

RESEARCH

Open Access

An assessment framework for safeguarding public values on mobility platforms



Rianne Riemens¹, Carolin Nast², Peter Pelzer^{3*} and Martijn van den Hurk³

* Correspondence: p.pelzer@uu.nl

³Utrecht University, Utrecht, the Netherlands

Full list of author information is available at the end of the article

Abstract

Urbanites increasingly turn to digital mobility platforms to make use of means of transportation and to plan and book journeys. While these platforms can contribute to making urban travel more sustainable and efficient, they can also lead to governance challenges and have negative external effects, raising questions about how public values can best be safeguarded. In this article, public values are defined as *normative concepts that describe both the impact on and democratic control of an affected public*. This article aims to initiate a more structured discussion about platform urbanism, specifically how and to what extent public values are incorporated in platform design and operation in the realm of mobility. It introduces an assessment framework for mobility platforms that was developed as part of a transdisciplinary research project in the Netherlands. This framework is grounded in two academic debates regarding 1) the rise of platform urbanism and 2) new forms of mobility that accompany the densification of cities. The paper refers to the mobility pilots Kutsuplus, UbiGo and Whim to illustrate how the safeguarding of public values can be evaluated. In the concluding section, the paper discusses some ways in which the assessment framework can be used for future research, for instance through scenarios.

Keywords: Public values, Digital platforms, Platform urbanism, Mobility, Pilot projects

Science highlights

- The article connects platform urbanism with new forms of mobility.
- The framework can spark and structure a debate about public values related to mobility in platform urbanism.
- The framework can be used as an analytical tool for empirical research on mobility platforms.
- The relevance of the assessment framework is illustrated by addressing three pilots: Kutsuplus, UbiGo and Whim.



© The Author(s). 2021 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Policy and practice recommendations

- The framework provides a vocabulary and overview of public values to structure platform urbanism debates.
- The framework gears attention to present residents, but also to future dwellers and generations.
- The framework could serve to develop scenarios, of which the paper discusses a first application.
- Formalizing minimum thresholds or aspirations makes it tangible how a public value is safeguarded.

Introduction

The rise of digital platforms has affected many fields, including transport, tourism and fashion (Geissinger et al. 2020). Platforms have the potential to shape societies by “gradually infiltrating in, and converging with, the (offline, legacy) institutions and practices through which democratic societies are organized” (Van Dijck et al. 2018, p. 2). As it relates to urban life, this development is also conceptualized as *platform urbanism*, which refers to the overall use and application of smart devices that together shape the informational infrastructure of cities (Barns 2020). Digital mobility platforms are an important component of platform urbanism, as they mediate the access of citizens to travel modalities, enabling them to plan and book journeys. Such platforms are often introduced due to changing mobility needs that accompany the densification of cities (see for example Churchman 1999) or in response to issues regarding the climate crisis (e.g. IRP 2018). Mobility platforms have the ability to change how and to what extent people have access to transport and travel. Examples of mobility platforms include Waze and Google Maps, which operate as traffic directors (Van der Graaf and Ballon 2019), and taxi service Uber, which operates as an urban transport provider (Pelzer et al. 2019).

Such platforms can have both positive and negative impacts on society, depending on what goals they prioritize, how they are embedded within a local context and how they are governed. The initiators of mobility platforms often claim that they are making urban transport more accessible, sustainable and efficient (Pangbourne et al. 2018). However, negative impacts have been observed, such as increased congestion (Erhardt et al. 2019), while citizen and community rights and needs, such as access to transport and protection against cyberattacks, are also at stake (Dotterud Leiren and Aarhaug 2016; Docherty et al. 2018; Pangbourne et al. 2018). Focusing on mobility platforms, this article argues that we should pay careful attention to the rights and needs of citizens and proposes to conceive them as *public values*.

The discussion of public values is not new to either mobility or platform studies. Scholars have discussed the relationships between freedom and mobility (e.g. Sheller 2016), transport and justice (e.g. Martens 2017), and digitization and autonomy or privacy (e.g. Van Dijck et al. 2018). However, several questions relevant to mobility platforms remain unanswered. For instance, Pangbourne et al. (2020) criticize how mobility platform Whim promises the unlimited availability of mobility services, which arguably negatively affects these services’ sustainability and does not deal with the limitations of current transport systems (e.g. in relation to congestion). However, as these critiques often fail to define public values, a systematic analysis of what values are at stake has been

missing. A more precise conceptualization of public values would aid discussions of the competing interests when mobility platforms are introduced or need to be regulated. This article aims to improve the understanding of public values by using insights from recent debates in public administration, transport geography, urban planning and platform studies. We present an assessment framework of public values that deserve consideration in the making and governing of new, digital mobility solutions. The framework has been developed as part of the transdisciplinary research project 'Algorithmic Studio' which ran from October 2019 till August 2020 and included a partnership between Utrecht University, the City of Utrecht and Rathenau Instituut. This paper reports on the assessment framework that resulted from this endeavor. We will emphasize the conceptual considerations and see the international academic community as our intended audience (for a practice-oriented publication discussing the neighborhood of Merwede in Utrecht and other cases, see Riemens et al. 2021).

The article is organized as follows. In the next section, we introduce our analytical approach including the design phases of the project. The following section 'Defining and safeguarding public values' provides an overview of the literature on public values and explains our definition of the term. In the fourth section, we discuss challenges and opportunities in relation to mobility and platforms and illustrate these with examples from three pilots: Kutsuplus, UbiGo and Whim. In the section 'The public values assessment framework', we present our framework of public values that are at stake in digital mobility solutions. Finally, we conclude with reflections on the application of the framework in relation to ongoing academic debates and policy considerations.

Analytical approach

Helberger et al. (2018) argue that the first step in safeguarding public values is to identify which values are at stake with the implementation of a platform: we, therefore, have conducted an integrative literature review of the relevant academic discussions in order to identify a set of public values (Bozeman 2007). In particular, we focused on the literature on digitalization, platforms and safeguarding public values in the platform economy as well as the literature on urban planning and mobility practices. Based on our analysis, we developed a framework of public values relevant to mobility platforms (see Table 3). Table 1 presents an overview of the phases of our research. An extended version of our methodology can be found in Appendix 1.

A literature review was an important part of Phase 1 of our research project. We analysed relevant bodies of literature in three steps. First, we conducted a literature review following six terms that are discussed in the report *Urgent Upgrade – Protecting public values in our digitised society* published by the Rathenau Institute (Kool et al. 2017): privacy, autonomy, security, control over technology, human dignity, equity and equality, and balance of power (see Appendix 2).¹ Second, we identified further literature based on the snowballing method. We followed up on authors identified in the first step as well as recommendations by interview partners. Third, we consulted academic articles that covered one or more of the three Scandinavian mobility platform pilots we chose as case studies: Whim, Kutsuplus, and UbiGo. These articles most closely

¹The report discusses a seventh theme, safety, that refers to physical safety. Physical safety of modes of transportation is key for a functioning transportation system, however we decided to exclude it from our literature review as we see physical safety as a matter of course for the introduction of a mobility platform.

Table 1 Short version of the research approach (see full methodology in Appendix 1)

Research phase	Research activity	Outcomes relevant for this paper
Phase 1: Inventarisation and desk research	Literature review in three steps. Interviews with experts.	Development of the assessment framework.
Phase 2: Design phase	Workshops with policy makers and academics. Interviews with experts. Project meetings.	Collection of information on the Scandinavian mobility platform pilots. Refinement of the assessment framework and its dimensions.
Phase 3: Dissemination	Writing of research findings in several publications aimed at different audiences.	Publication of academic paper, policy report, advisory report, media coverage.

describe our topic of mobility platforms and reflect on their function in practice, but are not always explicit about what values are being safeguarded or jeopardized. This step helped us to identify the issues that our framework could help tackle, by including public values that need to be safeguarded to prevent or deal with the issues.²

The three-step literature review provided a foundation for constructing a first draft of the assessment framework that could be further refined during meetings and creative sessions. After having created a first set of public values, we had to make decisions about the dimensions our framework would include, the definite choice of values and the precise formulation of the values. Therefore, we conducted meetings with experts in the form of workshops and interviews. During these meetings, we introduced concept versions of the framework to collect feedback and refine our framework (for details, see Appendix 1). For these sessions we invited experts both at the concrete (e.g. practitioners) and the conceptual level (e.g. academics). We have identified three relevant groups of experts: First, the research project was already connected to a range of experts and institutions that we have consulted during the project. Second, we have contacted experts that could give us feedback from their renowned expertise on public values, innovative mobility, governance of digital platforms or shared mobility governance. Third, we consulted experts that were involved in studying mobility platforms in the Netherlands or that had academic knowledge about the Scandinavian cases of mobility platforms.³ A selection criterion for the assessment framework was that the values needed to be of direct relevance for assessing mobility platforms. A value such as autonomy was therefore considered too general, and was translated into freedom of movement and freedom of choice.

Defining and safeguarding public values

A definition of public values

Before we proceed to the framework for mobility platforms, we will first define the term ‘public values’ (plural) and separate it from the term ‘public value’ (singular). In general, the term *value* indicates the worth of something (Bannister and Connolly 2014). Nabatchi (2018) explains that public value “refers to an appraisal of what is

²We are aware that because of the background of the individual researchers, the location where the project took place, the cases studied and experts included, our research is strongly grounded in a European socio-economic context, and therefore has limitations in terms of applicability and representation to other urban contexts, such as the Global South.

³Experts were selected based on the three following non-exclusive characteristics: renowned expertise in the respective field determined through a search for relevant publications, identification through the literature review, project partners.

created and sustained by government on behalf of the public” (p. 60). Referring to the work of Moore (1995, 2013) on creating and recognizing public value, she argues that “public value and public value creation are essentially management-centered concepts that focus on the appraisal of activities, actions, and outcomes produced by government agents and organizations (p. 60).

In contrast, values can be *held by people or an organization* as a mode of behaviour: “either a way of doing things or an attribute of a way of doing things, that is held to be right” (Bannister and Connolly 2014, p. 120). In this research we build on the definition of public values by De Bruijn and Dicke’s (2006), which states that most analyses of public values build on the reasoning “that a value is public if a collectivity benefits” from the protection of this value (p. 720). Bozeman (2007) provides a complementary definition: he defines public values as normative concepts that are based on consensus about “(a) the rights (...) to which citizens should (...) be entitled; (b) the obligations of citizens to society; and (c) the principles on which governments and policies should be based” (p. 13). This highlights the fact that public values are foremost consensual rights to which citizens are entitled, while also acknowledging citizens’ obligation to contribute to the safeguarding of those values. As Nabatchi (2018) writes: “public values are the social standards, principles, and ideals to be pursued and upheld by government agents and organizations. In this light, public values and the prevention of public values failure are oriented toward the broader society and the promotion and sustenance of its collective norms and beliefs” (p. 60).

Regarding the term ‘public’ in ‘public values’, our understanding is derived from the work of Dewey. He defines the public as “all of those who are affected by the indirect consequences of transactions to such an extent that it is deemed necessary to have those consequences systematically cared for” (Dewey 1927/2012, p. 69). In the case of mobility, the consequences of access to transport, or lack thereof, are considerable according to Martens (2012), as transport is “an indispensable resource shaping one’s life path” (p. 10). Thus, we argue that the access to mobility has consequences for one’s life path and that those consequences require systematic control. It is based on this logic that Dewey also distinguishes between public and private: something is public when “the extent and scope of the consequences of acts” need control, “whether by inhibition or by promotion” (Dewey 1927/2012, p. 69). The aspect of control through inhibition or promotion points to what we understand as the act of safeguarding public values, and hence we define this action in relation to mobility as either a minimum threshold (inhibition) or aspiration (promotion). Accordingly, building on Bozeman (2007), De Bruijn and Dicke (2006) and Dewey (1927/2012), we define public values as *normative concepts that describe both the impact on and democratic control of an affected public, which take the form of minimum thresholds or aspirations.*

We acknowledge that numerous public values exist, and that they are dynamic rather than static (De Bruijn and Dicke 2006; Nabatchi 2018). In this situation of value pluralism, public values compete with each other, and two aspects of one value can even conflict with one another, risking public values failure (Nabatchi 2018). The reconciliation of values-based conflicts requires a compromise, which can always be reconsidered (De Bruijn and Dicke 2006). The achievement of a compromise is challenging as the range of public values at stake depends on the issue(s) and context that are at play. Different combinations of prioritized public values can lead to very different outcomes. An issue-

specific framework pointing at the most relevant public values at stake can help policy makers and academics “to sort through values plurality on a specific issue or to make determinations about how to best create public value or prevent public values failure” (Nabatchi 2018, p. 61). Such a framework can be used conceptually, to evaluate which public values can be achieved together, as well as practically, to discuss which values might clash in the concrete implementation of a platform.

A typology of public values

As a next step towards an assessment framework, it is helpful to turn to two common typologies of public values, differentiating between (1) procedural public values and substantive public values (Jørgensen and Bozeman 2007; De Bruijn and Dicke 2006; De Graaf and Paanakker 2015; De Graaf et al. 2016) and (2) service-oriented public values and socially oriented public values (Bannister and Connolly 2014; Ingrams 2019). As for the first typology, substantive public values concern sector-specific targets (De Bruijn and Dicke 2006), while “procedural public values refer to the way the public sector should act and to standards that the process of government action to achieve these sector-specific targets should meet” (Jørgensen and Bozeman 2007, p. 64). Making an unambiguous distinction between ideal types of public values is challenging, as several values arguably fit into multiple categories (De Bruijn and Dicke 2006). Although differentiating between procedural and substantive helps to distinguish values that refer to *how* governmental action needs to be organized from values that refer to sector-specific targets, *what* these targets encompass remains very broad. The second typology defines service-oriented public values as “the responsibility of public administrators to provide a high level of service to the citizen in the same manner as a commercial company would provide good service to a customer” (Bannister and Connolly 2014, p. 123). Socially oriented public values refer to broader societal goals (e.g. inclusiveness, justice).

We combine the two aforementioned typologies of procedural and substantive public values and service-oriented and socially oriented public values in our analysis of public values in relation to mobility platforms. In addition to procedural public values, we make a distinction between service-oriented and socially oriented substantive public values. As such, we account for, on the one hand, public values related to mobility service provisions and, on the other hand, public values that relate to broader societal goals while being very much influenced by mobility-sector-specific arrangements. Our framework thus covers three types of values: (1) service-oriented substantive public values, (2) socially oriented substantive public values and (3) procedural public values.

Challenges and opportunities for mobility platforms

The rise of mobility platforms has prompted many new discussions, which in turn require new perspectives on public values. Based on the literature review on mobility, platform urbanism, public administration and public values, we have discerned four relevant themes: (1) mobility service, (2) climate impact, (3) well-being and (4) democratic control. Following Nabatchi (2018), we use these themes to classify public values according to a dimensional distinction. These themes represent the four dimensions of

our framework, each encompassing a type of value (Table 2), that together form the foundation of our assessment framework (Table 3).

Mobility service

The idea of mobility as a right is widely accepted and reflected in various policy guidelines, such as the European Union's White Paper on European transport policy, which states that "personal mobility, which increased from 17km in 1970 to 35km in 1998, is now more or less seen as an acquired right" (European Commission 2001, p. 11, as cited in Sager 2006). The ability to travel is seen as a value in itself, while also increasing the individual's choice of commodities and

Table 2 Theoretical dimensions of the assessment framework

Dimension	Description of dimension	Reason for inclusion in framework	Type of value covered by dimension	Description of type of value
Mobility service	This dimension refers to the qualities that are expected from mobility services.	The primary task of a mobility platform is to offer mobility services to citizens and thus safeguard people's life opportunities and participation in society (see Martens 2017). Therefore, we have formulated mobility service as a dimension to group the public values that refer to this.	Substantive, service-oriented values	Public values that are specific to the mobility sector and concern mobility-specific targets (see De Bruijn and Dicke 2006; Bannister and Connolly 2014; De Graaf et al. 2016; Ingrams 2019).
Well-being	This dimension refers to societal goals, whose achievement is influenced by the short-term impact of mobility practices.	'Health and well-being' named as an unanticipated implication of MaaS projects by Pangbourne et al. (2020).	Substantive, socially oriented values	Public values that refer to broader societal goals and are concerned with the impact of mobility on broader societal goals in the short term (see De Bruijn and Dicke 2006; Bannister and Connolly 2014; De Graaf et al. 2016; Ingrams 2019).
Climate impact	This dimension refers to environmental goals, whose achievement is influenced by the long-term impact of mobility practices.	'Environment' named as an unanticipated implication of MaaS projects by Pangbourne et al. (2020).	Substantive, socially oriented values	Public values that refer to broader societal goals and are concerned with the impact of mobility on broader societal goals in the long term (see De Bruijn and Dicke 2006; Bannister and Connolly 2014; De Graaf et al. 2016; Ingrams 2019).
Democratic control	This dimension refers to the procedures and standards actors have to comply with while safeguarding substantive values.	Van Dijck et al. (2018) refer to democratic control as a highly contested public value, we use the term as dimension, to cover a range of public values.	Procedural values	Public values that define how the procedures and actions to provide mobility services should be conducted (see Jørgensen and Bozeman 2007; De Bruijn and Dicke 2006; De Graaf et al. 2016).

Table 3 The assessment framework with the four theoretical dimensions, value descriptions and literature references

Public Value	Description	Literature
Service	This dimension refers to the direct impact available mobility services have on the mobility behaviour of citizens. The values involved can be categorized as specific to the mobility sector and therefore as substantive, service-oriented values.	
Freedom of movement	The availability of different transport modalities and their spatial proximity. In relation to a digital mobility platform, freedom of movement refers to a platform that combines transportation services and offers door-to-door trip planning through different modes of transportation.	Cass et al. (2003); IJsselsteijn et al. (2006); Lucas (2006); Lucas (2012); Sheller (2016); Ferreira et al. (2017); Kool et al. (2017); Martens (2017); Plantin et al. (2018)
Freedom of choice	The possibility for mobility service users to make their own informed decisions about how they want to travel: in terms of mode, route and time. Users have access to information about available travel modes and routes, as well as expected travel time.	IJsselsteijn et al. (2006); Lamont et al. (2013); Spahn (2013); Kool et al. (2017)
Accessibility	The possibility for people, regardless of their age, literacy and physical abilities, to use mobility services and thereby participate actively in society. In relation to digital mobility platforms, this refers to accessibility for all levels of digital literacy by, e.g., providing non-digital support and service personnel.	Cass et al. (2003); Hoffman et al. (2005); Goggin et al. (2017); Martens (2017); Rodriguez-Sanchez and Martinez-Romo (2017); Jin et al. (2018); Melis et al. (2018); Sourbati and Behrendt (2020)
Affordability	The financial means required for an individual to access transportation. On the public level, it refers to the sustainable finance model for the arrangement, whether through a private, public or private-public financial agreement. A digital platform can support dynamic pricing, creating the possibility to change prices depending on time, place and user specificities, but needs to safeguard affordability nonetheless.	Kamargianni and Matyas (2017); Martens (2017); Sarasini et al. (2017); Pangbourne et al. (2018); Wen et al. (2018); Van Dijck et al. (2018)
Reliability	The availability of specific mobility services if needed and as promised. This refers to punctuality and the offer of an alternative travel mode in case of delay, among other things.	De Bruijn and Dicke (2006); Veeneman et al. (2020)
Climate impact	This dimension refers to the long-term impact our mobility practices have on the environment. The values involved can be categorized as substantive, socially oriented values.	
Sustainable energy	Having minimal or no CO ₂ emissions can contribute to the limitation of climate change. For this value, modalities that use human or renewable energy (walking, biking, electrical vehicles) are important, as are collective transport (bus, train). In relation to digital mobility platforms, this refers to the pricing and promoting of different sustainable or less sustainable mobility options.	Kenworthy (2003); Sochor et al. (2015a); Pangbourne et al. (2018); Szell (2018); Haglund et al. (2019); Jokinen et al. (2019)
Proximity richness	The local availability of facilities and the density of the built environment related to it, with the goal to reduce the need to travel, especially the need for motorized modes of transportation. In relation to digital mobility platforms this refers to the possibility to	Jacobs (1992); Gehl (2010); Ferreira et al. (2017); Genre-Grandpierre et al. (2018)

Table 3 The assessment framework with the four theoretical dimensions, value descriptions and literature references (*Continued*)

Public Value	Description	Literature
	encourage short-distance transport and discourage long-distance travel.	
Well-being	This dimension refers to the short-term impact mobility practices have on the well-being of citizens. The values involved can be categorized as substantive, socially oriented values.	
Health	The physical and mental health of citizens (individual health and public health). In relation to digital mobility platforms, this value refers to the availability and promotion of healthy travel options.	Saelens et al. (2003); Woodcock et al. (2009); De Hartog et al. (2010); Pucher et al. (2010); Oja et al. (2011); Van Wee et al. (2013); Lupton (2014); Reinhard et al. (2018)
Social interaction	The potential for social interaction in city space by being able to see, hear and talk to each other because of safe and walkable spaces and a lack of noise. In relation to digital mobility platforms, social interaction potential refers to the possibility for users to communicate online by sharing information, collaborating or engaging in collective action.	Leyden (2003); Gehl (2010); Spagnoletti et al. (2015)
Democratic control	This dimension refers to the democratic norms to which actors have to comply when it comes to safeguarding values. The values involved concern these norms and processes and can be categorized as procedural values.	
Privacy	The right of users and other actors to decide how their data is used and who can access it, and the guarantee that data is collected, stored and processed in a secure way. In relation to digital mobility platforms, this value refers to confidentiality, safety of the collection and storage of data (or minimization of collection and storage), sharing certain data only with authorized entities or users in the network and by using personal data according to the law (e.g. GDPR).	Shokri et al. (2014); Nieto and Lopez (2014); Belletti and Bayen (2017); Perentis et al. (2017); Jin et al. (2018); Callegati et al. (2018); Zuboff (2019); Cottrill (2020)
Accountability	The presence and level of meaningful human control over the processes and outcomes of the mobility platform, in order to prevent the emergence of a responsibility gap. In relation to digital mobility platforms, this value refers to the implementation of a tracking condition (system responds to moral reasoning and contextual changes) and a tracing condition (system is designed to grant the possibility to retrace outcomes to humans or organizations in the chain of action).	Kool et al. (2017); Santoni de Sio and Van den Hoven (2018); Robbins (2019)
Adaptability	The flexibility to change policy measures after analysis and monitoring have determined that the effectiveness of the policy action is compromised and intentions and outcomes are not aligned. In relation to digital mobility platforms, this value refers to the implementation of analysis and monitoring mechanisms through an independent body, in order to adapt the digital platform environment as well as the structuring algorithm if needed.	Banister (2008)

Table 3 The assessment framework with the four theoretical dimensions, value descriptions and literature references (*Continued*)

Public Value	Description	Literature
Legitimacy	A clear and understandable explanation of the rules that apply on a platform and a justification of how power is exercised in an equal and consistent manner. It refers to what actions are legitimate and which are not. In relation to digital mobility platforms, this includes a justification of the use of (personal) data and an explanation about the decision-making process and the power balance between parties involved.	Jørgensen and Bozeman (2007); Bannister and Connolly (2014); Suzor (2018); Hofmann et al. (2019)
Transparency	The availability of and access to information on costs, agreements and performance of mobility services. Transparency ensures clarity for users on which public values are safeguarded or harmed in order to make an informed decision about which services to use and, eventually, trust. In relation to digital mobility platforms this refers to transparency about the functioning of the technological system.	De Bruijn and Dicke (2006); Reynaers (2014); Hofmann et al. (2019)
Ownership	The way in which diverse groups of citizens are represented in the planning, design and evaluation of a city, including its infrastructure. In relation to digital mobility platforms, ownership refers to the ability of users to have a say in the outlook of a platform (e.g. by providing feedback, or to have access to the data that is collected on the platform.	Jacobs (1992); De Lange and De Waal (2013); Szell (2018); Van Dijck et al. (2018)

activities (Sager 2006). Apart from this freedom to travel, individuals should, ideally, also be able to choose whether or not to take advantage of opportunities to travel (Sager 2006).

Given the importance of transportation in a highly mobile society, mobility determines possibilities for economic and social inclusion (Ferreira et al. 2017; Martens 2017). Consequently, the ways in which government and private companies distribute transport to their citizens and (potential) customers become immensely important (Martens 2017). Guaranteeing accessibility for all, distributing the transportation good equitably, constitutes a challenge (Martens 2017). According to Martens, accessibility “refers to the ease with which destinations can be reached [by a person] from a given location in space” (2012, p. 6). The level of accessibility depends on the context (spatial distribution of activities and transportation system) and the person (income, gender, knowledge, place of residence, household composition, physical ability). “An injustice is done whenever a person experiences an insufficient level of accessibility” (Martens 2017, p. 126). Moreover, given the importance of mobility for daily life, mobility infrastructure and services are expected to be reliable (Mugion et al. 2018). A recent development is Mobility-as-a-Service (MaaS): personal mobility systems that facilitate a multi-model mobility experience for travellers (Veeneman et al. 2020). MaaS platforms offer users access to a range of modalities, through pay-per-use or subscriptions, enabling them to plan and book a trip and make travelling more seamless. However, they might negatively affect social inclusion, as MaaS platforms do not tend

to focus on affordability for low income households or users with little or no digital literacy (Pangbourne et al. 2020). All in all, this theme established the right of mobility, which includes the availability and accessibility of travel opportunities, as well as the choice to decide whether to use these opportunities and which ones to use specifically.

Example: Whim and freedom of movement and choice

Whim's goal is to offer users ultimate freedom of mobility: "Whim will get you there. Near or far - wherever you want to go."⁴ To facilitate freedom of movement, Whim offers various subscription models and modalities, which are offered by multiple providers. While active in several European cities, Whim's offer in Helsinki is the broadest. Here, Whim offers four different models, one of them being Whim Unlimited. Whim Unlimited is a subscription package that includes public transportation, city bikes, taxis, e-scooters and rental cars on an unlimited basis with few limitations for around €500 a month. It is questionable to what extent the promise of freedom of unlimited mobility is realistic for all (potential) users in the urban context: "This promise is at odds with the challenge of satisfying simultaneous demand in a finite transport network" (Pangbourne et al. 2018, p. 39). Not only can unlimited travels have a negative effect on these services' environmental sustainability, such promises also neglect the reality of current transport systems' limitations (Pangbourne et al. 2018).

Climate impact

The transportation sector in the European Union (passenger and freight transport) is responsible for 25% of the EU's total emissions (Dimoula et al. 2016). Emissions from transport have increased by 29% between 1990 and 2009 while other sectors managed to decrease their emissions. The aim of the EU is to achieve a 60% reduction in transport greenhouse gas emissions from 1990 levels by 2050 (Dimoula et al. 2016).

The proliferation of private-car use has been an important driver of the increase in emissions since 1990; private-car use also remains the dominant mode of transportation in Europe (Kenworthy 2006). This dependence on non-renewable resources and low average occupancy has caused congestion, low air quality, noise pollution and environmental degradation (Howarth and Ryley 2012). Shifting travel away from private vehicles within cities and between cities has therefore been on the agenda of policymakers seeking to reform mobility patterns in light of the climate crisis. Private and publicly owned cars used for car sharing and ride pooling have also become components of sustainable transportation strategies (Bigazzi 2019), while alternatives to fossil fuel, such as electrification and hydrogen fuel, have the potential to improve the environmental performance of motorized modes of transportation (Chan et al. 2013). However, the most environmentally friendly mobility behaviour is based on low mobility or slowness, i.e. walking and cycling (Pucher and Buehler 2017). In order to increase walking and cycling and decrease the dependency on motorized modes of transportation, the spatial structure of cities (more specifically, density and zoning) is a crucial factor. Both density and zoning influence time, cost and the convenience of different modes of transport (Banister 2005; Buehler 2011). Walking and cycling are more feasible in higher density areas with a greater mix of land-use, the combination of these two providing a higher density of activity opportunities and local amenities as well as shorter trip distances (Nivola 1999; Boarnet and Crane 2001; Ewing and Cervero 2001; Timmermans et al. 2003; Scheiner and Holz-Rau 2007; Elldér 2018;). Due to traffic congestion, fewer

⁴Slogan on the Whim website: <https://whimapp.com/>. Accessed 14 December 2020.

parking spaces and the higher cost of parking in dense areas, travel by car is unattractive (Buehler 2011). Additionally, in higher densities, the provision of public transport is economically viable (Buehler 2011).

In contrast, walking and cycling are unattractive in low density and spread-out developments due to the long distances between trip origin and destination, which the car can cover faster (see Buehler 2011). To sum up, this theme established the importance of reducing the climate impact of urban transportation by promoting non-motorized modes of transportation. The prerequisite for the use of walking and cycling as modes of transportation is a high-density, mixed-use city where amenities are locally available.

Example: UbiGo and minimal climate impact

In 2013 and 2014, UbiGo offered the planning and booking of services for public transport, car sharing, car rental, bike rental and taxi services in Gothenburg, Sweden. About 83 households (173 adults and 22 children) participated in the pilot project. UbiGo rewarded environmentally friendly travel choices by enabling customers to collect points based on reduced CO₂ emissions compared to making trips by (private) car. The points could be exchanged for non-travel related goods and services provided by sponsors (e.g. museum or opera tickets, a visit to a swimming pool, gift cards, access to audio books, lunch discounts). If users used their own bike or walked somewhere – both eco-friendly yet non-UbiGo travel modes – they were not rewarded (Sochor et al. 2014). This can be explained by the financial gain for UbiGo if a user is using their services instead of private means of transportation. Based on an analysis of UbiGo user data, as well as questionnaires and interviews, Karlsson et al. (2016) conclude that participants significantly decreased their car use and increased their use of car sharing and buses and trams. Sochor et al. (2015b) found that the frequency of car usage during the UbiGo pilot was influenced by an individual's travel behaviour prior to using UbiGo.

Well-being

Gehl (2010) emphasizes another advantage of the use of slow modes of transportation: it brings more life to the streets and creates a greater wealth of experience. Social interaction in cities is dependent upon opportunities for people to see, hear and talk to each other. Gehl (2010) differentiates between passive and active contacts, as well as between planned and spontaneous interaction. Passive contacts refer to seeing and hearing life in the city in a non-obligating form (large group of social interactions), while active contacts refer to direct and engaging conversations (small group of social interaction). The use of public or shared transportation, public transportation hubs (e.g. stations) and non-motorized modes of transportation increase the social interaction potential.

Walking is a form of transport as well as “the potential beginning or an occasion for many other activities” (Gehl 2010, p. 120). Pedestrians can effortlessly stop, change direction, increase or decrease their speed and switch between various activities. Walking provides “a forum for the social activities that take place along the way as an integral part of pedestrian activities” (Gehl 2010, p. 120). Pedestrians are able to turn and stop to consider their environment or greet other people. One argument for the reduction of motorized travel in city streets is that it reduces the noise level and therefore offers the possibility for people to have pleasant conversations. Besides contributing to increased public health by reducing noise and air pollution, walking and cycling involve physical activity, which has many health benefits (e.g. lower risk of heart disease, type-2 diabetes, high blood pressure; see Warburton et al. 2006; Woodcock et al. 2009; Oja et al. 2011). Physical inactivity has drastically increased since the industrial revolution, especially in high-income countries, motivating governments to try to increase physical activity

through the introduction of public health policies and guidelines (Hallal et al. 2012). All in all, this theme concerns our physical and social well-being. Digital mobility platforms have the potential to affect our well-being positively or negatively.

Example: Kutsuplus and individual health

Kutsuplus offered shared rides on minibuses with a seating capacity for nine people, WiFi and real-time passenger travel information about the expected time of arrival (Jokinen et al. 2019). Haglund et al. (2019) indicate that non-motorized modes of transportation would have been feasible and faster alternatives for a significant number of journeys in comparison with the minibuses: 5% of all journeys could have been completed by foot (walking up to 2 km) and nearly 20% of all journeys could have been faster by bicycle (Haglund et al. 2019). Consequently, while it is not clear whether Kutsuplus replaced walking and cycling journeys or not, the fact that these journeys could have been completed without using a minibus points towards a trade-off between guaranteeing freedom of movement and promoting public health.

Democratic control

The transportation sector has been looking for new, future-proof forms of mobility and ways to organize travel. Digital technologies can facilitate shared use of mobility options but also raise new questions, such as about the necessity to establish new governance standards. Hendriks (2014) defines governance in the urban context as *“the more or less institutionalized working arrangements that shape productive and corrective capacities in dealing with—urban—steering issues involving multiple governmental and nongovernmental actors”* (p. 555, italics in original). He identifies five core values that form the principles for good urban governance: responsiveness, effectiveness, resilience, procedural justice and counterbalance (Hendriks 2014, p. 565). Building on these principles, Meijer et al. (2019) argue that an upgrade is required for governance to stand up to the challenges and opportunities of new technologies.

Platform urbanism is often accompanied by the introduction of new technologies. Some platform corporations have investments that secure their presence in the market, such as Google’s acquisition of Waymo, a firm that develops self-driving technologies. In other cases, companies provide an essential part of a larger infrastructure through the use of one of their services, such as the use of app stores (Android, Apple), navigation services (Google), login systems (LinkedIn, Facebook) or cloud services (Amazon), entangling local services with global platforms in a complex platform ecosystem (Van Dijck et al. 2018). In any case, platforms introduce new stakeholders, often non-governmental actors, as (partial) providers of the service that thus play a role in governing these services. While private actors such as platform providers can be good at safeguarding certain public values such as reliability, they often lack a clear vision on or have a contrasting vision about safeguarding socially oriented or procedural values. This can result in conflicting interests between public and private actors in the process of co-creation (Aschhoff and Vogel 2018; Rodriguez Muller and Steen 2019).

Platforms are marked by features such as programmability and application programming interfaces (APIs) that make data accessible and connect actors (Plantin et al. 2018). Through the use of digital technologies and the organization of a platform

ecosystem, platforms have the ability to restructure the mobility market and employ the commercial benefits of data collection:

Independent processes that required specific investments to deal with business needs (e.g., fleet management, fulfilment of quality of service obligations, route optimization, etc.) can be all seen as by-products of a single platform, where thousands of autonomous objects can constantly acquire data captured from their surroundings, analyse them for local decision making and forward them to third parties. (Melis et al. 2016, p. 2)

Against this backdrop, the role of data and algorithmic processes is important and needs to be taken into account when thinking about good governance. As new governing actors, platforms can introduce ways of algorithmic governance that create social order through automated systems, perhaps raising questions about bias and fairness, transparency and human agency (Katzenbach and Ulbricht 2019). Platform urbanism blurs the line between private and public transport (Van Dijk et al. 2018). Moreover, platform urbanism, through processes of ‘platformization’, intertwines “the economic logics typical of platforms with the public interests and quasi-universal services formerly characteristic of many infrastructures” (Plantin et al. 2018, p. 306). Based on these characteristics and processes, transparency and accountability are important values to address when assessing the impact of platforms.

Good governance thus involves the responsible use of digital technologies, which requires knowledge and control over the impact of technologies. Local and national governments will have to understand and assess how principles of good governance relate to mobility platforms. Understanding what public values are at stake is essential here. The democratic control dimension refers to precisely those principles of good governance that are challenged by digital (mobility) platforms.

Example: UbiGo and privacy

UbiGo’s reward system for environmentally friendly travel choices has required the service to keep detailed records of users’ travel choices. Additionally, users have had to use their smartphones in combination with Facebook or Google accounts to log in to UbiGo’s system (Sochor et al. 2014). While this login process might have been convenient for tech-savvy individuals, this requirement has arguably excluded individuals who have difficulties using digital tools, most prominently the elderly. Moreover, the login via Facebook or Google accounts raises questions about the extent to which data is being shared between the mobility service and Facebook or Google and how customer data is protected by those companies (Cottrill 2020, p. 53).

The public values assessment framework

The assessment framework (see Table 3) provides an overview of relevant public values that deserve consideration when implementing mobility platforms. The framework consists of four dimensions, each of which contains a set of values. We have chosen to work with rather narrowly defined values, as this allows both for detailed debate and an assessment of when citizens’ rights and needs are met. The description of each value refers to selected challenges and opportunities of platform urbanism in the mobility sector, as discussed above. Some values are platform-specific; for others, we have added information on

how a value, such as freedom of movement, relates to a digital platform. For this reason we have formulated abstract, more generally known public values in a very applied and specific manner. For example, the value of autonomy, identified by Kool et al. (2017), is *translated* into values more specific to the field of mobility: *freedom of movement* and *freedom of choice*. Taking the challenges and opportunities for the safeguarding of the different values into account can help to make informed choices about the design, governance and operation of mobility platforms. In the next and final section we will reflect on how the framework can be used.

Conclusion: how to use the assessment framework?

We argue that the assessment framework can be the starting point for a *constructive technology assessment*. A constructive technology assessment emphasizes the (early) involvement of all stakeholders to facilitate social learning about technologies and their impacts on society (Genus 2006). It asks how a technology, such as a new platform, can affect society and helps to design or understand it accordingly. As part of this assessment, the framework can help to define and analyze the public values at stake, preferably when a platform is conceived and when its impacts are assessed. It can also help to answer various questions: What is understood to be the affected public? What values do stakeholders want to prioritize? Which values are not safeguarded sufficiently in the current situation?

Whereas a constructive technology assessment is a conceptual tool, the steps that Helberger et al. (2018, p. 10) propose translate the assessment into a practical approach. They present four steps to shape the process of safeguarding public values in the case of co-creation with a complex multi-actor constellation: (1) collectively define the essential public values at play; (2) ensure that each stakeholder accepts responsibility in safeguarding these values; (3) develop a public process to discuss how values can be safeguarded and the role of each party; (4) translate the outcome into the design of technologies and regulations. By developing an assessment framework, this article predominantly contributes to the first step. As the definition of essential public values is the basis for the subsequent steps, the framework can be of value throughout the four steps of co-creation. However, it is important to acknowledge that the framework is a tool for inquiry. Its usefulness depends on the way it is implemented and it cannot prevent value conflicts. Value conflicts have been identified as recurring issues in examples of co-creation and require specific coping strategies from the actors involved (Aschhoff and Vogel 2018). The framework does not provide an answer to these dilemmas that can occur in step 3, but it can support the identification of potential value conflicts at an early stage.

Most importantly, the goal of the framework is to facilitate a discussion that puts public values center stage. We have approached the public values in a practical way, so that policy makers can operationalize when and to what extent a public value is precisely safeguarded. This is reflected in our definition, which specifies public values as taking the form of minimum thresholds or aspirations. An example of a minimum threshold that could be set is a reduced amount of

air or noise pollution, that relates to the public value health. An aspiration could be to design and introduce a platform through a process in which the public value transparency is safeguarded. This could for example mean that citizens have the ability to provide input before and during the implementation of the mobility platform and that it is clear to users what and how data is collected and saved, which also relates to the public value of privacy. Setting thresholds and aspirations both require a discussion and agreement on what they precisely entail and when they are successfully reached. Further research is needed to understand how safeguarding public values can be made tangible and measurable.

In addition, the media coverage by local news media and the invitation to give a presentation at the council meeting in the City of Utrecht (see Appendix 1), exemplify the possible impact the assessment framework can have, when discussed in relation to a local case, such as the debate on the mobility platform for the Merwede neighborhood in Utrecht (see Van den Hurk et al. 2021; Riemens et al. 2021). The meetings with the City of Utrecht made clear that the framework helps to identify possibly overlooked public values or value conflicts (see Appendix 1).

However, the framework should not be seen as a static model that can be 'applied' to any specific case. While it can serve as a starting point, the framework, along with the specific values, has a somewhat fluid meaning that demands contextualization. What a value precisely means, or which values are relevant, needs to be determined within the context of a specific case. Similarly, we imagine that the framework can be of different use for different stakeholders. Academics can use it as an analytical tool for empirical research on specific mobility platforms. Such research can, for instance, illuminate the trade-offs between different public values, through both qualitative and quantitative methodologies. On a more conceptual level, the framework can be used as an example to develop similar frameworks for platforms in other urban sectors, such as tourism or education (cf. Frenken et al. 2020). Such academic evaluations could inform *ex ante* as well as *ex durante* evaluation, which is a key component of governing platform urbanism (Frenken and Pelzer 2020).

The assessment framework could also be the basis for the development of policy scenarios as a first experiment, we developed four policy scenarios that are based on different clusters of public values and are labelled *Eco*, *Simple*, *Together* and *Unlimited* (see Riemens et al. 2021).⁵ Because the concept of public values is rather abstract to policy makers, not to mention the public at large, the scenarios are potentially a helpful way to structure a discussion about public values in relation to mobility platforms. Scenarios also have a substantive advantage over the pilot projects we discussed: they offer a wider possibility space by showing not only what is *feasible* at the moment, but also what is *desirable*. Such considerations are inevitable when assessing the future role of mobility platforms in our cities.

⁵For the scenarios, we focused on mobility platforms that would work in relatively dense, mixed-use cities and neighborhoods that are easily accessible by public transport and have a low parking standard (Riemens et al. 2021). Further research is needed, however, to know how mobility platforms could play a role in different contexts, and the assessment framework for public values can be useful in this regard.

Appendix 1

Table 4 Methodology: Overview of research activities and learning outcomes

Research phases	Research activities	Learning outcomes
	<ul style="list-style-type: none"> • This table only includes meetings we have had with actors external to the central project team. • For privacy reasons, respondents have been anonymized. • See Appendix 2 for a detailed description of literature review step 1. • See Appendix 3 for the interview guide that was used during interviews and meetings. 	Description of the insight gained in each step + changes made in assessment framework.
Phase 0: Getting started October 2019	Project meetings: <ul style="list-style-type: none"> • Kickoff meeting Algorithmic Studio project with City of Utrecht, Rathenau Instituut and researchers connected to the project. 	Defined project timeline, research agenda and deliverables.
Phase 1: Inventarisation & desk research November 2019– March 2020	Literature review in 3 steps: In each step of the literature review new public values are identified and those that are included in the final framework are pointed out in the column on learning outcomes. Already identified public values were constantly refined during the research process. The first step was conducted in the beginning of the research, the second and third step of the literature review overlapped in time.	Identification of existing public values and narrowed down to a selection of public values that are included in the final framework because of their relevance for mobility platforms.
	Step 1: Systematic literature search in Web of Science using values identified in Rathenau Instituut's report <i>Urgent Upgrade Protect Public Values in Our Digitized Society</i> (Social and ethical themes in Table 3.1) as search terms. For further information see Appendix 2.	Public values identified in this step that are included in the final framework: freedom of movement, freedom of choice, privacy, accessibility, proximity richness, sustainable energy, ownership and affordability.
	Step 2: Literature search based on snowballing method. We followed up on authors identified in the first step as well as recommendations by interview partners.	Public values (newly) identified in this step that are included in the final framework: health, social interaction, accountability, transparency and legitimacy.
	Step 3: Literature search to identify literature about three Scandinavian mobility platform pilots, namely Whim, Kutsuplus, and UbiGo. These three cases were selected for their recent implementation, high academic coverage, and comparable locations in Scandinavia. We identified relevant literature in Web of Science as well as based on recommendations by interview respondents.	Public values (newly) identified in this step that are included in the final framework: adaptability and reliability. In addition, this step informed us about public value safeguarding practices regarding the three selected cases.
	Interviews (conducted in parallel with the literature review): <ul style="list-style-type: none"> • Interview with international academic expert (E1) • Interview with international academic expert (E2) • Interview with Dutch mobility consultant (C1) • Interview with Dutch mobility consultant (C2) 	Collection of information about examples of existing mobility platforms in Finland and Sweden and anticipated platforms in the Netherlands. With the existing Scandinavian examples, we wanted to learn about safeguarding values and public values failures. Regarding the Dutch cases, we talked to consultants who assessed (a) the feasibility of MaaS cases and (b) the challenges for these projects that we could link to public values identified through the literature review.

Table 4 Methodology: Overview of research activities and learning outcomes (*Continued*)

	<p>Creative sessions:</p> <ul style="list-style-type: none"> • Workshop on the topic of post-mobility futures in collaboration with the Green Office (Utrecht University) <p>We presented our framework and conducted a workshop in which we applied the framework to empirical cases to steer a dialogue on how to safeguard public values.</p> <p>Project meetings:</p> <ul style="list-style-type: none"> • Meeting with project leader City of Utrecht (P1) • Meeting with Rathenau Instituut • Meeting with project manager at Dutch Ministry of Infrastructure (P2) 	<p>We learned that the framing of the public values was oriented towards academics and not intuitively understandable to practitioners or academics from unrelated disciplines. Also, the framework was considered too comprehensive and needed grouping into dimensions. Subsequently, we narrowed down the number of public values to the most relevant ones, organized them into four dimensions and phrased them in an intuitively understandable manner, applicable to the context of a mobility platform. The relevance of the selected public values as well as their intuitiveness was tested in subsequent workshops.</p> <p>Collection of information about the mobility project of the City of Utrecht. Creation of an overview of the relevant developments around mobility platforms in the Netherlands. Presentation of the public values framework to the Rathenau Instituut. We are thankful for the comments, discussion, and literature recommendations, which we incorporated subsequently.</p>
<p>Phase 2: Design phase March–June 2020</p>	<p>Creative sessions:</p> <ul style="list-style-type: none"> • Workshop with City of Utrecht • Expert session with Rathenau Instituut and PBL Netherlands Environmental Assessment Agency • Expert session with academic expert (E2) and colleagues • Expert session with academic experts (E3 and E4) <p>Interviews:</p> <ul style="list-style-type: none"> • Interview with Scandinavian mobility consultant (C3) • Interview with academic expert (E5) • Interview with academic expert (E6) • Interview with project leader City of Amsterdam (P3) • Interview with Dutch mobility consultant (C4) <p>Project meetings:</p> <ul style="list-style-type: none"> • Meeting with project leader City of Utrecht (P4) • Meeting with project leader City of Utrecht (P1) 	<p>Try-out of public values framework in workshops with different experts to see if public values were clear and if participants identified missing values. Furthermore, the coherence of the framework's dimensions and the policy scenarios was discussed (see our conclusion). Participants were invited to imagine their ideal mobility platform, to see which values they would prioritize. Participants gave feedback based on their expertise in governance, mobility or public administration. Subsequently, we refined the framework and its dimensions.</p> <p>Further collection of information on the Scandinavian mobility platforms. Collection of information on the Dutch mobility cases. Creation of an overview of the governance challenges of mobility platforms. Subsequently, we refined the framework. Most prominently we worked on the dimensions of "Service" and "Democratic control".</p> <p>Refinement of the public values framework. Received updates about the progress of the Merwede case and the occurring governance challenges. Gathered input for an advisory report for the City of Utrecht.</p>
<p>Phase 3: Dissemination July–August 2020 (activities continued after official ending)</p>	<p>Creative sessions:</p> <ul style="list-style-type: none"> • Follow-up workshop with City of Utrecht <p>Writing:</p> <ul style="list-style-type: none"> • Academic publication on the governance challenges of Merwede, Utrecht 	<p>Gathered input for an advisory report for the City of Utrecht.</p> <p>Construction of the final public values framework and reporting of the findings in publications aimed at different audiences.</p>

Table 4 Methodology: Overview of research activities and learning outcomes (*Continued*)

<ul style="list-style-type: none">● Academic publication on our public values framework (current article)● Policy report with the results of our research project, in Dutch and English.● Advisory report for City of Utrecht (not publicly available)	
Interviews: <ul style="list-style-type: none">● Interviews with media outlets	
Presentations: <ul style="list-style-type: none">● Presentation as part of a council meeting of the City of Utrecht Sharing our results about safeguarding public values on mobility platforms and answering questions with an audience of policy makers, local politicians, citizens and local organizations.	Publications by: RTV Utrecht, Verkeerskunde, Heijmans, Utrecht University.

Appendix 2

Table 5 Steps and criteria for literature review

Theme	Search term	Articles identified	Articles excluded based on abstract analysis	Articles included in further analysis (full-text analysis)	Articles excluded based on full-text analysis	Article reference included in the final framework
Public value identified in the Rathenau Instituut Report: Urgent Upgrade Protect Public Values in Our Digitized Society (Social and ethical themes in Table 3.1)	Term used in the advanced search in Web of Science.	The number refers to the number of articles that have been identified through the advanced search.	The number refers to the number of identified articles that have been excluded after reading their abstract.	The number refers to the number of articles that were read in full (meaning those that were not excluded after reading the abstract).	The number refers to the number of identified articles that have been excluded after reading them in full.	The number refers to the number of identified articles that have been included as a reference in the final framework. In brackets we indicate the exact public value for which the reference was included. We want to emphasize that also articles that are not included in the final framework informed our discussions.
	Inclusion criteria	We employed the following criteria when assessing if an article should be further included in the research (first referring to reading the articles in full and second referring to including it in the final framework): <ul style="list-style-type: none"> - Articles must have been published after 1999. This criterion was already implemented in the search strategy. - Articles must have been published in English. This criterion was already implemented in the search strategy. - Included articles must explicitly concern an aspect related to Mobility as a Service (MaaS) or mobility platforms. - Included articles must concern public values (as defined in our paper). 				
Public values	TS = (Public values AND MaaS)	11	7	4	3	1
Autonomy	TS = (Autonomy AND MaaS)	3	3	0	0	0
	TS = (Autonomy AND mobility platform)	38	37	1	1	0
Privacy	TS = (Privacy AND MaaS)	5	3	2	2	0
	TS = (Privacy AND mobility platform)	44	37	7	5	2 (Privacy)
Accessibility	TS = (Accessibility AND MaaS)	2	0	2	1	1 (Accessibility)

Table 5 Steps and criteria for literature review (Continued)

Theme	Search term	Articles identified	Articles excluded based on abstract analysis	Articles included in further analysis (full-text analysis)	Articles excluded based on full-text analysis	Article reference included in the final framework
	TS = (Accessibility AND mobility platform)	49	44	5	1	4 (Accessibility, Proximity richness)
Justice	TS = (Justice AND MaaS)	2	2	0	0	0
	TS = (Justice AND mobility platform)	12	11	1	0	1 (Sustainable energy, Ownership)
Equality	TS = (Equality AND MaaS)	0	0	0	0	0
	TS = (Equality AND mobility platform)	4	4	0	0	0
Equity	TS = (Equity AND MaaS)	0	0	0	0	0
	TS = (Equity AND mobility platform)	8	5	3	1	2 (Accessibility, Privacy, Affordability)
Balance of power	TS = (Balance of power AND MaaS)	0	0	0	0	0
	TS = (Balance of power AND mobility platform)	20	20	0	0	0
Control over technology	TS = (Control over technology AND MaaS)	0	0	0	0	0
	TS = (Control over technology AND mobility platform)	31	31	0	0	0
Human dignity	TS = (Human dignity AND MaaS)	0	0	0	0	0
	TS = (Human dignity AND mobility platform)	0	0	0	0	0

Appendix 3

Interview guide

For each interview and session, the questions were tailored to the knowledge of the experts. As the interviews were semi-structured, we used the questions below as starting points, but also asked follow-up questions if necessary. For the expert sessions, we used the last question as a starting point and asked participants to draw the interface of their ideal mobility platform. After introducing the concept version of our assessment framework, we asked the participants to link their design of a platform to the framework. Furthermore, during the sessions, we used the questions below to ask follow-up questions and collected feedback on the assessment framework and the policy scenarios we have developed.

- What is the state of Mobility as a Service in [country/Europe]?
- What were, or, how do you see the division of responsibilities among public and private actors in [name of cases]?
- What worked and what did not work in [name of case]?
- What organizational changes could have helped/help to safeguard public values in [name of case/country]?
- What role should governments take, and to what extent are they fulfilling this task already?
- How much interest do private parties have in co-organizing mobility platforms and what can you ask of them in terms of safeguarding public values?
- What kind of public values do you see as dominant in the discourse on public values and mobility platforms and which do not receive enough attention?
- What lessons have you learned about the implementation of mobility platforms?
- To what extent do you think a mobility platform should actively steer the safeguarding of values, for example by setting a maximum on kilometers by car per month?
- How would you imagine an ideal mobility platform?

Acknowledgements

An earlier version of the assessment framework for public values has been conceptualized in an unpublished essay by Luca Bertolini, Marco te Brömmelstroet and Peter Pelzer. The authors would like to thank the Municipality of Utrecht, the Rathenau Instituut and the interviewees for their contribution to the project. The authors would also like to thank Edward Jacobson for his valuable suggestions and comments on earlier drafts of the manuscript.

Authors' contributions

Rianne Riemens and Carolin Nast have executed the literature review and the research on case studies and have written most of the paper. Peter Pelzer was the initiator and project lead of the research project. Martijn van den Hurk structured the methodology. Both authors have thoroughly worked through the text several times and contributed to the paper. The creation of the assessment framework and main argument was a joint effort by all authors. All authors read and approved the final manuscript.

Funding

The paper is the result of the research project Algorithmic Studio, executed in 2019–2020 at Utrecht University, the Netherlands. The project is made possible by the VerDuS research program 'Smart Urban Regions of the Future' (project number 438.19.158), financed by the Dutch Research Council (NWO).

Availability of data and materials

The reports of the interviews and meetings (see Appendix 1 & 3) that were organized and analyzed as part of this research are available from the corresponding author on reasonable request.

Declaration

Competing interests

The authors declare that they have no competing interests.

Author details

¹Radboud University, Nijmegen, the Netherlands. ²University of Stavanger Business School, Stavanger, Norway. ³Utrecht University, Utrecht, the Netherlands.

Received: 18 December 2020 Accepted: 20 July 2021

Published online: 07 September 2021

References

- Aschhoff N, Vogel R. Value conflicts in co-production: governing public values in multi-actor settings. *Int J Public Sect Manag.* 2018;31(7):775–93. <https://doi.org/10.1108/IJPSM-08-2017-0222>.
- Banister D. *Unsustainable transportation*. New York: Routledge; 2005. <https://doi.org/10.4324/9780203003886>.
- Banister D. The sustainable mobility paradigm. *Transp Policy.* 2008;15(2):73–80. <https://doi.org/10.1016/j.tranpol.2007.10.005>.
- Bannister F, Connolly R. ICT, public values and transformative government: a framework and programme for research. *Gov Inform Q.* 2014;31(1):119–28. <https://doi.org/10.1016/j.giq.2013.06.002>.
- Barns S. *Platform urbanism: negotiating platform ecosystems in connected cities*. Singapore: Palgrave MacMillan; 2020. <https://doi.org/10.1007/978-981-32-9725-8>.

- Belletti F, Bayen AM. Privacy-preserving MaaS fleet management. *Transp Res Proc.* 2017;23:1000–24. <https://doi.org/10.1016/j.trpro.2017.05.055>.
- Bigazzi A. Comparison of marginal and average emission factors for passenger transportation modes. *Appl Energ.* 2019;242:1460–6. <https://doi.org/10.1016/j.apenergy.2019.03.172>.
- Boarnet MG, Crane R. *Travel by design: the influence of urban form on travel*. New York: Oxford University Press; 2001. <https://doi.org/10.1093/oso/9780195123951.001.0001>.
- Bozeman B. *Public values and public interest: counterbalancing economic individualism*. Washington, DC: Georgetown University Press; 2007.
- Buehler R. Determinants of transport mode choice: a comparison of Germany and the USA. *J Transp Geogr.* 2011;19(4):644–57. <https://doi.org/10.1016/j.jtrangeo.2010.07.005>.
- Callegati F, Giallorenzo S, Melis A, Prandini M. Cloud-of-things meets mobility-as-a-service: an insider threat perspective. *Comput Secur.* 2018;74:277–95. <https://doi.org/10.1016/j.cose.2017.10.006>.
- Cass N, Shove E, Urry J. *Changing infrastructures, measuring socio-spatial inclusion/exclusion: final report to the Department for Transport*. Lancaster: Lancaster University; 2003. <https://eprints.lancs.ac.uk/id/eprint/64788>. Accessed 13 Dec 2020
- Chan S, Miranda-Moreno L, Patterson Z. Analysis of GHG emissions for city passenger trains: is electricity an obvious option for Montreal commuter trains? *J Transp Technol.* 2013;3(2A):17–29. <https://doi.org/10.4236/jts.2013.32A003>.
- Churchman A. Disentangling the concept of density. *J Plan Lit.* 1999;13(4):389–411. <https://doi.org/10.1177/08854129922092478>.
- Cottrill CD. MaaS surveillance: privacy considerations in mobility as a service. *Transp Res Part A: Policy Pract.* 2020;131:50–7. <https://doi.org/10.1016/j.tra.2019.09.026>.
- De Bruijn H, Dicke W. Strategies for safeguarding public values in liberalized utility sectors. *Public Adm.* 2006;84(3):717–35. <https://doi.org/10.1111/j.1467-9299.2006.00609.x>.
- De Graaf G, Huberts L, Smulders R. Coping with public value conflicts. *Admin Soc.* 2016;48(9):1101–27. <https://doi.org/10.1177/0095399714532273>.
- De Graaf G, Paanakker H. Good governance: performance values and procedural values in conflict. *Am Rev Public Adm.* 2015;45(6):635–52. <https://doi.org/10.1177/0275074014529361>.
- De Hartog JJ, Boogaard H, Nijland H, Hoek G. Do the health benefits of cycling outweigh the risks? *Environ Health Persp.* 2010;118(8):1109–16. <https://doi.org/10.1289/ehp.0901747>.
- De Lange M, De Waal M. Owning the city: new media and citizen engagement in urban design. *First Monday.* 2013;18(11). <https://doi.org/10.5210/fm.v18i11.4954>.
- Dewey J. In: Rogers ML, editor. *The public and its problems: an essay in political inquiry*. Pennsylvania: The Pennsylvania University Press; 2012. (original work published 1927).
- Dimoula V, Kehagia F, Tsakalidis A. A holistic approach for estimating carbon emissions of road and rail transport systems. *Aerosol Air Qual Res.* 2016;16(1):61–8. <https://doi.org/10.4209/aaqr.2015.05.0313>.
- Docherty I, Marsden G, Anable J. The governance of smart mobility. *Transp Res Part A: Policy Pract.* 2018;115:114–25. <https://doi.org/10.1016/j.tra.2017.09.012>.
- Dotterud Leiren M, Aarhaug J. Taxis and crowd-taxis: sharing as a private activity and public concern. *Internet Policy Rev.* 2016;5(2):1–17. <https://doi.org/10.14763/2016.2.420>.
- Eldér E. What kind of compact development makes people drive less? The “ds of the built environment” versus neighborhood amenities. *J Plan Educ Res.* 2018;40(4):432–46. <https://doi.org/10.1177/0739456X18774120>.
- Erhardt GD, Roy S, Cooper D, Sana B, Chen M, Castiglione J. Do transportation network companies decrease or increase congestion? *Sci Adv.* 2019;5:1–11 eaau2670.
- Ewing R, Cervero R. *Travel and the built environment: a synthesis*. *Transport Res Rec.* 2001;1780(1):87–114. <https://doi.org/10.3141/1780-10>.
- Ferreira A, Bertolini L, Naess P. Immutability as resilience? A key consideration for transport policy and research. *Appl Mobilities.* 2017;2(1):16–31. <https://doi.org/10.1080/23800127.2017.1283121>.
- Frenken K, Pelzer P. Reverse technology assessment in the age of the platform economy. *Built Environ.* 2020;46(1):22–7. <https://doi.org/10.2148/benv.46.1.22>.
- Frenken K, Van Waes A, Pelzer P, Smink M, Van Est R. Safeguarding public interests in the platform economy. *Policy Internet.* 2020;12(3):400–25. <https://doi.org/10.1002/poi.3.217>.
- Gehl J. *Cities for people*. Washington, DC: Island Press; 2010.
- Geissinger A, Laurell C, Sandström C. Digital disruption beyond Uber and Airbnb. Tracking the long tail of the sharing economy. *Technol Forecast Soc.* 2020;155(1):8. <https://doi.org/10.1016/j.techfore.2018.06.012>.
- Genre-Grandpierre C, Sahuc C, Gueye S. Speed vs locations: accessibility level evaluations. The case of the ring of sciences in Lyon. *Case Stud Transp Policy.* 2018;6(3):423–31. <https://doi.org/10.1016/j.cstp.2018.04.001>.
- Genus A. Rethinking constructive technology assessment as democratic, reflective, discourse. *Technol Forecast Soc.* 2006;73(1):13–26. <https://doi.org/10.1016/j.techfore.2005.06.009>.
- Goggin G, Hollier S, Hawkins W. Internet accessibility and disability policy: lessons for digital inclusion and equality from Australia. *Internet Policy Rev.* 2017;6(1):1–18. <https://doi.org/10.14763/2017.1.452>.
- Haglund N, Mladenović MN, Kujala R, Weckström C, Saramäki J. Where did Kutsuplus drive us? Ex post evaluation of on-demand micro-transit pilot in the Helsinki capital region. *Res Transp Bus Manag.* 2019;32:100390. <https://doi.org/10.1016/j.rtbm.2019.100390>.
- Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet.* 2012;380(9838):247–57. [https://doi.org/10.1016/S0140-6736\(12\)60646-1](https://doi.org/10.1016/S0140-6736(12)60646-1).
- Helberger N, Pierson J, Poell T. Governing online platforms: from contested to cooperative responsibility. *Inf Soc.* 2018;34(1):1–14. <https://doi.org/10.1080/01972243.2017.1391913>.
- Hendriks F. Understanding good urban governance: essentials, shifts, and values. *Urban Aff Rev.* 2014;50(4):553–76. <https://doi.org/10.1177/1078087413511782>.
- Hoffman D, Grivel E, Battle L. Designing software architectures to facilitate accessible web applications. *IBM Syst J.* 2005;44(3):467–83. <https://doi.org/10.1147/sj.443.0467>.

- Hofmann S, Sæbø Ø, Braccini AM, Za S. The public sector's roles in the sharing economy and the implications for public values. *Gov Inform Q*. 2019;36(4):1–12, 1013992. <https://doi.org/10.1016/j.giq.2019.101399>.
- Howarth C, Ryley T. A behavioural perspective on the relationship between transport and climate change. In: Ryley T, Chapman L, editors. *Transport and climate change*. Bingley: Emerald; 2012. p. 261–86. [https://doi.org/10.1108/S2044-9941\(2012\)0000002013](https://doi.org/10.1108/S2044-9941(2012)0000002013).
- IJsselsteijn W, de Kort Y, Midden C, Eggen B, Van den Hoven E. Persuasive technology for human well-being: setting the scene. In: IJsselsteijn WA, De Kort YAW, Midden C, Eggen B, Van den Hoven E, editors. *Persuasive technology*. Heidelberg: Springer; 2006. p. 1–5. https://doi.org/10.1007/11755494_1.
- Ingrams A. Public values in the age of big data: a public information perspective. *Policy Internet*. 2019;11(2):128–48. <https://doi.org/10.1002/poi3.193>.
- IRP. The weight of cities: resource requirements of future urbanization. Nairobi: International Resource Panel, United Nations Environment Programme; 2018. <http://hdl.handle.net/20.500.11822/31623>. Accessed 14 Dec 2020
- Jacobs J. *The death and life of great American cities*. New York: Vintage; 1992. (original work published 1961)
- Jin ST, Kong H, Wu R, Sui DZ. Ridesourcing, the sharing economy, and the future of cities. *Cities*. 2018;76:96–104. <https://doi.org/10.1016/j.cities.2018.01.012>.
- Jokinen JP, Sihvola T, Mladenovic MN. Policy lessons from the flexible transport service pilot Kutsuplus in the Helsinki capital region. *Transp Policy*. 2019;76:123–33. <https://doi.org/10.1016/j.tranpol.2017.12.004>.
- Jørgensen TB, Bozeman B. Public values: an inventory. *Admin Soc*. 2007;39(3):354–81. <https://doi.org/10.1177/0095399707300703>.
- Kamargianni M, Matyas M. The business ecosystem of mobility-as-a-service. In: Paper presented at the 96th Transportation Research Board (TRB) annual meeting, Washington DC; 2017.
- Karlsson M, Sochor J, Strömberg H. Developing the 'service' in mobility as a service: experiences from a field trial of an innovative travel brokerage. *Transp Res Proc*. 2016;14:3265–73. <https://doi.org/10.1016/j.trpro.2016.05.273>.
- Katzenbach C, Ulbricht L. Algorithmic governance. *Internet Policy Rev*. 2019;8(4):1–18. <https://doi.org/10.14763/2019.4.1424>.
- Kenworthy JR. Transport energy use and greenhouse gases in urban passenger transport systems: a study of 84 global cities. In: Paper presented at the international sustainability conference, Fremantle, Western Australia; 2003.
- Kenworthy JR. The eco-city: ten key transport and planning dimensions for sustainable city development. *Environ Urban*. 2006;18(1):67–85. <https://doi.org/10.1177/0956247806063947>.
- Kool L, Timmer J, Royakkers LMM, Van Est QC. Urgent upgrade: protect public values in our digitized society. The Hague: Rathenau Instituut; 2017.
- Lamont D, Kenyon S, Lyons G. Dyslexia and mobility-related social exclusion: the role of travel information provision. *J Transp Geogr*. 2013;26:147–57. <https://doi.org/10.1016/j.jtrangeo.2012.08.013>.
- Leyden KM. Social capital and the built environment: the importance of walkable neighborhoods. *Am J Public Health*. 2003; 93(9):1546–51. <https://doi.org/10.2105/AJPH.93.9.1546>.
- Lucas K. Providing transport for social inclusion within a framework for environmental justice in the UK. *Transp Res Part A: Policy Pract*. 2006;40(10):801–9. <https://doi.org/10.1016/j.tra.2005.12.005>.
- Lucas K. Transport and social exclusion: where are we now? *Transp Policy*. 2012;20:105–13. <https://doi.org/10.1016/j.tranpol.2012.01.013>.
- Lupton D. Health promotion in the digital era: a critical commentary. *Health Promot Int*. 2014;30(1):174–83. <https://doi.org/10.1093/heapro/dau091>.
- Martens K. Justice in transport as justice in accessibility: applying Walzer's 'spheres of justice' to the transport sector. *Transportation*. 2012;39(6):1035–53. <https://doi.org/10.1007/s11116-012-9388-7>.
- Martens K. *Transport justice: designing fair transportation systems*. New York: Routledge; 2017.
- Meijer A, Schäfer MT, Branderhorst M. Principes voor goed lokaal bestuur in de digitale samenleving: Een aanzet tot een normatief kader. *Bestuurswetenschappen*. 2019;73(4):8–23. <https://doi.org/10.5553/Bw/016571942019073004003>.
- Melis A, Mirri S, Prandi C, Prandini M, Salomoni P, Callegati F. Integrating personalized and accessible itineraries in MaaS ecosystems through microservices. *Mob Networks Appl*. 2018;23(1):167–76. <https://doi.org/10.1007/s11036-017-0831-z>.
- Melis A, Prandini M, Sartori L, Callegati F. Public transportation, IoT, trust and urban habits. In: *International conference on internet science*. Cham: Springer; 2016.
- Moore MH. *Creating public value: strategic management in government*. Cambridge: Harvard University Press; 1995.
- Moore MH. *Recognizing public value*. Cambridge: Harvard University Press; 2013. <https://doi.org/10.4159/harvard.9780674067820>.
- Mugion RG, Toni M, Raharjo H, di Pietro L, Sebatu SP. Does the service quality of urban public transport enhance sustainable mobility? *J Clean Prod*. 2018;174:1566–87. <https://doi.org/10.1016/j.jclepro.2017.11.052>.
- Nabatchi T. Public values frames in administration and governance. *Perspect Public Manag Gov*. 2018;1(1):59–72. <https://doi.org/10.1093/ppmgov/gvx009>.
- Nieto A, Lopez J. A model for the analysis of QoS and security tradeoff in mobile platforms. *Mob Networks Appl*. 2014;19(1): 64–78. <https://doi.org/10.1007/s11036-013-0462-y>.
- Nivola PS. *Laws of the landscape: how policies shape cities in Europe and America*. Washington, DC: Brookings Institution Press; 1999.
- Oja P, Titze S, Bauman A, de Geus B, Krenn P, Reger-Nash B, et al. Health benefits of cycling: a systematic review. *Scand J Med Sci Sport*. 2011;21(4):496–509. <https://doi.org/10.1111/j.1600-0838.2011.01299.x>.
- Pangbourne K, Mladenović MN, Stead D, Milakis D. Questioning mobility as a service: unanticipated implications for society and governance. *Transp Res Part A: Policy Pract*. 2020;131:35–49. <https://doi.org/10.1016/j.tra.2019.09.033>.
- Pangbourne K, Stead D, Mladenović M, Milakis D. The case of mobility as a service: a critical reflection on challenges for urban transport and mobility governance. In: Marsden G, Reardon L, editors. *Governance of the smart mobility transition*. Bingley: Emerald Publishing Limited; 2018. p. 33–48. <https://doi.org/10.1108/978-1-78754-317-120181003>.
- Pelzer P, Frenken K, Boon W. Institutional entrepreneurship in the platform economy: how Uber tried (and failed) to change the Dutch taxi law. *Environ Innov Soc Transitions*. 2019;33:1–12. <https://doi.org/10.1016/j.eist.2019.02.003>.
- Perentis C, Vescovi M, Leonardi C, Moiso C, Musolesi M, Pianesi F, et al. Anonymous or not? Understanding the factors affecting personal mobile data disclosure. *ACM Trans Internet Technol*. 2017;17(2):1–19. <https://doi.org/10.1145/3017431>.

- Plantin JC, Lagoze C, Edwards PN, Sandvig C. Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media Soc.* 2018;20(1):293–310. <https://doi.org/10.1177/1461444816661553>.
- Pucher J, Buehler R. Cycling towards a more sustainable transport future. *Transp Rev.* 2017;37(6):689–94. <https://doi.org/10.1080/01441647.2017.1340234>.
- Pucher J, Buehler R, Bassett DR, Dannenberg AL. Walking and cycling to health: a comparative analysis of city, state, and international data. *Am J Public Health.* 2010;100(10):1986–92. <https://doi.org/10.2105/AJPH.2009.189324>.
- Reinhard E, Courtin E, Van Lenthe FJ, Avendano M. Public transport policy, social engagement and mental health in older age: a quasi-experimental evaluation of free bus passes in England. *J Epidemiol Community Health.* 2018;72(5):361–8. <https://doi.org/10.1136/jech-2017-210038>.
- Reynaers AM. Public values in public-private partnerships. *Public Adm Rev.* 2014;74(1):41–50. <https://doi.org/10.1111/puar.12137>.
- Riemens R, Pelzer P, Van den Hurk M, Nast C. Mobility platforms in the city of the future: an exploratory study of public values and possible futures: Utrecht University; 2021. <https://www.uu.nl/en/research/transforming-cities/algorithmic-studio>. Accessed 9 Jul 2021
- Robbins S. A misdirected principle with a catch: explicability for AI. *Minds Mach.* 2019;29(4):495–514. <https://doi.org/10.1007/s11023-019-09509-3>.
- Rodriguez Muller AP, Steen T. Behind the scenes of coproduction of smart mobility: evidence from a public values' perspective. In: Lindgren I, et al., editors. *Electronic government. EGOV 2019. Lecture notes in computer science*, vol. 11685. Cham: Springer; 2019. p. 338–52. https://doi.org/10.1007/978-3-030-27325-5_26.
- Rodriguez-Sanchez MC, Martinez-Romo J. GAWA—manager for accessibility wayfinding apps. *Int J Inf Manag.* 2017;37(6):505–19. <https://doi.org/10.1016/j.ijinfomgt.2017.05.011>.
- Saelens BE, Sallis JF, Frank LD. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Ann Behav Med.* 2003;25(2):80–91. https://doi.org/10.1207/S15324796ABM2502_03.
- Sager T. Freedom as mobility: implications of the distinction between actual and potential travelling. *Mobilities.* 2006;1(3):465–88. <https://doi.org/10.1080/17450100600902420>.
- Santoni de Sio F, van den Hoven J. Meaningful human control over autonomous systems: a philosophical account. *Front Robot AI.* 2018;5:1–14. <https://doi.org/10.3389/frobt.2018.00015>.
- Sarasini S, Sochor J, Arby H. What characterises a sustainable MaaS business model? In: 1st international conference on mobility as a service (ICOMaaS), Tampere, Finland; 2017. p. 28–9.
- Scheiner J, Holz-Rau C. Travel mode choice: affected by objective or subjective determinants? *Transportation (Amst).* 2007;34(4):487–511. <https://doi.org/10.1007/s11116-007-9112-1>.
- Sheller M. Mobility, freedom and public space. In: Sager T, Bergmann S, editors. *The ethics of mobilities: rethinking place, exclusion, freedom and environment*. London: Routledge; 2016. p. 41–54.
- Shokri R, Theodorakopoulos G, Papadimitratos P, et al. Hiding in the mobile crowd: location privacy through collaboration. *IEEE Trans Dependable Secur Comput.* 2014;11(3):266–79. <https://doi.org/10.1109/TDSC.2013.57>.
- Sochor J, Strömberg H, Karlsson M. Travelers' motives for adopting a new, innovative travel service: insights from the UbiGo field operational test in Gothenburg, Sweden. In: 21st world congress on intelligent transport systems, Detroit; 2014.
- Sochor J, Strömberg H, Karlsson M. Implementing mobility as a service: challenges in integrating user, commercial, and societal perspectives. *Transp Res Res J Transp Res Board.* 2015a;2536(1):1–9. <https://doi.org/10.3141/2536-01>.
- Sochor J, Strömberg H, Karlsson M. An innovative mobility service to facilitate changes in travel behavior and mode choice. In: 22nd world congress on intelligent transportation systems, Bordeaux; 2015b.
- Sourbati M, Behrendt F. Smart mobility, age and data justice. *New Media Soc.* 2020;23(6):1–17. <https://doi.org/10.1177/1461444820902682>.
- Spagnoletti P, Resca A, Lee G. A design theory for digital platforms supporting online communities: a multiple case study. *J Inf Technol.* 2015;30(4):364–80. <https://doi.org/10.1057/jit.2014.37>.
- Spahn A. Moralizing mobility?: persuasive technologies and the ethics of mobility. *Transfers.* 2013;3(2):108–15. <https://doi.org/10.3167/trans.2013.030207>.
- Suzor N. Digital constitutionalism: using the rule of law to evaluate the legitimacy of governance by platforms. *Soc Media + Soc.* 2018;4:1–11. <https://doi.org/10.1177/2056305118787812>.
- Szell M. Crowdsourced quantification and visualization of urban mobility space inequality. *Urban Plan.* 2018;3:1–20. <https://doi.org/10.17645/up.v3i1.1209>.
- Timmermans H, van der Waerden P, Alves M, Polak J, Ellis S, Harvey AS, et al. Spatial context and the complexity of daily travel patterns: an international comparison. *J Transp Geogr.* 2003;11(1):37–46. [https://doi.org/10.1016/S0966-6923\(02\)00050-9](https://doi.org/10.1016/S0966-6923(02)00050-9).
- Van den Hurk M, Pelzer P, Riemens R. Governance challenges of mobility platforms: the case of Merwede, Utrecht. *Eur Transp Res Rev.* 2021;13(23):1–12. <https://doi.org/10.1186/s12544-021-00483-5>.
- Van der Graaf S, Ballon P. Navigating platform urbanism. *Technol Forecast Soc Change.* 2019;142:364–72. <https://doi.org/10.1016/j.techfore.2018.07.027>.
- Van Dijk J, Poell T, De Waal M. *The platform society: public values in a connective world*. Oxford: Oxford University Press; 2018.
- Van Wee B, Annema JA, Banister D. *The transport system and transport policy: an introduction*. Cheltenham: Edward Elgar Publishing; 2013.
- Veeneman WW, Van Kuijk JI, Hienstra-van Mastrigt S. Exploring governance strategies and their consequences for personal mobility systems. In: Mueller B, Meyer G, editors. *Towards user-centric transport in Europe 2: enablers of inclusive, seamless and sustainable mobility*. Cham: Springer Nature; 2020. p. 225–39. https://doi.org/10.1007/978-3-030-38028-1_16.
- Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. *CMAJ.* 2006;174(6):801–9. <https://doi.org/10.1503/cmaj.051351>.
- Wen J, Chen YX, Nassir N, Zhao J. Transit-oriented autonomous vehicle operation with integrated demand-supply interaction. *Transp Res Part C Emerg Technol.* 2018;97:216–34. <https://doi.org/10.1016/j.trc.2018.10.018>.

Woodcock J, Edwards P, Tonne C, Armstrong BG, Ashiru O, Banister D, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet*. 2009;374(9705):1930–43. [https://doi.org/10.1016/S0140-6736\(09\)61714-1](https://doi.org/10.1016/S0140-6736(09)61714-1).

Zuboff S. *The age of surveillance capitalism: the fight for a human future at the new frontier of power*. London: Profile Books; 2019.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

