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Access denied: Digital inequality in transport services

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1. Introduction

Over the past few decades, the adoption and increase in use of digital technologies has become a major trend. This trend is known as digitalisation, affecting everyday lives, organisations and countries globally. Manifestations for the general public include the smartphone revolution, the massive growth in social media use, and the transitions from physical services and infrastructure to internet banking and e-health services for instance.

The transport sector is no exception: digitalisation in transport and travelling is already happening in ways that have transformed how people move around. From multimodal planners to GPS and Mobility-as-a-Service (MaaS), digitalisation has the potential to simplify mobility and to provide greater control and choice to travellers. Yet not everyone benefits from digitalisation to the same extent. Indeed, in order to benefit from services where a connected device is needed as a digital key (e.g. to unlock a vehicle), as a proof of payment or as a travel assistant, one needs to have the appropriate device and digital skills. When the spread of technologies is accompanied or followed by cuts or changes in physical infrastructure or services (e.g. less station staff), not engaging with such technologies might result in a form of exclusion. Eventually, it may increase the risk for transport-related social exclusion, defined by Kenyon et al. (2002) as "the process by which people are prevented from participating in the economic, political and social life of the community, because of reduced accessibility to opportunities, services and social networks, due in whole or part to insufficient mobility in a society and environment built around the assumption of high mobility" (p. 210-211).

The research presented in this paper explores how and why digital transformations in transport services may potentially have exclusionary effects, thereby increasing the risk for transport-related social exclusion. By organising and critically discussing literature on this theme, this research aims to shed light on the existing insights on this theme and to suggest relevant research avenues. To the authors' knowledge, no literature review on this theme exists.

Kenyon et al. (2002) also included the 'lack of access to technology' as a potentially exclusionary factor in general – not in mobility in particular. Research on how various social groups access Information and Communication Technologies (ICTs) (or digital technologies) and how different types of engagement with technology lead to offline social (dis)advantages and social exclusion has existed since the mid-1990s. It is called digital

inequality or digital divide research. In this study, we adopt a cross-disciplinary approach by examining existing knowledge on digital exclusion in transport services and related implications through the lens of digital inequality research. At a time when transport services increasingly rely on digitalisation, we argue that digital inequality research can offer meaningful insights to transport research.

Although digital inequality research initially relied on a binary conceptualisation – namely, those with access to a computer and those without, hence 'digital divide' – it has nowadays a much more nuanced and complex understanding. Personal situation (such as socio-economic and –demographic factors), resources of all kinds (material, time, mental, etc.), physical access to ICTs, ICT-related skills and ICT usage are all traditionally regarded as important factors determining access to ICTs (Van Dijk, 2005). Access to digital technologies is understood here as the whole appropriation of technology, and not only its physical access (*ibid*.).

We focus specifically on digitalisation in (public) transport services, such as public transport and access-based mobility (e.g. ride hailing, car sharing, bike sharing, etc.). We do not focus on privately-owned forms of transport such as private cars, because people have arguably more freedom of choice and control regarding (the pace of) digitalisation in privately-owned modes of transportation than in transport services, where digitalisation is "speeding up" (Canzler & Knie, 2016) and leaves fewer options to travellers.

2. Methodology for the systematic literature review

The nexus between the themes of digitalisation, mobility and social inclusion form the position of this research, as shown in Figure 1.
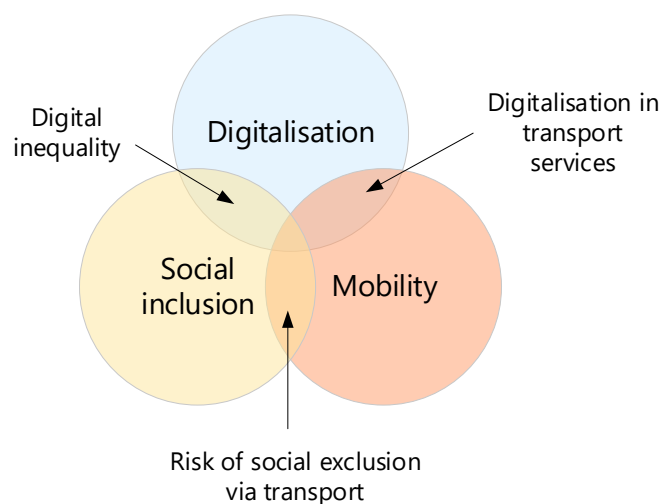

Figure 1: Central concepts of the research

To identify relevant studies, keywords are assigned to each of the themes of this study depicted in Figure 1. The goal is to find papers that address the overlap between all three main themes, i.e. papers that would stand at the centre of Figure 1. We are not specifically interested in the papers found for each theme.

- The keywords are chosen to be broad enough to cover a variety of fields, where scholars may be using different terminologies.
- The departure point for each theme is the keyword shown in Figure 1.
- Known relevant sources were used to add keywords to each theme.

Synonyms, historic terms, antonyms and homonyms for these main keywords were brainstormed, discussed and identified by all of the authors.

Each query is the intersection between one or multiple sets of keywords, as can be visualised in Figure 2.
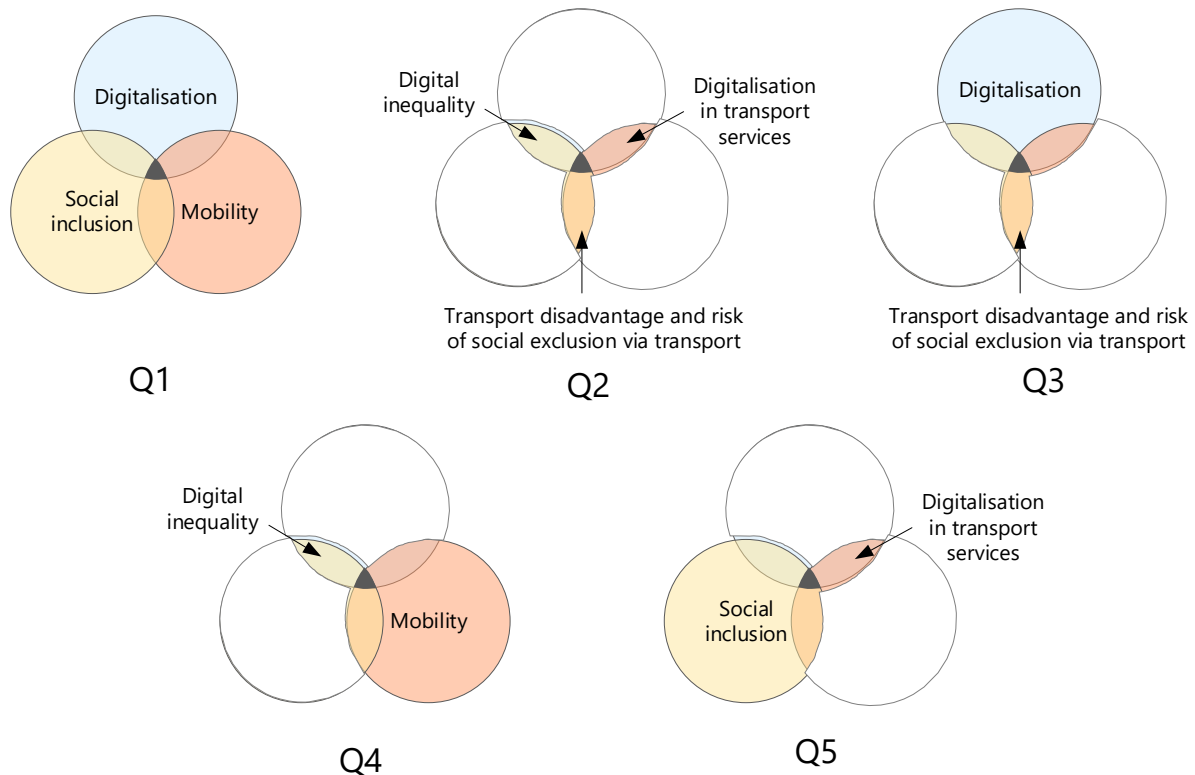

Figure 2: Queries

The list of keywords is not included in this abstract because of the restricted amount of words, but Table 1 shows the amount of keywords (separated by the operator OR) in each theme.

Table 1: Amount of keywords per theme.

Theme	Amount of keywords
Digitalisation	5
Mobility	4
Social inclusion	6
Digitalisation in transport services	13
Digital inequality	11
Transport-related social exclusion	17

The literature review is conducted in English and uses the scientific database Scopus. Titles, keywords and abstracts of journal articles, conference proceedings and book chapters are scanned.

To select papers, the PRISMA guidelines (Moher et al., 2009) are followed, as shown in Figure 3. Given the high amount of studies to screen, the web application Rayyan was used (Ouzzani et al., 2016), allowing for a smoother and quicker screening process. To ensure complete coverage, forward and backward snowball reviews were conducted on the papers found at the Eligibility step, as described by Van Wee and Banister (2016). After reconciliation, a total of 24 articles were included to be analysed.
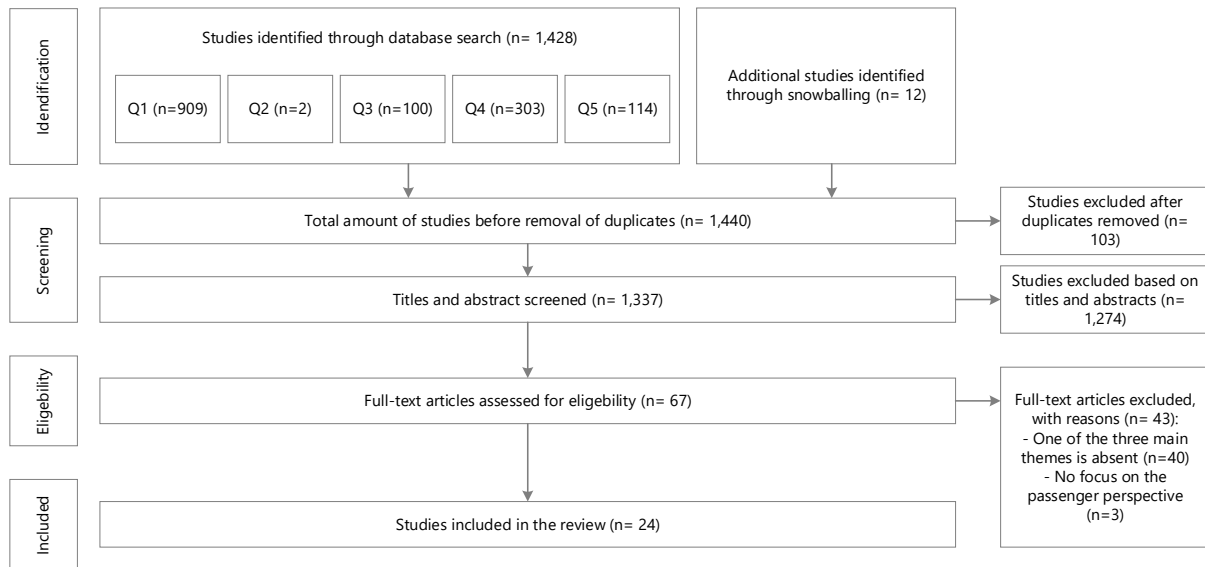

Figure 3: PRISMA flowchart for the systematic literature review (conducted in October 2019).

3. Main results

There seems to be a nascent but growing awareness of digital inequality in transport services, attested by the fact that two thirds of the selected papers are from 2018 or 2019. This section summarises the main findings from the literature review. To preserve a balance between word count and references, only a few of them are cited here, marked with an asterisk (*) to distinguish them from digital inequality studies.

The influential model on digital technology access developed by Van Dijk (2005) (see Figure 4) is used as a starting point to cluster and discuss the themes addressed in literature (see 3.1 and 3.2). At the same time, we also adopted an open-ended approach where other relevant and recurrent themes were included in our main results (see 3.3 and 3.4). Lastly, conclusions pertaining to transport-related social inclusion are presented (3.5).
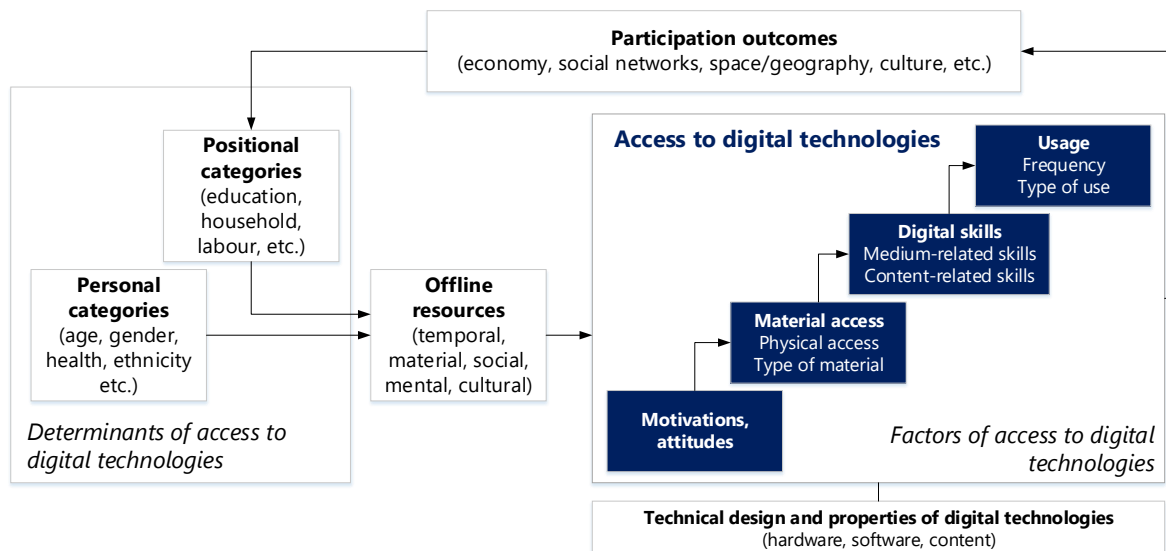
Figure 4: A model of digital technology access (inspired from Van Dijk (2019), based on Van Dijk (2005)).

3.1. Determinants and factors of access to digital technologies

Who is concerned by a digital inequality in transport services?
The selected studies report that vulnerabilities exist along dimensions of age, income level, ethnicity and education level. Half of the studies focused on older adults, perceived as particularly vulnerable. Multiple other complex factors such as learning, and communication impairments are recognised as playing a role in causing or exacerbating the risk to be excluded from digital initiatives in transport services. In general, the selected studies focused on specific groups which are known to be vulnerable because of the difficulties they encounter with ICTs generally and/or because they are more likely to be at risk of transport-related social exclusion. As such, they provide a first idea of who is more likely to be impacted but the overall picture they sketch still lacks nuances, both within groups and among groups.

Motivation to access ICTs
Multiple of the selected studies also mention motivations and attitudes as an entry point to engage with digital technologies in transport services. In general, literature reveals two main reasons for non-use of digital technologies in the context of transport services:
1. A rejection of the technology due to a perceived lack of security (especially with online payments), privacy (e.g. because of the ability of new technologies in transport to track people's journeys) and reliability (of online travel information, of access-based mobility which is relying heavily on digital technologies like ride hailing).
2. The belief that trip planning applications and websites, smartcards and other digital media are not adding (enough) value and/or not interesting. The lack of interest is especially common among generations that are used to travelling without digital technologies.

These two main reasons are closely linked with other reasons, such as a lack of money, social support, time, skills and ability to acquire such skills and the fear to appear foolish.

Material access to ICTs
Material access to technology mainly encompasses the physical access to a computer, a smartphone and the internet. Much like in digital inequality research, the selected studies point at money as a crucial conditional resource for material access. Indeed, while applications are often free or come at a small cost, the device to access them is not free.

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The smartphone is nowadays seen as a core component in transport services. The interviews of Rizos (2010)* with US and Canadian public transport operators revealed that already soon after the first modern smartphone was released (the iPhone in 2007), it was expected that people would "bring-their own access" to travel information. In addition to devices, data plans, a stable internet home connection and maintenance cost money. Owning the device in itself is not enough, as acknowledged multiple times in literature.

Digital skills
In his interviews, Rizos (2010)* noted two conflicting views regarding the future of traveller information systems. The first one saw traditional ways of disseminating information as fundamental (e.g. static information such as prints, call centres) and here to stay, while the second, or so-called 'progressive vision', predicted that smartphone penetration and further developments in transport technologies would make this type of dissemination of information obsolete. Although 'progressive' operators did recognise the existence of a digital divide, there was the belief that the digitally disadvantaged would "catch up" and that smartphone penetration would be so ubiquitous that physical displays would no longer need to be relied upon for information needs. A decade later, smartphone penetration has indeed increased, but this reasoning reveals a fundamental misunderstanding: having or even giving access to the physical technology does not mean that people benefit from what the technology has to offer them. This is also acknowledged in a few of the selected papers. Basic skills are a requirement to operate devices. However, information navigation and critical thinking skills are highly relevant in the context of transport services, where the richness and the fragmentation in terms of information and service provision mean an increase in complexity.

3.2. Technical design of digital technologies

In addition to hardware design potentially excluding people "by design" (through tiny keypads in smartphones for instance), software design is also seen as having the potential to exclude people. Not only may people be excluded from transport initiatives due to a relatively low access to digital technology (Figure 4), but also because commercial transport initiatives that developed their services primarily based on digital infrastructure (such as ride hailing platforms) may shun certain people or neighbourhoods for their lack of profitability. This could happen through self-learning algorithms for instance, that may "forget" to take into account certain neighbourhoods because people there are invisible in mobility data, either because they move in different ways or because they remain immobile due to insufficient resources or physical abilities.

3.3. Digital by default

One of the criticisms of the model of Van Dijk is that motivations are an entry point to access technology. According to Lupač (2018, p. 161), in order to better investigate digital inequalities, it is necessary to assess how indispensable ICTs are in a given context. Two aspects impact indispensability of ICTs in a given field according to him: how embedded these technologies are in everyday routines and in institutions of this field and how available non-ICT alternatives are, taking into account that an alternative costing a lot of extra resources (time, money, etc.) is not necessarily a 'real' alternative. The more indispensable ICTs, the more likely that some people might be excluded from a certain field due to digital technologies. The selected literature gives indications on where transport services stand on these two aspects, particularly access-based mobility.

The major shift in access-based mobility is that digital technologies make the transport option physically available. Not only is digital the default option, it is also the only option. This also means that having access to a bank account becomes a necessity to access these

modes. MaaS is often named as an example of this shift towards the digital by default in transport services, while still being compellingly marketed as a solution for cities' social inclusion problems. Even though it must be borne in mind that access-based mobility is only used by a minority, a few of the selected papers note that these modes remain frequently associated with more sustainable travel patterns via the idea that access-based mobility encourages multimodality. Groth (2019)* cautions that this form of multimodality may not be accessible to everyone.

In public transport in particular, some of the papers highlight that travellers are increasingly expected to find travel information online, to get their tickets from ticket machines, and that technologies are also used as a substitute for employees. These papers note that staff disappearing is a considerable cause for concern among people who already feel vulnerable to fulfil their mobility needs, like people with an impairment or older adults.

3.4. Solutions put forward

Literature suggests three main approaches when it comes to mitigating (the impacts of) digital inequality in transport services:

1) Teaching people how to use technology is frequently mentioned, but it is often unclear how this should take place (e.g. reactive or proactive).

2) Adapting technology to people is the most frequently cited solution, where organising technology around the way people process information and make decisions is seen as key.

3) Retaining and refining offline alternatives, safety nets and low-tech tools is mentioned as the internet, apps and smartphones do not work for everyone all the time.

In addition to concrete solutions, a few of the selected papers also call for an in-depth consideration about digitalisation in transport services, inviting us to re-focus on people first and on the public values that are traditionally seen as relevant in transport policy such as social inclusion.

3.5. Digital inequality and the risk for transport-related social exclusion

From the few selected papers that integrated digital inequality to a wider consideration on social inclusion, the consensus seems to be that current patterns of social exclusion via transport may well be reproduced and reinforced as digitalisation in transport services intensifies. Not only is the risk for exclusion pointed out in literature, but also the risk for polarisation and a "technological gentrification" of transport services (Pangbourne et al., 2019, p. 9)*. Still, there is very little empirical evidence on how digital inequality contributes to transport-related social exclusion. Furthermore, digital technologies are arguably one piece in a complex socio-technical system that poses challenges for meeting the needs of vulnerable populations in general.

4. Main conclusion and research avenues

Digital inequality in transport services is a multi-layered process with potentially exclusionary outcomes. The cross-disciplinary approach suggested in this paper can inspire transport researchers to approach this topic in a more comprehensive and nuanced manner.

Four broad research avenues are identified:

1. Getting a better understanding of the mechanisms behind digital inequality in transport services,
2. Identifying who is concerned by digital inequality in transport services,

3. Understanding the contribution of digital inequality to transport-related social exclusion,
4. Identifying potential solutions to mitigate digital inequality in transport services.

In the second phase of this research project, we will be addressing research avenue 1 and touch upon the three others, mainly through qualitative inquiry and by drawing upon experience in other relevant fields such as e-government.

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