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Preface

Following a history of more than 20 years, the 13th International Conference on Innovation in Urban and Regional Planning (INPUT 2025), entitled “Methods, models and technologies for future cities and regions,” focused on the advances in knowledge and on the technical perspectives that the evolution of planning systems might offer to scholars, professional planners, and practitioners.

The Conference was hosted by the Urban Project Laboratory (UPLab) at the University of Pavia, Department of Civil Engineering and Architecture (DICAr).

The INPUT legacy has grown over the years, and nowadays it is clearly recognizable, at the national and international scale, as an active group (with very promising young researchers) that is open-minded to technological revolutions and their effects on the analysis and management of cities, regions, and territories.

The tradition of INPUT was highlighted during the final ceremony with a round table in which some of the founders of the Conference, Prof. Dino Borri, Prof. Giuseppe Las Casas, Prof. Arnaldo Cecchini, discussed about the evolution of the ideas that carried to the creation of INPUT and about the realization (or failure) of forecasts made in the past basing on the trust in technological development possibilities.

INPUT 2025 was held from the 8th to the 10th of September, with an opening ceremony featuring distinguished hosts. The Conference was patronized by the Italian Society of Urbanists (SIU), the Province of Pavia, the Municipality of Pavia, the Lombardy Regional Council of Engineering Professional Associations (CROIL), the Engineering Professional Association of Pavia Province, Architects, Planners, Landscape Architects, and the Conservators Professional Association of the Province of Pavia.

This book gathers 47 papers submitted to the INPUT 2025 Conference. After undergoing a blind-review process, the accepted papers are arranged by the thematic sessions of the Conference:

- AI and Machine Learning for Urban and Territorial Analysis and Forecast.
- New Simulation Methods and Models.
- Transition’s Management: Ecological, Energetic, Economic.
- 3S City (Smart, Safe, Sustainable).
- Impact Assessment of Nature-Based Solutions in Cities: Theoretical, Methodological and Practical Perspectives.
- How Is the City Moving? Tracking Flows and Enhancing Planning Policies.

- Innovations in the 15-Minute-City Approaches: Conceptual, Data-Driven, and Practical Developments Towards a Sustainable Urban Planning.
- Circular Economy and Planning. Fostering Energy and Industrial Symbiosis in Cities and Ports.

November 2025

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Hide and Track: How Interviews Work for Investigating Users' Mobility Habits, Genoa Smart City Case-Study

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Abstract. Data-driven nature of Smart City implies an increasingly urgent need to track and deepen citizens behaviors and patterns, in order to build a coherent knowledge background on current state-of-the-art, as well as to shape realistic modeling of future perspectives and scenarios. Mobility planning in this direction represents a key-challenge due to the highly sensitive kind of data that are required and shared. In this direction, transport research and studies have evolved during time in order to define methodological approaches able to represent and model users' behavior properly. Similar researches were conducted initially through the direct involvement of users' through the implementation of surveys and interviews profiling respondents and respective patterns. Subsequently, technology evolution has made mobility tracking more and more an automated process through sensors and mobiles, thus requiring similar surveys to test and fine-tune Big-Data processing. Nowadays, telephone and web interviews still constitute consolidated techniques to deepen revealed and stated mobility intention and preferences of users within targeted initiatives (e.g. pilots and innovative services), nevertheless, representativeness of obtained results seem to waver. Despite statistical stratification of investigated samples, interviews' results may lead to an overall misrepresentation of the global population, thus questioning the legitimacy of their usage on a large scale. To address similar issues, present contribution focuses on Genoa Smart City Project (IT), investigating potential scenarios leading to the implementation of targeted restrictions to private vehicles' access to the city center to support sustainable mobility transition, as an interesting case-study to assess potential mismatch between statistical sampling and population representativeness due to the chosen research approach, as well as to face it properly from a methodological point of view. Stemming from the surveys' first results, wider consideration on potential integrated and mixed approaches will be provided.

Keywords: Mobility behaviors · Survey · Interview · Stated Intentions · Revealed Preferences · Transport research

1 Introduction

Smart City paradigm relies on a strongly data-driven structure, that requires to be continuously fed (Wang et al., 2020). Big-data gathering and processing constitutes indeed one of the main challenges for urban planners and policy makers (Bokolo, 2023). Similar process represent key-step to build both a coherent framework and knowledge basis of current dynamics and flows, as well as to perform accurate modelling and forecasting of future scenarios (Bibri, 2021). Transport and mobility planning does not constitute any exception in this direction. Tracking urban flows represent a pivotal challenge to target sustainable transition (Poslad et al., 2015) as well as increased safety (Liu et al., 2021) and public space quality (Bibri, 2023). Nevertheless, complete automation of similar processes may show some criticalities. Firstly, users growing awareness in terms of privacy-related issues may undermine their availability and consent to share sensitive data and information (D'Agostino et al., 2019), as the ones concerning their own location and displacements (Paiva et al., 2020). Secondly, users' sentiment, preferences and intentions may not be self-evident, since real-data only convey information on current behaviors. Whenever disruptive innovation and interventions are concerned, similar approach may not be enough (Huang, 2021). According to similar considerations, current transport research and studies still rely on direct involvement of users, both to fine-tune models and forecasts, as well as to investigate their preferences and intentions. Within the broad spectrum of investigative tools available to researchers, qualitative data is sometimes underestimated due to the increasingly pressing need to obtain objective information for public decision-makers. On the other hand, numerical and quantitative aspects appear insufficient when they are not correlated with the typical methods of social research and the contextualization of data within the lifestyles and urban culture of a place (Noseir et al., 2023; Punzo et al., 2022). These reflections are especially relevant in a field like transportation, where the provision of physical infrastructure intertwines with the users' acceptance of it, based on their lifestyles (Moradi and Vagnoni, 2018). The mobility dynamics that take place across the regions are often investigated either through statistics flattened to the national average or through isolated traffic studies, frequently focused solely on metropolitan cities. In the first case, the knowledge produced is widespread but lacks depth in terms of motivations and the changes that may occur over time; such surveys are conducted periodically and therefore cannot account for the relationship between the timing of the investigation and possible transformations. In the second case, studies are often polarized around transport dynamics in large urban centers, typically aimed at easing traffic through simulation models, but without simultaneously exploring mobility habits, especially those related to the geographic data of origin and destination. Mixed approach are usually targeted to address both quantitative and qualitative evaluations (Nogueira et al., 2023). Revealed (RP) and Stated Preferences (SP) surveys, that were traditionally designed to predict users' behaviors and willingness-to-shift (Ben Akiwa and Morikawa, 1990), are currently implemented to bridge this gap in transportation research (van Kasteren et al., 2024). Differently from real-data-driven processes, whenever surveys and interviews enter the flow, the definition of targeted and representative sample constitutes a key-element. From a methodological perspective, this step has primary relevance in the description of behaviors of the general population

(Amato, 2018). Even when the modeling effort (Li et al., 2021) is conducted concurrently with socio-economic investigations, the reliability of the analysis must always be assessed and validated in terms of its robustness, particularly in light of the epochal transformations currently underway. Many scholars have indeed delved into the subject of the change in travel patterns that occurred in the aftermath of the Pandemic since Covid 19 (Li and Lasenby, 2023; Liu et al., 2023), but changes in society cannot be limited to the post-Covid fallout alone. Numerous survey techniques have been presented in the transport literature to date (Huging et al., 2014; Maggi and Vallino, 2011): but do we still have the right lenses for intercepting the dynamics of urban mobility and the most representative choices? Stemming from similar considerations, Smart City Project supported by Genoa Municipality, in North-Western Italy and including University of Genoa as research partner, identifies a Mixed-approach to evaluate Genoese users' current mobility patterns and behaviors, as well as to investigate users' willingness-to-shift to sustainable alternatives following the implementation of access restrictions to the city center for private vehicles. The combined usage of mobile-data, RP and SP surveys should have led to a comprehensive evaluation of current and future mobility flows and patterns within Genoese urban area. Nevertheless, results descending from different segment of the investigation show deep differences in users' profile and behavior. Present contribution aims indeed at the deepening of the influence of different research techniques in the results concerning users mobility current patterns, future modelling and forecasting. In this direction, Sect. 2 will frame survey techniques features and goals within urban mobility research realm. Section 3 will introduce Genoa Smart City Project case study, while subsequent Sect. 4 will deepen different respondents profiles according to the different segment of the survey. Conclusive remarks on methodological approach choice and respective impacts on targeted results will be provided in Sect. 5.

2 Implementing Urban Mobility Surveys: Current State-Of-The-Art and Future Scenarios Forecasting

2.1 Stated and Revealed Preferences Surveys

The application of SP and RP to transport research has progressively gained relevance in terms of travel choices modelling and assessment. The analysis of users' travel behaviour could be addressed indeed through the integration of Revealed Preferences targeting observed choice behaviour, using information on the reported or network characteristics of alternatives in the choice set (for modes, routes, destinations, etc.) and Stated Preferences to frame behavioural responses from users expressed as a preference ranking/rating or a choice selection to produce empirical models for predicting travel choices, as well as for deriving the shadow prices and values of travel attributes (Hensher et al., 1988). In details, when analysing travel behaviour on existing transport alternatives, systems and facilities, the estimation of discrete choice models generally relies on RP data. On the other hand, SP data, collected from hypothetical travel scenarios, are important when forecasting the travel demand for new alternatives (Zhang et al., 2008), when actual travel data (RP) cannot exist. Moreover, particular attention needs to be paid to additional differences within each of these two categories. For instance, network journey

times and costs based on detailed zoning criteria prove usually more accurate than data based on a coarser basis, and self-reported journey times and costs have a different reliability again. Within SP data, responses from “within mode” experiments usually reflect less error than those from “across mode” experiments, and the type of the response variable (ranking, rating, choice) may also affect accuracy (Bradley and Daly, 1991). Travel demand forecasting, especially for subway and MRT systems before their implementation, has been a key issue targeted through RP and SP combinations, to investigate users attitudes to and likely behaviours on new systems (Ben-Akiva and Morikawa, 1990; Polydoropoulou and Ben-Akiva, 2001). Another potential application of integrated RP and SP can be found in the implementation of combined destination and mode choice models. Heilig et al. (2017), for instance, propose the application of similar methodology to innovative sharing services. To overcome barriers coming from agent-based demand modelling, asking to simulate sequentially destination and mode choices, thus underestimating complex choices impacts, a combined destination and mode choice model is implemented. In this sense, the low share of innovative modes required to integrate data coming from observed behaviour (RP) with SP experiments. This enable easier data collection, more accurate control of variables influencing modelling procedures. Nevertheless, several biases are highlighted, too. Respondents tend to cast their existing behavior in a better light, thus interfering with choices modelling reliability. In terms of mobility planning, Idris et al. (2014) focus on the analysis of users’ sensitivity to higher quality transport services as well as to the application of innovative solutions and technologies to existing mobility supply. Evaluation of emerging transit systems and technologies, such as passenger information systems and intelligent transportation systems (ITS), improving reliability, and their need potential In terms of transit ridership increase, requires to combine traditional RP with carefully designed stated preference (SP). Researchers indeed apply similar combination to evaluate the effectiveness of transit service attributes on mode choice. In this direction, a survey gathering RP mode choice information and SP mode-switching experiments along with qualitative psychometric questions on users’ perception of transit service was developed and later integrated to econometric mode-shift models, aimed at investigating commuting mode-switching behaviour toward different transit technologies of varying characteristics. Following one of the first studies assessing time and reliability value for users applied to road pricing initiatives (Brownstone and Small, 2005), Rotaris et al. (2012) address then the assessment of value-of-travel-time by Trieste University community through the use of a combined RP and SP approach, to feed the implementation of a discrete choice model. Combined RP and SP methodology could be applied to estimate users’ willingness-to-pay, thus allowing travel behaviour modellers to have a realistic understanding of the trade-off between time and cost of travellers (Tabasi et al., 2023).

2.2 Delivering Techniques: Telephone, Web or Mobile Interviews

Beyond research purposes of SPs and RPs, it is particularly interesting to focus on how surveys delivering techniques may lead to different outputs and results within the transport sector research realm. Main delivering methodology may be clustered as follows: i. Computer-Assisted Telephone Interviews (CATI); ii. Computer-Assisted Web Interviews (CAWI); Mobile Surveys (CAMI). Similar categories differ in the technology interface

through which respondents are required to answer questions. Academic research has frequently highlighted how survey design -thus implying delivering techniques, as well-may affect respondents engagement (Amato, 2018), especially whenever mobility and transport-related issues are concerned (Roddiss et al., 2019). Computer-Assisted Telephone Interviews (CATI) were evidently the first to be introduced in the 90's. Following the introduction of landline phone-based interviews in the previous decade, to overcome face-to-face interviews limitations -mainly dealing with high costs and the need to find selected time slots to provide them (Ampt and Ortuzar, 2004), interviewer progressively consolidated the use of interactive supporting systems to support them providing questions and completing data entry procedures (Talpur et al., 2012). In this direction, initial barrier was constituted by potential exclusion of householders who did not own a telephone. Currently potential bias may be represented by people that own mobile phone only, since mobile phone numbers are rarely available through public datasets, thus hampering the effectiveness of the investigation within the selected sample (Spangler et al., 2023). Similar issue may affect deeply survey targeting individual citizens and householders, while it may not constitute such a significant obstacle when companies and institutions are concerned, since similar stakeholders usually are still provided with publicly available telephone contacts. Nevertheless, since transport-related surveys usually deal with large samples of householders and individuals, different solutions have been implemented to overcome this barrier. On one hand, self-completion forms gradually emerged to support mobility data collection. In this direction, respondents are provided with questionnaires, that constitutes the only form of interaction between researchers and interviewees. Answers may be provided any time, thus making respondents burden less heavy (Ampt et al., 2009). Survey design procedure need to be extremely accurate due to the absence of human interaction, so that doubts cannot be deepened. Similar surveys may be delivered through three techniques: Paper-And-Pencil Interviews (PAPI), as used in mail-out/mail-back surveys, Computer-Assisted Web Interviews (CAWI), and Smartphone-Based Apps. CAWI were firstly introduced at the beginning of 2000s, to increase the engagement of users' groups that are more inclined to use technology (Eisenman et al., 2018). Similar technique provides several advantages: i. responses are collected automatically when questionnaires are submitted and they do not need to be manually entered into a database; ii. Addresses can be provided directly through maps indicating locations, locations directly; iii. Implausible answers are prevented by the logistics implemented in the questionnaire; iv. Only relevant questions can be shown to the participants, thus making the questionnaire easier and quicker; v. finally overall questionnaire accessibility may be improved for people with disabilities since answers are provided via common web browsers and smartphones (Eriksson et al., 2018). Nevertheless, progressive affirmation of smartphones and Global Navigation Satellite Systems (GNSS) to access automatedly travel information oriented mobility research towards the use of data coming from smartphone apps, thus generating travel diaries by combining various sensor data (e.g. location and acceleration). Some of the apps provides as well the possibility to implement questionnaires that collect information about the respondents mobility patterns (Spangler et al., 2023). The use of data provided by smartphone apps provides one significant advantage over PAPI, CATI, and CAWI: they do not depend on users' memory, so that item-nonresponse and other accuracy errors may be prevented;

moreover multimodal trips may be easily tracked, thus generating automated travel diaries, so that learning algorithms and suggestions may further ease respondents' burden (Roddis et al., 2019). Some relevant criticalities need also to be pinpointed (Zijlstra et al., 2019). Technical issues may emerge and lower response rates are usually present. Finally, it needs to be remembered that progressive transition from telephones to mobile phones translated into the gradual provision of CATI through mobile phones, despite the potential difficulties linked to the collection of reliable and exhaustive databases (Table 1).

Table 1. PROs and CONs of different surveys' delivering techniques

	PROs	CONs
PAPI	Directly addressed to targeted respondents	High costs, longer times to reach people physically
CATI	Lower costs, more people can be reached	Respondents are required to own a phone, their phone number needs to be publicly available
CAWI	Responses may be collected automatically, questions may be filtered due to previous answers, implausible answers may be prevented, accessibility issues may be faced in advance	Some groups of respondents may be marginalized due to limited use of technology, lower response rate
Sensors' data	Do not require users' direct intervention, they may generate automated travel diaries	Users may fear privacy issues, Less tech-savvy users may be excluded

3 Genoa Smart City Project

3.1 Description of the Case-Study

Genoa, one of the main ports in the Mediterranean, stretches along 30 kms of coastline between the Apennine Mountains and the Ligurian Sea, extending inland through two main valleys. City population approximates 566,000 residents distributed over 240 square kilometers, resulting in an average population density of 2,538 inhabitants per square kilometer. Within the 28 square kilometers that encompasses the city center, this density rises to around 10,000 inhab/sq.km (ISTAT, 2022). City's orographic layout has historically directed major transit routes through the central area, effectively connecting eastern and western sectors. In contrast, peripheral routes are generally perceived by users as less efficient in terms of travel time and cost, leading to an imbalanced use of the road network and, as a result, significant congestion. To respond to the challenges outlined above, the policies set forth in the local Sustainable Urban Mobility Plan focused on rationalizing traffic flows and encouraging a modal shift toward public transportation (PT) and active mobility. These goals were targeted through several

key initiatives, including the appointment of a mobility manager, the adoption of low-emission vehicles for goods distribution, and participation in the national car-sharing program (Delponte, 2021). In addition, among the possible scenarios investigated in the Plan, the idea of implementing a road pricing system in the city center, which was already pioneered some 25 years ago, is now being reconsidered again. To move toward verifying this change in city layout, a program of surveys was structured, with the help of interviews (RP and SP) used for the purpose of both calibrating the traffic model (to update the 2016 O/D Matrix) and to get policy guidance for how to regulate access to the city center. In contrast to most international experiences, Genoese initiative envisions a coordinated implementation of urban regeneration measures alongside the enhancement of infrastructure and public transport, carried out in parallel with the regulation of access to the city center. Procedurally, this approach involved advancing urban and mobility planning efforts independently of any revenue generated from road pricing, which has not yet been introduced. In this context, the extensive stakeholder consultation process represents a substantial undertaking in terms of consensus' building.

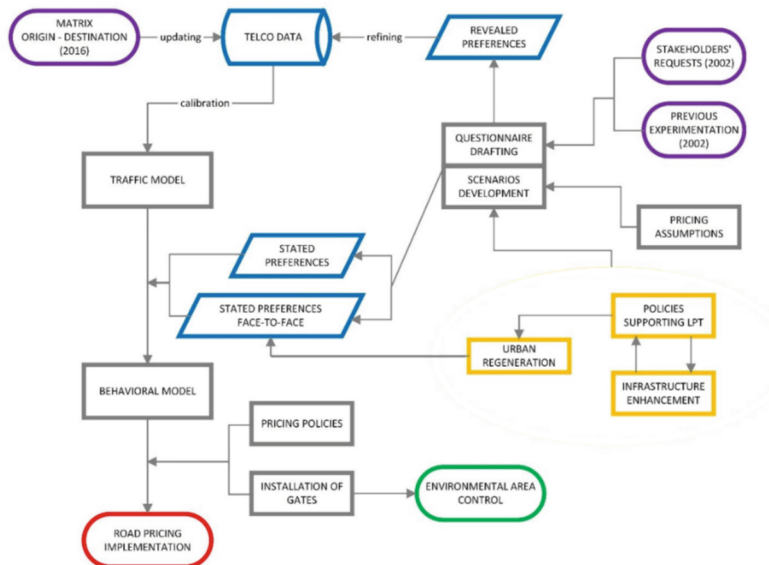


Fig. 1. Methodological framework of Genoa Smart City Project

3.2 Investigating Mobility Patterns

As previously stated, double purpose of O/D matrix calibration and users' willingness-to-shift and -to-adopt sustainable alternatives, was pursued through the delivering of a mixed RP and SP survey to a statistic sample that was supposed to be representative of Genoese municipality, as well as of commuters' community based on the previous version of urban O/D matrix, dating back to 2016. Targeted sample was therefore defined according to the following socio-demographic features: i. sex; ii. age; iii. Working condition; iv. Share of respondents coming from Genoa municipality, or living in other

bordering provinces. Respondents were provided CATI and CAWI surveys addressing several topics: a. individual features; b. main displacement origin and destination; c. current modal choices; d. trip chain and travel purposes; e. users' willingness-to-pay to access city center; f. willingness-to-shift to sustainable alternatives according to different scenarios. As shown in Fig. 1, survey results were supposed to contribute to the validation of new traffic model, based on TELCO data. Statistical stratification of the sample should have in this direction consolidated real-traffic data processing feeding the model. In this direction, 11 220 CATIs and CAWIs were delivered in parallel with the design and implementation of TELCO-fed traffic model, thus representing final fine-tuning tool to set the new O/D matrix. Partial results were delivered and analyzed monthly in order to identify potential biases during the process.

4 Results

Once similar workflow has been defined and implemented, two main issues have emerged progressively through monthly releases (Fig. 2):

- Global sample do not overlap with historical data and traffic model in terms of displacement origin and modal share;
- Significant differences between CATI and CAWI results were identified both on socio-demographic features and mobility patterns.

Despite having set statistical parameters in terms of socio-demographic variables and displacement origin, global sample differs from expected value due to: i. an over-representation of people reaching main travel destination outside Genoa municipality -only a 55% share of global sample travels within or to Genoa territory; ii. over-estimation of people travelling by private vehicles (approximately 59% of total share). According to national statistics, Genoa municipality is characterized by the highest self-contained commuting structure (ISTAT, 2020), with an 80% share of people living and working/studying within municipal boundaries. So that other travel purposes, difficultly may fall to 55%. Moreover, a 59% share of respondents travelling by private vehicles and only a 26% share of public transport users clashes with previous O/D matrix stating that only a 44% share of Genoese population was classified as private mobility user (Comune di Genova, 2016), as well as with TELCO-driven model defining a 54% share of people travelling by car and moper, versus a 47% of PT users. Going to CATIs and CAWIs subsample, outlier values become even more self-evident. The former ones appear to be: younger, workers and care-givers, car-chooser, travelling to other municipalities than Genoa. On the contrary, CAWIs respondents are older, not commuters travelling to Genoa for caregiving and leisure, highly dependent on private mobility.

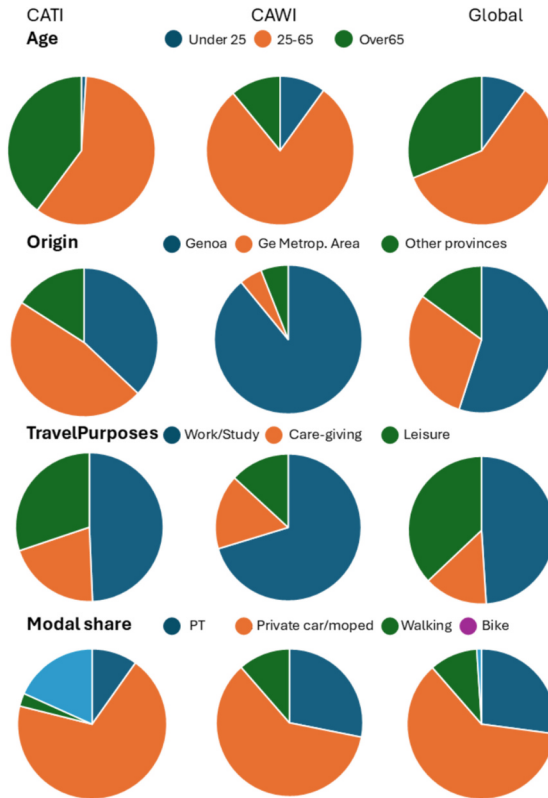


Fig. 2. CATIs and CAWIs samples synthetic results

As far as Genoese context is concerned, it needs to be pinpointed that similar techniques prove to be highly complementary.

Elderly non-worker users constitute a relevant share of global population, so that their mobility behavior require to be addressed properly. Similar aspect translates also into a limited availability of CAWI panels that undermine similar results representativeness. In this direction, Face-To-Face interviews may bridge this gap to track commuters behaviors and preferences, thus representing key-actors when speaking of peak hours weekly flows. A full integration of similar results on different days and hours basis supports indeed full understanding of general trends and urban dynamics.

5 Discussion and Conclusive Remarks

Present contribution provides interesting insights on heavy influences of investigation techniques and chosen approach on mobility related results. Despite statistical representation of the sample, Genoa Smart City Project has shown deep differences between mobility patterns and modal choices descending from real-life data (namely TELCO data) and results of mixed RP and SP survey. Public transport users and strictly urban travelers appears to be underestimated, despite being potentially committed and interested

in providing their view on urban sustainable mobility transition. Similar outcomes may descend from the methodological limitation linked to: the absence of younger urban users from official telephone number datasets (as far as CATIs are concerned), as well as to the biases of pre-defined statistical panel required to reply to CAWIs surveys. Previously introduced biases may translate also into the differences undergoing the achievement not comparable results of CATIs and CAWIs, both in terms of socio-demographic features and mobility behaviors. From a methodological perspective, survey results suggest that real-data validation could not perform as expected due to the impossibility to trace and track specific users' behavioural clusters, beyond statistical representativeness. Big-data processing, in this direction, seem to support more tailored and realistic modelling and simulation, thus constituting accurate premise for sustainable mobility initiatives. At the same time, it needs to be highlighted that similar automated process requires to be validated through on-field surveys in order to fine-tune simulation outcomes. Moreover, real-traffic data do not support deeper understanding of potential users' acceptance and willingness-to-shift or -to-adopt innovative solutions, so that similar gap needs to be filled through dedicated investigation. Achieving such an ambitious goal requires the implementation of policies that are specifically tailored to the unique characteristics of the territories in which they are applied. In this context, Revealed Preferences and Stated Preferences emerge as essential tools for capturing mobility habits and user choices, thereby providing a foundation for the development of predictive and targeted interventions. In a concise and balanced view, it can be affirmed that the application of these methodologies can be effectively employed, but primarily as complementary components within a broader investigative framework. In this direction, quantitative and statistical representative data could be processed separately, and subsequently integrated by deep investigation of behavioral clusters through dedicated survey. The decoupling of survey results from the identification of targeted sample and panel could contribute to more comprehensive and meaningful representation of transport-related scenarios. It is therefore essential to note that policy makers approach within Smart City context will require multi-level evaluation stemming from Big-Data analysis on the higher level to downscale to urban traffic models, finally focusing on vertical investigation descending from surveys' results processing of different users' segments.

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