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The Path to Sustainable and Equitable Mobility: Defining a Stakeholder-Informed Transportation System

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Abstract: A transportation system should be designed considering the relevant stakeholders' needs for a fundamental transformation in travelling behaviour. This research aims to contribute to that by characterising the future network in response to the stakeholders' requirements, using a systematic literature review paired with a grounded theory approach. Out of 39 reviewed publications, 13 transportation indicators were clustered into six dimensions representing stakeholders' requirements for the transportation system. These results depict a stakeholder-informed land transportation system as a system of accessible and integrated mode services, which should be supported by policy and infrastructure, economically balanced, socially, and environmentally sustainable and rely on mobility-dedicated assisting features. Further research is proposed on (1) adapting these results to the legal, social, economic, and environmental contexts and (2) the ability of MaaS scenarios to answer the collected dimensions. This research is crucial to determine the areas of focus of a stakeholder-designed transportation system and to frame them in the mobility ecosystem, both individually and interlinked. Furthermore, its originality lies in (1) the application of this methodology to collect, analyse, and define a set of mobility investment priorities, and (2) the recognition of the relevant stakeholders in mobility considering their diverse perspectives and needs.

Keywords: transportation system; sustainable mobility; behaviour change; stakeholders; active transport; collective transport; shared transport

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1. Introduction

The transport sector contributes to air pollution, energy consumption, greenhouse gas emissions [1], traffic congestion, road accidents and all the related health impacts [2]. Therefore, public transportation has increasingly been promoted as a viable alternative to reducing these problems while holding the potential to increase social inclusion [3] and contribute to a sustainable transportation system [4].

Despite the urgency for the adoption of sustainable transportation, the modal split of passenger transport in 2019 in Europe shows that passenger cars are still dominant over collective and shared transportation (trains, motor coaches, buses and trolleybuses), with the first accounting for an estimated 83.4% in modal share as opposed to the latter with 16.6% [5]. To meet the 90% reduction in transport-related greenhouse gas emissions by 2050 [6], a significant transformation in travelling habits has to occur.

Gil, Calado and Bentz [7] proved that when planning for an inclusive and equitable transformation in transport it is important to involve the relevant stakeholders in the development process. This will provide an effective transition in the transportation system by adapting it to the specific needs of the key actors involved, leading to more satisfactory and efficient transportation solutions and consequently an increase in the use of collective, shared, and active transportation.

Considering transportation stakeholders is the key to the successful design, implementation, and adoption of more sustainable mobility practices, it is fundamental to assess who they are and what are their needs regarding transport. On the one hand transport users depend on a frequent, reliable, flexible and convenient transportation system [8], transport providers are intent on collecting transport and user data to improve mobility services, while, on the other hand, municipalities and other forms of local authority want to decrease congestion and air pollution [9].

Even though a significant number of studies on the stakeholders' mobility needs have been completed, these are focussed on particular transportation services or modes, such as shared mobility [10], autonomous vehicles [11] or bicycle sharing [12]. An effective and sustainable change in travel behaviour requires articulating these areas and associated needs. Additionally, the development of an integrated stakeholder-informed transport system will enable the inclusion of diverse societal sectors concerning the different actors involved in mobility's regulation, supply, and demand. Therefore, the following research questions need to be addressed:

1. What are the stakeholders' requirements for the transport system?
2. How can these requirements come together as an integrated approach stakeholder-designed transport system?

This research employs a systematic literature review to determine the investment priorities for the future transport system, based on stakeholders' requirements for mobility. This is achieved through three objectives:

1. Identify who are the relevant stakeholders in mobility.
2. Determine and characterise the requirements these stakeholders have concerning transportation.
3. Understand the linkages between the requirements and their contribution to the transport system.

The remainder of this paper is structured as follows. Section 3 describes the research tools used to collect and analyse the information needed to answer the proposed research. Section 3 describes the results obtained with the employed methodologies. Following that is Section 4, which highlights and discusses the most important outcomes. Section 5 emphasises the main findings and proposes future research.

2. Materials and Methods

2.1. Data Collection

To conduct this systematic review, an analysis of relevant publications dedicated to collecting stakeholders' requirements for the transportation system was conducted within a 15-year time frame (2007–2022). This includes publications reporting on surveys, focus groups, interviews, questionnaires, and workshops that were dedicated to one or more areas or transportation modes.

To be as thorough as possible both the *Web of Science* and *Scopus* scientific engines were used to gather the data under two different search strategies:

1. The first one consisted of using the keywords "transportation" and "network" to encompass two components of mobility; "priorities", "needs", "requirements", and "stakeholders" to focus on the stakeholders' opinions and needs on the subject; and "interviews", "surveys", "focus groups" and "workshops" to incorporate the inclusion criteria of selecting only qualitative data collection methods.
2. The second research strategy was devised as a way of trying to encompass any data that might have been missed with the first one. For this, to the already applied search strategy, the keywords "mobility", "developments" and "improvement" were added; and the keyword "stakeholders" (in the first search strategy) was substituted by the keywords "users", "policymakers" and "authorities".

After including only categories related to engineering, urban planning, psychology and social sciences, policy, economics and business, transportation and sustainability and the environment, both searches resulted in a total of 143 papers.

A preliminary analysis consisted of down-selecting using the abstracts of the publications collected, only including the ones that met the two inclusion criteria of being research papers on (1) interviews, focus groups, surveys, or workshops on (2) stakeholders' needs and requirements for the transportation system. This step decreased the number of publications being considered to 65.

The second step consisted of reading the full papers to validate if they met the aforementioned criteria. Out of the 65 analysed, 39 were specifically dedicated to reporting and analysing qualitative methods of gathering stakeholders' requirements for a well-developed mobility system.

2.2. Data Analysis

A grounded theory approach was used to understand and analyse the data collected from the 39 papers gathered in the first stage. The methodology developed by Glaser and Strauss [13] is employed to discover or construct a theory from data, which is systematically obtained and analysed using comparative analysis. While very flexible and iterative, this is a very complex methodology, hence there is not a single framework to conduct this approach, but instead, one that can be adapted to the research project it is being used for [14]. However, Corbin and Strauss [15] confirm that, when adequately employed, this methodology fulfils all the requirements of rigorous scientific research.

The Grounded Theory approach has been applied in multiple areas of knowledge ranging from tourism [16] to innovation [17], allowing for more in-depth and comprehensive interpretations of a phenomenon that has already been studied [15]. Following the research from Sandelowski [18], this methodology aims at emphasising the theoretical reformulation of data, showing that the theory was constructed from the gathered data.

The results discussed in this paper will be obtained with the grounded theory approach framework based on Chun Tie, Birks and Francis' [14] research, while drawing from principles and techniques of other example publications [19–21] where the methodology is used (Figure 1). Additionally, the process was conducted with the support of Microsoft Excel to store the data and conduct the process.

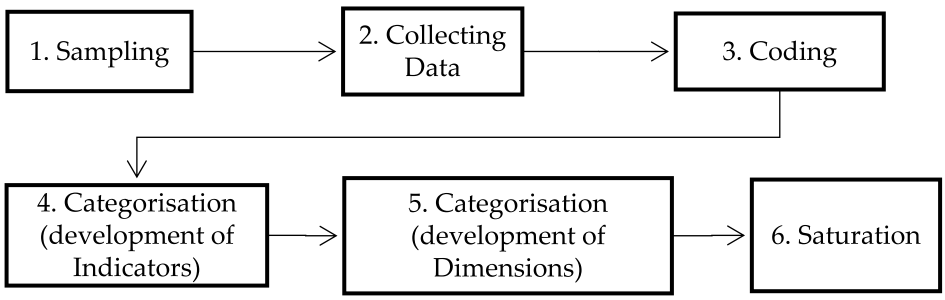

Figure 1. Grounded theory approach steps used in this review.

As stated by Hsu, Cai and Wong [22], the grounded theory approach is appropriate for textual data that reflects the experiences of survey participants. Therefore, the first two steps of the grounded theory (Sampling and Collecting data) were performed using the review process described above. The first stage corresponds to the collection of papers described above and the second stage was performed through the review of those papers and listing of stakeholders' requirements for the transport system directly from those papers.

The Coding stage constitutes the pivotal link between the data gathered and developing a theory that explains the data [14]. Charmaz [23] states that codes rely on the close interaction between researchers and their data, attaching short labels that are constructed as a result of that interaction. Therefore, the third step of the approach involved getting familiarised with the data gathered in the collected publications and initiating a coding process where the listed requirements were attached to short labels that were kept as similar as possible to the original information. As an example, the original requirements *saving parking spaces* and *providing more parking spaces* were coded under the label *increase parking*. This step is essential for identifying concepts, similarities and reoccurrences in the data [14].

The fourth and fifth steps involve diving deeper and constantly comparing the coded data to identify categories that represent similar information and group them (clustering) into indicators (fourth step) and dimensions (fifth step). For example, the labels *Bundling and pricing* and *Betting on multimodal packages* were clustered under the indicator *Mobility packages* as these are both related to the requirement of developing multimodal mobility packages. An example of the fifth step is the clustering of the indicators *Economic viability for users* and *Economic viability for providers* under the dimension *Economy*. This process goes on until there are no similarities among the formed clusters, meaning the data is saturated (sixth step).

Table 1 provides a small sample of examples for the Coding process as well as for the two Categorisation stages for developing the indicators and dimensions. The final results allow the detection of the areas that should be targeted when developing a stakeholder-informed transportation system.

Table 1. Examples of the three stages of implementing the methodology in this research.

Extracted Data	Coding	Categorisation (Indicators)	Categorisation (Dimension)
"integrate services between urban and suburban areas"	Integrating services geographically	Geographical accessibility	Accessibility
"social inclusion"	Socially inclusive	User accessibility	Accessibility
"Competitive financial model"	Economically viable service	Economic viability for providers	Economy
"Reducing travelling cost"	Reducing travelling cost	Economic viability for users	Economy
"multimodal packages are preferred"	Creating multimodal packages	Mobility packages	Economy
"Providing necessary infrastructure"	Necessary infrastructure	Infrastructure	Infrastructure
"Need for real-time information"	Real-time information	Assisting Features	Mobility Design
"Include sharing services"	Shared mobility	Fleet composition	Mobility Design
"Exercising opportunities"	Exercising opportunities	Social impacts	Sustainability
"Less air pollution"	Reducing pollution	Environmental impacts	Sustainability
"Legal framework is needed"	Legal framework	Regulation and policy	Governance
"Public transport is one of the preferred modes of transport"	Increasing public transport offer	Fleet composition	Mobility Design

The entire method was performed by the first author alone. Considering the flexibility and complexity of the method, the two Categorisation stages were performed twice to ensure the consistency of the process. The obtained results were reviewed by the second and third authors of this research to guarantee their validity and ensure compliance with both principles stated by Corbin and Strauss [15]:

- "Hypotheses about relationships among categories should be developed and verified as much as possible during the research process" until they hold true for all the evidence concerning the phenomena under study.

- "Grounded theorists need not work alone" since an important part of the research is testing concepts and their relationships with colleagues who have experience in the same substantive area.

3. Results

In the total of papers reviewed a wide variety of stakeholders were considered from public to private entities, including research and academia groups, citizens and commuters, technology companies and consultancies, governmental agencies (public administration and regulators) and the transport sector (operators, authorities, and providers).

The results obtained from this review are represented under a total of six dimensions characterised by 13 associated indicators. Table 2 also includes the number of mentions each dimension and indicator had in the total of papers reviewed. It is worth highlighting that these mentions were determined based on clear statements and results presented in the reviewed papers, therefore they are a representation of the various and diverse requirements and ideas of the relevant stakeholders in mobility.

Table 2. Dimensions and indicators considered important by mobility stakeholders.

Dimensions (D)		Total Count	Indicators	Mentions
D1.	Accessibility	36	Social accessibility Geographical accessibility	10 26
D2.	Governance	17	Policy and regulation Stakeholder engagement	12 5
D3.	Mobility design	68	Service characteristics Assisting features Fleet composition	12 13 43
D4.	Economy	35	Mobility packages Economic viability for providers Economic viability for users	6 14 15
D5.	Infrastructure	20	Infrastructure	20
D6.	Sustainability	44	Environmental impacts Social impacts	18 26

Although the quantified dimensions are presented above, there is some uncertainty in the coding as commonly noted when using grounded theory and the quantified outcomes should be considered as indicative and for information only. The intention of using grounded theory is to develop a conceptual model based on qualitative information rather than to quantify the importance of the different dimensions.

3.1. Accessibility (D1)

The first dimension (D1.) represents the "Accessibility" of the transportation system under two different indicators, the first one ("Social accessibility") being the guarantee of a mobility service to all demographics [24,25], and the second ("Geographical accessibility") the area covered by the transportation system, involving the integration between urban, suburban, and rural areas [26].

3.2. Governance (D2)

The "Governance" dimension (D2.) involves (1) a "Regulation and policy" indicator encompassing the need for introducing and updating policies on data sharing and collection, transportation as well as its integration with land use and planning [27,28] and (2) a "Stakeholder engagement" indicator involving the need to take advantage of synergies between stakeholders and encourage cooperation and collaboration among them [26,29].

3.3. Mobility Design (D3)

The third dimension (D3.) represents the stakeholders' requirements for the design of the mobility service. It includes a "Service characteristics" indicator, representing an ideal mobility service that is described by the stakeholders as being flexible, reliable, efficient and frequent [30–32], another indicator involving the "Assisting features" provided to the users, such as real-time information, assistance with planning and integrated ticketing and paying options [8,11,33], and a third indicator listing the ideal "Fleet composition" for the mobility as including integrated and multimodal transportation based on shared, active and public transport, Demand Responsive Transport (DRT) and future integration of Autonomous Vehicles (AVs) [10,34–37].

3.4. Economy (D4)

The "Economy" dimension (D4.) includes the financial requirements mentioned by the stakeholders. The first indicator regards the introduction of new "Mobility packages", which are multimodal transport packages with a fixed price that are user-tailored and could rely upon monthly subscriptions or pay-as-you-go models [38,39]. The second indicator introduces the "Economic viability for providers" [40,41] and the third is the "Economic viability for users" [42,43]. The latter two indicators express the stakeholders' requirements of ensuring a transportation system that is adapted to the economic needs of both providers and users.

3.5. Infrastructure (D5)

The "Infrastructure" dimension (D5.) encompasses the need for robust infrastructure-related requirements, whether it is the need for new infrastructure or the integration between the already existing one. It includes the need for continuity of the cycling network, dedicated bus lanes [44] and enough space for walking [9,45]. Essentially, it requires investment in infrastructure that facilitates public transportation and active mobility.

3.6. Sustainability (D6)

The sixth dimension (D6.) represents the need for a transport system that contributes to social and environmental "Sustainability". The first indicator ("Environmental impacts") translates the need for improvement in air quality [46,47] and working toward decarbonising transportation [48,49] by reducing emissions and meeting environmental targets. The second indicator ("Social impacts") relates to the requirement for mobility-related social benefits such as the change in travelling behaviour to reduce private car use [50,51] as well as the subsequent reduction in traffic [52] and human health benefits [53,54].

4. Discussion

The purpose of this research is to characterise a transportation system that meets the requirements of its stakeholders. The methodology described above allowed for the collection and analysis of those requirements and grouped them into 13 indicators clustered in six dimensions (Table 1).

First of all, data was often mentioned in a multitude of reviewed papers and the reason why there is not an indicator or dimension targeting this area specifically is due to its representation across different indicators. Data is a key element in future mobility either through the development of user-tailored mobility packages [55], environmental monitoring data [56] or through sharing, utilising and analysing transport data to be able to offer the required mobility demand [57].

4.1. Dimensions and Indicators

The number of times these dimensions, and associated indicators, were mentioned in the total of papers reviewed highlights certain transport-related areas as the focus for future investments in transportation. "Mobility design", "Sustainability", "Accessibility", and "Economy" are the dimensions with the highest number of mentions with a total of

68, 44, 36 and 35 papers, respectively. “Infrastructure” and “Governance” are the least mentioned with, respectively 20 and 17 mentions.

The “Mobility design” dimension includes what is needed in an efficient transportation system (“Fleet Composition” and “Assisting Features”) and how that will influence the stakeholders’ perception of mobility (“Service Characteristics”). Not only does it represent the most relevant dimension, but also includes the most relevant indicator (“Fleet Composition”). Considering that this dimension deals with the main aim of most (if not all) of the publications reviewed, this was an expected result. Nevertheless, these requirements are at the core of the transport system as well as the linkages with all the other dimensions, which is made clear in several of the publications that were analysed. For example, in Noring, Fróes and Tellgren [9] the key challenges in mobility were assessed, and even though results include frequent and reliable bus services and congestion (categorised within the “Mobility Needs” dimension). More dedicated bus lanes and continuity between cycle paths are also mentioned, which are categorised within the “Infrastructure” dimension. This example allows for the interpretation that the line that separates this dimension from others (e.g., Infrastructure) is very thin which is one of the reasons why it is possible to identify the dimensions but, difficult to accurately quantify them. Furthermore, it is worth highlighting the important role the “Assisting Features” indicator (the second most relevant indicator) could play in the transport system with studies connecting these features as important for an improvement in transport accessibility [24] and management [27].

“Sustainability”, which encompasses the environmental and social impacts of mobility, is the second most mentioned dimension. The indicators included in this dimension are, in a way, interdependent, since providing zero-emission transportation contributing to reducing pollutant emissions (“Environmental impacts”) will contribute towards a change in travelling behaviour and private vehicle use affecting positively human health (“Social impacts”). This dimension encompasses stakeholders’ transportation environmental concerns [28] and the intention of improving air quality [33] and its effects on human health [12]. It is interesting to highlight that these requirements along with others related to the “Infrastructure” dimension, such as having more public [45] and green spaces [46] are deeply related to the ongoing shift in living standards in cities, in the sense that citizens are starting to demand a better quality of life through improved air quality and health and claiming back the space that is mostly used for private transportation, whether that is in the form of parking spaces or large roads.

The latter dimension is followed by “Accessibility”, which is the third most mentioned dimension. The need for extending (geographically) the coverage of the mobility service (“Geographical accessibility”) is the most mentioned indicator within this dimension. This means that for stakeholders in transportation not only is it important to have a multimodal and reliable transportation service, but also a good network coverage that extends outside big urban areas. This highlights a needed articulation between this dimension and “Mobility Design”, not only for the “Geographical accessibility” indicator but also when it comes to developing an inclusive transport system that considers the different user groups (“User accessibility”) when defining the combination of transport modes (“Fleet composition”) that are necessary to best respond to their multiple needs [25,55]. It is worth pointing out that “Accessibility” is one of the most important dimensions when it comes to incentivising an equitable transition in travelling behaviour and most likely the only one that frames (geographical and user) inclusivity as a variable in a transport system.

The “Economy” dimension is still a variable that is highly regarded in the stakeholders’ mobility-related requirements. This dimension represents the financial sustainability of the mobility network, which relies heavily on the economic balance between transport providers (“Economic viability for providers”) and users (“Economic viability for users”). This balance is crucial since an unsustainably expensive mobility system will decrease its demand and consequently the operators’ revenues [42]. On the other hand, when a transport mode is harming the financial security of mobility operators and providers, few options are left other than to increase the prices or having to cut down on transport services [40]. This could be further studied and enhanced with the development of user-tailored "Mobility packages" and by providing transportation operators with user data that will enable balancing offer and demand. Additionally, the use/introduction of "Mobility packages" will allow for transport authorities or mobility operators to promote and incentivise the shift towards sustainable transport by developing packages where the shared and collective mobility options are less expensive than other options or even through the offer of discounts or point systems for choosing the environmentally friendly options [38].

The transportation requirements highlighted the least by the stakeholders in the reviewed papers are the "Infrastructure" and "Governance" dimensions. This could be associated with the perception of these dimensions as secondary mobility requirements and therefore being forgotten by the stakeholders considered in these publications. Nonetheless, the fact that they are still considered significant by the stakeholders makes them noteworthy. While "Infrastructure" can facilitate bus operation and the usage of active travelling modes through the introduction of dedicated bus lanes and reinforcing the cycling network, "Governance" will provide the structural and political governance model for a mobility system that is integrated, multimodal and accessible as corroborated by trial in Helsinki, Vienna and Hanover [58]. Therefore, it is possible to describe these two dimensions as the backbone of the transport system, where the "Infrastructure" dimension plays the role of a physical and "Governance" represents the much-needed regulatory foundation.

4.2. Stakeholder-Informed Transportation System

Even though these requirements are a part of different areas of intervention in the transport sector, the analysis provided above highlights their interdependent nature, substantiating the idea that mobility encompasses an integrated system of dimensions that rely on each other as it is shown in Figure 2. The "Mobility design" dimension (D3.), which describes the entire mobility service, relies on a robust and responsive infrastructure network (D5.), to provide (social and geographical) "Accessibility" (D1.), which, in turn, contributes to the social and environmental "Sustainability" (D6.) of transport. D1., D5., and D6. are sustained by a user-provider economic balance (D4.). Furthermore, both transport infrastructure (D5.) and its economic balance (D4.) are enabled by a well-designed governance model (D2.).

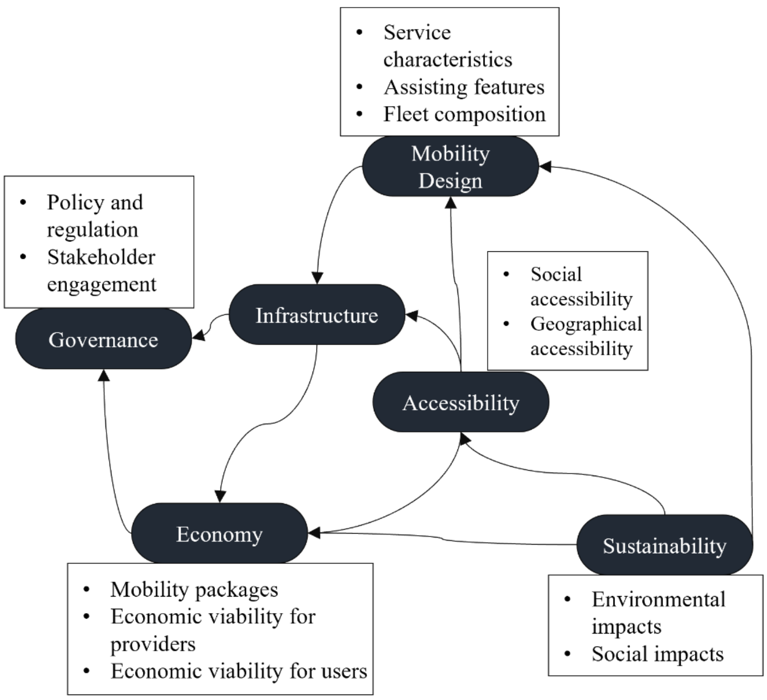

Figure 2. Linkages between the dimensions of a stakeholder-informed transport system.

This interdependence can be further substantiated by the fact that out of the 39 papers reviewed there were 31 papers where "Mobility design" was mentioned along with the other dimensions, which highlights the fact that the balanced cooperation among these dimensions is important for a robust transportation system. Other examples of this are the fact that (1) 35.9% of the reviewed papers detailing an ideal "Mobility design" also include the importance of the economic model ("Economy") and (2) having "Sustainability" heavily linked to the design of the mobility service as it is shown in 48.7% of the papers reviewed. Furthermore, even though "Governance" is the least mentioned dimension in these papers (17 mentions), its correlation with "Economy" (30.8% of the papers) and "Mobility design" (20.5% of the papers) corroborates its importance in the development of an economically balanced and well-designed mobility service.

Overall, the results enable the characterisation of a transportation system based on the requirements mentioned by the relevant stakeholders. This system should be accessible, multimodal, and integrated into one mobility service, which should be supported by policy and infrastructure, economically balanced, socially, and environmentally sustainable, and rely on the use of mobility-dedicated assisting features.

Even though these characteristics are individually covered in existing transportation services, the concept of Mobility as a Service (MaaS) could successfully cover all these requirements in one mobility service. MaaS is a multimodal and integrated transportation service aiming to deliver users' transport needs through a single interface [59,60], it is also perceived as an opportunity to provide accessible and affordable travelling solutions and contribute toward the strategic goals of substituting private vehicles with alternative modes [61].

The transportation service envisioned with MaaS encourages mostly the use of shared public transportation (bus, train, etc.) and active modes (e.g., bicycle and walking) while relying on a mobile application that possesses assisting features such as trip-planning, ticketing, and paying options (D3.). The service intends on providing users with accessible (D1.) and affordable transportation while enabling mobility providers to generate profit through user-tailored mobility packages (D4.) and design a service that meets societal goals for human and environmental sustainability (D6.). Additionally, a successfully implemented MaaS calls for a dedicated urban and transport infrastructure (D5.) and, robust legal and regulatory foundations (D2.).

4.3. Novelty in the Research Presented

The current paper differs from the existing research dedicated to improving an integrated transport system involving its diverse stakeholders in the process. The originality of this research lies in the use of this methodology to (1) recognise the relevant stakeholders in mobility, and (2) determine an integrated set of investment priorities (dimensions and indicators) for planning and developing a transport system.

There is research considering the involvement of the relevant stakeholders and their requirements for a sustainable transport system using the grounded theory approach to analyse the collected data [20]. However, it is focused on one area of transportation (on-demand systems) whereas the present research approaches the entire transportation system, including the different transport modes that are relevant to the stakeholders, as it is shown in the "Fleet composition" indicator of the "Mobility design" dimension. Additionally, the present research goes one step further to consider other dimensions of transport that are not considered in the aforementioned, such as "Infrastructure" and "Governance".

Another study [62] describes the principles and guides toward a more efficient transportation system and presents examples of good practices used in different urban areas such as London and Copenhagen. The authors consider similar variables within the "Infrastructure", "Mobility design" and "Governance" dimensions of this study. However, the present research adds to it by recognising the stakeholders' requirements as drivers for the priorities in the development of a sustainable future transport system.

Al Maghraoui, Vallet, Puchinger, and Yannou [63] outline the relevant concepts to be considered in designing urban mobility by proposing a conceptual model that describes and analyses different areas of traveller experience and categorises problems that travellers face when interacting with said system. Even though the authors also consider transport users in the design of a future urban mobility system, the present study adds to it by also contemplating transport regulators and providers, policymakers, experts, and academia among many others as important actors in the transport ecosystem. Furthermore, the present research regards the extension of the transport system outside urban areas, through the previously determined "Geographical accessibility" indicator.

Spirin, Zavyalov, and Zavyalova [64] emphasised developing a marketing approach to standardising the quality of public transport services. The authors based their research on public transport service quality measurement and included focus groups, interviews, passenger surveys, and an analysis of transport infrastructure. Even though the study recognises as important some of the dimensions determined in the present research such as "Accessibility", "Sustainability" and "Mobility design", it does not look at "Governance" and "Economy" which are two important pillars to achieve higher acceptance of public and active transportation.

5. Conclusions

The ultimate purpose of this study is to characterise a transportation system that meets stakeholders' needs and, consequently increases the use of public transportation and active modes while making the need for the private vehicle obsolete. The aim was met through the work accomplished when answering the following research questions:

1. What are the stakeholders' requirements for the transport system?
2. How can these requirements come together as an integrated approach to a stakeholder-designed transport system?

The results obtained with the methodology applied show that "Mobility design" is highly considered by the stakeholders, appearing in 31 out of the 39 papers reviewed. The "Sustainability" and "Accessibility" dimensions were also among the most mentioned in the papers reviewed, emphasising the need for a transportation system that is accessible and compliant with environmental targets for improving air quality and decarbonising transport while contributing to human health by investing in active modes of transportation. The "Economy" dimension highlights the need for an economic model that balances the financial needs of users and providers. Even though the "Infrastructure" and "Governance" dimensions were the least mentioned in the reviewed papers, they are still two structural and political foundation pillars in a stakeholder-informed transportation system.

The interdependent nature of these dimensions corroborates the need to not only consider them in their entirety but also the linkages and balance between them. Overall, a transportation system that answers stakeholder needs should be focused on being accessible, flexible, and reliable, supported by policy and dedicated infrastructure, multimodal and integrated into one mobility service, economically and environmentally sustainable, and should include a user-friendly app with dedicated mobility assisting features.

Considering that the results and analysis achieved with this research are based on the 39 papers reviewed, it is likely that potential transport-related variables may have been left out because they were not mentioned in these papers. An example of this is how mobility could impact poverty and development levels or the effect on the Gross Domestic Product (GDP). Nevertheless, the research is still able to propose a comprehensive set of investment priorities in varied sectors of transport.

The publications analysed for this research add a degree of social and geographical variability considering that the included stakeholders represent diverse groups and demographics and are based in different cities, countries, continents, and scales (local, regional, and national). Therefore, further research is proposed to (1) adapt the obtained results to the context they are being implemented in, considering the surrounding political, social, environmental, and economic contexts as well as the existing infrastructure, and

(2) understand their existing metrics or, if needed, proposing new ones that meet societal needs and goals.

An important outcome of this research is the detection of the potential of MaaS, an integrated and multimodal mobility service, to meet the dimensions (and indicators) determined, by incorporating all of them at an early design stage of development. Building on that, additional research should be considered on its response to the collected requirements when implemented in a suburban, rural, or even regional context.

This research is crucial to determine the areas of focus of a stakeholder-informed transportation system by not only understanding them individually, but also how they all fit together in a mobility ecosystem that is inclusive and equitable, through its adaptation to stakeholders' needs and considering the surrounding social, political, environmental, and economic contexts.

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