Breaking Barriers: stakeholder-based approaches to evaluating and enhancing inclusivity in digital transport services

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Abstract:

This PhD research investigates the inclusivity of digital transport services from a stakeholder-based perspective, with a primary focus on digital inclusion and accessibility. It also introduces two new assessment tools: a first one for evaluating digital inclusivity and accessibility, and another for assessing the social, economic, environmental, and transport-related impacts of Mobility-as-a-Service schemes. The research adopts a mixed-methods approach, combining qualitative and quantitative data-collection, including interviews, surveys, stakeholder-based evaluations, bottom-up co-creation, and test events, to provide a comprehensive understanding of the barriers and opportunities for creating equitable and accessible digital mobility systems.

The rapid digitalization of transport systems has created significant opportunities to enhance mobility through innovations like real-time information, digital payment systems and advanced ticketing systems. However, these advancements also present challenges, particularly for vulnerable populations who often lack the digital skills or resources required to access these services, exacerbating the digital divide and contributing to transport and thus societal exclusion. Despite a theoretical understanding of inclusivity and the societal benefits of accessible transport systems, practical implementation remains questionable. Many services fail to address the needs of vulnerable persons due to gaps in regulatory frameworks, limited stakeholder collaboration, lack of knowledge about vulnerable users and the absence of inclusivity and accessibility in digital transport systems further hinders progress. This research aims to address these challenges by exploring barriers, developing assessment tools, and proposing practical solutions to promote equitable and inclusive digital mobility services.

For this purpose following research and sub-research questions were developed:

"How can digital transport services be developed and evaluated to promote inclusiveness and accessibility for all users?"

SRQ1: What barriers and opportunities do stakeholders experience while attempting to create a more inclusive digital transport system?

SRQ2: How can we facilitate the stakeholder-based evaluation of the social, economic and environmental impacts of digital transport services?

SRQ3: How inclusive are widely spread digital transport services?

I start this PhD by introducing the digital transport system, what technological developments led to its creation and what the (dis)advantages are. Secondly I introduce relevant digital transport services and associated stakeholders. Finally I present the theoretical framework and the various research questions.

In Chapter 2, the study adopted an exploratory approach to investigate the barriers and opportunities for enhancing inclusivity in digital mobility services across Europe by analyzing the perspectives of developers, operators, and policymakers. Based on 32 semi-structured interviews, the study explores regulatory frameworks, user involvement during development and operation, privacy and data protection, and financial support of digital transport services. The thematic content analysis revealed that although stakeholders recognize the importance of inclusive design, many services fail to effectively meet the needs of vulnerable-to-exclusion groups. The lack of co-creation, insufficient knowledge, limited financial resources, and a lack of frameworks on inclusivity hinder efforts to develop more inclusive services.

Next, we narrowed the focus to Mobility as a Service (MaaS) in Belgium, analyzing the challenges stakeholders face in creating an inclusive MaaS. Through 21 semi-structured interviews with public and private MaaS operators, policymakers, and other stakeholders, this study adopted a thematic evaluation approach similar to Chapter 2, focusing on regulatory frameworks, data governance, user involvement and collaboration, and financial barriers that hinder the development of inclusive MaaS. A deductive thematic analysis provided insights into the need for comprehensive regulatory frameworks across different geographical regions, stronger collaboration to safeguard privacy, and ensure accessibility, particularly for individuals with limited digital skills or socio-economic challenges. Furthermore, an effective approach for financing accessibility and inclusivity should further improve access for the most vulnerable groups.

After the initial exploratory approaches in Chapters 2 and 3, the following chapters take a more practical, applied research approach. Chapter 4 introduces the development and testing of the INDIMO Service Evaluation Tool (SET), designed to assess the inclusivity of digital mobility and delivery services. The tool, a self-assessment questionnaire based on the capabilities approach and universal design principles, was co-created with multiple mobility and accessibility experts. It provides practitioners, such as policymakers, with both quantitative metrics and qualitative recommendations to design strategies that avoid digital exclusion. The SET aims to ensure that the advantages of digital mobility are accessible to all citizens, especially those vulnerable to exclusion.

In a subsequent study (Chapter 5), the Stakeholder-Based Impact Scoring (SIS) method was used to develop a MaaS evaluation framework to assess the societal, environmental, economic, and transport-related impacts of three MaaS business models in Belgium. Engaging 21 stakeholders, this research evaluated and visualized the relative importance of 15 impact factors. Initial results indicate that (semi-)public MaaS models have the highest potential for positive societal impact, while private MaaS is better suited to address specific user needs. However, for public MaaS to attain this societal impact, significant public funding will be required, unlike private MaaS, which often operates on venture capital. The findings call for further research and continuous stakeholder engagement to comprehensively assess the societal implications of MaaS. Additionally, research to determine the division of goals for public and private MaaS could prove beneficial in addressing a broader range of user needs.

The final study evaluated the inclusivity of five digital transport services using the INDIMO SET tool, involving 16 experts in accessibility and mobility. The SET evaluated a multimodal route planner (Citymapper), car-sharing (Cambio), ride-sharing (BlaBlaCar), food delivery (Uber Eats), and parcel lockers (Bpost). The results reveal significant differences in inclusivity, with Cambio scoring highest and Uber Eats and BlaBlaCar scoring lowest. Overall barriers include insufficient privacy protection, limited payment options, lack of assistance offered to vulnerable users, and poor communication between users and developers, which disproportionately affect vulnerable groups. The tool also demonstrated high understandability among practitioners, indicating its potential for future use in guiding inclusivity improvements.

Finally, I present several limitations to the research and suggestions for further research. This PhD faced challenges such as the impact of COVID-19, which limited engagement with digitally excluded groups and reduced the quality of online interviews. Limited stakeholder collaboration and underrepresentation of vulnerable groups were other constraints, as were insufficient participation during evaluations and early stakeholder unawareness of digital inclusion concepts. A lack of data and methodological choices, such as maintaining uniform thematic frameworks for chapters 1 and 2, also potentially influenced the clarity and depth of some analyses.

Future research should prioritize engaging vulnerable groups in co-creation processes, exploring the economic benefits of inclusive design, and enhancing data protection transparency. Further development of the INDIMO Service Evaluation Tool (SET) should include tailored weighting, enable service comparisons, and expand its application to diverse services and socio-demographic contexts. Combining evaluations of the Service Evaluation Tool and MaaS evaluation framework, and increasing the volume of assessments will improve the reliability of findings and enhance inclusivity in digital transport systems.

Overall, this research underscores the need for a more structured, bottom-up co-creative and stakeholder-driven approach to creating and evaluating inclusive digital transport systems. The tools and methods developed in this PhD offer valuable insights but also highlight the continuing gap between theoretical design principles for inclusivity and their practical application. Collaboration between stakeholders, improved data governance, clear and uniform regulatory frameworks, and actionable metrics and KPIs for inclusive design are essential for making digital mobility services more inclusive and accessible to all.