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The impacts of MaaS bundles over mobility habits and behavioral changes

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Abstract

MaaS addresses the challenge of reducing the gas emissions from the mobility sector to fight back the climate change by promoting mobility alternatives to private car use. MaaS applications propose to gather mobility modes across a region in a single app and to promote accurate and reliable mobility information.
Beyond this simplistic definition, MaaS concept aims to reshape the old-fashioned way to organize mobility where each mode is segmented and analyzed on its own side. It is a shift of paradigm from a vertical and fragmented vision to an interconnected and horizontal ecosystem. It represents an opportunity for public authorities to collect extensive sets of data coming from heterogeneous sources (mobility providers, end-users, infrastructures, etc.). The transversal vision offered by digital aims to streamline the understanding of use patterns, to cross-reference data, and to identify the improvement's opportunities.
The next step towards an integrated MaaS approach is to break down the vertical organization for payment and access. This abstract presents the experiment 'Mobility Vouchers', led by the City of Turin and in collaboration with 5T S.r.l., which aimed to test the most evolved version of the "Mobility as a Service" (MaaS) (4th level). The experiment was conducted at a local level in the urban area of Turin and with "real" users. The real innovation of this experiment lays in testing the app in real conditions for the first time in an Italian city. This paper seeks to challenge the prevailing assumption and to investigate whether facilitating the booking and payment of multiple modes through a fully integrated workflow, coupled with customized fare structures, could foster a greater inclination towards multimodal transportation among users.

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1. Introduction

1.1. Structure

The growing urban population suggests that by 2050, up to 70% of people may reside in cities. This gradual shift prompts questions about cities' capacity to accommodate such numbers and manage their transportation needs. Additionally, the introduction of new technologies and mobility providers during the past decade challenges existing infrastructures and governance structures within urban areas. The user experience has been revolutionized by various advancements, including the use of QR codes for unlocking free-floating vehicles, real-time GPS-based geolocation for private, shared, and public transportation modes (e.g., for private cars, for carsharing, or for public transport), and NFC technology for ticket payment (e.g., open payment).

These combined innovations may have led to the emergence of the Mobility as a Service (MaaS) concept, which integrates diverse mobility solutions from various providers into a single platform offering trip planning, booking, and payment functionalities (Kamargianni et al., 2016; Hensher et al., 2020).

1.2. Objectives

According to some topology, MaaS concept can be categorized in 5 levels (from 0 to 4) and the "Mobility Vouchers" project corresponds to the 4th level, the highest one, proposing a service offer subscription with predesigned packages (Sochor et al., 2018), which corresponds to the few applications in the world with a high level of integration (Macedo, 2021). The objective of this experiment was to test the 4th level of MaaS integration and services, as well as to identify the packages preferred by the users, assess how they use them, and also to get more insights about their mobility habits and the behavioural triggers to make them change.

This paper is structured as follows. The section 'State of art' provides a literature review of MaaS and the insights regarding attempts to find the best bundles. Then, the section '3. Turin's experiment about bundles' describes the results from different experiments in Turin. In the end, the 'Conclusion' wraps-up the main results from the experiment.

2. State of art

One of the primary goals of Mobility as a Service (MaaS) is to promote, and even encouraging, multimodality (i.e., the use of several modes) in people's daily mobility patterns. While significant progress has been made in enhancing travel information dissemination and facilitating intermodal trip planning by integrating private, public, and shared modes, there remains considerable scope for improvement in payment systems and fare structures in one hand and in promoting new alternative modes in the other hand.

MaaS is an opportunity to 'repackage' less popular modes and to help users discover them through the subscription to bundles (Headicar, 2009). Mátyás and Kamargianni, (2019) demonstrates that even if respondents are not fond of shared mobility, they tend to subscribe to bundles with shared modes and over 60% of them would try new modes of transportation included in their mobility package. Bundles can be an opportunity to encourage people to try new modes. The trial made by Ubigo in Goethenburg, Sweden, monitors the evolution of the use of micromobility and it demonstrates that bike and carsharing use increased while private vehicle use declined (Sochor et al. 2016).

The existing scientific literature has extensively explored the concept of offering bundles to users, operating under the assumption that a bundle incorporating various modes is more appealing than individual modes alone (Enoch et al., 2012). MaaS research is still bumping on the definition of the mobility packages. The first challenge is to define the type of fare over a period of time (e.g. monthly): fixed number of usage (e.g. n° trips of taxi), flexible travels and unlimited option (e.g. public transport monthly pass) (Esztegár-Kiss and Kerényi, 2020), pay per use or the two/three

part tariffs including a fix fee and a variable usage charge (e.g. kick-scooter, bike sharing) (Reck et al. 2020). The bundles about daily mobility differ from the full experience package for business or leisure travel (travel package made of flight, hotel, car rental, etc.) or from public transportation season tickets (e.g., bus) (Reck et al. 2020). As underlined by Ho et al. (2018), MaaS innovates by proposing multimodal bundles with a level of service and an amount of time to use the mode.

Caiati et al. (2020) studied the 'portfolio choice' approach (Wiley and Timmermans, 2009), i.e., the respondents could compose their own bundles, choosing among a set of transport modes, a geographical scope, and additional services. Mátyás and Kamargianni (2017) have run different experiments to challenge the decision base making process. One of them focuses on submitting four pre-designed packages to users while another experiment focuses on the promotion of shared modes within a bundle. The conclusion leads to the non-willingness of the users to select shared modes in their bundles, except if there is a strong added value. (Mátyás and Kamargianni, 2017).

Whim proposed by MaaS Global in Finland is one of the most advanced MaaS app in the world that has reached the level 4, proposing multimodal bundles with a score of 10/10 on mobility integration (Kamargianni et al., 2016). They have structured their packages based on socio-demographic groups (family, couple, etc.). During the phase 1 of the 'Mobility vouchers' experiment in Turin, a similar approach was followed (single, family, couple, etc.) (Hietenan, 2016). In the other hand, during the phases 2 and 3, bundles built around a major mode or to fit the season were proposed.

Nevertheless, the composition of the bundles creates a bias, it may impact the results about the use of modes and mislead the conclusion. Some papers have already addressed the difficulty to frame the packages and the users' expectations (Reck et al. 2020). Different experiments run in different ways led to opposite conclusions: to have carsharing within a bundle may be expected by respondents (Guidon et al. 2020; Ho et al., 2018) while other studies demonstrate the contrary (Mátyás and Kamargianni, 2019).

The city of Turin has already been part of studies about MaaS. In one of their paper, Mátyás and Kamargianni wanted to create tailored mobility packages based on a set of criteria combining environmental, modal split, city structure and financial aspects. Among the 15 European cities studied, Turin was part of them. The monthly tailored bundle for Turin, based on their methodology, should contain 10 days of unlimited public transport, bike-sharing in pay-as-you-go, unlimited car-sharing and 50km of taxi for free (Mátyás and Kamargianni, 2020).

This paper seeks to challenge the prevailing assumption and investigate whether facilitating the booking and payment of multiple modes through a fully integrated workflow, coupled with customized fare structures, could foster a greater inclination towards multimodal transportation among users.

3. Turin's experiment about bundles

3.1. Methodology

This one-year long trial called 'Mobility Vouchers' was run in Turin by the City of Turin and 5T S.r.l. has recruited 100 participants to use a MaaS application integrating several mobility modes. The services were organized by packages and the users got a monthly amount of 150€ to spend in-app. Among the prerequisites to be selected, the participants needed to have an electronic/digital payment method, a recent smartphone, not to own a private car and to have an ISEE under 50,000€. The non-possession of car was a choice of the City of Turin to focus on people that are already convinced adopters of public, shared and carbon-free mobility.

3.2. The modes & the mobility bundles

Most of all the mobility services available over the Turin's city were integrated (fully or lightly) in the app: e-scooter sharing, taxis, Local Public Transport (LPT), e-moped sharing, carsharing, and car rental.

The e-scooter sharing and taxi services 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), e-moped sharing, car sharing and car rental services, on the other hand, integrated in "light" mode, were accessible via the BIP (Biglietto Integrato Piemonte - 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) card and/or vouchers with a code to be entered on the transport operators' apps.

During the experiment, the data of use were collected by the Mobility Service Providers through the app and several surveys were made during the trial to collect feedbacks from users. Based on the comments, the packages were adjusted to fit their needs.

PHASE 1		
Bundles	**Included mobility services**	**Value/month**
SINGLE	LPT subscription + Sharing e-scooter 100 min + Sharing e-moped 120 min + Carsharing voucher 25€ + Car rental voucher 25€	149€
COUPLE	LPT subscription + Sharing e-scooter 100 min + Sharing e-moped 120 min + Carsharing voucher 25€ + Car rental voucher 25€	148€
FAMILY	LPT subscription + Sharing e-scooter 100 min + Carsharing voucher 2x25€ (tot. 50€) + Car rental voucher 30€	148€
EXCLUSIVE	Taxi wallet 50€ +Carsharing voucher 2x25€ (tot. 50€) +Car rental voucher 2x25€ (tot. 50€)	150€
PHASE 2		
Bundles	**Included mobility services**	**Value/month**
COUPLE	LPT subscription + Carsharing voucher 25€ +Car rental voucher 25€ + Sharing e-moped 120 min + Sharing e-scooter 100 min	152€
METRO-SMART	LPT subscription + Sharing e-moped 180 min + Carsharing voucher 2x30€ (tot. 60€)	148€
NO LPT	Sharing e-scooter 100 min + Taxi wallet 40€ Sharing e-moped 120 min + Carsharing voucher 2x25€ (tot. 50€)	151€
PICKED UP	LPT subscription + Taxi wallet 110€	148€
FAMILY 2.0	LPT subscription + Sharing e-scooter 100 min Carsharing voucher 30€ + 25€ (tot. 55€) + Car rental voucher 25€	148€
WINTER	LPT subscription + Taxi wallet 30€ + Carsharing voucher 30€ + 2x25€ (tot. 80€)	148€
PHASE 3		
Bundles	**Included mobility services**	**Value/month**
COUPLE	LPT subscription + Sharing e-scooter 100 min Sharing e-moped 120 min + Carsharing voucher 25€ + Car rental voucher 25€	152€
METRO-SMART	LPT subscription + Sharing e-moped 180 min + Carsharing voucher 2x30€ (tot. 60€)	148€
PICKED UP	LPT subscription + Taxi wallet 110€	152€
FAMILY 2.0	LPT subscription + Sharing e-scooter 100 min Carsharing voucher 30€ + 25€ (tot. 55€) + Car rental voucher 25€	152€
WINTER	LPT subscription + Taxi wallet 30€ + Carsharing voucher 30€ + 2x25€ (tot. 80€)	152€
SUMMER NIGHT	Sharing e-scooter 300 min + Carsharing voucher 2x30€ (tot. 60€)	150€

Table 1. Detail of the mobility packages during the one-year trial (source: 5T & City of Turin, 'Mobility Vouchers Project – final report' (2023))

3.3. The results of Mobility Vouchers project

The panel had an equal number of men and women, with an average user age of 39.5 years.

At the beginning of the trial, the users have spontaneously chosen mobility packages with diversified modes. But, when bundles were reshaped based on users' feedbacks and new ones focusing on less modes were introduced during the two other phases (March-May 2022, June-September 2022), a major part of the participants shifted towards 'WINTER' and 'PICKED UP' offers (cf. Table 1). Only the packages 'COUPLE' kept a constant number of users. Once the discovery phase was over, a consequent part of users selected packages focused on two/three transport modes among which LPT. The complementary modes are taxis and carsharing, traducing a certain need for flexibility given by the car. This conclusion may be shaded by the fact that users received a coupon of 150€ to be spent each month that may have provoked opportunist attitudes.

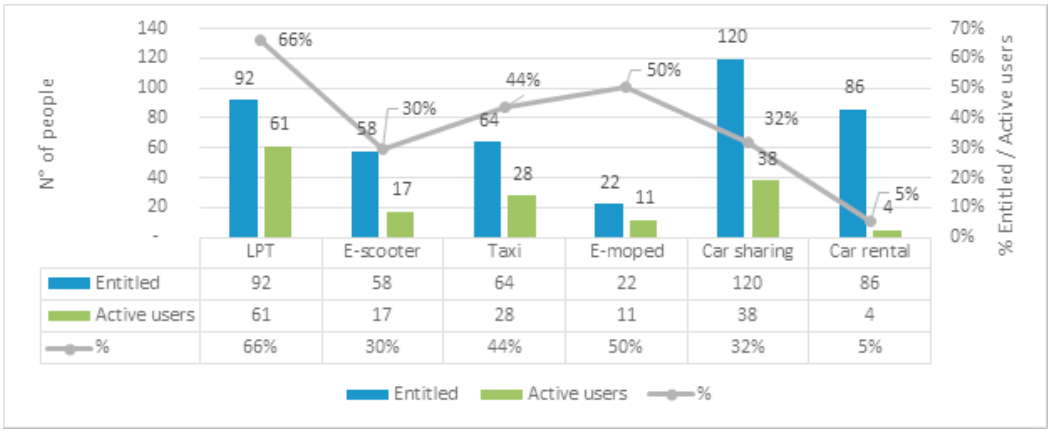

Figure 1. Usage of mobility services (source: 5T & City of Turin, 'Mobility Vouchers Project – final report' (2023))

The highest rate of entitled users/active users is registered by TPL (66%), confirming the main interest for TPL, followed by e-moped (50%), attracting a small but regular group of supporters throughout the project. This figure confirms that MaaS showcases diversity and may boost these underused modes (Mátyás and Kamargianni, 2019).

Aside from the consumption data, three surveys were distributed to collect feedback from users' experiences and highlight the flaws and advantages of the MaaS concept in a city like Turin. Users reported a reduction in travel time for their daily trips (74%), with half of the participants (49%) noting a reduction of 5 to 15 minutes for an average of 13 km/day and 2.5 round trips/day. Half of the trips lasted between 15-30 minutes.

This experiment confirms the eagerness of users to have tools like a MaaS application to assist them during their trips. The satisfaction rate is 4.4 out of 5, and the improved quality of the journeys was also appreciated (safety received 3.4/5 points and sustainability 4/5). The mobility bundles received positive feedback from users (3.8/5), a score higher than the 43% of positive opinion recorded in a previous study (Liljamo, 2020).

LPT appears to be the most required mode because it was always included in the selected packages, while very few participants selected the 'NO LPT' package. Through the surveys, participants almost unanimously declared a desire for LPT in the MaaS application (4.6/5). LPT was used almost daily by the participants, highlighting the adoption of this service. The interesting conclusion concerns the modes selected in addition to LPT: 18% selected carsharing, 15% taxis, and 7% carsharing and scooter sharing.

The mode that benefits the most from the new packaging is carsharing: the number of users jumps from 20% up to 40%. This increase may have been a consequence of the introduction of a new carsharing provider. The taxi service was the most used: many participants used their entire taxi credit and even paid for more. For the record, each participant received a 150€ coupon per month to spend on mobility, which influenced the consumption behavior of the majority of participants regarding the taxi service. Very few users would have paid out of pocket (5%). This

represents an average of 2/3 rides per month. The level of integration may have penalized car rental, which was used by only a few participants. Current users of this service may be accustomed to the daily offer and did not see the need to use it through the application.

Micromobility (Montes, 2023) benefits from increased visibility and initially attracts a bunch of new users. Transactions for e-moped and e-scooter sharing show a loss of users after this discovery phase, followed by a stable group of supporters of the service who always choose packages containing this mode. Its use increases especially when the LPT is not operating, for instance, at night. This confirms that micromobility is complementary to LPT, particularly for the first/last mile (Böcker et al., 2020; Torabi et al., 2022).

Another level 4 MaaS experimentation was conducted in Turin in 2022: it's the BIPforMaaS trial by Piedmont Region, coordinated by 5T as well. From June up to September 2022, 250 users tested a single MaaS application, with the possibility of also enjoying a monthly cashback of 50% in the digital wallet of the BIPforMaaS application, up to 15€ per month. Compared to Mobility Vouchers, some conditions were different and are exposed in Table 2). As we ca see in Figure 2, the most purchased service was train ticket, followed by e-scooter ride and parking toll, confirming the central role played by public transport.

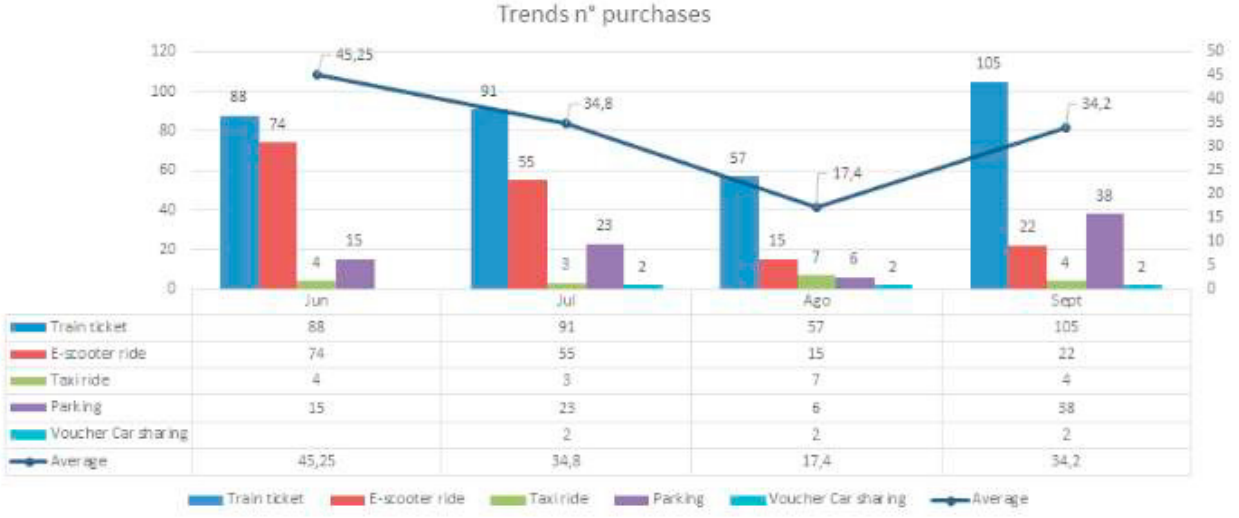

Figure 2. Trends of number of transactions (source: 5T (2023))

Both the Mobility Voucher project and the BIPforMaaS trial were level 4 MaaS project: integration of societal goals, through incentives by the public administration. In the following table, we can see and notice the small differences between the two projects.

	Mobiliy Voucher	**BIPforMaaS trial**	**Notes**
Dedicated MaaS Application	✓	✓	White label in both projects
Public Administration (PA)	City of Turin	Piedmont Region	
Duration	12 months	4 months	
Type of incentive provided by the PA	Monthly mobility bundle	50% monthly cashback (up to 15€)	
Costs for the users	Only if the availability of the month was exceeded	The purchase of tickets, rides and vouchers. Every purchase was eligible for increasing the cashback.	

Full integrated services	E-scooter sharing, Taxi	E-scooter sharing, Taxi, Parking toll, Train tickets	Book, buy, pay within MaaS app
Light integrated services	E-moped sharing Car sharing Car rental	Car sharing	Voucher purchasable from the MaaS app, but usable on the MSP's app
Public transportation	Dedicated BIP Card	Only infomobility (no purchase)	
Most used services	Public transportation	Train ticket	
Eligibility for joining the project as user	Not owning a car Low income level	Smartphone Card for digital payments	
Key findings	LPT was the most used service: backbone of MaaS Higher customization led to higher usage	Train ticket most used service Users exceeded the minimum threshold necessary to obtain the cashback	Users tried new modes of transportation because it was user friendly
The incentive helped the habits and behavioural change?	Yes: mobility needs were filled so users didn't have to buy a car	Yes: users kept using the app even after reaching the maximum for the cashback	

Table 2. Comparison between "Mobiliy Vouchers" and "BIPforMaaS trial"

4. Conclusion

One aspect of the MaaS definition that everybody agrees on is that MaaS should improve the user experience, optimize the use of the transport infrastructure (Veerapanane et al., 2018) and serve as an attractive alternative to car ownership (Mulley, 2017; OECD and ITF, 2021). This paper contributes to feed data and insights about how bundles may influence mobility and behavioral habits and how MaaS can promote underutilized modes at a local level. 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. The findings reveal that users often opt for packages aligning with their existing habits, even if they were initially open to try new modes. Moreover, the effectiveness of vouchers as incentives highlights that users tend to utilize certain modes more frequently when the cost is covered externally. Taxis for instance could appear less essential in normal conditions of use as already demonstrated by other studies' conclusions (Hensher et al., 2020; Strömberg et al., 2018). However, the lack of technical integration and digitalization fails to streamline the user experience and may disadvantage certain modes, resulting in their exclusion and exacerbating competition with more digitized alternatives. In the Turin experiment, public transportation emerges as the cornerstone of daily mobility in the city, as evidenced by Mátyás and Kamargianni (2017), as mentioned earlier in the paper. Throughout the year-long trial, entrenched habits may persist, leading users to predominantly rely on one or two modes for their daily travels.

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