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# The Digitalisation of Mobility: Insights from the Social Sciences & Humanities on impacts and innovation

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## ABSTRACT

Social Sciences and Humanities (SSH) can play an important role in investigating the impact of digitalisation on the mobility system. While digitalisation has led to the development of new, innovative mobility and logistics services there is an increasing divide between the digital capabilities of many people and the skills that new services require. Emerging methods and approaches developed within SSH can help to bridge this gap by fostering user involvement in development of services and developing tools to assess user needs, assess inclusiveness, and provide recommendations.



## SUMMARY/HEADLINES

- This literature brief focuses on the role of Social Sciences and Humanities (SSH) in investigating how the digitalisation of mobility impacts people.
- Digitalisation has led to the development of new, innovative mobility and logistics services and the accelerated transformation of existing services.
- There is an increasing divide between the digital capabilities of large population groups and the requirements that new applications, services, and interfaces impose on them.
- Social Sciences and Humanities (SSH) can help to bridge the digital divide and accelerate the adoption of new mobility technologies.
- Recent EU-funded projects have established a set of tools and methods that can help to overcome the digital gap in mobility.
- Co-creation and co-design are possible approaches to include vulnerable people in the development of new mobility services.
- Research should, in the future, go beyond just identifying the need for digital inclusion, it should focus on additional aspects such as the impact of the digitalisation of mobility on sustainability, how bottom-up innovations can improve the mobility system and the human rights perspective.

## KEY DEFINITIONS

**Digital mobility services:** Transport services that have a digital interface (smartphone app, website, ticket vending machine, information terminal) through which one or more parts of the travel process can be arranged (booking, payment, information, feedback).

**Digital divide/digital inequality in transport:** “How various levels of engagement with digital technologies in a given context affect access and navigation of transport services” [2, p. 34]

**Community of practice:** A group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly [4].

## Introduction

Mobility communities are groups of individuals utilising particular modes of transport in particular places, and in particular ways. Within the literature brief, focus is placed on the role of digitalisation in mobility and the influence on mobility communities. The ways in which digitalisation provides opportunities for mobility practices, but also reduces

the ability for different cross-sections of society to participate in (digital) mobility communities are discussed.

Mobility services are becoming increasingly digital. Some services (e.g., car sharing, shared e-scooters, public transport ticketing) are already exclusively accessible via a smartphone app or a website, with only electronic payment options. According to the Sustainable and Smart Mobility Strategy of the European Commission, digitalisation and automatism are expected to make transport safer, more secure, more resilient, more comfortable, and more reliable [1]. Yet the strategy also recognises the threat of digital exclusion [1]. **Transport-related digital exclusion** occurs when people cannot access transport services which are exclusively accessible via a digital interface (e.g. app, website) because they lack the motivation, skills (such as being able to use a digital interface) or material access (including having access to a smartphone or computer) [2] not everyone is willing or able to follow the new, more or less formal requirements digitalisation has brought along. Existing reviews on the intersection between Information and Communication Technologies (ICTs). The strategy recognises that digitalisation should not create or reinforce digital exclusion, and mobility should be accessible for all. The European Commission therefore aims to ensure that the digital transition of mobility is socially fair and just using The European Pillar of Social Rights as a “compass” [1].

While the Horizon 2020 and Horizon Europe programmes have invested in research into the technological aspects of digitalisation and automatism, research into the human and social aspects of these technological developments has been neglected [3]. Many questions can be raised about a potential digital gap in mobility. How does increasing digitalisation in transport affect people with limited digital skills or other vulnerabilities? What measures should be taken to avoid that digitalisation leads to social exclusion? How can stakeholders of the digital mobility ecosystem collaborate to develop inclusive and accessible digital mobility services? Addressing these questions requires research where SSH approaches are involved, or even take a leading role.

This literature brief focuses on recent research on the social aspects of the technological transformation of transport, and especially on accessibility and inclusivity in the context of digitalisation. It outlines the state of the art of how SSH approaches can address the digital mobility divide.

## Current understandings

### Significant Findings to Date

The current understanding of the implications of the digitalisation of the transport system on social life, justice and equity is still relatively limited. Research about digital literacy will be key in the introduction of new technologies such as autonomous vehicles and especially cooperative intelligent transport systems (C-ITS) [AB]. Although significant research has been carried out on the topics of transport equity, digitalisation, accessibility and inclusion [2, 5, 6, 7], **very limited research is available explaining the impact of digital transport services on people who are vulnerable to exclusion.** Over the last few years, researchers have voiced their con-

cern about the lack of knowledge about the barriers people experience while interacting with the digital transport system and how these affect a person's mobility and their access to essential social activities [8, 9, 10, 11]. For example, Durand et al. [2] concluded that existing transport inequality, digital inequality and the increased digitalisation of the transport system come together to negatively impact accessibility and inclusivity of mobility.

**Research should go beyond identifying the need for an intervention, such as why we need to address the topic of digital inclusion, to focus on how technology can lead to a better life for people** [FdC]. The capabilities approach [12] offers a powerful theoretical framework to examine this aspect. This approach argues that everyone should enjoy a level of ‘capabilities’ which allow them to fulfil their needs and develop their lives [13]. Martinez and Keseru [14] proposed that the capabilities approach can provide a new way to appraise the inclusiveness of digital transport services by going beyond socio-technical considerations and acknowledging cultural factors. This approach recognises that individual characteristics of people such as gender, age, ethnicity, income, physical or cognitive impairments, education level and residential location are key factors in the adoption of digital mobility services. Nevertheless, it is very often the technology, (e.g., mobile connectivity) that is an overarching barrier to using digital mobility services even in cities [FdC]

Recently, the European Commission has also recognised digital exclusion as a possible side-effect of the digitalisation of the transport sector [15]. **Research has identified the need for a full understanding of the process that leads to digital transport services, i.e., the design, planning, implementation and operation of digital mobility services.** This process must be viewed from a multi-stakeholder point of view. The stakeholders of the digital transport system include developers, operators, policy makers, users and non-users [16]. An SSH-approach can help to bring the stakeholders into the research and development. On the other hand, there is a challenge that SSH researchers are usually not very experienced with technology [FdC].

Several research and innovation projects have been funded under the umbrella of the Horizon 2020 programme that address this issue. The Inclusive Digital Mobility Solutions (INDIMO)<sup>1</sup>, the Digital Transport in and for Society (DIGNITY)<sup>2</sup> and Transport Innovation for Persons with Disabilities Needs Satisfaction (TRIPS)<sup>3</sup> projects improved our understanding of the users' needs and our knowledge about users' requirements towards the digital transport system.

The Dignity project found that people with low education levels, older people, people with disabilities are especially prone to digital exclusion in the transport context [17]. In the INDIMO project, human contact and assistance emerged as key requirements by people in vulnerable situation when using digital mobility services. [18]. The TRIPS project explored the potential of new digital transport technologies in improving accessibility for persons with disabilities. Their findings suggest that a real-time, interactive, accessible journey planner would motivate people with disabilities to travel and make their journey more independent, faster, easier and safer [19].

1 Project website: [www.indimoproject.eu](http://www.indimoproject.eu)

2 Project website: <https://www.dignity-project.eu>

3 Project website: <https://trips-project.eu/>



## Emerging Practices

Several tools have been developed that aim to assess the needs of vulnerable people, the current level of digital inclusion and propose strategies for the various stakeholders to enhance the design and operation of services.

The **INDIMO Inclusive Digital Mobility Toolbox<sup>4</sup>** was co-created with the participation of 72 stakeholders through a series of co-creation workshops and 64 communities of practice events related to the five INDIMO pilots in Madrid (Spain), Antwerp (Belgium), Berlin (Germany), Galilee (Israel) and Emilia-Romagna (Italy). This process is a good demonstration of how SSH and STEM researchers, policy makers and citizens can collaborate in developing concrete solutions (such as apps, software and services) as well as guidelines and strategies [20, 21] user involvement is vital for success. Especially critical is the inclusion of groups vulnerable to exclusion, so they can equally benefit from such services. In this respect, the Inclusive Digital Mobility Solutions (INDIMO). The toolbox supports developers and operators when designing accessible and inclusive mobility solutions by incentivising a user-centric thinking and offering a Universal Design perspective. **The online INDIMO Service Evaluation Tool supports policy makers to evaluate digital mobility solutions and services before their deployment in terms of compliance with the principles with inclusivity and accessibility principles** [16]. The toolbox that also addresses the STEM community, builds on the assessment of needs of vulnerable people through various SSH methods such as semi-structured interviews, qualitative content analysis and communities of practice workshops [16, 18, 21] but at the same time they have also created uneven impacts across society. It is, therefore, the goal of this paper to introduce the online Service and Policy Evaluation Tool (SPET).

The **DIGNITY Toolkit<sup>5</sup>** developed in the DIGNITY project provides a set of tools that help key public and private stakeholders to improve their understanding of the issues that those vulnerable to social exclusion face. The toolkit provides guidelines for methods such as surveys, focus groups, customer journey mapping and also includes a digital gap self-assessment tool, which assesses how the skills and practices of individuals, the market (i.e., the services offered by mobility service providers and the policies of local, regional and national governments) may cause digital gaps in mobility [22]. In order to bridge any potential gaps, the toolkit offers practice-based tools and methods such as the Inclusive Design Wheel [23].

**Co-creation and co-design provide the opportunity to better involve vulnerable people in the design of digital mobility services and applications.** According to Vasconcelos et al., [24], however, a co-design process may also lead to many frictions between the diverse participants. They propose a set of coping mechanisms based on participant feedback to improve the co-design process, such as listening to the needs of the participants, nurturing local variation, integration of multiple methods into the co-design process, and letting people in vulnerable situation to set the agenda of the co-design process through an identity and vision document. Finding the participants of such process, keeping them mo-

tivated and developing a safe space for them is also challenging. Bulanowski et.al. [20] user involvement is vital for success. Especially critical is the inclusion of groups vulnerable to exclusion, so they can equally benefit from such services. In this respect, the Inclusive Digital Mobility Solutions (INDIMO) offers some recommendations based on their experience with the co-creation process of the INDIMO toolkit, including strategies for recruitment, user engagement, and face-to-face interviews. Within these recommendations they stress the importance of a customised approach depending on the target group (e.g., which vulnerabilities) and the local cultural, social and demographic context (e.g., ensuring balanced distribution of participants by age and gender). Hueting et. al. [25] introduced a user-centric approach to design accessible user interfaces and icons for mobile applications that includes user evaluation, co-creation workshops and a user survey.

**To ensure that the local context and stakeholders are involved in the co-creation process, so-called Communities of Practice (CoP) can be established including developers, operators, policy makers, researchers and users (vulnerable to exclusion)** [21]. Communities of Practice are a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly [4]. These CoP's can provide a testing environment where new, inclusive features could be introduced to digital mobility services and tested. Secondly, and perhaps even more importantly, CoPs can provide a safe space for users to voice their concerns and for the other stakeholders to collect knowledge about user groups, interacting with them and co-creating features/recommendations that have a positive effect on the inclusivity and accessibility of a digital transport service [21].

## Future SSH priorities

The need for an inclusive digital transport system cannot be understated, as its effect on the mobility of people vulnerable to exclusion may severely impact their potential to participate in social activities. Although initial research has been conducted, with promising results, there are still several questions that are unanswered.

While previous and ongoing research has explored the needs of vulnerable people towards digital mobility services, **it is still unclear how policies and regulatory frameworks could ensure that existing and new digital mobility services are more inclusive and accessible.**

Co-creation and co-design have been found promising approaches to include vulnerable people in the design process of digital mobility services. **It is, however, still unclear how co-creation and co-design can embrace the local specific context**, i.e., the diverse needs of different groups in vulnerable situation, differences in cultural expectations and in policy frameworks.

Since the digital mobility ecosystem includes multiple stakeholders (including developers, operators, policy makers, and citizens), more inclusive and accessible services can only be developed through better collaboration. Therefore, **new ways of stakeholder engagement are needed, that focus on developing a way to match user needs, business priorities and policy objectives.**

There is the need to consider digital inclusion in transport in the context of frugal innovation, i.e. innovations that use

4 Available at <https://www.indimoproject.eu/indimo-digital-mobility-toolbox/>

5 Available at <https://dignity-toolkit.eu/>



limited financial, technological, material or other resources but the outcome serves the basic needs of the target groups [26] [FdC].

**Gender is an emerging topic in research about digital mobility.** Transport is traditionally male-oriented both for the development of the infrastructure (roads), vehicles (car engineers) and software (IT engineers). Nevertheless, gender should not be considered in isolation, but as part of the overall concept of inclusiveness [AB].

Digital inclusion is also related to overall sustainability as digital services use a lot of energy. Devices such as smartphones contribute to pollution due to their rapid obsolescence and their production is often linked to exploitation of people in developing countries. Therefore, the human rights perspective is also important to investigate [FdC].

**Overall, it is expected that additional SSH research in the inclusivity and accessibility of digital transport services will have a positive effect on people's access to social activities,** it will support the shift to multimodal travel, and it will have a positive impact on carbon emissions, air quality and liveability in general.

## Takeaways

### Takeaways for the European Commission

- Funding needs to be made available for research that focuses on the intersection between digitalisation and mobility, and not only in the context of high-impact technologies (such as autonomous vehicles) but also related to route planners, ticketing, shared mobility and e-commerce delivery services. Funding is also needed to conduct research focusing on the role of gender in digital exclusion in transport.
- Research on digital inclusion/exclusion should be extended to emerging economies, to account for the impacts of digitalisation on human rights, sustainability and bottom-up innovation.

### Takeaways for Stakeholders and Businesses

- There is the need to foster a bottom-up, co-creation approach when planning and designing new mobility services, with this being supported through the provision of guidelines and training. Developers and operators of digital mobility services need easy-to-use guidelines with best practice examples to mainstream inclusivity and accessibility in software and service development.
- The communities of practice method should be embraced through trainings and demonstration of best practices to engage all stakeholders in the development of digital mobility solutions.
- There is the opportunity to provide testing grounds for new inclusive approaches by developing, and undertaking, pilots.

### Takeaways for the SSH CENTRE project

- The digitalisation of mobility provides a good topic for the investigation of how SSH research can provide new insights into people's needs, requirements towards new technology and how collaborative research and innovation (e.g. through co-creation) can contribute to better outcomes. This can be incorporated into through the collaborative projects undertaken as part of "WP2 *Epistemic laboratories for the EU Green Deal*".

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