Tangible futures: Combining scenario thinking and personas - A pilot study on urban mobility

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ABSTRACT

Scenario planning methods tend to work at an aggregate level and to consider homogeneous populations, thus levelling the variable effects of future developments on different social groups. Decision-making based on such scenarios bears the risk of missing undesired impacts on specific groups of people, which may cause social tensions or require costly countermeasures. New approaches are needed to provide a better basis for socially responsible planning by making clearer the complex social impacts of future scenarios. In marketing and user-centered design, persona models are developed to represent typologies of users to cover a broad range of needs and requirements. We propose a systematic method, called the Scenario Personarrative method, for combining scenario thinking and personas into a structured but nonetheless flexible process, which allows generating fine-grained individualized narratives. We describe a pilot application in a case study on urban mobility. This pilot used existing scenarios and focused on a two-hour workshop where twelve experts created personas and the associated narratives across three scenarios of urban mobility in 2030. This pilot shows the applicability of the method for making potential effects on different social groups more tangible. We propose ways forward for further evaluation of the proposed methodology.

1. Introduction

The future may not be predicted or written, as it is "*multiple, undetermined and open to a large variety of possible futures*" (Godet & Durance, 2011, p. 29). The development of foresight scenarios is meaningful for building medium to long-term projections with the purpose exploring alternative futures, with or without predictive aims. Scenario techniques appear to be valuable to deal with issues of complexity and uncertainty (McGrail & Gaziulusoy, 2014). This is the situation in urban mobility studies today, where the wide spectrum of interwoven societal issues, combined with the long time frames, make the building of future scenarios on travel demand especially complex (Bernardino et al., 2015). Many future mobility studies involving scenario building have been elaborated in the past years, notably due to the growing interest for electrified and automated vehicles (Hannon, McKerracher, Orlandi, & Ramkumar, 2016). Anticipation of mobility practices is an overwhelming and challenging topic to many stakeholders involved in the developments of urban areas around the world (Urry, 2016).

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However, scenario techniques often consider the impact of possible futures at an aggregate level and tend to consider homogeneous populations. This is a limitation, as future developments will not affect everyone in the same way: socio-cultural, biological, behavioral and other factors will determine how individuals will respond and adapt to unfolding futures (Andreani, Kalchschmidt, Pinto, & Sayegh, 2019). Therefore, there is a need for methods that allow a finer-grained analysis of the impact of future scenarios on different categories of the population. User-centered design and marketing researchers and professionals have been using a method called personas to build archetypal user profiles that offer planners, managers and designers with a typology of users on which to base their decisions (Cooper, 1999; Grudin & Pruitt, 2002; Pruitt & Grudin, 2003). Some studies have already combined personas and scenarios, but without a systematic approach to guide this combination. Practitioners like designers, planners and policy-makers, who need to identify in a short timeframe what aspects of a decision need further exploration and what dimensions of a problem affect their project most could benefit from such a structured approach. To fill this gap, this paper introduces a method to combine personas with scenario thinking. The approach is illustrated on a pilot case study in urban mobility. The feasibility, utility and scope of application of the method are discussed.

The paper is structured as follows. Section 2 presents an overview of the core elements of the paper, i.e. scenario thinking and persona models for the methods, and future mobility scenarios for the applicative domain. The proposed approach for combining scenarios and personas - called the Scenario Personarrative method - is exposed in Section 3. In section 4, we present the results of a pilot study in the mobility domain, which involved the definition of archetypal scenarios and four traveler personas, allowing for a systematic delineation of their mobile lives in 2030. Section 5 discusses the implications of the approach for scenario planning and urban mobility research, and the limitations of the study. Section 6 concludes on the study.

2. Literature review

2.1. Scenario thinking

Scenario thinking is a participative approach to strategic planning, based on the construction of different possible scenarios for the future, which help illuminate decisions in the present (Chermack, 2011). Scenarios are not exact depictions of a future reality, but rather a means to represent it as part of a pertinent, coherent and transparent project building process in light of desirable futures. For instance, scenario building is the first step in the Multi-Actor Multi-Criteria Analysis (MAMCA) methodology (Macharis, Turcksin, & Lebeau, 2012), which is used to involve various stakeholders in systemic and complex projects.

The dominant school in scenario thinking is the so-called 'intuitive logics' school (Bradfield, Wright, Burt, Cairns, & Van Der Heijden, 2005). This label covers various approaches (Chermack, 2011; Schoemaker, 1995; Wack, 1985a, 1985b; Wright & Cairns, 2011); however, these methods all share the same core principles, and follow the same generic process:

1 Define the project's objectives, the perimeter and timescale of the analysis.
2 Define a system of interest (e.g. a firm's market, a region or an industrial sector) and a timescale (e.g. 10 or 20 years) for the analysis.
3 Identify key trends in the environment for the chosen timescale as well as the strategy of actors.
4 Analyze and group these trends to keep only a few key drivers, often along two main dimensions corresponding to the two main uncertainties for the future (Chermack, 2011; Wright & Cairns, 2011).
5 Design and write narratives of the state of the system of interest in the different combinations of the key trends.
6 Evaluate the impact of the scenarios on the system of interest and feed this assessment into strategic decision-making (with cost-benefit analysis for each scenario and decision).

In this last step, impact is often assessed at an organizational level (Kamprath & Mietzner, 2015). For instance, in corporate projects, the objective is to understand what a given future would mean for the organization, and how to prepare the organization to be resilient across different scenarios. Despite stakeholder participation often being part of the scenario building process, the resulting scenarios often consider a homogeneous population. However, a given scenario may have very contrasted consequences for different groups of users, which suggests the need for more detailed analyses. For instance, climate change is likely to be more difficult to adapt to for people with limited resources, either in low-income countries or for poor people in high-income countries (Levy & Patz, 2015). Among poor populations, women may be affected differently than men, young people may cope differently than older people, and rural populations will encounter different issues from the ones urban populations will have to deal with. In business contexts, technological forecasting and market foresight also require a fine-grained analysis of different categories of the population, to identify needs and expectations in the market(s) and make strategic decisions on the firm's offerings accordingly.

Therefore, it seems important to develop methods that allow assessing the impact of scenarios on different categories of stakeholders. In the face of great uncertainty, personal judgment will often be a key element of the decision making process, so having a more detailed presentation of stakeholders and an accurate knowledge of their issues could be useful. This requires scenario thinkers to be able to identify meaningful typologies of stakeholders, to combine them with scenarios, and to convey the result of this analysis in a way that can be as engaging as scenario narratives themselves. One technique that has been used in marketing and user-centered design to build and represent typologies of users and customers is the use of *personas*.

2.2. Persona models

According to Cooper (1999), a persona is a fictional user model that is representative of archetypal users throughout the design process. Personas are a powerful tool for communication in design teams (Cooper, 1999), as the technique forces designers to consider social and political aspects of design that otherwise often go unexamined. Personas also provide a shared basis for communication, e.g. between designers and clients (Grudin & Pruitt, 2002; Pruitt & Grudin, 2003). Personas are increasingly used in policy making to help imagining more human-centered policies and services to the population (Gonzalez de Heredia et al., 2018). De Moor, Saritas, Schuurman, Claeys, and De Marez (2014) demonstrate the use of personas combined with cultural probing for investigating the future of TV experiences. They generate three pairs of two personas of TV users, called 'positive' and 'negative'. Positive personas are characterized by their ability and taste to take full advantage of the technology, whereas negative personas are reluctant or marginally use the technology (De Moor, Saritas, Schuurman, Claeys, & De Marez, 2014). Urry (2016) illustrates four future scenarios with four distinct characters inserted in a brief vignette (or narrative story), to inform about how people engage in different ways in the practice of 3D printing. In this case the characters are developed in the spirit of personas, but are not named 'personas'.

In the transportation domain, personas are mainly applied in relation to different mobility behavior patterns in order to develop services for different types of travelers, e.g. based on vehicle driving behavior patterns defined by motives for car use or the amount of annual vehicle kilometers travelled, to allow for various levels of energy consumption (De Clerck et al., 2018). Other approaches use personas for representing different types of drivers, public transport passengers or ride sharing customers for considering different preferences and expectations regarding vehicle design or user experience, e.g. by combining different levels of openness towards various features (Beyer & Müller, 2019; Gargiulo, Giannantonio, Guercio, Borean, & Zenezini, 2015; Oliveira et al., 2018). More recently, personas have been used to investigate user requirements and acceptance issues on novel concepts like autonomous services (Kong, Cornet, & Frenkler, 2018). Closely related to persona models, Kesselring (2006) isolated three "paradigmatic cases" of individual mobility pioneers out of a hundred interviews of journalists. The real profiles are representative, in this case, of three distinct mobility strategies which relate social and physical mobility: centred, decentred and virtual mobility.

Although personas are gaining increased attention outside the domain of product design as an appropriate method to follow a user-centric approach, they are partly criticized for lacking solid empirical grounding (Chapman & Milham, 2006; Miaskiewicz & Kozar, 2011). The level of predictive power of a foresight process significantly depends on the quality and soundness of its underlying assumptions. To avoid these methodological weaknesses, it is possible to develop personas using a Delphi process (Schmidt, 1997), involving domain experts to gain consensus on the definition of archetypal users (Brancheau & Wetherbe, 1987; Miaskiewicz & Kozar, 2011). Using a different approach, Gonzalez de Heredia et al. (2018) presented three structured methods for developing personas closer to empirical data: collecting new survey data; clustering existing data from multiple surveys; iterating between interviews with a small sample of people linked with survey data. Stevenson and Mattson (2019) recently proposed to increase the accuracy of personas by creating a computational persona generator, based on aggregated national survey data and individual micro-data. The method was applied to define a persona population of representative motorcycle taxi drivers in Brazil.

Another option to improve the validity of personas is to ground them on empirically derived theories and models explaining typical behavior patterns, or on segmentation approaches from social sciences. Building explicitly on established behavior change theories and behavioral models to develop personas can help limit the level of uncertainties in the assessment of future developments.

Even though personas are usually applied for the design of new products and services, comparable approaches exist in scenario thinking. For instance, existing scenario studies in the mobility domain frame scenarios as personal narratives, close to the persona approach (Rogers & Mitzner, 2017). However, these examples do not provide a systematic method for combining these two approaches.

2.3. Future urban mobility scenarios

Urban population around the world is expanding, while rural areas become depopulated. Today, around 50 % of the world population live in urban areas. In the future, urbanites may increase up to 60 % in 2030 (Bouton, Knupfer, Mihov, & Swartz, 2015) and reach about two thirds of the world population by 2050 (Van Audenhove, Korniichuk, Dauby, & Pourbaix, 2014). According to current estimations, the augmentation of road and rail transport of persons will raise between 120 and 150 % at the 2050 horizon (International Transport Forum, 2015), making mobility one of the major urban issues. Major concerns of livability, sprawl and accessibility arise in this context, which have favored the use of prospective thinking and scenario planning.

These scenario thinking studies future urban mobility are often anchored on medium-term projections around 2030–2035 (Ecola, Zmud, Gu, Phleps, & Feige, 2015; Marletto, 2014; Rohr et al., 2016; Townsend, 2012; Trommer et al., 2016; Zmud, Ecola, Phleps, & Feige, 2013), 2040 (Gazibara & Future, 2011), or longer-term projections in 2050 (Fulton, Mason, & Meroux, 2017; Kaufmann & Ravalet, 2016; Urry, 2016). In terms of process design and methodology (van Notten, Rotmans, van Assel, & Rothman, 2003), both analytical scenarios based on quantitative models and qualitative, intuitive scenarios built around storytelling have been published. For instance, creative future mobility scenarios aiming at a more humanized and less technological approach may be found in Paucot (2018), who synthesized participatory workshops into twenty short provocative stories.

Urban mobility scenarios have explored a broad range of 'influencing areas', i.e. *broad topic[s] that potentially affects mobility*'

(Ecola et al., 2015). Influencing areas may be, in turn, associated with descriptors, which are metrics connected to one specific element of the influencing area (for example cost of travel or vehicle ownership). Frequent combinations of variables include social considerations (demographics, education, awareness etc.), environmental issues (resources, energy etc.), technology, economic growth and governance (Bernardino et al., 2015). For instance, Bernardino et al. (2015) developed four global scenarios – or pathways - for the evolution of transport demand in Europe towards 2050 based on five factors: climate change, energy scarcity and price, economic performance, global cooperation, social preference (consumerism vs spirituality). In this study, technology is an input that affects the importance of the other variables. Other studies have investigated technological trends and prospects, such as propulsion technology for Rohr et al. (2016), or tackle transitions to future urban travelling from a socio-technical perspective (Julsrud & Priya Uteng, 2015; Moradi & Vagnoni, 2018; Schuckmann, Gnatzy, Darkow, & von der Gracht, 2012; Spickermann, Grienitz, & von der Gracht, 2014). Studies on autonomous and electrical vehicles often introduce variables like shared ownership and sharing schemes (Fulton et al., 2017; Trommer et al., 2016). Human factors and behavioral variables, and variations in social structures, values and lifestyles are also more or less explicitly expressed in scenarios, see for instance (Gazibara & Future, 2011; Kaufmann & Ravalet, 2016; Townsend, 2012; Urry, 2016). In order to build scenarios for 2050, Kaufmann and Ravalet (2016) claim to rely on various scientific sources but also on perceptions of people's aspirations, which they refer to as 'weak signals'.

Finally, variations across user groups are accounted for in some urban mobility scenario studies. Trommer et al. (2016) developed their scenarios stressing out new user groups who might benefit from autonomous vehicles more than others. Three groups are globally addressed in the description of scenarios for the US, Germany and China: people with medical or age-related constraints, teenagers and long-distance commuters. The individual perspective also introduced through verbatim of travelers, who were asked about their self-driving affinity. Rohr et al. (2016) developed three one-page stories for different scenarios entitled 'a day in the life of Digital Divide / Live local / Driving ahead'. Digital Divide interestingly features two individuals, brother and sister. Max, 25, is struggling with life doing badly paid jobs, whereas Jules is a successful entrepreneurial woman. Live Local tells the story of Mia, 29, who works at home emerged in digital environments but also meets friends in physical locations. Lastly Driving Ahead elaborates on the activities of the Borowski family, whose parents emigrated from Poland to UK. The achievement of their day relies on fully automated vehicles. If the stories are indeed relevant to illustrate several 'winners and losers' routes, these do not allow to reflect on the implications of society projections on a given persona.

However, the assessment of the impacts of future developments cannot be limited to the technological dimension (Andreani et al., 2019), but also needs to account for impact upon different social groups; indeed, "*Developments vary in their impacts upon social groups as they generate new losers and sometimes new winners*" (Urry, 2016, p. 136). In the transition move towards sustainable mobility, it is important to strive for 'mobility justice' or to fight against 'uneven mobilities', as coined by Sheller (2018). This accounts for the existence of differential experiences of mobility. Although it is deployed at different scales, the bodily scale of mobility injustice has special interest in 'restrictions on mobility related to gender, race, class, ethnicity, sexuality and physical abilities' (Sheller, 2018).

Innovations in mobility systems will not only include a technological dimension, but they will also bring with them new consumption patterns (service economy, sharing economy), and the desire of part of the population to contribute to the ecological transition means that foresight models must also be social.

3. Materials and methods

3.1. Combining scenarios and personas: introducing the Scenario Personarrative Method

Scenario thinking and persona methods come from different streams of research and practice. Our review has shown their potential complementarities. Scenario thinking focuses on broad trends that will affect the socio-economic environment through defining narratives of alternative futures. Personas focus on the personal level through defining ideal-typical user profiles. Combining the broad view offered by scenarios with the fine-grained analysis allowed by personas seems like a promising perspective for new developments to describe how different subgroups of a population may experience, and adapt to, different futures. However, in order to be evaluated and to guide practice, such a combination would need to be formalized in a methodological framework. We propose a systematic and applied method for combining scenarios and personas. The method has five steps (Figure 1):

1. Define the objectives and scope of the study. Like for other scenario studies, define the expected use of the results, the timescale of the analysis, the project team.
2. Build narrative future scenarios. Most existing methods can be used, e.g. (Chermack, 2011) or (Wright & Cairns, 2011), as long as they provide narrative scenarios (and not only quantitative projections).
3. Construct a typology of individual user profiles. Review scientific knowledge and theory relevant to the topic to identify the individual characteristics that most affect individual behavior on the topic of interest. These characteristics could be, for instance, personality traits, socio-economic factors or demographic variables.
4. Develop personas for each identified user profile. The personas will be ideal-typical embodiments of the user profiles. Existing methods for developing personas can be used, e.g. (Pruitt & Adlin, 2006) or (Brangier & Bornet, 2011).
5. Map personas to scenarios; develop short narratives for each scenario-persona pair. These narratives describe the experience of the persona in each future scenario.
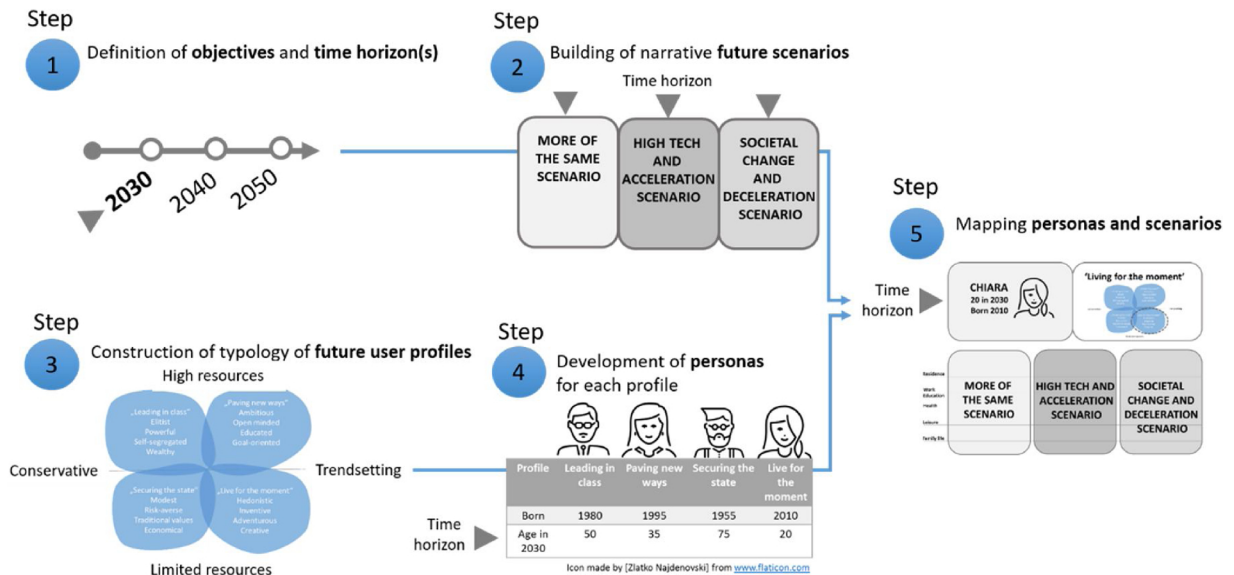
Fig. 1. Workflow of the Scenario Personarrative Method.

The proposition lies in the systematic combination of existing methods. We take advantage of the accumulated knowledge on scenario thinking and persona development, and combine them into a structured process. Nonetheless, the proposed method remains flexible, as people can develop scenarios and personas using their usual methods.

The two first steps are similar to the scenario-building stage of scenario planning methods. Step three makes use of existing knowledge and theory from various fields to identify those characteristics that drive individual behavior on the topic of interest. Academic knowledge from behavioral, cognitive and social sciences will be of particular interest, as well as market research, economic analyses and demographic databases. Step four covers the development of personas, using existing methods. In step five, a narrative is developed for each persona in each scenario. If three scenarios and four personas are developed, the final product is a set of twelve narratives.

In practice, we anticipate that this method will be best implemented in participative workshops with experts and users, supported by a methodological facilitator. This approach builds on collective intelligence to develop both scenarios and personas.

3.2. Setting and data collection

We applied the method described above in a pilot project on the future of mobility in Paris region. Steps one, two and three were performed as desk research, and steps four and five were carried as a two-hour expert workshop held in October 2017 (Fig. 2). We recruited experts for the workshop by e-mail through our project network. Twelve experts participated in the first workshop. The workshop was repeated one week later with five participants recruited from the first workshop sample in order to do the same for the remaining mobility profile.

We collected data through observation by the three facilitators during the workshop and through collecting the outputs produced

Fig. 2. Overview of the workshop session.

Table 1
Major trends for the three archetypal scenarios, based on (Rohr et al., 2016).

Trend	More of the Same based on Digital Divide	High-tech and acceleration of travel based on Driving Ahead	Societal change and deceleration of travel based on Live Local
Demographic and economic trends	Slow to medium economic growth	High economic growth	Steady economic growth
Technology development	Linear technological development	Defining technology: fully autonomous vehicle (FAV)	IT sector highly developed Autonomous vehicle development ongoing, arguments about regulation and policy, open liability issues
Work and business	Change in the structure of work. For regular employees increase in remote work	Physical workplace has not changed much FAVs allow people to live further from work	Increased level of telework Cultural changes: increased valuation of working at home due to the lack of calm office spaces Younger generation decreasing tolerance for unnecessary travel
Health	Increased population over 65 Growing incidence of chronic medical problems Many medical advances mainly benefitting people with private insurance	Easier access to medical care due to FAVs	Increased importance of telemedecine and monitoring
Retail	Retail is not doing very well, per capita consumption has stagnated	Retail sector is booming in general Considerable rise in online sales, FAV deliveries, smart delivery concepts including returns	Enormous increase in online sales In-person shopping is thriving in food/fresh markets. Live local ethos
Freight	Package delivery is increasing substantially	Increase in on-line deliveries	Package delivery strongly increases
Long-distance travel		High disposable income Many opportunities for short breaks	Overall trend towards fewer but longer holiday trips
Travel implications	Telework Ride sharing Private package delivery	Overall FAVs have lowered travel cost for many users	Travel is more expensive Climate legislation, high fuel cost, road pricing, train and air travel cost increase due to high maintenance cost of ageing infrastructure Mileage based road pricing

by participants. We analyzed and synthesized this data in a descriptive way (Sandelowski, 2000) to illustrate the main steps of the process and to present exemplars of the outputs of the workshop. Results of the pilot are developed in the next section.

4. Case study: introducing different categories of travelers into future mobility scenarios

4.1. Step 1: objectives and time horizon

In this project, the objective was to identify possible futures for the mobility of people and the impact on their way of life, as well as implications for mobility systems development. No geographic boundaries were imposed in the initial briefing, although it was assumed that travelers would evolve in a French urban area. A medium timescale (2030) was chosen to frame the narratives, which is reasonably challenging but still makes it possible for participants to rely to social trends and evolutions.

4.2. Step 2: defining three future mobility scenarios

Due to the time constraints, and because this pilot focused on the impact assessment stage of the scenario planning process, the scenarios were not generated in this intervention. Instead, we used existing scenarios. We identified eleven forecast studies related to electric, automated, shared and digital mobility. Using the affinity diagram or KJ method approach (Martin & Hanington, 2012), we clustered these scenarios. A selection of three scenarios showing the most representative trends of the clusters was made and unified into three storylines for 2030: (1) continuity of present situation or 'More of the same'; (2) High tech and acceleration of travel; (3) Societal change and deceleration of travel.

Full details on how we identified futures studies of mobility, which scenarios we selected and how we analyzed them can be found in Appendix A. Table 1 presents a digest of trends for the three scenarios based on the study of Rohr et al. (2016) for the UK, which are developed into consequences for urban life. In this study, it has to be noted that (debatable) assumptions are made regarding (1) economic growth (see (Jackson, 2019) for alternative views on 'secular stagnation'); (2) development of fully automated vehicles.

4.3. Step 3: definition of four traveler profiles

In mobility behavior research, explanatory models used for describing the heterogeneity of travelers stem from different segmentation approaches, aiming to identify specific target groups or to distinguish definable homogeneous groups. They focus on different classes of variables; most approaches are based on travel behavior, geographical-features, socio-demographic variables, or attitude/value approaches (Markvica, Haufe, & Millonig, 2016; Pronello & Camusso, 2011). For the study presented in this paper, three established theories from different disciplines have been combined for developing personas representing plausible mobility profiles:

- The sociology-based Social Practice Theory (SPT) (Reckwitz, 2002; Shove, Pantzar, & Watson, 2012) describing the basic components of everyday routines,
- The Sinus Milieu approach developed in market research (Bertram & Berthold, 2012), which relates to the idea that behavior is influenced by general values, beliefs and viewpoints,
- The Behavior Change Model (BCM) introduced in Persuasive Design Research (Fogg, 2009), focusing on preconditions for encouraging behavior change.

Although not originally developed for the mobility context, all three approaches have already shown to be valuable for describing phenomena of traveler behavior patterns in mobility related studies (Haufe, Millonig, & Markvica, 2016; Wunsch et al., 2016). The theories are not fully compatible as they stem from different disciplines, but each of the three approaches basically identifies two major components which are responsible for developing or changing a behavior pattern within a range of given behavior options (e.g. when choosing a mode of transport). These two factors are (1) Resources, or the ability to perform a specific behavior (e.g. educational or financial resources), and (2) General attitude, or the willingness to do so (e.g. external or internal motivation). In this way, the design of the personas is based on elements which are used across several disciplines, providing a sound basis potential participants in an expert workshop are more likely to relate to.

In SPT, the *Resources* aspect is denoted as "competences", referring to a person's practical and tacit knowledge and skills relevant for a specific behavior. The Sinus Milieu Model (which shares some of its roots with SPT in Bourdieu's social theory) refers to three levels of social status (higher, middle and lower class) that define ability in relation to a person's economic, social and cultural capital. The BCM also describes "simplicity factors" facilitating the ability to do something (e.g. time, money, training, physical and mental ability). For the purpose of this study, we detailed *Resources* with the three components Material and competences, Social status and Ability.

General attitude, on the other hand, is described in SPT as dependent on the meaning of a behavioral practice to the person, e.g. the significance of the practice and its relationship to wider ideas in society and to personal values. The Sinus Milieu Model also emphasizes the relevance of basic values and the general orientation in life (e.g. traditional or post-modern) as significant influence on the willingness to perform a specific behavior. A similar dimension is "motivation" as defined in the BCM, which also describes negative motivators such as fear or aversion in relation to personal interests or social rejection. We detailed *General attitude* under the three components of Meaning, Personal Values and Motivation.

Figure 3 illustrates how the dimensions extracted from the theoretical background form the basis for defining potential characteristics of future mobility profiles, which can further be translated into specific personas.

We generated four different profiles which are characterized by access to (material and immaterial) resources as well as their general attitudes referring to the behavior change dimensions identified in related empirical models (see Section 2.2). Based on the knowledge provided by the theoretical models informing these dimensions, the profiles can be described with regard to their social characteristics and lifestyles and more specific with regard to their mobility routines. Table 2 gives a short characteristic of each
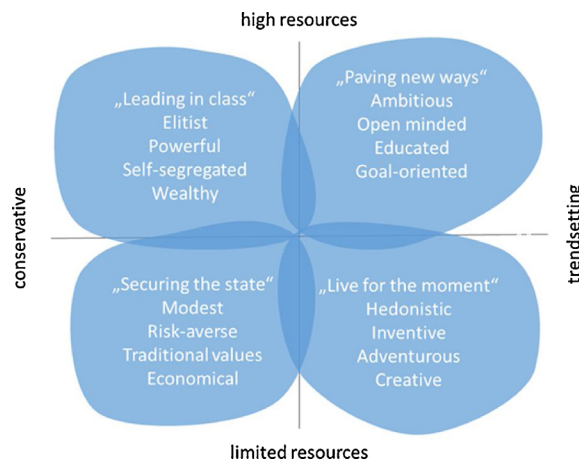

Fig. 3. Mobility profiles defined by combinations of availability of resources and general attitudes.

Table 2
Prototypical traveler profiles.

Profile	Social characteristics	Mobility characteristics
Securing the state	Conservative milieu of residents living in rural or low-income urban neighborhoods, traditional values are important (family, religion, honesty, modesty). Novel developments (new/other social groups, technological developments, political changes) are met with skepticism. People are very much based in routines and do not like changes. They prefer to stay among themselves.	Mobility is a necessity; it needs to be affordable, safe and efficient. In rural areas, the car is dominant; in urban areas public transport can be an alternative, if it is deemed safe enough. The activity radius is quite narrow.
Leading in class	Highly influential conservative elite, wealthy and established in society; feeling of social responsibility, but preserving or expanding the status and influence has priority. Novel developments are accepted, if they support their conservative attitudes. Due to their societal status, they have also the power to influence (support or hinder) future developments.	Mobility is also a means for displaying the status. Far-distance travelling is common for business and leisure. Transport modes allowing (hierarchical) separation from other groups (exclusive car, business/first class in trains and aircrafts) are preferred.
Paving new ways	Young modern performers and individualists, interested in new developments and devices, but at the same time very pragmatic (goal-oriented); like everything supporting their goals and their self-esteem; take calculated risks if success is likely. Intensive use of digital media (for fun and for specific purposes, e.g. efficiency and career).	Mobility is a means of getting somewhere and is viewed pragmatically, although "new" and trendsetting options are more interesting than others. Services offering a notion of coolness along with ease of use and flexibility are very attractive (e.g. Uber).
Living for the moment	Hedonistic milieu, try to make the most of limited resources. Status and fun are important, hence savings are sometimes used for expensive car/smartphone/body-art, even if the regular life (residence, food etc.) needs to be cut down for it. Interested in new things and willing to take risks, creative and adventurous, therefore often seed for disrupting ideas.	Mobility is fun, either through the experience provided by the means of transport itself or by the chance to provoke reactions from other people (e.g. colorful or self-build longboards, tuned up cars), risky behavior is possible. Financial limitations determine their options.

profile. These profiles form the basis for deducting specific personas, allowing the assessment of profile-specific behavior developments in relation to the three selected mobility scenarios. Note that the profiles do not reflect the percentages of the target population of Paris area in each group.

4.4. Step 4: elaboration of four traveler personas

In this sub-section and the next, the main results of the expert workshop are introduced. Twelve people agreed to participate in the workshop: seven transport and innovation practitioners and five mobility researchers, including two of the co-authors. Participants were split into three groups of four participants. They were introduced to the three scenarios (20 min), and each group was then tasked with creating a persona based on one of the four mobility profiles (30 min).

The four combinations that define the personas that were taken into account by the four groups are presented in Table 3. These features were predefined by the facilitators because of time constraints on the workshop. The profile and the indicative age was given in the brief, but the choice of gender was left free. Based on these characteristics, one group presented Pierre-Antoine as follows:

> *Pierre-Antoine is a business solicitor. He lives in a nice old fashioned flat in the 16th district west of Paris. He runs a successful law practice in the 8th district. He is divorced from his first wife, and got married again seven years ago with a young and attractive solicitor, 35, that he met at work. He has two children, 19 and 21 from his first marriage, and also a 6-year old daughter. The family usually goes for short holiday or weekends in a cottage they bought in Benerville/mer (near Deauville resort). Once a year, they plan a trip to Maldives Islands, and go skiing on a glacier at Easter in Switzerland. He is keen on golf practice, and is also sailing from time to time. With his wife, he enjoys going to concerts at La Philharmonie de Paris.*

The four personas are provided in full in Appendix B.

Table 3
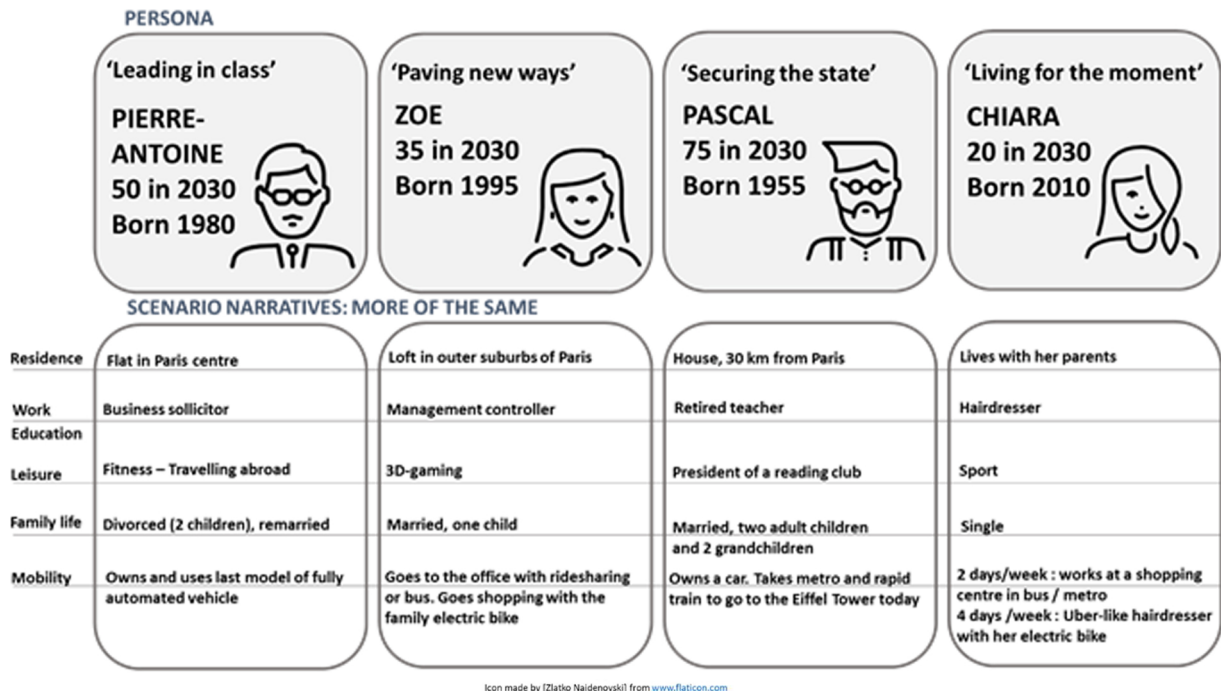Features of four future travelers in 2030.

Name (Gender)	Pierre-Antoine (M)	Zoe (F)	Pascal (M)	Chiara (F)
Profile	First in class	Paving new ways	Securing the state	Living for the moment
Resources	High resources	High resources	Limited resources	Limited resources
Orientation	Conservative	Trendsetting	Conservative	Trendsetting
Year of birth	1980	1995	1955	2010
Age in 2030	50	35	75	20
Is/was 20 in …	2000	2015	1975	2030

Table 4

Narratives of Chiara for the three scenarios.

General features	Chiara is a 20-year-old hairdresser. She lives at her parents place but she is looking for an apartment for herself. She loves travelling and she likes to do sport regularly so she can maintain her health. Chiara has a childhood friend, Eleonore, who is studying at Harvard in the US. Eleonore comes to visit Chiara from time to time.
'More of the same' scenario	As a hairdresser, Chiara works two days per week at a shopping centre for which she must take public transportation: bus and metro. Each time she takes public transport, she checks the itineraries and timetables using an online application. Besides working at the salon, she works four days per week as home service hairdresser for which she uses an electric bike to go to her clients' homes. To protect her bike from being stolen and to preserve her hairstyle while biking, Chiara wishes to have a biometric bike equipped with air-flow anti-rain component.
	While looking for a new apartment, Chiara uses an online service, aiming at moving to the city centre where the number of home hairdressing demands is higher.
	Chiara uses video calls to stay in touch with her friend Eleonore. Although she does not have the possibility to travel a lot, she loves doing 3D virtual dives from time to time. Except for buying bread, Chiara does her shopping online.
'Acceleration' scenario	Chiara works in a beauty care autonomous vehicle. For doing so, she spends four days per week in Paris and two days per week in Nice. For the remaining day, she spends time with her friends having parties in a party bus. While traveling between Paris and Nice, she likes to watch some TV series on a streaming service.
	Chiara is no longer searching for an apartment. If she needs a calm place to spend the night, then she uses a hotel automated vehicle.
	She no longer needs to do shopping as well because all what she might need is delivered directly to the autonomous vehicle. Eleonore comes to visit Chiara while she is at Nice using a high-speed airplane. For doing her regular sport, Chiara takes a gym automated vehicle.
'Deceleration' scenario	Chiara works as an Uber hairdresser only. Thus, she serves her clients directly at their homes while using her old -2020 model-bike for her travels. In order to support her living, she sells some hair-made figurines directly to her clients or through an arts and crafts platform. She is searching for a flat share with a garden where she can grow the herbs she needs in her bio-hairdressing.

Fig. 4. Four future traveler features for 'More of the same' scenario.

4.5. Step 5: mapping personas and scenarios into twelve short Scenario Personarratives of urban mobility

After generating a persona, participants in each group were asked to generate a 5- to 10-line narrative of one day in the life of the persona, for the first scenario (30 min). They then did the same and generated 5- to 10-line narratives for the two remaining scenarios (30 min). A collective debrief was organized at the end of the workshop (20 min).

Stories are exemplified for the case of Chiara developed across the three scenarios (Table 4). The same logic was applied to obtain

the variations of narratives for the other personas (see Appendix C, for 'More of the Same'). To bring more consistency to the set, it was decided to locate all stories in the Paris metropolitan area. A slight change was made to the features of Zoe, who was initially settled in China as a management controller. Fig. 4 provides a graphic overview of baseline scenario 'More of the Same' for the four personas. This allows checking that personas do not present overlapping characters, which could be a bias of the workshop. Moreover, the examination of the stories for one persona across the three scenarios ascertain that the grounding elements of scenarios are well embedded into narratives.

5. Discussion

In this section, the implications of the implementation of the Scenario Personarrative Method are discussed for the practice of scenario planning in a broad sense, and for applications in the field of urban mobility. The final sub-section reflects upon the limitations of the approach to formalize improvement propositions, notably on the sampling of participants and on persona generation.

5.1. Implications for scenario planning

Our approach constitutes an "add-on" to the scenario planning approach since it can support decision makers from the private and public sector by allowing to create a portfolio of multiple situated narratives. Compared with previous attempts to use personal narratives in scenario thinking projects (Palmer, 2014; Rogers & Mitzner, 2017), our approach is more applied and systematic as it consistently explores the consequences of each scenario for each persona, rather than using a specific persona to tell the story of each scenario.

The pilot project reported in this article shows that the method we propose for combining scenario thinking with the persona method is feasible, also for limited resources. We managed to focus the involvement of experts to a two-hour workshop by using pre-existing scenarios. This could be particularly interesting for smaller organizations, which sometimes do not have the resources to use classic foresight methods (Foster, 1993; Lamé, Jouini, & Stal-Le Cardinal, 2019; Sørensen, Vidal, & Engström, 2004).

This method can be combined with scenarios generated through any method (Bradfield, Wright, Burt, Cairns, & Van Der Heijden, 2005), although narrative scenarios seem more advisable than more quantitative projections. We tested the method in the context of urban mobility, but it can be expected that it would be easily transferred to other contexts. For instance, questions regarding social and technological change and their impact on access and funding are particularly important in healthcare. Combining personas with scenario thinking could be useful in gaining a better understanding of this situation.

Nonetheless, the approach may need further refining. Even though we developed several very different individual perspectives, it may be necessary to develop a more diverse set of narratives to create a fine-grained coverage. This perspective could for instance be supported by the generation of representative persona in the spirit of the 'persona generator' (Stevenson & Mattson, 2019). Personas and narrativescould hence be developed with a targeted selection of participants, from a variety of backgrounds depending on the design goals we have in mind.

5.2. Implications for urban mobility studies

Urban mobility faces a period of dramatic changes, as disruptive technological advances such as digitalization and automation are expected to significantly alter the way we travel in the future. Merging physical transport assets like infrastructure or vehicles with a digital layer opens vast possibilities in terms of the development of new transport services, business/operating models and social innovations. New services such as multimodal travel planners, transportation network companies, mobility as a service, on demand public transportation, new airline ancillary products, or various forms of tracking and tracing providing both transport operators and travelers themselves with better insight in to travel patterns to optimize collective or individual transport are developing rapidly (Canzler & Knie, 2016). At the same time, societal trends such as individualization, attitudinal shifts (as observed in the growing acceptance of sharing instead of owning vehicles), or increasing perception of environmental responsibility in the light of climate change (as seen in the "flight shame" movement in Sweden; (Ledel, 2019)) break up usual patterns of how transport is perceived, valued and used (Circella, Tiedeman, Handy, Alemi, & Mokhtarian, 2016).

In this situation of radical changes, thorough planning of future transport systems becomes more and more difficult due to a wide range of uncertainties, while it also becomes ever more important to avoid undesired developments, rebound effects or social disparities following wrong or uninformed policy decisions. Scenario studies try to tackle this challenge by offering different plausible variants of the future, but these visions often stay on the surface and are mainly perceived in the experiential context of the researcher or the reader. Combining scenario thinking with theory-grounded personas enriches scenarios with additional dimensions of impacts on different realities of life and facilitates the identification of potential new risks to equity which otherwise would have been undisclosed. This is of high value for decision makers to take an integrated perspective of combined mobility services to satisfy various traveler needs and train developers, designers and transport providers in considering different user requirements. In addition, this user centric perspective of assessing the impact of transport developments also allows the prevention of undesired effects on the travelers' side, e.g. by improving general education to avoid lack of competences to use specific systems and ensure inclusion of all

societal strata of transport users.

Future studies could explore where and how this method could fit within the existing toolbox in urban and mobility planning. The method seems particularly indicated for early stages of design or decision-making; therefore, its interactions with co-design and co-creation methods and other participative agenda-setting approaches requires further exploration. To this end, a relevant framework of integration could be the mobility Staging Model (Jensen, 2013), which suggests that mobilities are not only designed 'from above' (by planning and regulation) but are also appropriated 'from below', meaning that travelers also co-constitute technologies and designs.

5.3. Limitations and recommendations

Methodological limitations must be acknowledged. This discussion then leads to recommendations aimed at strengthening the proposed method.

In the case study, the sample of workshop participants may have biased the results towards an optimistic view. Indeed, all participants were mobility professionals with a high level of education and will most probably be able to benefit personally from future developments, whereas other groups of the population may be left aside in some scenarios of future mobility. Even though we tested the method with mobility experts, it seems possible to use it with other participants, including minority and disenfranchised groups. If the number of personas and narratives is to be increased, it is especially important that they cover voices that are less often heard in public debate (Sand, 2019), and move to the involvement of more 'inclusive groups' (van Notten et al., 2003). It is supported by the conclusions of Soria-Lara and Banister (2018), who conducted a collaborative backcasting approach for transport policy scenario building. They emphasized the need to guarantee the social heterogeneity of participants, that is to say involve people affected by decisions as well as decision-makers (Soria-Lara & Banister, 2018).

This contribution describes a pilot study on a single project, using essentially descriptive methods. In the future, the usefulness of the personas and the persona-specific scenario narratives for decision-makers should be evaluated. This could first be done through a qualitative interview study. Going further, we should assess whether the addition of personas is deemed more insightful than scenarios alone. If personas are found to be a useful addition, then another point would be to understand what formats work best for reporting the narratives to decision-makers. Finally, it would be interesting to further explore to what extent combining scenarios and personas can mitigate the limits of the individual methods of scenario planning (Harries, 2003; Wright, Bradfield, & Cairns, 2013) and personas (Cabrero, Winschiers-Theophilus, & Abdelnour-Nocera, 2016; Turner & Turner, 2011).

The approach could also be refined by specifying the method for defining personas and scenarios in more detail. The generation of relevant representative personas could be inspired by quantitative methods based on surveys, or mixed methods based on interviews and surveys, as e.g. by Gonzalez de Heredia et al. (2018) or Stevenson and Mattson (2019). Furthermore, the pilot study did not include the development or discussion of scenarios in the group, which could be a limit to the co-creation approach. To this end we could suggest giving more time to the workshop activity, inserting a criticism phase and participative updating of a set of basic scenarios, and also making scenarios more socially and geographically embedded (depending on the future issue to tackle). In the same vein, participants could be more involved in setting of the persona attributes, which would bring greater nuance and diversity into the thinking, and possibly revealing hidden assumptions or ignored aspects. Finally, future studies could explore a broader set of technological and non-technological changes. Because of time constraints on the project and the workshops, only a handful of scenarios could be explored, which means that we may well have overlooked provocative, contrasted or radical trends and perspectives. Trying the methodology on a longer project would allow for the exploration of a broader set of scenarios before choosing those presented in the workshop.

6. Conclusion and perspectives

Future scenarios sometimes lack a differentiated view on the impact of future developments on different social realities. Although some studies already include narratives describing specific personal experiences, there is no systematic approach to ensure that the effects of future changes on people of different walks of life are taken into consideration. The initial research question was how to methodologically combine personas and scenario thinking to enable richer decision-making, considering a wider range of societal impacts.

Although previous studies have experimented with combining personas and scenarios, the originality of this work lies in the proposition of a systematic method for generating persona-focused narratives across archetypal scenarios. We propose a formalized process with five steps and a workflow for defining and combining scenarios and personas. This approach enables decision makers to compare the experience of different social groups in different futures.

Early results of a pilot workshop in the mobility domain show that the method is feasible, flexible and requires little resources. Rich pictures of alternative futures are expected to come out from workshops. There is an additional perspective of deploying the approach in relation to the evolution of the circular ring and roads in the Greater Paris. It is expected to produce mid to long term scenarios (for 2030 and 2050) incorporating a vision of urban planning solutions and evolutions of mobility practices. The results are bound to be presented to the public, to professional and local authorities by means of deliverables, publications and a collective exhibition. It seems very relevant in this case to rely on the Scenario Personarrative Method to encapsulate imagined solutions into

future lives of people who live in the targeted area. The collaborative workshop will be, in this case, an intermediate step that is going to nurture the work of a cartoon designer.

The developed narratives provide a very comprehensible illustration of the actual effect of technological innovation on the reality of people. This makes potential effects of decisions on different social groups more tangible for decision makers, as the diverse impacts of proposed changes in a complex system become more apparent. We also suggest it may be a powerful tool to support citizen debates on future society issues. For the involvement of lay people in participatory scenario building, telling stories is believed to be easy and enjoyable. For thinkers who wish to communicate about their ideas, stories are also an appropriate medium to catch the public's attention. It is in line with the recommendations of Soria-Lara and Banister (2018), who advocate for a participatory approach with different stakeholders in building future scenarios based on face-to-face workshops. Finally, the proposed approach provides the opportunity to embody academic and theoretical assumptions about our future life, and it also enables a thoughtful debate on non-formatted futures.

Acknowledgments

Appendix A. Selection and clustering of mobility studies

Future studies can hence be analyzed regarding the main points of focus, which were (1) personal mobility in a broad sense; (2) automated vehicles or mobility (3) electric mobility; (4) shared mobility. Topics can also be addressed in combination, for instance the future of electric and shared mobility in Marletto (2014). Moreover, to investigate scenarios, each study had to provide two to four variants (i.e. scenarios) of the future vision. The detailed rationale of the selection of documents about future of transport and mobility is the following:

- publication period from 2010 to 2017,
- medium to long-term time-span, which corresponds to 2030–2050,
- various sources (journal papers, technological reports and watches, books) from search engines like Science Direct, Google Scholar,
- target key-words in English combining 'mobility' or 'transport' to 'future study', 'future scenario', 'vision', 'foresight'.

Table A1 proposes a characterization of future mobility scenarios with their variables of interest and studied impact. Table A2 shows the detail of scenario clustering. The rationale for constructing archetypal scenarios respects the original time frames. Across studies A to K, it is possible to distinguish a medium-term frame (2030–2035) and a long-term frame (2050). The final set of studies for each temporal frame is expected to elaborate on various topics: mobility in general, but also technological developments (electric and automated vehicles especially). In this paper, we decided to concentrate on the medium time horizon 2030–2035 for brevity, provided that no major differences were observed between the medium and long-term projections. Moreover, scenarios that were not detailed enough (for instance B, C, E, G) were included in the clusters, but could not be chosen as representative scenarios for the clusters.

Although the scenarios described in the RAND study (Rohr et al., 2016) are mainly analyzed from a national (UK) perspective, the scenarios themselves are quite representative and universal. After an in-depth analysis, we use the scenarios I1, I3 and I2 as representatives for the classes we have previously defined: "More of the same", "High tech and acceleration of travel", "Societal change and deceleration of travel". The study addresses the following topics for each of the scenarios: general demographic and economic trends, technology development, work and business, health, retail, freight, long-distance travel, and travel implications. These topics can be completed with topics such as urban form, policy and societal trends, also labelled 'megatrends' (Hoppe, Christ, Castro, & Seppänen, 2014). We further adapt the descriptions given in the original scenarios to generalize them and disconnect them from the local UK perspective.

Table A1
Variables and impacts of future mobility studies.

Reference	Title of study	Code	Scenario name	Scenario code	Variables or influencing areas	Impact
Gazibara & Future, 2011	Megacities on the move	A	Planned-opolis Sprawl-ville Renew-Abad Communi-city	A1 A2 A3 A4	Energy, Governance, Resources, Economy, Climate change, Social structures, Values, Business, Technology	Urban form, Mobility
Zmud et al., 2013	The Future of Mobility: Scenarios for the United States in 2030	B	No Free Lunch Fueled and Freewheeling Red dusk: China Stumbles The autonomous vehicle revolution	B1 B2 B3 B4	Oil price, Environmental regulation, Infrastructure expenditures	Travel demand and passenger-miles travelled, Innovation, Regulation, Housing, Work, Employment
Marletto, 2014	Car and the city: socio-technical transition pathways to 2030	C	Auto-city Eco-city Electri-city	C1 C2 C3	Propulsion technologies, Business models, Power (coalitions)	Policy options
Townsend, 2012	Re-Programming Mobility	D	Growth Collapse Constraint Transformation	D1 D2 D3 D4	(Not explicitly stated from "driving forces") Energy, Technology, Economy, Governance, Climate change, Social structures, Digital technology	Land Use and Transportation, Financing, Role of Planning
Ecola et al., 2015	The Future of Mobility: Scenarios for China in 2030	E	The Great Reset Slowing but Growing	E1 E2	Demographics, Economic growth, Energy, Transportation supply and constraints (driving and vehicle ownership), environmental conditions	Travel demand in all modes
Kaufmann & Ravalet, 2016	From weak signals to mobility scenarios: a prospective study of France in 2050	F	Proxymobility Ultramobility Altermobility	F1 F2 F3	Aspirations, Governance (centralized or not)	Modal share Traffic volumes CO_2 emissions
(Lang, 2016)	Self-driving vehicles, robo-taxis, and the urban mobility revolution	G	The premium car that drives itself SDVS rule the streets Robo-taxis take over The ride sharing revolution	G1 G2 G3 G4	Ownership Model, City Policy	Number of vehicles Accidents Parking space CO_2 emissions Modal mix
Urry, 2016	What is the future?	H	Fast mobility city Digital city Liveable city Fortress city	H1 H2 H3 H4	(Not explicitly stated) Energy and Resources, Social structures, urban forms	Mobility practices
Rohr et al., 2016	Travel in Britain in 2035 – Future scenarios and their implications for technology innovation	I	Digital Divide Live Local Driving Ahead	I1 I2 I3	Gross Domestic Product (GDP) growth Technological development Cost of travel Total travel	Strategic roadmap of policy and investment
Trommer et al., 2016	Autonomous driving – The impact of vehicle automation on mobility behavior	J	Evolutionary automation Technological breakthrough Rethinking (auto) mobility	J1 J2 J3	Share of AVs with total vehicle fleet Shared use of AVs	Mobility behavior using a travel demand model (vehicle miles travelled, modal share, user groups)
Fulton et al., 2017	Three revolutions in urban transportation	K	Business as usual 2R 3R	K1 K2 K3	Share of AVs sales Share of EV sales Share of shared mobility	Total number of vehicle /passenger kilometer per mode, kilometer of travel Total number of vehicles in use Total energy use CO_2 emissions Cost per Passenger Kilometer Policy

Table A2
Clustering of future scenarios.

Cluster name	Identified scenarios										
More of the same	A1 A2	B2	C1	D2	E2	F1 F2	G1	H4	I1	J1	K1
High tech and acceleration of travel	A4	B4	C3	D1			G2 G3	H1	I3	J2	K2
Societal change and deceleration of travel	A3	B1	C2	D3	E1	F3	G4	H2 H3	I2	J3	K3

Appendix B. 'More of the Same' narratives for Pierre-Antoine, Zoe and Pascal

Persona	General features	Narrative for 'More of the same' scenario
Pierre-Antoine	See Section 4.5	Pierre-Antoine has bought the last model of fully autonomous vehicle. He moves most of the time from home to work with his FAV, where he can work and eat if necessary. As he is very stressed with his life, he is told by his doctor that he should practice more sport. He has bought an indoor bicycle but rarely cycles at home. His wife and the au-pair girl are in charge of the grocery shopping, delivered daily at home. He enjoys strolling through a market once a month to buy delicatessen and nice special food (sea food, cheese etc).
Zoe	Zoe is married to Pablo and they have a 5-year-old child (Noe). They have just returned from a two-year expatriate stay in China. Zoe works as a management controller for the airline company Air France. Pablo works as an independent graphic designer specialized in 3D logos. They live in a loft in the outer suburbs of Paris.	Zoe must wake up early to go to her office using ridesharing or the bus. Heavy traffic pushes travelers to use shared transportation solutions. She works four days out of five. It is Pablo who takes along Noe to the walking school bus. He uses his electric bike if he has an appointment or when he goes to work at a co-working space. Pablo attaches a trailer to his electric bike for picking up, from the neighborhood's delivery box, the weekly grocery they buy online. Otherwise, it is Zoe who goes shopping by electric car during her day off.
Pascal	Pascal is 75 years old and has been retired for 10 years. He was a French teacher. He is married and his wife is a librarian. He has two children (they live in Japan and Brazil) and two grandchildren aged 11 and 13. He often takes care of them during the holidays. He lives in the Saclay region (south of Paris). He is taking care of himself and he is overall healthy. He loves his car and he always uses it to travel around. He owns a second generation electric car (ZCE, 2020 model). He is indeed an early adopter. He cares about issues related to society. He has a smart-phone which he uses for basic communication features and to take pictures. For his activities, he is president of the association "Reading club of Saclay". He is also a representative to his neighborhood union. He often goes to the media library. He goes to his neighborhood market. For the other groceries, he uses home delivery.	This is the day of Pascal with his grandchildren during the holidays. Generally, he uses the car for his travels on the Saclay plateau. He cannot drive at night because of growing eyesight problems. Pascal has planned the detailed program of the day in advance. It is set as follows: at 10 am he leaves the house with the car. At 10:15 he parks in the parking P + R of the station. They take line 18 of the metro at 10:30 direction Versailles-Chantiers and then the RER C to the Eiffel tower. Children check the traffic on the way. After the Eiffel tower, they have lunch on the spot and they take the famous riverboat on the Seine in the afternoon. Throughout the day, the children send the photos with WhatsApp to their parents.

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