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# Mobility as a Service: Defining a Transport Utopia

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**Abstract:** Having been widely acknowledged as enabling access to education, employment, leisure and social activities, transport choices are also the cause of many challenges cities face. Recognising that change is needed, planners and policymakers are considering alternative methods of planning and delivering transport. Mobility as a Service (or MaaS) is one such idea that has gained traction with academics and professionals alike. Hailed as the answer to integrating complex transport systems, MaaS has yet to be implemented at scale in urban transport systems due in part to the lack of an agreed conceptual definition, the top-down approach to implementing what is meant to be a more personalised method of accessing transport, and the lack of local promoters (in comparison to global corporations and lobbyists). This article reflects on the current barriers to defining MaaS, considers how a novel public engagement approach could be used to create local definitions that support citizen engagement, and suggests a route forward for future research.

**Keywords:** transport policy; mobility as a service; MaaS; urban planning; citizen engagement; co-design; sustainability



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## 1. Introduction

It is widely acknowledged that mobility has helped shape urban design and development, and wider urban policies and planning have shaped transport infrastructure and service investment [1–6]. The transportation sector, in a similar manner to other industries, has evolved throughout history in a way that attempts to satisfy consumer requirements or needs [7]. However, transport systems over time have begun to face a growing number of pressures. These pressures include pollution from transport-related emissions [1,8,9], congestion [10,11], accessibility issues [12], and negative impacts on physical and mental health [13]. In response to the current challenges, interventions that enable and encourage the uptake of sustainable modes have become an active consideration in policymaking at city, national, and international levels and in academic research [14,15]. Alongside this, new concepts in transport planning and operations, such as Mobility as a Service (MaaS), are gaining traction amongst professionals and academics as a mechanism to enable improved user experience, resolve transport challenges, and meet city aspirations [7].

This article summarises the current obstacles to defining MaaS at a local level, commencing with a brief literature review of the current challenges faced by cities and MaaS as a concept. This article goes on to consider the benefits of taking a deeper engagement approach to support the creation of a definition by the community most likely to use it. Finally, recognising the challenges of the suggested approach, the article concludes by considering potential directions for future research. This article aims to support the development of a research agenda in this area, posing new areas for further research to consider.

## 2. Transport, Urban Planning, and New Concepts: A Literature Review

Today, transportation predominantly enables access to education, employment, leisure, and social activities [16,17] but can also reduce seclusion and broaden economic opportunities by connecting urban and rural areas and other marginalised areas [7]. Literature concerning the challenges and resolutions for cities is varied and extensive and incorporates a range of new theories and planning scenarios at a range of scales including (but not limited to) smart cities (the utilisation of data and technical infrastructure to improve urban performance) [18–21], Smart Growth (the implementation of compact, urban centres that prioritise active travel and mixed-used developments) [22], and, Superblocks (fixed size areas that divert traffic around instead of through residential spaces) [23]. Silva, Khan, and Han [24] argue that new concepts such as smart cities require additional institutional and social infrastructure to advance beyond being known only as terms relating to increased digital connectivity, instead enabling them to ensure developments support cities in achieving their policy goals. However, the structure and components of a transport system differ significantly depending on the location, population density, and historical and cultural preferences of the area. Cities around the world are experiencing similar ongoing trends, highlighting that mobility in urban areas has reached a critical point [2–29].

Noting the current challenges faced by cities, concepts of liveability and placemaking have entered discussions on transport, with policy goals being centred on creating an urban realm that not only is functional but also promotes happiness [30,31]. Ancaies and Jones [30] argue that expectations from individuals on what transport should deliver has changed over the years, but many local, regional, and national governments are now considering ways to reduce or restrain the use of private cars in an effort to improve urban spaces and reduce health disbenefits of excess motor vehicles.

Several interventions have been trialled to encourage behaviour change, including (but not limited to) congestion charges, positive publicity associated with active travel modes, parking fee changes, and free and discounted public transport tickets [18–20,28]. Noting the challenges of effecting long-term change, Jones [28] argues that any intervention must address the conditions in which sustainable travel can prevail, including new infrastructure and the use of innovative technologies, alongside changing travel behaviours.

Advanced technology and better use of technical systems have presented an opportunity in urban areas, namely allowing efficient networks to emerge that can positively utilise new innovations and create a newer, resource-light economy, while maintaining and expanding access to transport products and services [32]. Similarly, these new networks will enable cities to improve their overall resilience to disruption, offering greater operational reliability for cities and their residents and visitors [33]. As a result of terms such as ‘smart cities’, other concepts that utilise a similar principle (the use of technology to improve planning, operations and consumer experience) have emerged [34,35]. Mobility as a Service or ‘MaaS’ is a term that has recently gained traction amongst transport planners, operators, automotive manufacturers, and technology developers, as a potential mechanism to reduce or remove the challenges currently faced by urban areas [7].

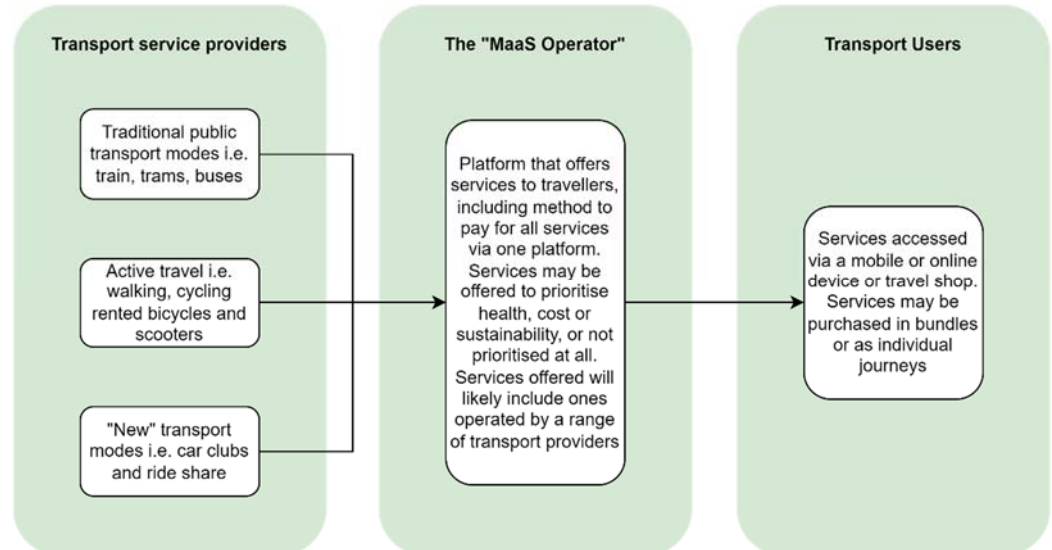
### 2.1. Mobility as a Service: Towards a Definition

To date, there are ongoing discussions and disagreements around what MaaS is and the core components of what a MaaS system should include, with different academics focusing on different aspects. Melis, Prandini, Sartori, and Callegati [36] consider the communications technologies and the use of data as being key to MaaS. Giesecke, Surakka, and Hakonen [37] offer a similar assessment but go on to argue that it is the recent technical advancements that allow for the intelligent use of new technologies (such as communications and information) that will enable a sustainable MaaS system to be implemented. Matyas and Kamargianni [38] argue that MaaS could be more of a soft mobility management tool, enabling the public authority to use MaaS to prioritise certain modes that support public policy aims. In contrast, Finger, Bert, and Kupfer [39] imagine that the key MaaS offer should be the overall integration of the transport system. This is supported in part by

Holmberg, Collado, Sarasini, and Williander [40], who believe the ability to purchase travel services via one portal will offer more choices to travellers.

Clearly, there is disagreement and differences of opinion, but there are several components which feature in publications (academic and non-academic) that discuss MaaS and the particulars of a MaaS system, including integrating services for easier access physically and virtually (through online platforms), a greater degree of personalisation to transport services, being able to access a wider range of transport modes, and access to services instead of ownership. It is not yet known how MaaS might impact a city, as existing operations are scarce and no trials have been conducted at scale or for significant lengths of time (small trials in confined areas for short periods have been conducted in a number of places to date) [41]. However, interest in the term and range of definitions is ongoing. A number of studies have identified either key characteristics (such as those identified by Jittrapirom, Caiati, Feneri, Ebrahimigharehbaghi, Alonso-Gonzalez, and Narayan [42] in a 2017 review of 12 conceptualisations), a MaaS dictionary (such as the one devised by Karmargianni, Matyas, Muscat, and Yfantis [43]), or a MaaS 'hierarchy' (as published by Lyons, Hammond, and Mackay [44]). To offer a MaaS transport planning and delivery system, a range of seemingly independent systems must work together, including physical infrastructure and communications technologies [7]. These publications offer insight into potential components or systems required to devise and implement a MaaS system, i.e., a sufficiently robust ICT platform or a range of modes already available in an area.

Noting the differences in transport systems around the world, it may not be possible to summarise how this system may be practically implemented at scale in one definition. Figure 1 highlights how a MaaS platform may work in its simplest form. However, the ability to determine what MaaS means to a city may lie in the preferences and aspirations of the city's inhabitants.



**Figure 1.** A simple representation of what a MaaS system may contain. (Source: author).

In recent years, global competitiveness has resulted in cities designing and investing in high-quality, well-developed urban spaces [30]. Lagos, Pittsburgh, and Busan have been noted in particular by the World Economic Forum as examples of cities that are competing on a number of factors, including infrastructure spending, policy development, and attraction of new skills [45]. The competitiveness of cities is not exclusive to larger, capital cities but is also noted in secondary and tertiary cities that are developing areas of capability that allow them to compete on a global scale [45]. This competition is not limited to infrastructure investments or policies but also includes utilisation of new technologies and inclusion of these technologies within daily processes, i.e., mobility planning and choices [45]. However, when determining what technologies should be implemented and

how a wider system may be designed, those who will use it are frequently seen as passive consumers and not active participants in the planning process [46]. Nevertheless, bringing a wide range of potential users into the discussion to shape a MaaS system may provide additional ideas to complement (or contrast with) the existing information.

## 2.2. Gaps in Knowledge and Research

Whilst the quantity of literature on MaaS is increasing, thanks in part to ongoing trials in different areas around the world, there are several gaps in knowledge that could benefit from additional research. This is particularly true in the case of MaaS systems co-designed with communities. Many systems trialled to date have relied on operators, software companies, transport authorities, and consumers testing out systems that have been designed as part of a funded project, for a specific event, or to test whether a specific process or structure would work for an area [44]. In these instances, consumers are frequently engaged in the process through the provision of feedback once they have used the MaaS trial. This puts the emphasis of designing a suitable system on the partners involved and reduces the input of potential users, as any input they provide is given after the MaaS system parameters have been defined. One notable exception to this is the NaviGoGo trial, which took place in Scotland in 2017. This trial aimed to provide an improved transport experience to users aged 16–25 [47]. Funded through a project called Pick&Mix, the trial incorporated co-design into the project from the start, creating a National Youth Team, formed of volunteers from the specified age group, to be part of the decision-making process when designing how the system would operate during the trial and what it would offer [47].

Alongside the gap in co-design with communities, and additional gap in knowledge relates to what MaaS and, by extension, public transport is meant to achieve within a MaaS system. Due to its complex nature and the lack of an overall definition, the purpose or ‘mission’ of MaaS is unclear. It is often mentioned that the purpose is to reduce the level of ownership of private vehicles by offering attractive alternatives that replicate the benefits of car usage. However, the level of car ownership is based on several factors, including psychological and societal pressure, infrastructure investment in cities to support vehicle usage, and, as highlighted by Mattiolo, Roberts, Steinberger, and Brown [48], the achievement of decent levels of satisfaction of needs [48–53]. According to Ikezoe, Kiriyama, and Fujimura [49], car sharing services that aim to replicate the convenience and reliability of car ownership do not necessarily result in a reduction in car ownership. Alongside this, Tirachini [50] argues that car-sharing and ride-hailing services actually cause an increase in traffic levels and congestion in urban areas, highlighting that some of the key issues that have emerged as a result of car usage would not necessarily decrease by replacing ownership with a service-based model. With ongoing trials taking place, a range of ‘mission’ types could be tested. However, input from communities on what the system should and could deliver may allow for a wider discussion around local and regional policy goals relating to reducing some of the challenges faced by cities as a result of transport choices.

Finally, how MaaS may enable cities to increase their resilience in the face of unexpected disruption or unpredictable events requires additional consideration. Bruzzone, Dameri, and Demartini [33] argue that increased resilience will enable cities to maintain their levels of social and economic capability, along with their ability to be innovative, in the face of disruption and change. Literature relating to MaaS and resilience is limited, in part due to its limited implementation. Further research relating to how MaaS could contribute to the development of additional resilience is required and could form part of pilot and trial programmes. The following section discusses community participation and engagement as part of the planning process, and how it could be used to define a sustainable MaaS system.

## 3. Co-Designing a Deeper Engagement Approach

The participation of members of the public in planning exercises is thought to improve community acceptance of a scheme and legitimise the outputs of a project [54,55]. A

positive consultation response results in the community acceptance of a project, offering it a 'social licence' to continue [56] (p. 163). Consultation is typically the main form of public engagement when planning, designing, and implementing infrastructure and service investment [56]. Traditionally in the Global North, small groups of individuals representing the total population would be invited to voice opinions and arguments with planners and policymakers, resulting in joint decision making, distribution of budgets, and/or approval of projects [54,57]. However, in recent years, this type of consultation has typically been passed over in favour of a digitised, larger exercise that involves remote contribution of opinions to plans published online [54,58]. This type of consultation aims to reach a wider audience, in line with larger infrastructure projects that might impact a larger audience, for example, a new light rail line. The limitations of this practice mean that opinions are typically taken at a later stage in planning and the ability of community representatives or the community as a whole to be part of the decision-making process is reduced [54]. Typically, the consultation phase is also a one-time event during a planning process, offering limited opportunity for engagement [54]. Alongside this, the ability of community opinions to resonate with or influence decision-makers now largely relates to the volume of responses that follow the same pattern as opposed to quality, persuasiveness, or individual need.

Whilst the participation of the community in scheme planning is limited, consultation is still seen as a positive step in engaging with those will use or be impacted by the project [56]. However, the success of a consultation strategy rests on the goals of the engagement and the approach to be taken to engage with the community [54]. Alongside this, the timing of the consultation (particularly in relation to political key dates or programmes of political interest) is also an important consideration [54,58].

In contrast with the consultation method described above, a more involved action for engaging with communities is available and already well used by some groups: co-design. Co-design is a public participatory approach to scheme engagement that originated in Scandinavia in the 1970s [59,60]. However, it is sometimes used as a buzz word to demonstrate engagement with communities without co-design methods actually being utilised [60]. Defined by Sanders and Staffer [61] as a collective exercise in jointly creating something from the start to the end, co-design includes those trained and untrained in the design and implementation of a concept or process. Whilst many organisations have adopted a narrower view of co-design, focusing instead on cooperation during a process in place of joint creation, this paper will focus on co-design in the broader sense, defined by Sanders and Stappers [61]. This process brings people into the discussion, before anything has been designed or created, to inform the next steps.

Co-design in its broadest form incorporates the critical components of community engagement: it empowers individuals to be part of the development of something that may affect them, it provides a wider range of perspectives on both the challenge and the solution to a problem, and it creates community buy-in or ownership of a project [60]. Indirect benefits of co-design include improving local education on the possibilities and limitations of investment, improving mutual understanding of other ideas, increasing community wellbeing, increasing the quality of the overall community system, and providing a method for ongoing wider community engagement [60,62,63]. The purpose of directly engaging citizens, including those termed 'lay persons' as opposed to just community representatives or experts, is highlighted by Smith [64] in the book 'Democratic Innovations: Designing Institutions for Citizen Participation': evidence suggests that communities are becoming increasingly disillusioned with public institutions, resulting in low community engagement and participation, poor electoral turnout, and increasingly low level of trust in central and local governments [64,65]. Methods that encourage deeper community and individual participation in investment decision-making may enable a reduction in the disillusionment of citizens in cities and a stronger relationships between user need and investment action [66].

By incorporating users into the design process, the end result is more likely to better match or represent user needs [67,68]. This is re-emphasised by Burns, Cottam, Vanstone

and Winhall [69] who argue that users are experts in their own right as experts in their experiences, which leads them to have valid inputs into solutions to challenges that impact them. This is particularly true in the case of mobility, which is influenced by several factors in an individual's life, but the choice of the individual also influences what transport choices are available (such as in privatised bus markets seen in most areas of the UK). Therefore, by actively defining the vision or 'imagined future' of transport with potential users, the users can be key actors in the development of a transport system that meets both their needs and the goals of the local area [70].

#### 4. Co-Designing an 'Imagined Future' for Transport

In relation to transport, making investment choices that positively impact users and work towards local strategic goals is a complex problem, with some researchers going as far as labelling it a 'wicked problem' [71–73]. In efforts to think around the problem and generate more innovative solutions, principles of design and design thinking are increasingly being used to consider transport planning, particularly in the area of stakeholder engagement [72]. Traditionally, customers of transit networks have been viewed by planning professionals as users or passive consumers and not has a potential source of ideas in a co-creation process [53,74]. However, with service expectations of users changing, the co-creation process could provide the 'personalised' element of mass transit that has been missing to date (Gebauer, Johnson, and Enquist, 2010). This is particularly important in relation to MaaS, which is frequently mentioned alongside creating a more personalised method of providing and accessing transport services. However, as noted by Karlsson et al. [29], MaaS analytical frameworks typically feature users as one of many sections within a system and not necessarily at the heart of it.

The emergent and innovative nature of MaaS has meant transport, planning, and ICT experts have provided opinions on potential configurations and contributed to advancing the debate on the potential benefits of MaaS. Nevertheless, to date, no large-scale democratic process on a collaboratively created definition has been undertaken. Larger participation exercises are frequently deemed too challenging, resulting in engagement at a local level only, with the alternative being seen as a decentralisation exercise by senior political figures [64]. However, calls to change the consultation process into one of deeper engagement support the uptake of a method like co-design, as it provides the opportunity for a wider range of citizen participation [65]. In order to bring about meaningful change at a local and regional level, deeper community engagement is needed to better understand the reason for current actions, to support the idea and development of real alternatives and to enable the implementation of alternatives that will be fully utilised by the community [65,72]. Consequently, co-designing a new transport system with a population could enable richer engagement and better understanding of constraints and opportunities on all sides. Whilst not undertaken at scale, co-design and MaaS have already been trialled as an approach together.

#### 5. Community Owned Transport and Urban Planning

Currently, urban planning is typically a practice undertaken by experts, with the outputs being outside a democratic process or citizens' control [75]. However, with the development of ideas such as 'the liveable city', the impression of urban areas as diverse and evolving systems has emerged [75,76]. Current practices have led to the development of ordering cities by excluding other possibilities, which re-iterates an illusion that the current methods of planning and engagement are correct and the only choice [77]. Alongside this, embedded institutional environments and practices can sometimes be a barrier or constraint to innovative or creative thinking [41]. This is particularly true in the case of transport investment, which is typically negotiated on many levels [41]. However, by incorporating a democratic method of planning in practice, this can support the exploration of alternative possibilities for interventions [78].

Currently, over 60% of all travel globally is undertaken within areas that are considered urban areas, but this is expected to triple by 2050 [79]. With this in mind, how transport is planned, operated, and accessed will have a significant impact on urban planning, access to employment and education, public health, and mobility accessibility [80]. The possibility of a paradigm shift relating to transport planning and provision in urban areas is gaining interest and momentum [81]. Whilst planners may previously have looked to out-of-town employment and shopping facilities, now transport and urban planners are looking to bring home and key travel locations closer together, with the intention of making sustainable transport modes a more attractive option. With the impact that cities have on economic growth, quality of life, and the natural environment being increasingly under scrutiny, the ability of urban systems to create people-focused, sustainable development will be critical to shaping future urban growth [82,83]. When paired with the pressure on planners to consider problems relating to ongoing urban sprawl, ageing infrastructure challenges, and the potential for densification, using urban planning as a method to set parameters on a transport 'imagined future' would ensure that any developments are routed in city policies and goals and that co-design outputs do not reverse urban planning successes already achieved to date.

## 6. Conclusions: MaaS, Co-Design, and Future Research

This comment paper has developed a research agenda for MaaS, to help germinate future research questions, using a review of related literature and a discussion of the research gaps and potential co-design approaches. Whilst co-design has been used for many years, in its broadest sense its use in transport planning is still relatively new. Tools to refine the methods to be used and monitor the impact of co-design use and evaluation practices as part of an iterative process of refining methods would be beneficial to guide use in future transport planning processes. These could be implemented alongside clear KPIs to help assess whether co-design methods have had a positive impact on a project, area, or community. Use of co-design as a development tool will be more costly than traditional engagement and consultation practices [60], but other potential barriers to co-design uptake include a higher level of risk due to relying on ongoing community participation, a lower level of control being retained by an organisation that may result in poor buy-in at an organisational level, and a higher level of overall coordination will be required to manage the interactions and outputs relating to engagement in multiple areas of a large project (which will likely result in a greater resource burden) [60]. Alongside these challenges, when using an urban plan to coordinate a co-design engagement approach to create a community led MaaS system, it is also required that urban plans reflecting inhabitant and user needs and aspirations. Without this, the community engagement may not reflect a true 'imagined future' of transport for the area. Finally, the reasons for the lack of at-scale trials or implementations of MaaS are many, including regulatory frameworks, uncertainties around commercial (or subsidised) operating models, the level of cooperation, and information sharing amongst key actors within the system (including operators and stakeholders), and a lack of investment to build the system [41]. The independent systems mentioned in this article may be fragmented to an extent that they are unable to be integrated and offered in a MaaS platform in their current form.

However, with cities becoming increasingly important as their populations and influence on economic and social growth also increase, the contributions of citizens will grow in importance as well [75]. With this in mind, more research is needed on how co-design could be translated into an engagement approach on a large scale, along with how the use of co-design could be embedded into city and transport planning and operations. This is particularly true when considering how transport will be planned and operated in cities looking to move beyond the impact of the global COVID-19 pandemic. These cities may be looking towards MaaS and other innovative concepts to improve or adjust transport services in order to reflect changing commuting, leisure and education practices [84]. Research exploring the following questions would add value to the MaaS debate and would



benefit those looking to develop and implement a system: What is the ‘mission’ of MaaS? Is there only one broad ‘mission’ or goal, or does it relate to the unique needs and choices of each community in which it is implemented? If it is the latter, how can communities feed into the development and feel a sense of co-ownership as a result?

The use of co-design methods may enable urban spaces to transition from passive planned areas to designed outputs of a complicated but collaborative process [23]. For MaaS, this may result in a locally relevant definitions and strategies to begin engaging with operators, stakeholders, and funders with the intention of progressing MaaS to the next stage in a way that has not been achieved to date. Whilst it is not a fix-all solution for MaaS or wider transport planning, co-designing a future system could bring benefits not previously seen with traditional forms of community engagement [66].

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