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(Article begins on next page)

12 June 2023

AIIT 3rd International Conference on Transport Infrastructure and Systems (TIS ROMA 2022), 15th-16th September 2022, Rome, Italy

Turin, Rome and Genoa: comparison of the level of maturity of three large Italian cities towards Mobility as a Service

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Abstract

Mobility as a Service (MaaS) is the new urban mobility paradigm which, through a digital platform, makes all types of public and private transport services available to users. This contributes to increasing sustainability in cities and the quality of citizens' mobility. However, several factors influence the success of MaaS implementation: openness and data sharing of transport operators; citizens' familiarity and willingness to pay; policy, regulation and legislation; transport services, and infrastructures. Many of these factors are strictly related to the features of the city where MaaS has to operate, and more specifically to its maturity (including multimodality, integration, flexibility, and user-oriented approach). To this end, target users and their willingness to pay for MaaS operations require a specific assessment. This paper compares three large Italian cities - Turin, Rome and Genoa, very different in terms of size, complexity, local transport policies and potential for MaaS application-, with the final goal of outlining common and specific drivers, barriers and requirements for the successful adoption of MaaS. The research findings can provide useful insights to urban mobility decision-makers to avoid the unsuccessful implementation of MaaS, especially when dealing with cities with conservative mobility policies, such as Rome, or where MaaS is a novelty.

Keywords: urban mobility, Maas mobility as a service, Italian metropolitan areas, willingness to pay

1. Introduction

Urban mobility has been facing various challenges in recent years: increasing traffic, reduction of green spaces and massive use of private vehicles. This happens because many European cities were conceived at the beginning of the twentieth century in a self-centred way, where the liveable space for the citizen is reduced to a minimum and the roads are often congested. It is in this historical context, in which a radical change in mobility becomes increasingly urgent, that a series of new paradigms such as Mobility as a Service (MaaS) evolves.

Mobility as a Service refers to a new business model for the provision of transport services to users that are truly alternatives to the use of the car. The term MaaS was first introduced in 2014 during the 10th European Congress on Intelligent Transport, it was defined as: "a system in which a complete range of mobility services is provided to customers by transport operators".

Thanks to a MaaS system, through the use of a single application on his smartphone, users have a service available that allows them to plan their trip and choose the most suitable means of transport for each trip to be made, paying for a single trip (*pay-per-ride*) or by taking advantage of monthly subscription or unified rates for several different means of transport. In order for MaaS to fully express its potential, it is essential that public transport service providers (such as buses, trams and trains) collaborate and join with private individual services (car sharing, bike sharing, NCC, etc.), in order to offer users tailor-made solutions based on users' real travel needs. With all mobility public and private providers on a single platform, travellers can plan their trip and pay using a single account. Very recently, several scholars have written about MaaS trying to assess its impact on the mobility habits of users and its governance and organizational aspects (Arias-Molinares and Palomares, 2020), also providing first dataset about early-stage initiatives (Esztergár-Kiss et al., 2020). Becker et al. (2020), reflecting on Zurich, showed how transportation efficiency may be higher if shared modes were used as a substitute for public transport in lower-density areas and is up to 7%, whereas the impact of ride-hailing appears less positive. In synthesis, authors sustained, thanks to a microsimulation with all modal choices, that a MaaS scheme with the coordinated proposal of shared mobility may allow to slightly increase system efficiency, substantially reducing energy consumption. Among the range of very positive reactions related to the phenomenon, there are also some studies which tried to deepen specific topics and raise a wider debate. Shikofsky et al. (2020) investigated the motivation behind travellers' adoption of Maas: through qualitative interviews, psychological issues and behavioural intentions like autonomy and being related to peer groups arise. Their conclusions are similar to those of Tomaino et al. (2020) about the importance of psychology in transportation. In this regard, Esztergár-Kiss and Kerényi (2020) argue that the proactive involvement of cities in the process needs to be tailored starting from the different characteristics of cities in terms of modal split, facilities, environmental mindset, and so on. About the future implementation of Maas and consequent barriers and reactions, more relevant are also the recent study of Hensher et al. (2021a), Jittrapirom et al. (2020), Cottrill (2020) and Alonso-Gonzales et al. (2020). Nevertheless, Ho et al. (2018) and Li and Voege (2017) started a few years ago to identify the willingness-to-pay related to Maas and the level of preparedness of potential developers of the system, in order to reach a commercially viable uptake level. Following this logic, the present paper is focused on three large cities in Italy (Turin, Rome and Genoa) which are going to implement their Maas system. In particular, authors want to show the different level of awareness in users, describing the results of a social media survey. The article, after the introduction is structured into 3 sections: the second is devoted to the cases, then the third to method and results and the fourth to the final remarks and future perspectives of the research. The paper is specifically designed to help fill the research gap regarding the maturity level of MaaS systems in cities. Given the relative newness of MaaS system, this aspect has not yet been sufficiently explored.

2. The methodology

Given the novelty of MaaS in the three cities, the methodology originally applied for the case of Rome (Corazza and Carassiti 2021) was adopted to the cities of Genoa and Turin, starting from preliminary desk analysis to highlight experiences, barriers and drivers to launch the MaaS experience in Europe. This was the basis to launch a survey to profile potential customers and identify users' behaviors, requirements and willingness to pay. The questionnaire was designed according to past similar successful experiences in European Commission-funded projects (Bousse et al. 2018), which helped to create a user-friendly and easy-to-fill-in online tool, further detailed. Due to its conservative transport policy (i.e., more oriented to public transport such as buses and metros, and less not to innovative mobility services), Rome was the natural pilot case to test the questionnaire which was, then, submitted first in this city in the last quarter of 2020 and closed at the beginning of 2021, with a number of respondents beyond expectations. City-specific results have been already discussed elsewhere (Corazza and Carassiti 2021), and led to replicate the survey in Turin and Genoa. Eventually data from the three cases were benchmarked and results presented in the next section.

The 40-question survey was divided into two parts: the first aimed at investigating the travel habits of the respondents, while the second part aimed at evaluating their interest in mobility bundles and understanding their

preferences towards them. In this last section, respondents were also given the opportunity to "create" their own personal bundle (the "ideal MaaS bundle"), indicating the services to be included to meet their needs and proposing a price for this, from a range of multiple options proposed in the questionnaire. More specifically, the questions in the first part were designed to highlight respondents' car ownership and typical modal share patterns, travel frequency, purpose and duration, multimodal options, average expenditures for transit. In the second part, the "ideal MaaS bundle" was to be created from the following options: bus, metro, rail, parking, car, bike or moped sharing, and ride-hailing. The related willingness to pay ranged from "less than 30 Euros" to "more than 50 Euros", also including the pay-as-you-go option. To make the bundle more attractive, respondents were also asked to state their interest in bonuses like cashback, free tickets to entertainment, free home deliveries, special discount for recharging electric vehicles.

The questionnaire was on-line, via social media, and designed to be filled in no more than 15 minutes. Data collection lasted until it was possible to reach an average of 150 full set of responses for each city, although the number of respondents was markedly different among the three cities.

3. The case studies

MaaS was initially conceived for urban areas (Heikkilä 2014), with further developments in less-densely and rural areas (Eckardt et al. 2018, Barreto et al 2018), thus the natural arena where to launch a study on the MaaS potential in Italy was a set of metropolitan areas (Turin, Rome and Genoa), different enough to run the whole gamut of mobility options and behaviours typical at national level. The three cities have a similar demographic structure (Figure 1), and a GDP trend classified as "low" for the 2000-2018 period by OECD (2020), although they can be considered wealthy areas if compared to other Italian cities.

Rome, Turin and Genoa have different mobility patterns and transit supply, as described in the next subsections, but they have become central when they were recently ranked third, fourth and eight in the national Recovery Plan funding program to launch MaaS in Italy. Rome will become a leading city in the national test lab for MaaS (which includes the development of a specific digital platform) and Turin and Genoa will be followers.

3.1 The city of Turin

Turin is an Italian town of about 850,053 inhabitants, the fourth largest Italian town by population and heart of a metropolitan area of 2.238.663 inhabitants, 68.34% of which is over 35 years of age (ISTAT, 2011). According to data referred to 2019, Turin is the Italian city with the highest number of cars in relation to its population. From 2010 to 2019, the city counted a growth in registered cars from 544 to 554 thousand (ANFIA, 2020); in the same period of time, the population fell from 907 thousand to 870 thousand, and the ratio therefore rose from 60% to 63.7%.
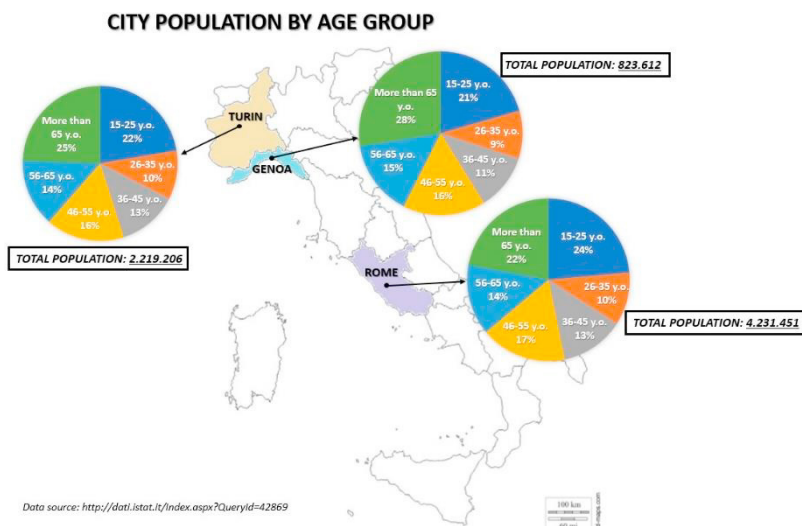

Fig. 1. Turin, Rome and Genoa populations by age group

The public transport network of Turin is managed by GTT (Gruppo Torinese Trasporti). The subway and urban railway mobility system is developed for a total of 29 km, divided into 8 lines served by 28 stations. As regards public transport, in 2006 the first section of Line 1 of the first automatic metro in Italy is inaugurated in Turin and a month later 20, 1 million passengers were transported.

In addition to public transport, many mobility services are to be found in the metropolitan area of Turin: bike-sharing, car-sharing, scooter-sharing motorcycle sharing and ride-hailing. In 2019, free-floating carsharing rentals were around 12 million, concentrated in just 5 major cities and Turin was one of them (ISFORT, 2020). Thanks to a predominantly flat territory, the city promotes the use of environmentally sustainable means such as bicycles. As a result, the city benefits of gain of 207 km of cycle paths and cycle-pedestrian paths and several bike sharing services and rental points. Turin is a pioneer in Mobility as a Service. 5T s.r.l., a local government-owned company, has been working on the BIPforMaaS project for some years developing the first regional MaaS project in Italy with public governance which is considered essential to implement an effective MaaS service.

3.2 The city of Rome

Rome is a metropolitan area including more municipalities with a total population of 4.2 million inhabitants, with just less than 3,000,000 living solely in the Rome urban area. The city has a hilly topography and its location and form laid out more than 2700 years ago still affect local mobility patterns. Coherently with its status of capital city, Rome presents a very mixed land use to accommodate the different administrative, commercial and tourist activities, the latter mostly located in the city center (a district of around 100,000 inhabitants), with few pure residential areas. This corresponds to a vibrant city life, but also to congestion phenomena across the whole urban area, due to commuting and non-systematic trips occurring not only from/to the city center, but also inter-districts, as evidenced by the modal split, where cars have the lion's share (50% in peak time, according to Rome Municipality, 2020; or 60% private cars, 20% transit, 18% walking, and 2% bike, according to TEMS 2015). This is not surprising given the high local motorization rate: the 2019 motorization index was 0.91 (number of vehicles/number of inhabitants, excluding infant and senior populations, including Powered Two-Wheelers -PTWs), which becomes 0.63 if the total population and only passenger cars are computed (Rome Municipality, 2020). One more contributing factor to such massive motorization is the transit supply status: the local public transport company manages both the 2286-km bus network (with a coverage index of 1.78 km/km^2) and the 60-km underground metro one (18 km out of which driverless-operated) resulting in a more modest production than that forecasted (161.1 × 10^6 veh*km vs. a planned one of 185 × 10^6 vehkm in 2019, according to Rome Municipality, 2020). Transit management problems and poor customers' satisfaction (with a positive assessment of just around 40% for the 2017–2019 period, as from ATAC 2020) are long lamented problems for the city and probably the result of reiterated conservative local transport policies. Paratransit and micromobility can be considered additional options to mitigate the use of passenger cars, but in Rome among the different experimental services launched at the beginning of the 2000s, only car-sharing, survived until nowadays. However, also boosted by the recent pandemic, other sharing and micromobility services like bikes, PTWs and electric kick-scooters were recently launched too, although not without problems: too many operators, space management, road safety (as extensively described in Corazza and Musso 2021, Corazza et al. 2021). This increased supply of shared modes might support the introduction of MaaS in Rome, along with two more conditions: first, MaaS is part of the local Sustainable Urban Mobility Plan vision, which enforces the implementation of a web platform, managed by the Municipality, specifically designed to integrate operations (Rome Municipality 2018), anticipating thus the national Recovery Plan measure previously mentioned. Secondly, the local availability of apps and web platforms meets the requirements of the lower levels of integration, i.e., those concerning planning/service and ticketing/payment, typical of MaaS ecosystems (Sochor et al. 2018).

3.3 The city of Genoa

Genoa is a densely populated area but only 30% anthropized: the rest of the municipal area is not accessible and is covered by uncultivated vegetation and is characterized by steep slopes. The complexity is increased by the fact that the roads climb towards the hills and the lack of space does not allow ample room for maneuver. These factors significantly affect the way people move around the city. In fact, the data reported on the Municipality of Genoa show how the rate of use of LPT by residents is 32%, a rather high percentage for the Italian scenario and also the share of non-motorized internal movements, i.e., on foot or by bike, is 22%, an extremely high score for a city that is not

exactly flat, third only after Turin (32%) and Bologna (28.2%) in which the contribution is made by bicycles, not by pedestrians. However, an emblematic data for Genoa is the density of cars (car fleet per 1,000 inhabitants) of 492.94, very low compared to other metropolitan cities. Speaking in terms of absolute value, Genoa's car fleet is rather small; lower values are present in Cagliari, Messina and Reggio Calabria (ISPRA, 2017). The Genoese reality is unique also in relation to its demographic structure and dynamics of transformation. The resident population is aging and contracting significantly. The old-age index, i.e., the ratio between the population aged over 64 and those under 15, is higher (2.4) than the weighted average of the 14 Italian Metropolitan Cities (equal to 1.5) (SISTAN, 2019).

4. Results and discussion

The responses reveal some relevant features in terms of travel patterns and behaviors, often in common for Turin and Genoa, and partly shared by Rome, but all very useful to assess the feasibility of local MaaS ecosystems.

4.1 Profiling the potential MaaS customers

In the three cities, the majority of respondents owns a vehicle older than two years or more and conventional (i.e. no hybrid or fully electric). However, only in Turin and Genoa (almost 83% and 75%, respectively), a clear reluctance in giving up the owned vehicles is stated, whereas in Rome the percentage is lower. Along the respondents, those who do not own a car, do that for very different reasons, and among these due to its limited use (52.2% in Genoa and 48.7% in Turin), which suggests a good level of attractiveness of the local transit supplies or walking and/or bike-riding to cover large legs of the trips); on the contrary in Rome the percentage is extremely lower. However, when asked about the purchase a new car, in general, in the near future, the majority of those who do not plan to do that can be found in Genoa, only (52%).

Since MaaS is often associated with environmental-consciousness and sustainability, due to an expected consequence in the change of travel behaviors in favor of MaaS-managed shared or collective modes (Hensher et al. 2021b, Chang et al 2019), the respondents' environmental awareness was also analyzed. The environmental concern is clear in all the cities (55.4% Genoa, 52.2 % Rome, and 43.1% Turin) and this is evidenced by the willingness to buy an electric or hybrid vehicle, if need be (69,5% in Genoa and 76.9% in Turin). On the contrary in Rome, this question did not provide certain directions, inconsistently with the statement that 43 % has already used an electric vehicle, which leads to an educated guess that this was either a micromobility or a paratransit vehicle, rather than the owned car. Likewise, it was important to assess the respondents' familiarity with sharing options, which highlighted three different situations: in Turin, where the sharing option is available since few years, 58,5% of the respondents stated to have already exploited sharing mobility services, whereas in Genoa 73% of the respondents never used a sharing service (a sign that, in this city, this type of service is neither very present nor used). In Rome, where car sharing is in place since the first decade of the 2000s and bike and PTWs services followed in the years after, percentage of sharing service customization or familiarity was expected to be high; on the contrary, 49.7 of the respondents stated to have already used sharing options vs 50.3 who did not, which evidences how this type of service is still perceived as a niche option.

Eventually, the 2020 pandemic effects on the everyday mobility were impossible to ignore. To this end it was asked whether this event changed the personal travel behaviors; responses were clear: in Turin and Genoa, Covid-19 does not appear to have changed the travel habits of the majority of respondents, whereas in Rome only 41.4% stated the same.

The resulting snapshot, according to the respondents, is clear: private cars are still central in everyday mobility patterns and considered an asset hard to divest, although the environmental concern is genuine and the appreciation towards non-conventional propulsion systems (either electric of hybrid) sufficiently good. At the same time, sharing - a pillar of the MaaS ecosystem - seems to be the weak link.

4.2 The "ideal" MaaS bundle

The second part of the questionnaire was targeted to have respondents creating their own "ideal" bundle of MaaS services. In general, most respondents would be interested in a multi-modal bundle (for example, 65.5% in Genoa and 61.5% in Turin). First results from Rome are interesting as they show the quality of such bundles. In Rome, preferences were consistent with the expected effect of the local conservative approach in place for many years: respondents would create bundles with what they already have since long time, i.e., public transit (both rail and rubber-tired, surface and underground), parking and car sharing, whereas more recent micromobility and ride-hailing appear to be less required. Likewise, Genoa respondents, regardless of the age group or income considered, stated recurring preferences for subscription package including public transport (bus, metro, urban and regional railway), with ride-hailing (including taxi and services with drivers, also known by the acronym of "NCC" in Italy) again less requested, probably because in Italy it is considered a very expensive service, especially among the youngsters: only 10.34% of respondents under 35 would include NCC in their subscription package. In line with this, the analysis of preferences per age group (more than 35 years old, and between 15 and 35 years old) shows a kind of "age divide" for some modal options (Figure 2).
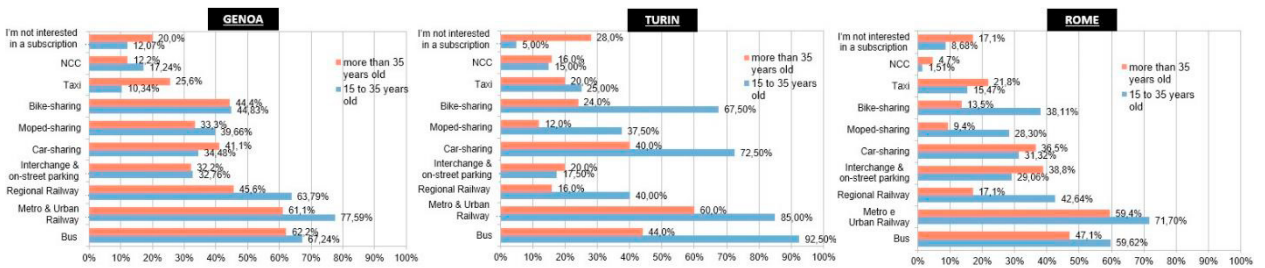

Fig. 2. Turin, Rome and Genoa stated preferences by age group

Certainly, the general, major favor towards public transit among the youngster can be associated with reasons like affordability, lack of driving license for the teenagers, and good physical status for biking. But this assessment is challenged by the observation of the Genoa case, where bike sharing is equally favored by the two age groups, thus debunking the myth that riders must be necessarily young. Moreover, Genoa seems to be the case where options are more evenly distributed among the two age groups. In Turin, in addition to bus, metro and railway, the 15-35 age group largely favor car-sharing (72.5%) and bike-sharing (67.5%) as most popular services for potential MaaS bundles. Also, in this case Taxi, NCC and interchange/on street parking are of little interest to the respondents, even when considering higher income groups. However, income in general, does seem to steer the bundle creations mostly in Turin, whereas Genoa and Rome seem rather less affected (Figure 3). For the case of Rome, this can be explained with the very low costs of transit fees.
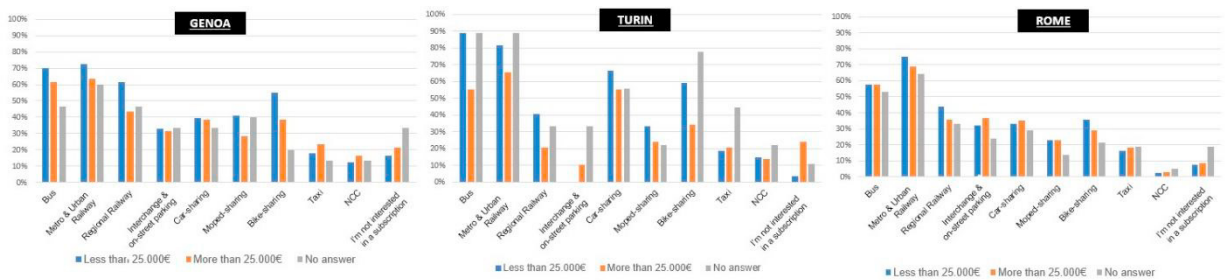

Fig. 3. Turin, Rome and Genoa stated preferences by income group

In terms of willingness to pay, the majority of respondents considered reasonable, for the ideal MaaS bundle, a cost "between 31-50 Euros", and "less than 30 Euros" as second option. The result does not change substantially if the preferences are analyzed by the two age groups (Figure 4).
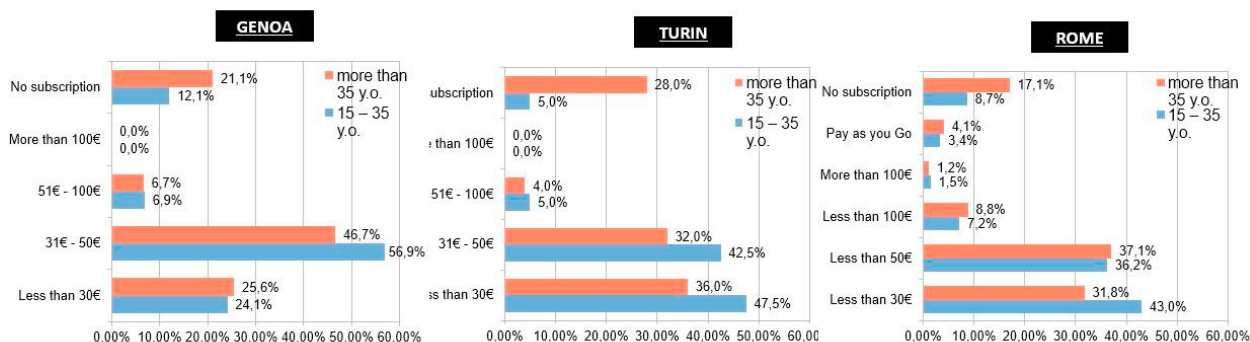
Fig. 4. Willingness to pay by age group

If the same data are considered by income groups ((Figure 5), still in Genoa and Turin a good portion of respondents consider the 31-50 Euros price range appropriate for the proposed bundles. However, the majority consider a price range below 30 Euros to be more appropriate. Unexpectedly, those with incomes over 25000 Euros also consider the lower price range to be more appropriate. At the same time, it to observe how neither Genoa nor Turin are willing to pay more than 100 Euro (a reference value for many MaaS case study already in place in Europe), whereas this is deemed as appropriate for a small number of respondents in Rome.
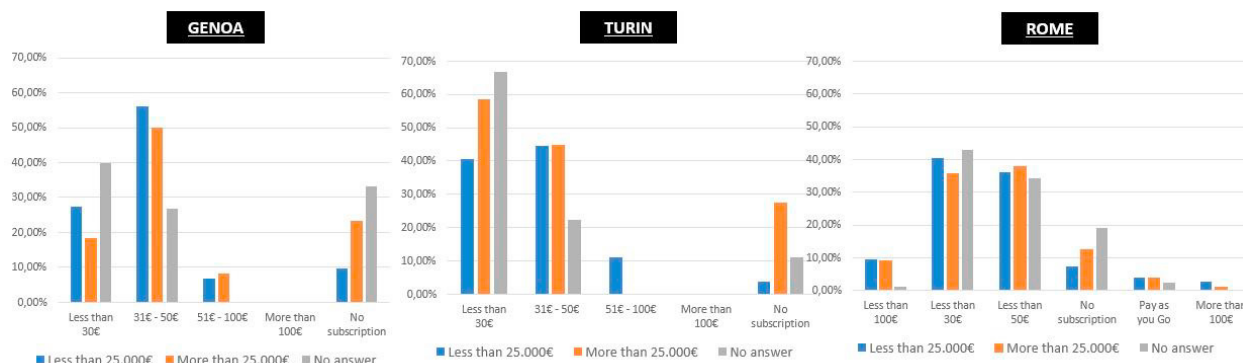

Fig. 5. Willingness to pay by income group

Last to consider is also the lack of interest for MaaS ("no subscription") expressed by some respondents, mostly due to the supposed little convenience of the service and the uncertainty of being able to take advantage of it.

5. Conclusions

Maas is a system that is considered by many to be promising and all the regulations and intentions of worldwide policies are directed towards its progressive implementation

Nevertheless, as Jittrapirom et al. (2020) have already noticed, in evaluating the acceptance of the service, uncertainty dominates, in particular, in the unclear perception of the advantages and in the insecurity. Uncertainty is related to an exclusive use of private car as a status symbol, but not only. Basically, the percentage resulting from interviews showed perplex responses referred to a general moment of transition, in terms of vehicles' fuels, awareness of travel expenses, information about new technologies.

The results obtained here for the cities of Turin, Genoa and Rome are fairly representative of the Italian situation. Generally speaking, old ways of scheduling daily habits is considered more efficient and affordable, because consolidated and tested by personnel experience. But, evidently, there is a lack of experimentations of novel uses (sharing, hybrid vehicles) by interviewed, which influenced the propensity to change. However, a positive factor highlighted by the survey is the openness of young people to the MaaS system.

The survey found that willingness to pay is a sensitive issue, and the modest rates are justified by the novelty of MaaS and respondents' poor recognition of its potential, although the rate in Turin and Genoa is commensurate with that in other European cities. To overcome such initial barrier, information and awareness campaigns could be the

drivers. This would also contribute to raise the level of maturity of Maas, which seems currently affected by the poor propensity to change travel behaviors.

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