transport (bus/metro/tram, hereafter also LPT), car sharing, e-scooter sharing, e-moped sharing, car rental and taxi service.

As this was an experiment, not all mobility services were fully usable in-app. The e-scooter sharing and taxi services, for example, were integrated in "full" mode and usable directly via the MaaS app "Mobility Vouchers", made available by the project for the testers. Local public transport (LPT), scooter sharing, car sharing and car rental services, on the other hand, integrated in "light" mode, were accessible via the BIP[4] (Biglietto Integrato Piemonte – Piedmont Integrated Ticket) card and/or vouchers with a code to be entered on the transport operators' apps.

The mobility bundles

The project was developed over the 12-month experiment in three phases. Each phase offered users different compositions of the "vouchers", i.e. mobility packages available to the experimenters.

The first phase (October 2021 - February 2022) was the most delicate and interesting one from a design point of view, as it was the real "pilot" phase. Although it collected some preliminary information on the mobility habits of the selected users, the project initially proposed four mobility packages to the experimental users.

Thanks to the continuous dialogue with the users, the analysis of the feedback received and actual usage data, the package offer was redesigned and remodelled over time. This continuous monitoring activity made it possible to intervene flexibly on the definition of the services included in the packages, with a view to improvement and greater user satisfaction.

The second phase of the project, with the proposal of new mobility packages, ran from March to May 2022, and the third and final phase from June to the end of September 2022. Users were able to change packages every month, choosing from those available at that time.

Below is a summary table of the mobility bundles offered to experimenters in the 3 project phases:

PHASE 1		
Bundles	**Included mobility services**	**Value/month**
SINGLE	LPT subscription Sharing e-scooter 100min Sharing e-moped 120min Car sharing voucher 25€ Car rental voucher 25€	149€
COUPLE	LPT subscription	148€

[4] The BIP card is a rechargeable contactless smart card valid throughout Piedmont that provides quick and easy access to public transport (urban and suburban bus, tram, metro and rail services) and bike sharing services, https://bip.piemonte.it/;

	Sharing e-scooter 100min Sharing e-moped 120min Car sharing voucher 25€ Car rental voucher 25€	
FAMILY	LPT subscription Sharing e-scooter 100min Car sharing voucher 2x25€ (tot. 50€) Car rental voucher 30€	148€
EXCLUSIVE	Taxi wallet 50€ Car sharing voucher 2x25€ (tot. 50€) Car rental voucher 2x25€ (tot. 50€)	150€
PHASE 2		
Bundles	**Included mobility services**	**Value/month**
COUPLE	LPT subscription Sharing e-scooter 100min Sharing e-moped 120min Car sharing voucher 25€ Car rental voucher 25€	152€
METRO-SMART	LPT subscription Sharing e-moped 180min Car sharing voucher 2x30€ (tot. 60€)	148€
NO LPT	Sharing e-scooter 100min Taxi wallet 40€ Sharing e-moped 120min Car sharing voucher 2x25€ (tot. 50€)	151€
TRANSPORTED	LPT subscription Taxi wallet 110€	148€
FAMILY 2.0	LPT subscription Sharing e-scooter 100min Car sharing voucher 30€ + 25€ (tot. 55€) Car rental voucher 25€	148€
WINTER	LPT subscription Taxi wallet 30€ Car sharing voucher 30€ + 2x25€ (tot. 80€)	148€
PHASE 3		
Bundles	**Included mobility services**	**Value/month**
COUPLE	LPT subscription Sharing e-scooter 100min Sharing e-moped 120min Car sharing voucher 25€ Car rental voucher 25€	152€
METRO-SMART	LPT subscription Sharing e-moped 180min Car sharing voucher 2x30€ (tot. 60€)	148€
TRANSPORTED	LPT subscription Taxi wallet 110€	152€
FAMILY 2.0	LPT subscription Sharing e-scooter 100min Car sharing voucher 30€ + 25€ (tot. 55€) Car rental voucher 25€	152€
WINTER	LPT subscription Taxi wallet 30€ Car sharing voucher 30€ + 2x25€ (tot. 80€)	152€

SUMMER NIGHT	Sharing e-scooter 300min Car sharing voucher 2x30€ (tot. 60€)	150€

Any change in value of the mobility package, as the phase of the project changes, is due to a simple tariff adjustment by the provider of the LPT subscription, without changes to the services offered.

Results analysis

The users who took part in the trial were equally divided between men and women. The average age of users was 39.5 years, while the average age of users was about 37 years, with 70.7% in the 21-50 age group.

In the first phase, the most popular packages were the "Couple" and the "Family". In the second phase, they were the "Winter" package and again the "Couple", tied with the "Transported". In the third and final phase, users confirmed their preference for the "Winter" and "Transported" packages.

The analyses highlight that, in the first phase, users showed more interest in having more services available within the mobility package. In the second and third phase, however, preferences shifted to more sectoral packages, favouring a greater use of one or two transport modes.

Below are some considerations on the preferences of the experimenter users that emerged from the analyses conducted on the collected data:

- There is a significant cluster of users who are not in favour of self-driving (21%)
- Similarly, there is a cluster of users inclined to travel sheltered from the elements (27%)
- There is a cluster of e-moped fans, not numerous but resilient, who consistently chose the package with the most minutes of this service and the fewest transport alternatives
- Also confirmed the persistence of e-scooter fans, even during the winter months and for night travel not served by public transport.

In general, it could be observed that the remodelling of packages after each phase resulted in an increase in the utilisation rates of all available transport and mobility services.

Figure 1 illustrates an analysis of the percentage of users who actually used the different mobility services available to them: it can be seen that the services most actually used, once the corresponding packages were chosen, were public transport (66% of those eligible), e-moped sharing (50%) and taxi (40%), followed by the other sharing services, while car rental was the least used (only 5%).

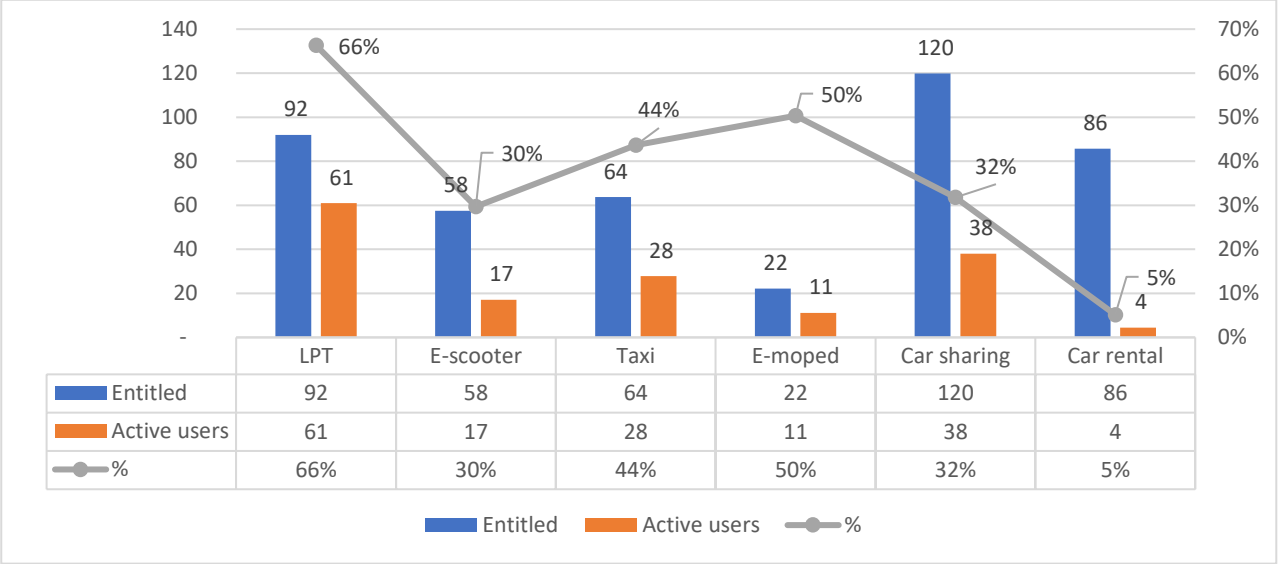

Figure 1: Usage of mobility services

Questionnaires analysis

As already mentioned in the previous section, continuous feedback from experimenters was one of the key success factors of the project.

During the 12-month trial, three questionnaires were administered to the users: one at the beginning, one in the middle and then one at the end of the project.

Especially the results gathered from the last one were interesting and significant for understanding and identifying strengths and weaknesses of a MaaS model applied in an urban context.

In fact, it emerged that many users expressed general satisfaction with the MaaS platform tested, giving it a score of 4.4 out of a maximum of 5 points.

Particularly, journeys were perceived by users as safer (score 3.4 out of 5) and more sustainable (score 4 out of 5). In addition, 74% of users perceived a reduction in overall travel time, 24% from 5 to 10 minutes and 25% from 10 to 15 minutes.

Users made 2.5 trips (round trips) per day, an average of 13km/day. Using Mobility Vouchers, 55% of users stated that they mostly used local public transport, 45% car sharing, 31% taxis, 26% e-scooters, 6% e-moped. On the other hand, 3% said they travelled less than before the trial.

Users' trips, whether for work/study or leisure purposes, lasted, for the majority of experimenters (49%), between 15 and 30 minutes. However, while for work/study trips the most used means of transport was local public transport (64%), car sharing was the most used service for leisure trips (44%).

Another interesting finding is about the combinations of mobility services preferred by users. The three main combinations indicated by the experimenters were:

- local public transport + car sharing (18%)
- local public transport + taxis (15%)
- local public transport + car sharing + scooter sharing (7%).

Public transport is therefore confirmed as the mode of transport most desired by users, both in absolute terms (it was used by 85% of respondents to the questionnaire) and in combination with other mobility services. Furthermore, it was observed that the "NO LPT" package was not successful, further demonstrating that public transport is fundamental in a MaaS offer.

The e-scooter sharing has been able to count on a solid base of "fans", who have used the service significantly and consistently over time, with an average of 68 minutes and 9 rides per month per user, for an average trip of 3km and 8 minutes. Users have become loyal to the service and usage has even increased during the winter months, despite the less favourable weather. In addition, longer journeys were observed at night, when public transport is not available.

E-moped sharing saw an initial peak in enthusiasm and usage, which then dwindled and consolidated into a group of enthusiastic users, who continued, month after month and despite remodelling, to choose mobility packages that included the service.

Car sharing was chosen by a large number of users, while its actual use increased over the months from 20% to around 40%, probably as a result of the reshaping of packages and the entry of a new operator in the trial.

Car rental, on the other hand, was the least used service, only by 5% of potential users, but one has to consider on the one hand that the service is still not very digitalised and therefore more difficult to integrate into a MaaS offer, and on the other hand that car sharing services currently present in the Turin area already offer daily rental to the user.

Finally, the taxi service was used extensively, often to the point of saturating the available credit in the chosen package, even for higher values. However, only 5% of users stated that they would use the service even if it was at their own expense.

Regarding the users' use of the different mobility services offered, local public transport was mainly used every day, while scooter sharing was mainly used 1-2 days a week. Users then chose the taxi, scooter sharing and car rental 2-3 times a month.

At the end of the questionnaire, users were asked to evaluate the MaaS app made available to them.

A first positive result was the interest of users in the MaaS app: 59% would be interested in using a MaaS app if it was always available.

The satisfaction with the experimental Mobility Vouchers app was also positive: the user rating was 3.8 out of 5 points.

A key service that users would always like to have in the future of the MaaS is local public transport (4.6 out of 5 points). In this respect too, LPT is confirmed as the backbone - a central element - of MaaS, confirming the results illustrated above regarding the use of this service by the experimenters.

Finally, the app Mobility Vouchers met with favour among users both because it presents many alternatives for mobility (3.7 out of 5 points) and because it allows users to choose the best means of transport according to the time of day, destination, and motivation for travel (3.6 out of 5 points).

The analyses conducted have made it possible to gather interesting elements and to develop a greater knowledge, on the part of the City of Turin and the investee company 5T, of the MaaS paradigm, which may certainly prove useful in accompanying a transformation of the local territory's mobility towards greater accessibility, inclusion, and sustainability.

MaaS and environmental sustainability: a hypothesis for calculating atmospheric emissions

At the end of the trial, 5T prepared a preliminary quantitative analysis, with the aim of understanding how much the use of MaaS services can actually contribute to the reduction of mobility-related atmospheric emissions, creating a benefit for citizens in terms of air quality. The latest Legambiente "Mal'Aria" Report 2023[5] ranked Turin first among provincial capitals for exceeding air pollution limits.

As described above, the test users stated that they travelled an average of approximately 13 km (round trip) per day. Therefore, starting from this figure, the analysis considered the daily kilometres travelled by the 152 users during an entire year (365 days).

In 2021, the circulating fleet in the city of Turin will consist of 498,550 cars, 53% of which will run on petrol, 28% on diesel, 12% on LPG, 2% on methane and 5% on hybrid and electric. In terms of environmental class, most cars are Euro 6 and Euro 4.

Starting from this data and the EEA emission inventory[6], the analysis worked out the total in kg (/ton for CO_2) of pollutant emitted into the atmosphere for both petrol- and diesel-powered cars by averaging the pollutant values made available by the EEA for "small – medium – large/suv/executive car".

Air pollutants are the substances that alter the normal chemical composition of the air, with consequences for human health and the environment. For the analysis, the following were considered:

[5] Legambiente e CleanCities, *Mal'Aria di città. Cambio di passo cercasi*, 2023, https://www.legambiente.it/wp-content/uploads/2021/11/Rapporto_Malaria_2023.pdf
[6] European Environment Agency, https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view

- Nitrogen oxides: include nitrogen monoxide (NO) and nitrogen dioxide (NO_2). They are mainly formed in areas of high vehicular traffic with little air exchange – further sources of production are thermal power stations and domestic heating. The dangers of nitrogen oxides are linked both to their location in human respiratory areas, and to the role they play in the formation of photochemical smog, which is created on days characterised by stable weather conditions and strong sunshine, forming substances that are toxic to humans, animals and plants, as well as being capable of degrading various materials due to their strong oxidising power;
- Atmospheric Particulate Matter (PM): consists of a heterogeneous collection of particles, the origin of which may be primary (emitted as such) or secondary (derived from a series of physical and chemical reactions). Larger particles (diameter > 10 μm[7]) have an average lifetime in the atmosphere of a few minutes to a few hours and can be transported in the air for a maximum distance of 1-10 km. In contrast, smaller particles have an average lifetime of a few days to several weeks and can be transported in the air for up to hundreds of km. It is the most widespread pollutant, found at both traffic and background sites, especially during the winter period, as stagnant conditions for pollutants are more frequent. Anthropogenic sources of particulate matter are essentially the combustion of biomass for domestic heating, vehicular traffic and agricultural activities. The size of particulate matter determines the degree to which it penetrates the respiratory tract, creating minor or major health damage;
- Carbon dioxide (CO_2): is a gas formed in combustion processes from the union of carbon contained in fuels with 2 oxygen atoms in the air. Excess production causes environmental damage by endangering the existence of ozone, the gaseous layer in the atmosphere that protects the Earth from the harmful action of ultraviolet rays from the Sun. Another effect of the excess presence of carbon dioxide is global warming: during the day, the Earth's surface accumulates the heat radiated by the Sun, while at night the heat is dispersed. The excessive concentration of anhydride in the air, on the other hand, forms a sort of hood that prevents the expulsion of the heat absorbed by the earth during the daytime hours.

Returning to the analysis carried out, if we then consider 13km travelled on average per day, in one year the 152 experimenting users travelled a total of 721,240km. Therefore, by multiplying the total km travelled by the circulating fleet in Turin and the average EEA emission factors (small – medium – large/suv/executive car), it is possible to obtain quantitative estimates of the impact relative to the various pollutants, as shown in the following explanatory table:

[7] The micrometre is a unit of measurement derived from the International System. It corresponds to a millionth of a metre (i.e. a thousandth of a millimetre).

Car power category	Polluting agent	Quantity/year
Petrol car (small – medium – large/suv/executive)	$NO_{x,}$	158,8kg
	$PM_{2.5}$	5kg
	PM_{10}	8,9kg
	CO_2	84,3ton
Diesel car (small – medium – large/suv/executive)	NO_x	121,5kg
	$PM_{2.5}$	7,9kg
	PM_{10}	9,2kg
	CO_2	37ton

As can be seen from the estimated calculations, 152 people driving 13km per day (and 721,240km in total) with a petrol car would have produced **8.9kg of PM_{10} and 84ton of CO_2** in one year, while with a diesel car they would have produced **9.2kg of PM_{10}** and **37ton of CO_2**.

With a MaaS ecosystem, which could encourage greater use of public transport and other multimodal mobility services to the detriment of one's own car, an environmental sustainability objective would be pursued, with significant savings of pollutant emissions in cities for every user who chooses to move with MaaS services and multimodal solutions.

At the end of the trial, users answered a questionnaire, from which it emerged that for work/study trips they mainly used LPT and to a lesser extent the other available means of transport.

Starting from this data, 5T elaborated a further analysis in order to obtain a preliminary quantitative estimate of the potential benefits of MaaS in terms of CO_2 reduction for the entire local ecosystem.

Taking the UK Guidelines[8] as a reference this time, the value of CO_2 emitted on average by a bus is 101gr*km*ps, whereas if one considers a journey by car sharing or taxi the values are 110.6gr*km*ps and 66.4gr*km*ps [9]respectively. Therefore, considering only the CO_2 emissions emitted during the journey - and therefore not the so-called life cycle assessment[10] - only journeys made using local public transport, car sharing and taxis were considered for estimation. Evaluating the 13km travelled in one year by the users who responded to the questionnaire, and considering the percentage distribution for their trips by mode of transport, an estimate of the total CO2 emitted in one year by them is presented in the table below:

[8] UK Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, 2022, "Greenhouse gas reporting: conversion factors 2022, Greenhouse gas reporting: conversion factors 2021 - GOV.UK (www.gov.uk);

[9] Regarding car sharing and the taxi service, the calculation methodology used considers an occupancy rate of 1.5 and 2.5 passengers * journey, respectively. Therefore, the emission factor - grCo2 - of a medium-sized diesel car reported in the quoted UK Guidelines has been remodeled according to the respective occupancy rate.

[10] Life Cycle Assessment (LCA) is an analytical and systematic methodology that evaluates the environmental footprint of a product or service along its entire life cycle. In fact, the calculation ranges from the extraction phases of the raw materials that make up the product, to its production, distribution, use and final disposal, returning the environmental impact values associated with its life cycle.

COMMUTING TRAVELS (WORK/STUDY REASONS)			
Way of transportation	**Users**	**Travelled Km/year**	**CO_2/year**
LPT	68%	241.995	24,4ton
Car sharing	16%	56.940	6,7ton
Taxi	3%	9.490	0,6ton
Other (e-scooter, e-moped)	13%	47.450	0ton
Total		355.875	**31,4ton**

Therefore, by choosing multimodal solutions thanks to MaaS, users produced 31.4 tons of CO_2 in one year. By inverting the paradigm, it is interesting to note how the same users, using a private car, for the same km travelled in a year, would produce 50% more tons of CO_2. In fact, as shown in the table below, always referring to the UK Guidelines cited[11], the same users would produce 62ton of CO_2 with a petrol car and 59ton of CO_2 with a diesel car.

CAR TRAVELS			
Autovettura	**Users**	**Travelled Km/year**	**Ton CO2/year**
Benzina	100%	355.875	**62**
Diesel	100%	355.875	**59**

As the results show, during the Mobility Voucher trial, around 80 users travelling by collective and shared modes of transport produced a reduced CO_2 compared to what would have happened if they had each travelled by their own car.

In conclusion, comparing multimodal journeys - more sustainable - with individual journeys made exclusively by car, the former appears to be the best choice also in terms of CO_2 emissions into the atmosphere: **31.4ton CO_2** for all journeys per year vs. **62ton CO_2** for all journeys per year with a petrol car.

Having reached this point, what role can MaaS play in everyday life?

Having a mobility system that responds to our travel needs, which can be accessed via a simple and understandable app, as well as being able to benefit from different mobility options by choosing the most suitable route to reach the destination, will encourage citizens not to use their cars and to favour alternative and more sustainable means of transport. Furthermore, adding the possibility of having an "all-inclusive" subscription in the future, thanks to which one no longer has to worry about which means of mobility to choose/purchase for one's journey, will bring an additional benefit to the user experience.

MaaS will therefore be able to become a valid ally for designing the future of mobility together with users, public administrations and the market.

[11] UK Department for Energy Security, *cit.*. The UK Guidelines report 173grCo2*km*ps for an average size petrol car, and 166grCo2*km*ps for an average size diesel car.

Who is 5T

5T is a wholly publicly owned company that deals with smart mobility and operates in the interest of its shareholders: the City of Turin, the Piedmont Region and the Metropolitan City of Turin.

5T manages the Central Mobility and Infomobility Centre of the Municipality of Turin and the Metropolitan City of Turin, and the Central Mobility Centre of the Piedmont Region, ensuring its operability and continuity 365 days a year, providing tools, data and analyses to support the policies of the member bodies.

5T provides information to citizens and all those who move around Turin and Piedmont, with real-time infomobility services, increasingly digital and developed with the best open-source technologies, to meet their mobility needs.

5T designed the first regional ticketing system, which is managed by implementing new features to make local public transport services more accessible.

Finally, 5T is a leader in new mobility issues and coordinates strategic projects in the fields of Mobility as a Service (MaaS) and Smart Roads, actively participating in national and international networks to collaborate and share new ideas and new mobility models.