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Creating a future that overcomes the digital divide through Scenario Building: strategies for inclusive public transport in the Barcelona Metropolitan Area

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Abstract

Recent technological developments characterizing the mobility sector such as digitalization, smart applications, location-based digital services etc., have been radically altering mobility patterns, with a great potential to improve users' transportation options and experiences. In spite of this fact, some groups – such as people with low levels of education or with low income, elderly people, rural inhabitants, migrants, disabled people etc. – may be vulnerable to exclusion. This paper analyses a foresight activity aimed at co-creating potential inclusive transport scenarios in the metropolitan area of Barcelona, involving key mobility actors. The results include three co-created future scenarios based on the metropolitan context, as well as a set of specific policy recommendation and strategies that can support political planning in the promotion of inclusive public transport models.

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1. Overview and motivation

Scientific and grey literature ((Durand and Zijstra, 2020, Goodman-Deane et al. 2021a; Kuttler and Moraglio, 2020; Loos, 2020; MWC, 2016; OECD 2001; OECD, 2018)), as well as research and national surveys carried out in the framework of the DIGNITY project (Goodman-Deane and Waller, 2022; Hoeke et al. 2020), identify several digital

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gaps, which prove that large parts of population cannot access or properly operate in digital complex systems characterizing current transport services, lacking the means or the required knowledge and skills. Consequently, a considerable percentage of population currently not only is not able to take fully advantage of novel digital transport services, but also the trend towards massive digitalization is progressively increasing their risk of exclusion (Groth, 2019; Van Dijk, 2020).

Understanding and promoting the aspects related to the integration of inclusiveness in digital mobility services is one of the research objectives of the DIGNITY H2020 initiative (DIGNITY, n.d.), a European initiative funded as part of the European Union's Horizon 2020 research and innovation programme. The initiative aims to develop a framework to make digital mobility services inclusive over the long term. The project involves four pilot studies in sustainable and inclusive mobility solutions in four partners countries Belgium, Italy, Spain and The Netherlands. This paper reports on work from one of these pilots, conducted in the Metropolitan Area of Barcelona (AMB) in Spain. Extensive information on this local initiative can be find in Roca Bosch et al. (2021) and Wybraniec (2021).

With the aim of promoting inclusiveness in the mobility sector, the DIGNITY approach combines proven inclusive design methodologies – such as the Inclusive Design Wheel of the University of Cambridge – with the principles of foresight analysis to examine how a structured involvement of all actors – local institutions, market players, interest groups, and end-users – can help to bridge the digital gap by co-creating more inclusive mobility solutions and by formulating user-centered policy frameworks. This research work particularly focuses on the analysis of the results of foresight activities in a local demonstration of the project; specifically, the application of a ‘scenario building’ methodology in a pilot case based on the Metropolitan Area of Barcelona.

2. Methodology

The scenario building technique (Aligica, 2005) is a foresight methodology that aims at co-creating and analyzing possible future developments related to transport inclusiveness, and to present them coherently. One or more alternative future situations can be outlined, as well as possible paths that lead to them, showing possible options for future developments. Scenarios help overcome thinking limitations by developing multiple futures and its processes create possible and preferable visions of the future, focused on what might yet be. Besides, scenario development increases the ability of cities and regions to deal with their uncertain environments (Goodspeed, 2020). The scenario approach is not meant to be a way of anticipating the future, but rather provides a foundation for strategic decision making (Shoemaker, 1995), as it increases the ability of organizations and institutions to deal with their uncertain environments. This technique was specifically adapted (Kollosche, 2016; Kollosche and Florian 2021) for the DIGNITY project.

Three scenario-building workshops, integrating representatives of vulnerable-to-exclusion users, transport services operators/companies and the public administration of the AMB, were carried-out during the months of June and July 2021, specifically:

- Workshop 1: Understanding the gap. Key factors affecting digital inclusiveness of public transport (18 attend.)
- Workshop 2: Anticipating the future. Evolution of digitalization and the gap in public transport (20 attendants)
- Workshop 3: Building the future. Guidelines and strategies for a more inclusive mobility (17 attendants)

The workshops were organized by the following entities working in the transport sector:

- Barcelona Regional: a public agency for strategic planning, urban planning and infrastructure created in 1993 and operating in the Barcelona Metropolitan Area.
- The Polytechnic University of Catalunya - BarcelonaTech (UPC): a public institution of research and higher education in the fields of engineering, architecture, science and technology, and one of the leading technical universities in Europe.
- Factual: an innovative mobility private consultancy based in Barcelona and operating in Spain and Europe.

The number of attendants comprises also members of the organizing entities, mainly academics and experts of the transport sector. The entities participants and the responsibility/expertise of the representatives attending the workshops comprises main public actors operating in the AMB, which can be appreciated in Table 1.

Table 1. Entities and responsibility/expertise of attendants

	ENTITY	RESPONSIBILITY/EXPERTISE
ENTITIES OF THE PUBLIC ADMINISTRATION	Barcelona City Council	Digitisation plans and programs
	Barcelona City Council	ICT Agents programme
	Government of Catalonia	Regional Bus & Transport
	Metropolitan Transport Authority (ATM)	T-Mobility implementation
	Barcelona Metropolitan Area (AMB)	Social pricing of public transport
PUBLIC TRANSPORT OPERATORS AND COMPANIES	RENFE - Spanish National Railway Network	Implementation and management of transport technology
	TMB – Metropolitan Transports of Barcelona	Implementation and management of transport technology
	B:SM – Barcelona Municipal Services	Management of Mobility Services
	Factual - Innovative mobility consultancy	Transport on demand + other mobility experiences
REPRESENTATIVES OF USERS AND GROUPS AT RISK	PTP – Public Transport Promotion	Public Transport Promotion Association
	Caritas	Income vulnerability / third sector
	DINCAT - Cognitive Disabilities	Defence of the rights of people with intellectual disabilities
	ACIC - Catalan association for the integration of blind people	Integration of visually impaired people in society
	Barcelona City Council	Advisory Council for Elderly People

Due to the pandemic restrictions, still in place in Spain in that period, the workshops had to be held virtually. A company specialized in facilitating participatory and co-creation activities was hired in order to better engage participants and maximize the impact of the virtual activities. All the activities of the three workshops were designed and prepared with the supervision of such company. Before each workshop, the invited participants received ad hoc materials comprising data and questions relating mobility and digitalization in the AMB. They were invited to reflect on such data and bring their answers or doubts to the sessions. During the workshops, participants decided collectively the working strategies aimed at building the scenarios.

The evaluation of the results of the whole activity is based on an analysis of an online survey addressed to workshops' participants, aimed at assessing the activity in terms of: personal satisfaction, learning and quality of the results, which was sent out to all attendants at the end of the third workshop and which received 17 answers. The survey was comprised of 18 closed-ended questions, mostly employing a 5-point Likert scale from 'strongly disagree' to 'strongly agree', which were complemented with 4 open-ended questions to ask respondents to indicate positive and improvable aspects of the activities, as well as further comments and suggestions. In this paper, the main results of the workshops and some reflections for further application are briefly presented.

3. Results and main contributions

In a first step of the scenario building process a comprehensive analysis of the situational context was conducted. This analysis was backed by detailed data and statistics about mobility in the Barcelona region, public transport use, and the digital mobility environment as well as access to technology solutions by different groups. After collecting a number of influential factors for the mobility sector in the Barcelona region, the workshop group mutually decided on a list of seven key factors. These future projections were then combined to build the basic narrative of three different scenarios, as indicated in Table 2. The final results of the workshops were three scenarios with different storylines, as well as formulated policy recommendations and strategies based on these scenarios.

Table 2. Detail of key future projections related to the different scenarios.

Key Factor	SCENARIO 1	SCENARIO 2	SCENARIO 3
	Continuity	Lost opportunity	World of contradictions
Level of digital competence	The majority of the population is digitally competent	The majority of the population is digitally competent	A fraction of the population is digitally competent
Participation in accessibility policies	Active listening to users	No user participation	User participation
Legislation and regulation of the digital transformation of public transport	Governments establish regulations for the digital transformation of transport, but market dynamics play an important role.	The digital transformation of transport is market-driven	Government establishes regulations for the digital transformation of transport
Level of accessibility	Accessibility to basic services	Low level of accessibility	High level of accessibility
Level of transport use	Balanced level of public transport use (trend modal split)	Increased use of individual mobility	Massive use of public transport
Pace of change and technological transformation	Gradual migration	Rapid and accelerated migration	Gradual migration
Economic context	Economic stability	Economic growth	Economic crisis

3.1 Developed scenarios and policy recommendations

The results include three co-created future scenarios based on the Barcelona metropolitan context, as well as the identification of a set of specific policy recommendation and strategies.

The first scenario was called “continuity” (see details in Table 3) and reflects a general business-as-usual future development, not very much different from the current situation. It implies a stable economic context and a regulation of the digital transformation. Participation policies have improved, but the impact of the economy and the market is still dominant. The mobility sector shows more digital interconnection and a higher level of intermodality with some new modes of transport such as carpooling. The use of public transport has slightly increased thanks to the fact that the government has continued to invest in this field and has implemented policies to promote its use. Still there has not been a quantitative leap leading to a surpass of individual transport. Data privacy is not fully guaranteed and there is digital exclusion of certain groups of the population.

Table 3. Details of the scenario ‘Continuity’.

KEY FACTOR	PROJECTION	DESCRIPTION
Level of digital competence	The majority of the population is digitally competent	The majority of the population has a sufficient level of digital competence and correctly uses ICTs in their interactions with government services, public transport and most of the commonly used applications. As such, exclusion due to lack of digital competence is rare and is limited to only some sections of the population.
Participation in accessibility policies	Active listening to users	Government, operators and developers take the needs of all types of users into account, through design processes that allow them to play an important role in the design.
Legislation and regulation of the digital transformation of public transport	Government establishes regulations for the digital transformation of transport, but market dynamics play an important role.	Regulatory scenario similar to the current one. Different governments set certain guidelines, but the guidelines are insufficient due to the prevalence of market dynamics in the provision of services, public transport in general and digitisation in particular. Improvements are gradually being incorporated, but there is no budgetary guarantee for digitisation and it is difficult for service providers to make progress. Users’ purchasing power influences and determines access to many digital services. The government does as much as it can, as does the private sector, as long as it is profitable for them. Some risk of exclusion due to the banking services involved in the system. Data privacy is not 100% guaranteed.

Level of accessibility	Accessibility to basic services	Accessibility is only guaranteed for the most necessary services. Other complementary services are often not universally accessible.
Use of public transport	Balanced level of use	Trend and stable modal split (PT 20%, PV 33% Active mob. 47%), with small increases in PT to the detriment of PV. There is investment in improvements, but the structural economic deficit suffered by collective public transport (CPT) makes it difficult to invest heavily in improvements that would enhance the level of use.
Pace of technological transformation	Gradual migration	Migration to new ways of relating to technology in the field of mobility occurs gradually, without major cognitive ruptures for the general population.
Economic context	Stable	Stable with moderate investments in new digital and accessible products as well as in CPT infrastructure.

The second scenario has been titled “lost opportunity” (Table 4). In this scenario economic growth has not led to a higher level of accessibility or sustainability in the mobility sector. Governments play a rather weak role here and have not been able to counteract the trend towards increased individual mobility after the pandemic. The private transport sector has increased to the detriment of collective transport. Public-private partnerships have not produced satisfying results. There’s still a lack of inclusiveness, data is not managed transparently and the lack of governance leads to several different issues. Profit-driven market dynamics have not been able to increase accessibility for users with specific needs. Instead, service providers focus on the most profitable population groups.

Table 4. Details of the scenario ‘Lost opportunity’.

KEY FACTOR	PROJECTION	DESCRIPTION
Level of digital competence	The majority of the population is digitally competent	The majority of the population has a sufficient level of digital competence and correctly uses ICTs in their interactions with government services, public transport and most of the commonly used applications. As such, exclusion due to lack of digital competence is rare and is limited to only some sections of the population.
Participation in accessibility policies	No user participation	Users are not involved in the design and implementation of digital accessibility policies. User diversity is hardly considered.
Legislation and regulation of the digital transformation of public transport	The digital transformation of transport is market-driven	Little regulation of the digital world by government. Each business/operator establishes the level of accessibility of its digital services to suit its target audience. Interfaces are designed for the general population with some digital competences. The mobility market is always changing. Modes of transport, operators and mobility aggregators appear and disappear. Transport operators work with narrow margins and compete with each other for customers, focusing on the most profitable niches: middle class, city centres, etc. Areas with less demand and sectors of the population with specific needs are neglected.
Level of accessibility	Low level of accessibility	Most services and/or ways of accessing them are not universally accessible, which makes them difficult to use.
Use of public transport	Increased use of individual mobility	Mobility by public transport is decreasing. (PT 15%, PV 38% Active mob. 47%). The causes may be diverse (pandemic, emergence of new forms of mobility, worsening of the CPT service, etc.). Aggravated economic deficit of the CPT. Withdrawal of investment. Investment limited to basic maintenance, no improvements.
Pace of technological transformation	Rapid and accelerated migration	Rapid and sudden changes. The causes may be varied (due to a desire to accelerate the process, unexpected external events, market dynamics, etc.). It forces the population to adapt quickly, with possible traumatic effects for some groups.
Economic context	Economic growth	A time of economic expansion It facilitates investment by government and businesses in terms of digitisation and accessibility.

In the third scenario, the “world of contradictions” (Table 5), the global context is one of climate crisis, economic crisis and increasing social inequalities. Governments have tackled most pressing issues with restrictive policies on the use of private vehicles, making the use of public transport much more favourable. The government is also actively

involved in regulating the digitisation of transport, with a high level of accessibility for all population groups and the introduction of several new digital services. Despite these efforts, the results can still be improved and there is more room for improvement regarding the digital competence of the population.

Table 5. Details of the scenario ‘world of contradictions’.

KEY FACTOR	PROJECTION	DESCRIPTION
Level of digital competence	A fraction of the population is digitally competent.	Only a minority of the population feels able to interact effectively with government, modes of transport and the most common basic services using ICTs. The low level of competence may be caused by different aspects, such as a lack of training, rapid technological evolution, no need for use, etc.
Participation in accessibility policies	User participation	Users participate in the design and application of digital accessibility policies. The needs of different users are considered in a moderate way.
Legislation and regulation of the digital transformation of public transport	Government establishes regulations for the digital transformation of transport.	The government actively regulates the mobility market. It also regulates new forms of mobility. It intervenes in the supply, guarantee and quality of service provision (timetables, coverage, security, data privacy, attention to the diversity of users, etc.). Legislation obliges governments to invest in incorporating inclusion and accessibility standards into the digital world. Given the guarantee of the services provided by the government, users' purchasing power does not determine their access to these services.
Level of accessibility	High level of accessibility	All services are available to all types of users.
Use of public transport	Massive use of public transport	Governments are tackling the climate emergency in a decisive and ambitious manner. Public transport is the backbone of metropolitan mobility, with a majority modal share. (PT 27%, PV 23% Active mob. 50%). Governments and operators invest heavily in the improvement and modernisation of the system. Policies are implemented to limit the use of private transport (urban road tolls, pre-paid permissions, parking regulations, etc.). Fares are simple and appropriate for the population. A leap in the number of public transport users.
Pace of technological transformation	Gradual migration	Migration to new ways of relating to technology in the field of mobility occurs gradually, without major cognitive ruptures for the general population.
Economic context	Economic crisis	Government and business withdraw investment from services that are not profitable in the short term.

Based on these three scenarios different policy recommendations and strategies were discussed and outlined within the workshop group. Specifically, the working group supported unanimously the promotion of a set of recommendations aimed at improving the inclusiveness in mobility, regardless the scenario developed. Specifically:

- Strong political commitment on public transport and its accessibility. Prioritization of public transport and other complementary sustainable modes.
- Legislation for universal accessibility on public transport from a digital point of view, so that this aspect is above market dynamics. Ensure compliance from framework policies to the design and certification of specific solutions.
- Digital integration of the different public transport services, with all the necessary actors, in order to facilitate access to the system. Implement the concept of Mobility as a Service (MAAS). Anticipate and plan different formats of access, so that they can be useful to the diversity of users.
- Co-creation of public policies with the users throughout the cycle process, so that the design of solutions is user-centered.
- Transparency and public control of data linked to transport digitization processes. Transparent change management and public leadership.
- Simpler and customizable fare system, to facilitate access to public transport.
- Universal guarantee of rights in accessibility. Link to basic income policies to ensure that the most vulnerable citizens have access to digital tools.
- Face-to-face assistance. Ensure that some of the access formats to the services offered by public transport involve face-to-face and personalized attention to the user. This assistance which can be used to manage specific aspects or also to help training in digital skills.

- Awareness and dissemination. Establish awareness-raising mechanisms to facilitate integration of people with difficulties into the transport system. Disseminate accessibility policies through campaigns.

The diversity of the participants (public administrations, transport companies, users, academics/experts etc.) was seen as a key factor to obtain representative conclusions, while creating policy recommendations and strategies. A deep reflection on possible future scenarios was key to formulate agreed policy recommendations.

3.2 Assessment of the activity

Overall, 94% of the respondents have been highly satisfied of the workshops in terms of quality of the organisation and support provided by the organisers. Besides, 94% also agree on the fact that all relevant stakeholders were present at the workshops. As regards the learning aspects, 77% indicate that their understanding of mobility future challenges has greatly improved after the activities and that the scenario building process provided new knowledge and perspectives on digital inclusion in mobility. Furthermore, it is worth highlighting that 82% of the respondents consider that they gained a better understanding of the perspective of the other stakeholders attending the workshops. The perception of the quality of the results of scenario building activities, namely the three scenarios developed, is overall very positive. In this regard, 71% of the respondents indicate that the scenarios created are plausible and realistic and that the policies and 88% that the strategies proposed through the process are relevant for future digitally inclusive mobility systems. In addition, 82% of the respondents state that the scenario building process helped to converge diverse participants' perspective.

Respondents were also asked to highlight positive aspects of the process and those aspects that could be improved. Among positive aspects, it is worth pointing out the importance of reflecting different points of view in the development of the workshops. In this sense, participants stressed the very good representation in workshop activities of the mobility ecosystem of the metropolitan area of Barcelona, including groups at risk of exclusion. Furthermore, focusing on methodological aspects, it was especially appreciated the idea of creating scenarios, as a way to put in practice, in a concrete way, the results of the workshop activities. Regarding the improvable aspects of the process, it was indicated that the working group should include also political representatives, since eventually decision making strongly rely on political will. Besides, respondents pointed out that it should be integrated, as part of the process, a plan of communication and dissemination of the results, aiming at influencing policy makers.

4. Conclusions and future works

In the coming years, the accelerated development of digital mobility tools is likely to lead to an important paradigm shift in travel. While such a shift has potential to improve travel for many, it also has potential to exclude those who find digital tools difficult to access or use for various reasons. This could lead to greater social inequalities that limit social development in all its senses. In addition, it will be important to address particular aspects, such as improvement of public transport for women and older persons, who represent a significant percentage of users.

Significant advance from the present situation, characterized by a large degree of potential exclusion of vulnerable-to-exclusion groups, will be possible only with strong political commitment on the improvement and integration of public transport digital services. Overall, the scenario building technique, applied within the DIGNITY approach, showed that can be an effective methodology to explore future orientation concerning the mobility sector and a way to inform and raise awareness among policymakers and relevant mobility actors about potential challenges and needed future changes. Beyond the specific results of the local demonstration analyzed, the outcomes of these foresight activities can facilitate the anticipation of critical circumstances concerning potentially excluded groups and categories, and can help public administrations and urban planners contributing to the development of robust strategic policies. Besides, this approach promotes the importance of democratizing transportation planning processes and decision making. Future research includes the evaluation of the Scenario Building methodology jointly with other methodologies employed within the DIGNITY approach. Furthermore, group discussion with policy makers on the created scenarios and respective policy recommendations would bring relevant insights to the present research.

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