THINKING THE UNTHINKABLE: THE DESIGN OF DISRUPTIVE VISIONS FOR LAND USE AND TRANSPORT INTEGRATION

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ABSTRACT

Transport Scenario-Building is a well-established methodology to investigate strategic decisions for cities and its transport systems. It is often used to examine different futures where there is considerable uncertainty or where the business-as-usual is no longer appropriate. While the use of participatory approaches in Transport Scenario-Building has resulted in more democratic and implementable outcomes, the usefulness of those approaches is limited when the generation of disruptive transport futures and unusual policy solutions are considered.

This paper addresses the abovementioned issue by presenting a participatory approach aimed to obtain disruptive visions on land use and transport by 2050. The context of the Metropolitan Area of Madrid (Spain) is taken as case study. The novel approach incorporates disruptive factors about city futures - "wild cards"- during the participatory visioning process, triggering an unconventional thinking from participants. First, a total of 139 people were engaged by using semi-structured interviews on the future of land use and transport in the case study. Each semi-structured interview explored the desired future for each participant as well as disruptive futures according to "wild cards" previously established. Second, responses were transcribed, coded, and analysed resulting in seven different future narratives.

Third, a group of 20 experts in innovation and strategic thinking evaluated the disruptive level of each future narrative with respect to a business-as-usual scenario. The paper shows the methodological process, the future narratives obtained, and reflects on the capacity of this participatory approach to generate disruptive future visions for land use and transport.

1. INTRODUCTION

Cities and transport systems are changing faster than ever, which is a fertile ground for the emergence of sudden, unique, anomalous, and low predictable incidents (Barber et al., 2006; Dammers, 2010). In this apparently changing age, transport planning experiences challenging times, in which instrumental rationality has come under attack (Innes and Booher, 2018) and deep uncertainty must be treated when supporting decision-making (Lyons and Marsden, 2019; Marchau et al., 2019; Navarro-Ligero et al., 2019). The incorporation of low predictable incidents/processes into decision-making remains a challenge that strongly limits the options for non-linear policy pathways. Those low predictable incidents/processes are here called wild cards: sporadic events or long-lasting processes that are assumed to be improbable, but would have large consequences for cities, transport systems, and social trends if they finally take place (Mendoça et al., 2004; Smith and Dubois, 2010).

Transport scenario building is a well-established methodology that can effectively address the challenge of incorporating wild cards in decision-making (Hickman and Banister, 2014; Soria-Lara and Banister, 2017a; Van Drunen et al., 2011). Transport scenario building investigates strategic and long-term futures marked by considerable uncertainty (e.g., the role of street space in cities) and/or situations where business-as-usual is no longer appropriate (e.g., transport emissions). The visioning phase is a crucial methodological step in transport scenario building, where a series of explorative and/or normative visions are constructed about the city's future and its transport systems (Banister and Hickman, 2013). This methodological phase is seen as a democratic exercise where "all voices" should be heard (Wangel, 2011), engaging the widest variety of actors: members from the public, practitioners, policymakers, etc. (Soria-Lara and Banister, 2017b; Tuominen et al., 2014).

Although there has been a burgeoning application of participatory visioning approaches in the transport field (Zimerman et al., 2012; Wangel, 2011; Hickman et al., 2011; Schade and Schade, 2005; Olsson et al., 2015), limited attention has been paid to deal with non-linear thinking. The implementation of participatory visioning has usually followed consensus-based techniques (e.g., Delphi methods), which limits the capacity to add outlier views into future visions (Shiftan, 2003; Melander et al., 2019). Experts-guided processes have been predominant in participatory visioning exercises, and those experts are usually trained to visualise futures linearly (Hickman and Banister, 2014). Visionary participants are also heavily influenced by current social and technological trends, making outside-the-box thinking a challenge (Soria-Lara and Banister, 2018a). If those barriers persist, the social,

democratic, and participatory value of visioning processes will be curtailed, and their strategic value for decision-making will be drastically reduced, due to the limited capacity to incorporate disruptive views. As a result, linear thinking will continue to dominate, reducing the usefulness of transport scenario building.

To address these challenges, this paper aims to explore the following research question: To what extent can the use of wild cards stimulate a more disruptive thinking in participatory visioning? To explore potential answers, a specific region in the Metropolitan Area of Madrid (the Henares Corridor) provides the empirical focus. In a first step, a total of 129 participants were engaged via semi-structured interviews to construct a desirable future vision on transport and land use by 2050. In a second step, the same participants were asked to distort their desired future vision according to six context-based wild cards, guiding participants to visualise additional endpoints outside of their comfort zone. The visioning exercise resulted in seven 2050 visions: one desired vision plus six wild card visions. Then, the level of disruptive thinking reached during the visioning process was evaluated by a group of 21 experts.

The remainder of the paper is organised as follows. Section 2 outlines the theoretical background and the working hypothesis. Section 3 provides details on the research design, including a description of the case study. Section 4 summarizes the main results. Finally, Section 5 closes with concluding remarks and reflections.

2. THEORETICAL BACKGROUND AND WORKING HYPOTHESIS

Current participatory approaches in transport scenario building usually do not generate radical, anomalous, and low predictable visions. A group of authors have used workshops and focus groups to stimulate open and deliberative visioning processes (Banister and Hickman, 2013; Hickman and Banister, 2007; Hickman et al., 2009), rather than implementing more-restricting methods (e.g., questionnaires). However, the obtained long-term visions are still very close to the business-as-usual (BAU) projection, being strongly focused on linear thinking. To overcome this limitation, Tuominen et al. (2014) involved young participants during the visioning stage, resulting in more "original" visions. Soria-Lara and Banister (2017b) also evidenced the higher capacity of younger and non-expert participants to visualize more disruptive visions compared to highly experienced professionals, adults, and seniors.

Traditionally, Delphi techniques, in-depth interviews, and workshops have been used for participatory visioning. The dominance of a consensus-based approach limits the chance to incorporate outliers and divergences. Delphi techniques usually build future visions by carrying out several rounds of questions, where experts are informed about the main agreements reached in past participatory rounds (Mason and Alamdari, 2007; Melander, 2018; Shiftan et al., 2003; Zimmerman et al., 2012). When other more open participatory

methods are used (e.g., in-depth interviews and workshops), only highly frequent and common thoughts remain in the obtained visions, limiting the incorporation of "outside-the-box" thinking into the process (Soria-Lara and Banister, 2018b). Other aspects impeding disruptive thinking are the use of BAU projections to orient participants during visioning processes (Julsrud and Uteng, 2015; Piecyk and McKinnon, 2010; von der Gracht and Darkow, 2016), and the construction of a single long-term vision instead of a wide range of options (Mason and Alamdari, 2007; Schuckmann et al., 2012; Trolley et al., 2001).

It is believed that utilizing wild cards –low probability and high impact processes- in participatory visioning processes can break down the abovementioned barriers and stimulate inventive, non-traditional outcomes in participatory visioning exercises. Traditionally, wild cards have been used to analyse unexpected future trends (Barber et al., 2006) as well as to test the stability of future visions in light of external and internal interferences (Steinmuller, 2004). For example, four different wild cards are used to test the robustness of long-term visions in the framework of the European Spatial Planning Cohesion Policies (Dammers, 2010). In the particular context of transport scenario building, Hauphman et al. (2015) explore fourteen technological, geopolitical, and societal wild cards, analysing their likelihood of occurrence and potential effects. Walsh et al. (2015) also use wild cards as a destructive test to evaluate the behaviour of future transportation infrastructure systems. Finally, Von der Gracht and Darkow (2010) extract wild cards from a Delphi process and deploy them to visualise long-term transport logistics futures by using divergent views in combination with desk work. However, the mentioned authors do not test the level of disruptive thinking reached for each vision.

The basic hypothesis underlying this paper is that wild cards can be used to stimulate thinking outside of the BAU zone during participatory visioning processes. Specifically, wild cards could be useful for interrupting linearity in the participants' visioning processes, resulting in more-disruptive outcomes (Figure 1). The confirmation of this hypothesis –even partially- can show useful and practical lessons for decision-making and planning processes.
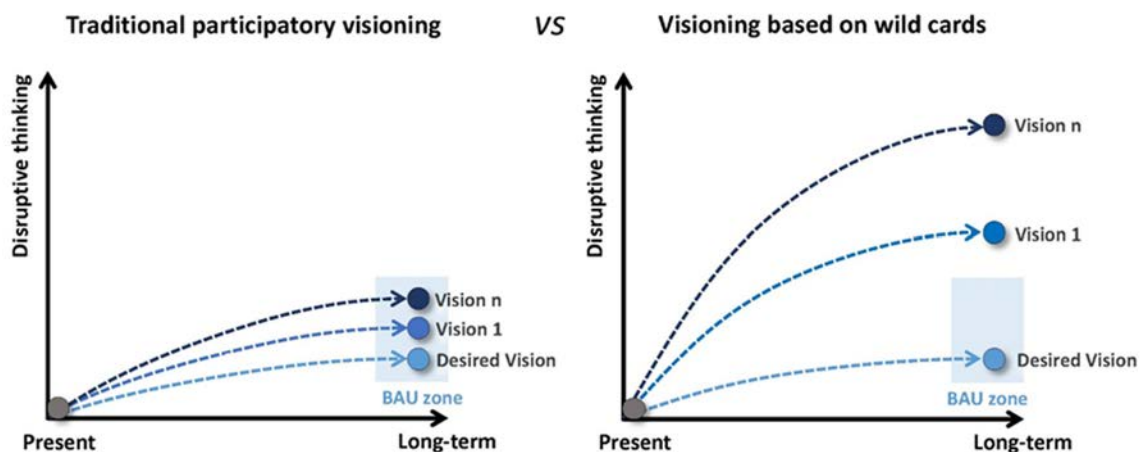

Figure 1: Working hypothesis

3. RESEARCH DESIGN

Our participatory visioning approach entailed three-stages:

- Case study and wild cards selection:
- Construction of 2050 visions and sample characteristics:
- Evaluation of disruption of 2050 visions.

3.1 Case study and wild card selection

The Henares Corridor (approx. 50 km) is located in the east part of the Metropolitan Area of Madrid (MAM) in Spain, connecting the cities of Madrid (3,223,334 inhabitants) and Guadalajara (255,336 inhabitants). More than a million people live in the 17 municipalities located in the Henares Corridor (INE, 2021). It is one of the most industrialised places in the MAM, originating a relevant number of commuters (Barreira-González et al., 2019; Cantergiani and Gómez-Delgado, 2018).

A set of context-based wild cards have been identified to confirm/deny our working hypothesis. Specifically, the research team identified six wild cards (table X) that would disrupt the BAU projections in official planning documents for the case study. The level of context-based surprise originated by those six wild cards was also discussed, identifying two different types:

- imaginable processes: possible surprises in the short and long term
- unimaginable processes: highly improbable surprises in both the short and long term.

Imaginable processes	Unimaginable processes
Zero-emission vehicles: Fossil fuel–powered vehicles will be fully prohibited in the case study, including individual and collective transport modes.	*Shared motorized mobility dominates:* Individual car ownership will be fully prohibited, and only shared motorized mobility can be used in the case study.
Non-motorized city centres: City centres along the corridor will be exclusively limited to active mobility (walking and cycling) and certain collective transport modes. Access to city centres by car will be fully prohibited.	*Overpopulation:* Natural disasters triggered by climate change will originate strong migratory movements from other geographical latitudes to European countries, resulting in a 200% population increase in the Henares Corridor.
E-working dominates: E-working will be implemented for all jobs where physical presence is not required.	*High levels of insecurity in urban areas:* The public space will become very insecure due to high social inequality rates. Walking, cycling, and motorbiking are not advisable actions.

Table 1: Wild cards selected.

3.2 Construction of 2050 visions

Semi-structured interviews were conducted to construct 2050 visions on transport and land use, totalling 129 valid interviews. Each semi-structured interview consisted of four-time blocks. In the first block participants provided socio-economic details (e.g., age, gender, frequent transport mode). In the second block participants shared their desired 2050 vision on transport and land use for the case study. They were asked to visualise an ideal workday in 2050. According to that imaginary day, they had to openly respond to the following questions:

- How do you see covering your daily travels to work, leisure, and shopping on this imaginary day?
- How does the neighbourhood you live in look like?

The third block of the interview focused on distorting the 2050 desired vision generated in the second block, by using the imaginable processes detailed in Section 3.1. First, participants had to select the most disruptive of the three imaginable processes (Table 1), according to their individual opinion. Second, participants had to respond to the same questions from the second block of the interview, conditioned by this imaginable process. Finally, the fourth block of the interview focused on distorting the 2050 desired vision generated in the second block of the survey, by using the unimaginable processes detailed in Section 3.1. First, participants had to select the most disruptive of the three unimaginable processes previously presented. Then, participants had to respond to the same questions from the second block, conditioned by this unimaginable process.

In summary, each semi-structured interview provided a total of three individual visions per participant: desired vision (block 2); vision based on one imaginable process previously selected by the interviewee (block 3); vision based on one unimaginable process previously selected by the interviewee (Block 4). Then, those individual visions were codified and added to other individual visions to obtain collective 2050 visions. Each collective vision was translated into a specific narrative, with seven narratives in total: the 2050 desired vision plus six 2050 wild card visions (three visions based on imaginable processes and three visions based on unimaginable processes). To provide legitimacy over the process, the sample target included members from both the public and professionals from a wide range of sectors. All selected participants were younger than 32 years old, i.e., those who would be at most 65 years old by 2050, the visioning horizon.

3.3 Evaluation of disruption of 2050 visions

To analyse to what extent this participatory approach can stimulate non-linear thinking, the seven 2050 visions were evaluated by a group of 21 experts in innovation, strategic decision-making, and creative thinking. The aim of the evaluation was to grade the seven 2050 visions according to their disruptive thinking level. The evaluation was completed via an on-line questionnaire, based on asking the expert to indicate whether the 2050 visions were:

- non-disruptive
- somewhat disruptive
- disruptive
- very disruptive
- highly disruptive.

Descriptive analysis based on the frequency of responses were used to evaluate the level of disruptive thinking reached by each 2050 vision.

4. RESULTS

4.1 The desired collective vision for 2050

Based on participant responses, the narrative for the desired vision could be formulated as follow:

This vision relies on decreasing the level of transport emissions; however, the daily modal split remains largely unaltered. Cleaner private vehicles dominate work commutes, while fossil fuel–powered vehicles are not fully replaced. E-working is seen as a marginal option and walking and cycling are the preferred modes for shopping and leisure activities. A relevant percentage of vehicles are autonomous. Cities have reduced the distances between residential, shopping, and leisure places – by high levels of mixed-use planning and by connecting amenities in a dense network of green corridors. However, workplaces are far away from residential areas and are still mainly located in the city's periphery. Both residential and work areas are connected by car infrastructures and efficient public transport services.

4.2 Visions based on imaginable processes

Based on participant responses, the narrative for the "zero-emission vehicles" 2050 vision could be formulated as follows:

The vision relies on a fundamental technological change – the prohibition of motorized vehicles that are not zero-emission vehicles. However, it does not bring about a drastic change in the daily modal split. Zero-emission vehicles (collective and private) are the main mode for reaching daily work destinations. E-working is seen as a marginal option, while walking and cycling are the desired mode for reaching shopping and leisure activities. A relevant percentage of vehicles are autonomous. Also, car-sharing has a substantial share in personal mobility. Cities should provide for shorter distances between residential, shopping, and leisure places, requiring areas with a high mix of those activities and connected each other by a dense network of green corridors. Workplaces are mainly located in the city's periphery and far away from residential places. Both residential and working areas would be connected by car infrastructures and efficient collective transport services.

According to participant responses, the following narrative was constructed for the imaginable process "non-motorized city centres":

This 2050 future is fundamentally based on the full restriction of private vehicles access to city centres. All public space in city centres is recovered for active mobility – with the exception of public transport road space and platforms – and for the creation of socialization spaces (e.g., parks, leisure areas). That would increase walking and cycling levels to all daily destinations (work, shopping, and leisure activities). E-working is seen as a marginal option. The restriction of private vehicles access to city centres would severely limit both the rollout of autonomous vehicles and the promotion of car-sharing services. There would be a preference for cities that offer a high mix of residential, shopping, leisure, and working places, reduce the distances between those activities and foster active mobility patterns. Consequently, working places would be transformed into more mixed-use areas. A dense network of green corridors will connect different places of the case study.

The following 2050 vision can be generated according to the wild card "e-working generalization":

This 2050 future is distinguished by the e-working generalization, with all jobs not requiring physical presence. That would initiate a change in modal split patterns, increasing walking and cycling levels for daily destinations such as shopping and leisure activities. Car ownership rates would drastically decrease in favour of car-sharing solutions. Moreover, a percentage of vehicles would become autonomous. People would still prefer to live in the city's periphery, but in mixed use neighbourhoods marked by shorter distances between residential, shopping, and leisure places, triggering an increase of active mobility. A dense network of green corridors will connect residential, shopping, and leisure activities. Current workplace destinations would be transformed into mixed use locations, as most of workplaces would be located at individual households or other community (co-working) locations.

4.3 Visions based on unimaginable processes
Based on participant responses, the following narrative has been elaborated according to the wild card "Overpopulation":

This 2050 vision would trigger changes in modal split patterns, with increased use of collective modes for work commuting and increased walking and cycling rates to shopping and leisure locations. Car ownerships rates would decrease in favour of a generalization of car-sharing habits. E-working would be seen as a marginal option. There would be a preference from high-income families to live in the city periphery and in low density places, but with a high land use mix. Current work areas – located in the city's periphery – would be transformed into more multifunctional places. Low-income

families would prefer to live in high-density areas in city centres. A dense green network of corridors would connect different places along the case study.

The 2050 vision based on the unimaginable process "shared motorized mobility dominates", could be formulated as follows:

The future vision relies on a fundamental travel behaviour change, based on the prohibition of individual car ownership and the generalization of shared motorised mobility. Public modes would be the preferred option for reaching daily destinations – working, shopping, and leisure activities. Walking and cycling would be also a preferred mode, fundamentally for shopping and leisure trips. The use of car would be drastically limited to shared services. E-working would be seen as a marginal option. There would be a preference for living in city centres with shorter distances between residential, shopping, and leisure places. The built environment would provide these activities in mixed use location, connected by a dense network of green corridors. Workplaces – mainly located in the city's periphery – would remain far away from residential areas. Both residential and work areas would be connected by efficient collective transport services.

Finally, the third unimaginable process, "high level of insecurity in urban areas", led to the following vision:

The visualised transport future is strongly affected by a high level of insecurity in urban areas. Walking and cycling are not advisable. The modal split would be drastically altered, with the private car dominating all daily trips –work, shopping, and leisure. There would be also preferences for increasing the level of car sharing, as well as for the promotion of clean and autonomous vehicles with zero emissions. Public green areas would be removed and recovered for car infrastructures. There would be a preference by high-income families for living in the city periphery in private communities. Land uses would be highly segregated in homogenous areas connected by motorized infrastructure. City centres would be mainly transformed into work destinations, with most employees commuting from the city's periphery. Low-income families would also tend to live in those insecure city centres.

4.4 Evaluation of disruptive thinking

The expert evaluation provides new insights into the basic hypothesis underlying this research, i.e., that different types of wild cards can be used to stimulate thinking outside of the BAU zone during participatory visioning processes. This working hypothesis was confirmed when unimaginable processes were used; however, some problems were noted in the 2050 visions based on imaginable processes.

The evaluation shows how the most disruptive 2050 visions – compared to the common 2050 desired vision – were those generated by using the following unimaginable processes "high level of insecurity in urban areas" and "shared motorised mobility dominates" (Figures 2 and 3). More than 90% of experts find that the 2050 vision "high level of insecurity in urban areas" is disruptive, very disruptive, and highly disruptive. Additionally, almost 70% of experts indicate that the 2050 vision "shared motorised mobility dominates" is disruptive and very disruptive. However, different results are found for the third vision generated through the other unimaginable process "overpopulation", where only 43% of experts signal this vision as disruptive and very disruptive.

Although multiple reasons can explain the previous results, one relevant aspect should be emphasized. The two most disruptive visions ("high level of insecurity in urban areas" and "shared motorised mobility dominates") were obtained from smaller portions of the sample of participants who selected those unimaginable processes during the interview process. Moreover, the socio-economic characteristics of these two sub-samples are highly homogenous unlike the population that selected "overpopulation". For example, employed people older than 25 years who travel daily along the corridor in public transport modes were the group that selected "shared motorised mobility dominates" during the interview. In the case of "high level of insecurity in urban areas", it was a majority of women younger than 25 years who travel daily along the corridor in public transport modes. In both cases, these sub-samples had divergent opinions regarding those participants selecting "overpopulation" during interviewed. In other words, smaller population sub-groups seem better equipped to generate divergences and disruptive thinking.

In the experts' opinion, the level of disruption reached by those visions generated on imaginable processes is more similar to the disruption level perceived for the 2050 desired vision (Figures 2 and 3). In all the three cases (non-motorized city centres; zero-emission vehicles; e-working dominates), only a percentage of experts lower than 52% signal these 2050 visions as disruptive, very disruptive, and highly disruptive. Even, the 2050 vision generated by the imaginable process "e-working dominates" is recognised as disruptive by a lower percentage of experts (33%) in comparison with the desired vision (43%). These assessments can indicate higher probability to generate disruptive thinking among participants when highly surprising factors (as unimaginable processes) are incorporated in the process, as participants are largely used to visualize short-term futures and are strongly affected by linear thinking. Nevertheless, it is worth mentioning that the most disruptive level of thinking has been found for the vision generated through the imaginable process "non-motorised city centres", which is selected by a minority of participants during the interview process (20% of participants). That reinforces the findings obtained for the visions generated through unimaginable processes, smaller sample sub-groups can have more divergent opinions on transport and land use futures.
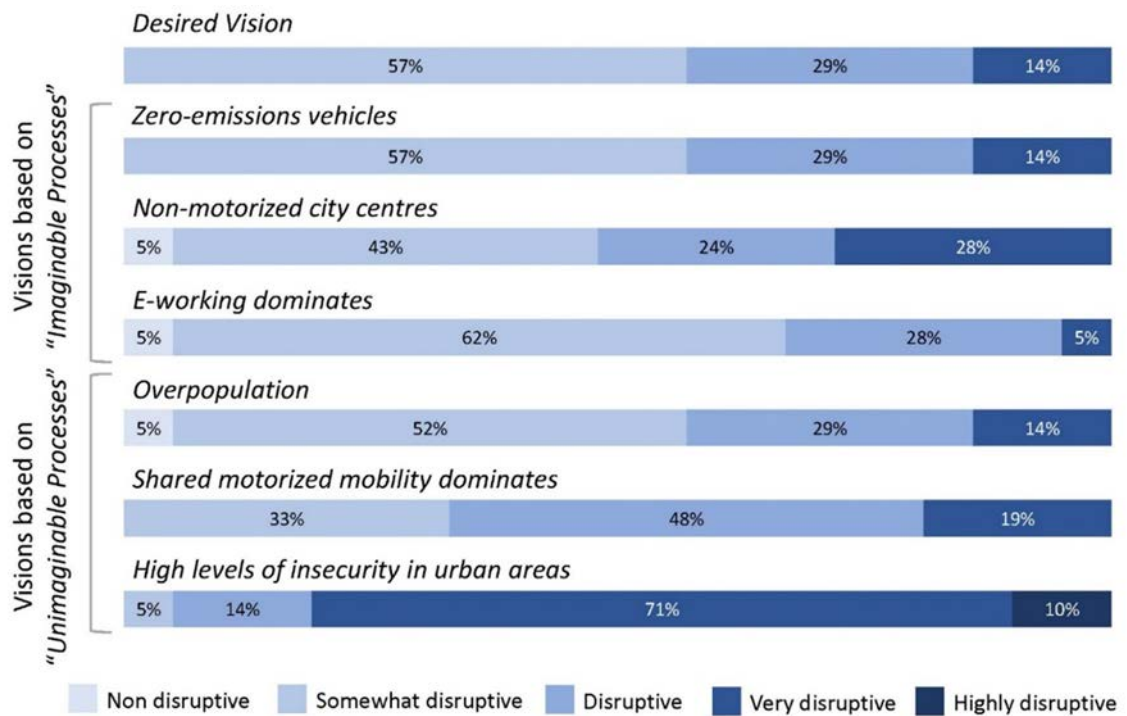
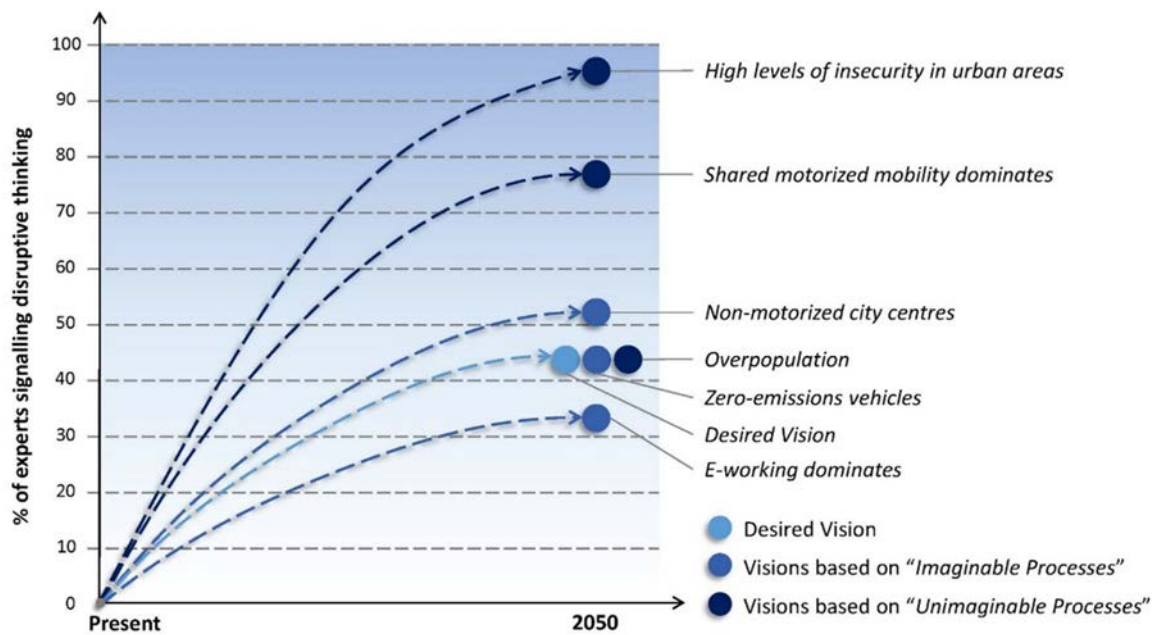**Figure 5: Percentage of experts identifying levels of disruptive thinking.**

Figure 6 – Level of disruption identified by experts for each 2050 visions.

5. CONCLUSIONS AND DISCUSSION

In the reminder of this Section, a set of issues, limitations, and emerging questions are presented, discussing which elements of the visioning process have worked well (or not), and why. The purpose is to comment on what has been learned to distil some "prescriptions" for research and decision-making.

The visionary participants were local people between 18 and 32 years old. That is a convenience sample that allows the research team experimenting with a group of participants that can initially have more willingness to visualise futures under wild cards conditions. The limitation is that it would be impossible using the obtained 2050 visions in a real decision-making process, because it is unknown of what population this sample is representative. However, this convenience sample provides the research team with a more controlled environment to prove causality associated with the working hypothesis. Of course, further research steps are needed to distil usable "prescriptions" for thinking disruptively in decision-making, in which the control level of the research environment decreases, and the visionary participants are engaged according to the canons of probability sampling.

The research design opted for larger samples, engaging one of the highest number of participants in the field of transport scenario building. Larger samples would facilitate the emergence of smaller groups of participants with divergent views able to select the widest range of wild cards. For both imaginable and unimaginable processes, the most disruptive thinking (compared to the desired common vision) was obtained for those visions triggered by wild cards selected by a minority of participants. Moreover, those smaller sample sub-groups have tended in our context to be homogeneous regarding certain socio-economic characteristics. In this respect, most of participants selecting "shared motorised mobility generalization" were older than 25 years old, employed, and frequently used public transport modes to travel along the case study. The unimaginable process "high level of insecurity in urban areas" was mostly selected by women younger than 25 years old that frequently use public transport modes to travel along the case study.

The main limitation of semi-structured interviews is the null capacity of participants to interact with each other, missing the opportunity to activate learning processes. Both the structure and further analysis of semi-structured interviews in different blocks and phases, including multi-options to add several wild cards, facilitated the capture of minority views and their translation into narratives. It was seen how these minority views usually brought by homogenous group of populations resulted in higher level of disruptiveness. The comparison of a 2050 desired vision vs six wild cards visions has been conducted in this study. An alternative option is to run several visioning exercises separately, some of which had wild cards and some of which did not (control group). That would facilitate to gain additional and stronger insights into the capacity of wild cards to add non-linear thinking.

The use of wild cards proved useful for generating disruptive thinking between participants when unimaginable processes were used. However, imaginable processes provided 2050 visions with similar level of disruption as the common desired vision. This finding implies that highly surprising factors are needed to generate disruptions and break linear thinking. In this respect, using a wide range of wild cards can be crucial for two main reasons. First, the probability to generate disruption is higher as a larger number of highly surprising factors will be on the table. Second, larger numbers of wild cards can increase the chances to

generate divergences between participants. In this respect, it is key that participants are forced to choose between wild cards rather than to visualize futures for all of them. Having to choose between wild cards triggers divergences, as proved during the participatory visioning presented in this research. Moreover, the choice of participants between different types of wild cards have served to incorporate outlier views from participants, represented by those wild cards selected by a minority of participants.

This participatory visioning provides decision-making with the option to incorporate unexpected incidents/processes but high impact in planning processes. It can contribute to define a more strategic vision of planning goals that include possible threats and/or accelerators originated by wild cards visions. For example, the COVID-19 crisis during 2020 underlines the importance of incorporating more diverse and non-linear visions into decision-making. Further steps are still needed to distil useful practice tools by using wild cards. This participatory approach that engages the widest range of participants provides legitimacy over planning processes. However, it must be said that each participatory process should be customized for each particular situation. Legal barriers and the low commitment of politicians to those participatory visioning exercises are also seen as obstacles to overcome in real practice.

Finally, this research presents a participatory visioning process aimed at evaluating the capacity of wild cards to stimulate disruptive thinking. The results are encouraging – especially when introducing wild cards. Further research could inform how to deploy wild cards more effectively used during transport visioning processes. In this respect, new challenges are related to the development of efficient methods to generate and identify wild cards as well as the design of effective mechanisms to assess the level of disruption generated through the visioning process.

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