Unlocking Social Sustainability in Urban Transportation: Investigating Stakeholder Perspectives and Sustainable Indicator Strategies

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Abstract.

This paper delves into the concept of social sustainability in urban transportation and its crucial role in improving the overall quality of life within built environments. While extensive research has been conducted on planning sustainable transportation systems, there remains a dearth of theoretical and empirical exploration concerning social sustainability concepts in urban development, particularly in developing nations. To bridge this gap, this study aims to address the importance of continuously evaluating the social outcomes of sustainability. The intricate interplay of various variables involved in urban transportation sustainability poses a challenge in developing universally accepted sustainability indicators. Additionally, the divergent perspectives and overlapping interests of stakeholders further complicate the process of finding common ground. Hence, this research examines the potential and limitations of different stakeholder perceptions regarding urban transportation sustainability to identify the most pertinent stakeholder groups. This enables the development of an indicator system that encompasses the interests of all stakeholders, thus enhancing its applicability. To accomplish this, the research employs the analytic hierarchy process (AHP) and utilizes expert opinions in a case study of Amman, Jordan to compare and rank the relative importance of these indicators. The study underscores the significance of social sustainability and provides a method for its evaluation, offering valuable insights to decision-makers regarding potential areas for policy intervention. The research argues that socially sustainable urban transportation plays a pivotal role in augmenting the quality of life for individuals residing in built environments. By developing sustainability indicators that consider the perspectives of various stakeholders, decision-makers can effectively assess the social dimension of sustainability and guide policy interventions. This study emphasizes the necessity for a paradigm shift and ongoing monitoring to achieve sustainable urban transportation systems that benefit society as a whole.

keywords: Analytical hierarchy process, Social sustainability, Stakeholder perceptions, Sustainability indicators, Urban transport

1. Introduction

1.1 Evaluating Social Sustainability in Urban Transport

Sustainable development has become a global priority, with cities worldwide striving to achieve growth while preserving the environment, improving social welfare, and increasing economic prosperity (United Nations, 2015). Within the realm of sustainable urban planning, sustainable transportation has garnered significant attention as a common goal to manage urban transport systems that serve citizens while embodying sustainability principles (Makarova et al., 2016). Urban transportation has emerged as a crucial aspect of urban planning, drawing the attention of planners, traffic authorities, researchers, specialists, and urban residents alike (Ahmed et al., 2020). The importance of transport accessibility in enhancing the sustainability of urban arrangements, along with the quality of life for citizens, has been widely recognized (Moniruzzaman et al., 2017).

While economic sustainability has been extensively studied in transportation planning, social sustainability remains an area that requires further research attention (Budnyk et al., 2019). In the context of urban transportation planning, social sustainability refers to the transport system's ability to support and improve the quality of life for diverse groups of people, including those who are vulnerable (Transportation Research Board, cited in Nakase et al., 2021). The significance of social sustainability in urban transport cannot be overstated, as it plays a critical role in achieving the ultimate goal of sustainable development. However, despite the growing awareness of its importance, there are existing gaps in social sustainability research for transportation planning (Song et al., 2017).

The dynamic and interdisciplinary nature of social sustainability poses challenges in its definition and measurement, contributing to the limited research in this area. Additionally, the concept of social sustainability itself is continuously evolving due to changing human needs and engineering opportunities. This ever-changing nature provides an opportunity for researchers and practitioners to re-evaluate the indicators used to assess social sustainability in urban transport.

1.2 Challenges in Defining Sustainability and Stakeholder Perspectives

Defining sustainability in the context of urban transport presents challenges due to overlapping and sometimes conflicting perspectives. Sustainability encompasses economic, social, and environmental factors, making a unified definition difficult to establish (Jeon & Amekudzi, 2005). Economic sustainability emphasizes efficiency and cost-effectiveness, while social sustainability focuses on equity and accessibility, and environmental sustainability prioritizes pollution reduction, energy consumption, and CO2 emissions (Banister, 2008).

The overlapping nature of sustainability leads to divergent priorities among different stakeholders involved in urban transport planning. Stakeholder groups in urban transport

sustainability include policymakers, transport planners, the private sector, non-governmental organizations, and the general public. Each group may possess distinct objectives, which can sometimes clash with one another (Banister, 2008). Understanding stakeholder perceptions and priorities is crucial for effective decision-making in urban transport planning.

Participatory multi-criteria decision analysis (PMCA) is an approach that addresses the challenge of divergent stakeholder views. It involves involving different stakeholder groups in the decision-making process, enabling discussions on varying perspectives and the development of shared sustainability goals. This collaborative effort not only facilitates decision-making but also enhances the legitimacy of resulting strategies and actions (Huang et al., 2011). It fosters a sense of shared ownership and commitment to sustainable urban transport outcomes among stakeholders, which is vital for long-term success.

Another challenge in defining sustainability in urban transport lies in balancing conflicting viewpoints. For instance, promoting public transportation usage may enhance environmental sustainability but inadvertently impact social sustainability if the infrastructure primarily benefits middle- and upper-class users, leaving low-income and marginalized groups with limited access (Cervero & Dai, 2014).

Engaging diverse stakeholders and conducting thorough research is crucial in understanding the complexity and nuances of urban transport sustainability. By involving stakeholders in the decision-making process and employing evidence-based strategies, urban planners, policymakers, and researchers can better navigate the challenges of defining sustainability in urban transport. Furthermore, considering the dynamic nature of sustainability, it is essential to continuously evaluate and adapt urban transport planning approaches to address new challenges and capitalize on emerging opportunities (Gudmundsson et al., 2016).

1.3 Developing an Indicator System for Social Sustainability

An effective approach to advancing social sustainability in urban transport is through the development of an indicator system that includes relevant indicators for monitoring and evaluation. These indicators provide a reliable basis for decision-making and facilitate continuous improvement in social sustainability outcomes.

Before selecting indicators for social sustainability, it is critical to understand the elements that govern social sustainability in urban transport systems. These elements may include accessibility, equity, security, health and well-being, social capital, and community engagement, among others. Identifying relevant indicators requires a thoughtful review of available literature, stakeholder input, and evaluation of existing frameworks (Van Acker et al., 2010). The United Nations' Sustainable Development Goals (SDGs), particularly SDG 11, which emphasizes making cities inclusive, safe, resilient, and sustainable, can serve as a global framework for selecting relevant social sustainability indicators in urban transport (United Nations, 2015).

Typical examples of social sustainability indicators relevant to urban transport include:

1. Accessibility: Measuring the ease of reaching desired destinations using available transport modes (Litman, 2017). Metrics may include the number of job opportunities accessible within a certain travel time or the presence of public transport within a specific distance from residential areas.
2. Equity: Ensuring that transport services are distributed fairly, affordable, and available to everyone, regardless of age, income, or ability (Lucas et al., 2016). Indicators for equity may include fare affordability, the spatial distribution of transport services, and the availability of accessible transport options for people with disabilities.
3. Security: Assessing passenger safety and the perception of security while using public transportation (Zeibots & Bell, 2017). Metrics can involve crime rates on public transport, the number of accidents, or the percentage of passengers who feel safe using public transport.
4. Health and well-being: Evaluating the impact of transport systems on the health and well-being of residents. Measures may include air and noise pollution levels, the share of active transport (e.g., walking and cycling), or the number of transport-related injuries and fatalities (Rabl & De Nazelle, 2012).
5. Community engagement: Assessing the involvement of the community in transport planning and decision-making processes (Dempsey et al., 2011). Metrics for community engagement may include the level of public participation in transport planning consultations or the number of community-led transport initiatives.

To develop these indicators, various methodological tools and techniques can be employed, including literature reviews, stakeholder consultations, the Delphi method, case studies, and Geographic Information Systems (GIS) (Bond et al., 2012; Marsden & Rye, 2010; Hsu & Sandford, 2007; Lindau et al., 2010; Paez et al., 2012). These approaches can help identify the most relevant indicators for measuring social sustainability in urban transport and ensure their validity, reliability, and applicability to different contexts.

Once the indicators are selected, data collection and monitoring mechanisms should be established to track progress and evaluate the effectiveness of policies and interventions aimed at enhancing social sustainability in urban transport. This may involve collecting data from various sources such as surveys, interviews, existing databases, and sensor technologies (e.g., air quality sensors, GPS tracking). Regular monitoring and reporting of the selected indicators will enable policymakers and stakeholders to identify areas for improvement, make informed decisions, and adjust strategies to better align with social sustainability goals.

1.4 Integrating Social Sustainability in Urban Transport Policies and Planning

Integrating social sustainability into urban transport policies and planning requires a holistic and multidisciplinary approach that involves collaboration between different stakeholders, including government agencies, transport operators, community organizations, researchers,

and the public (Bond, Morrison-Saunders, & Pope, 2012). Here are some key steps to consider:

1. Policy integration: Ensure that social sustainability objectives are explicitly incorporated into urban transport policies and plans at different levels, including national, regional, and local. This may involve revising existing policy frameworks or developing new ones that prioritize social equity, accessibility, and community well-being alongside environmental and economic considerations.
2. Multi-stakeholder collaboration: Foster collaboration and engagement among diverse stakeholders, including transport authorities, community representatives, advocacy groups, researchers, and private sector entities. This collaboration can help identify social sustainability priorities, share knowledge and expertise, and co-create solutions that address the needs and aspirations of different groups within the community.
3. Participatory planning processes: Implement participatory approaches in urban transport planning to ensure that the voices and perspectives of marginalized and vulnerable groups are heard and taken into account. Engage communities in decision-making processes, involve them in identifying transport needs, and empower them to contribute to the design and implementation of sustainable transport solutions.
4. Infrastructure and service provision: Develop and improve urban transport infrastructure and services to enhance social sustainability. This may involve expanding public transportation networks, improving accessibility for people with disabilities, ensuring safe and inclusive public spaces around transport hubs, and promoting affordable and efficient transport options in underserved areas.
5. Education and awareness: Raise awareness and promote education campaigns to enhance public understanding of the benefits of socially sustainable urban transport. Encourage behavior change towards more sustainable travel modes, such as walking, cycling, and public transportation, and educate the public about the positive impacts of these choices on health, well-being, and community cohesion.
6. Monitoring and evaluation: Establish robust monitoring and evaluation mechanisms to track progress, measure the impact of social sustainability initiatives, and identify areas for improvement. Regularly assess the selected indicators, collect data, and analyze the results to inform evidence-based decision-making and ensure accountability in achieving social sustainability goals.

By integrating social sustainability principles and practices into urban transport policies and planning, cities can create transport systems that are not only environmentally and economically sustainable but also inclusive, equitable, and supportive of the well-being and quality of life of all residents. This approach contributes to the creation of more livable and resilient cities, where people can access opportunities, participate in community life, and thrive in a socially sustainable urban environment.

To sum up, achieving social sustainability in urban transport requires a comprehensive approach that considers the needs and aspirations of all community members, particularly

marginalized and vulnerable groups. By integrating social sustainability principles into urban transport policies and planning, cities can create transport systems that are equitable, accessible, and supportive of community well-being. This involves selecting appropriate indicators, establishing monitoring mechanisms, fostering multi-stakeholder collaboration, implementing participatory planning processes, improving infrastructure and service provision, raising awareness through education campaigns, and ensuring robust monitoring and evaluation. By prioritizing social equity and community well-being alongside environmental and economic considerations, cities can build more inclusive and livable urban environments for all residents.

2. Case study

Amman, the capital city of Jordan, is confronting significant challenges associated with urbanization, transportation, and sustainability. The focuses on the three main categories of urban transport social sustainability of accessibility, safety, and livability. The study aims to provide a comprehensive evaluation of the current state of urban transport in Amman and identify challenges and limitations.

Amman is the capital city of Jordan. In terms of population, it is also the largest. Around 4 million people inhabit this city which is considered one of the oldest continuously inhabited cities in the world. The population density in Amman is 3,143 persons per square kilometer. In terms of population density, Jordan is 97th in the world with 115 people per square kilometer (World Population by Country, 2022).

Amman, Jordan was chosen as the case study for this research due to several factors. Firstly, the city of Amman is facing significant challenges in terms of urbanization, transportation, and sustainability (Alnsour, 2016). With a rapidly growing population and increasing demand for transportation services, the city is facing significant pressure to improve its transport systems.

Additionally, Jordan has been actively pursuing sustainable development goals, particularly in urban transport (UN-Habitat, 2021). This has created an opportunity for the city to improve its transport systems and address the challenges it faces sustainably.

Furthermore, Amman is a unique case study as it has a diverse population and culture, making it an ideal location for exploring the social dimensions of sustainability (UN-Habitat, 2021; Shbeeb, 2018). This diversity is reflected in the city's transportation systems, with a mix of private and public transport options, as well as traditional modes of transportation such as walking and cycling.

3. Data Collection and Analysis Methods

In this study, the ATSSI (Amman Transport Social Sustainability Indicators) method is employed as the chosen methodology. The primary objective of the study is to develop a site-specific social sustainability indicator system for urban transport in Amman, Jordan, and validate the reliability and accuracy of these indicators.

To develop the indicator system, an extensive literature review was conducted, focusing on identifying the main methodological approaches utilized in developing urban transport sustainability indicators. This review encompassed the analysis of 23 systems and frameworks across disciplines such as sustainable development, social sustainability, transport policies, and sustainability assessments. The ATSSI method was selected as an intermediate state that combines multiple approaches. Subsequently, a site-specific social sustainability indicator system was constructed by categorizing the selected indicators and integrating various concepts of urban transport social sustainability, including safety, livability, and accessibility.

The selection of research papers and frameworks for developing the database encompassed a multidisciplinary approach, incorporating areas such as sustainable transport, urban sustainability, quality of life, and transport policies. This process involved selecting appropriate databases, conducting a thorough literature review, categorizing the selected indicators, identifying conceptual definitions, and integrating different concepts of urban transport social sustainability from 28 systems and frameworks.

To determine the relative importance of the identified indicators, the study collected the opinions of 29 experts and professionals from various levels through a survey using the Analytic Hierarchy Process (AHP). The experts were identified through an examination of the institutional and planning system of transport in the case study area. Additionally, the study constructed the hierarchy of public transport in Jordan, which had not been previously published clearly and comprehensively.

To validate the reliability of the indicators, secondary data from various sources including government agencies, research institutes, research papers, and international organizations were utilized. Data related to over 85% of the indicators across the three main social sustainability categories (accessibility, safety, and livability) were obtained. The findings were then compared to existing literature and the current situation in the case study area to establish the reliability and accuracy of the indicators.

By employing the ATSSI method, conducting a comprehensive literature review, gathering expert opinions through a survey, and validating the indicators using secondary data, this study ensures a robust and reliable approach to developing and assessing the social sustainability indicator system for urban transport in Amman, Jordan.

4. Findings and Insights

Based on the comparison of expert opinions on the importance of indicators and the current situation of the case study, 19 out of 22 indicators were validated. Among these validated indicators, 14 were found to be applicable, indicating alignment between expert opinions and the current situation. However, five indicators were deemed not applicable as they did not align with the current situation. Three indicators could not be validated, requiring further investigation.

The combination of the ATSSI approach and the transport planning approach has proven instrumental in achieving consistency and resolving conflicts between different levels of stakeholders. This integrated approach has effectively addressed limitations and provided a valuable tool for the development of sustainability indicators that are applicable at all levels of transport planning.

Accessibility indicators

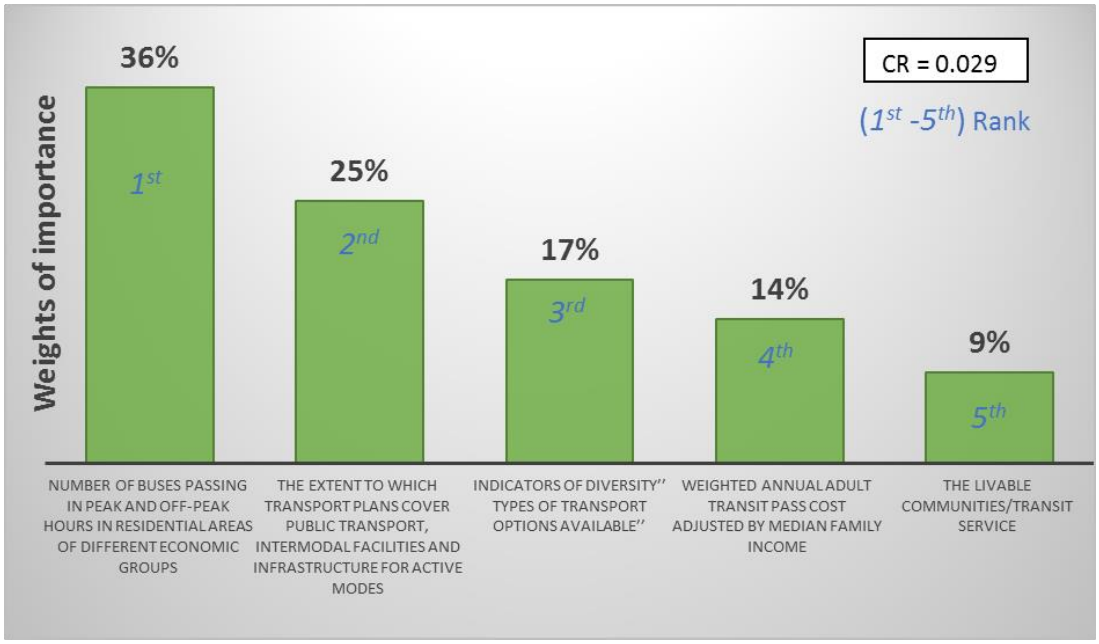

Figure 1: Weights Assigned to Accessibility Indicators by Experts with Consistency Ratio

Source: Mohammad Thaher (Author).

Accessibility indicators emerged as a significant concern in Amman. Disparities in access to public transportation across different neighborhoods and limited access in newly developed residential areas were identified as major issues. Affordability posed a challenge, particularly for marginalized groups. Additionally, inadequate infrastructure and safety concerns for non-motorized modes of transportation hindered sustainable and accessible mobility in the city.

The frequency of public transport lines was highlighted as a top priority for passengers and deemed essential for the sustainability of the public transport system. While the Livable Communities/Transit Service accessibility indicator received the least importance among the accessibility indicators, its significance was underscored by the available secondary data. The data revealed significant variability in accessibility based on the location of the city, with newly developed residential areas on the outskirts experiencing limited access to the public transportation network. Moreover, the increasing population growth has not been met with a corresponding expansion of urban public transport, exacerbating the accessibility problem. Inequitable access to public transportation was also observed across different neighborhoods within Amman, emphasizing the need to improve overall accessibility to ensure equal transportation options for all residents.

The weighted annual adult transit pass cost adjusted by median family income indicator highlighted the crucial need for transportation affordability among different income groups. High transportation expenses, coupled with limited availability and high costs of accessible public transportation, present significant barriers to employment access and usage, particularly for marginalized groups. Addressing these issues requires clear policies and regulations regarding pricing and subsidizing public transportation services to ensure equitable access for all members of society.

Diversity in transportation modes and the contribution to community cohesion were identified as important indicators in the Mobility Master Plan for Amman. Although their combined importance was relatively lower compared to other indicators, they should not be overlooked. A diverse transportation system offering various modes such as buses, taxis, cycling, and pedestrian facilities can cater to the unique needs of the population and reduce dependency on private cars. Developing a transportation system that promotes social interaction and community cohesion can have significant benefits, including mitigating social isolation and promoting active mobility for healthier lifestyles.

Environmental impacts of transportation, including air pollution and greenhouse gas emissions, were of major concern. Although the corresponding indicator in the Mobility Master Plan held a slightly higher importance, sustainable practices, and environmentally friendly transportation options are vital. Strategies to reduce pollution and promote sustainability should be prioritized, such as expanding electric vehicle infrastructure, implementing better land-use policies, and supporting alternative transportation options like public transit and active transportation.

In summary, while the individual percentages of importance may vary, it is crucial to consider the impact of each accessibility indicator in developing a comprehensive and efficient transportation network in Amman. Addressing these indicators holistically will ensure a more equitable, accessible, and environmentally sustainable transportation system for the city's residents.

Safety Indicators

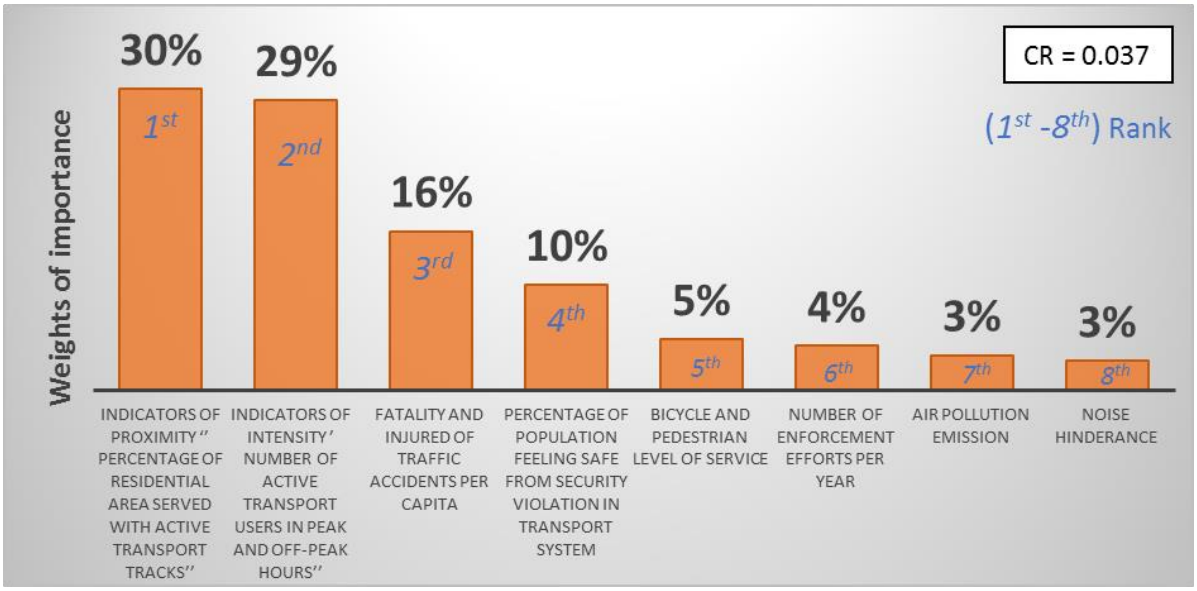

Figure 2: Weights Assigned to Safety Indicators by Experts with Consistency Ratio

Source: Mohammad Thaher (Author).

Safety is a significant concern in Amman's transport system, with various issues impacting the well-being of its residents. Traffic accidents, air pollution, and noise pollution are the primary safety concerns. The low usage of public transportation coupled with an increasing number of registered vehicles has resulted in traffic congestion, longer commute times, and elevated levels of air pollution. The fatality and injury rate in traffic accidents is also worrisome, with a possibility of an increasing trend in the future.

Among the safety indicators, experts assigned the least importance (3% each) to noise hindrance and air pollution emissions. However, it is crucial to address these issues in the urban areas of Jordan. Noise pollution caused by road transport is a significant environmental and economic problem, while traffic remains a major source of air pollution, particularly PM10. To mitigate these concerns, it is recommended to promote the use of public transportation, encourage active modes of transportation, and regulate vehicle emissions standards. The establishment of the Ministry of Environment's network for monitoring ambient air quality in Amman is a positive step, but further efforts are necessary to ensure the well-being of Jordan's residents.

In terms of the indicator "Number of enforcement efforts per year" in urban transport, which pertains to regulatory compliance and enforcement levels, it received a relatively low importance rating (4%) compared to other safety indicators. Data availability for this indicator can be challenging, underscoring the need to prioritize indicators with greater significance. In the absence of reliable data, alternative sources or proxy indicators may be

utilized. Transparent disclosure of data limitations is essential for better understanding and encouraging future data collection and sharing efforts.

Despite safety concerns regarding pedestrian and cycling infrastructure in Amman, policymakers may not be prioritizing these issues as much as road congestion and public transport ridership. However, neglecting the development of safe and accessible pedestrian and cycling infrastructure may perpetuate reliance on private vehicles, leading to adverse environmental and health outcomes. Policymakers must recognize the importance of investing in active transport modes and prioritize the enhancement of pedestrian and cycling infrastructure.

Safety indicators rank fourth in terms of importance according to experts' assessments. Safety and security issues in transport terminals, personal security concerns for women using public transport, and traffic accidents pose significant challenges in Jordan. These issues result in loss of life, serious injuries, and substantial financial costs. Despite these concerns, public transportation usage remains low, with private vehicles being the dominant mode of transport. Addressing safety in Jordan's transport system is vital for improving the well-being of the population.

The fatality and injury rate in traffic accidents holds a moderate importance rating (16% of overall indicators). The current situation is of great concern, as the increasing number of registered vehicles in Jordan has led to traffic congestion, longer commute times, higher air pollution levels, and increased accident risks. Further analysis is needed to identify the underlying causes of fluctuations in the number of accidents, injuries, and fatalities. In Amman, most accidents involve collisions or run-over incidents.

The indicator of proximity, specifically the percentage of residential areas served with active transport tracks, is of utmost importance, constituting 30% of the overall accessibility indicators. It is closely interconnected with other accessibility indicators and plays a critical role in transportation equity. Currently, only 41% of Amman is served by public transit within the 400-meter limit, and newly developed residential areas face limited access to the public transportation network. The demand for urban public transport does not adequately meet the population growth, exacerbating the accessibility problem.

Livability Indicators

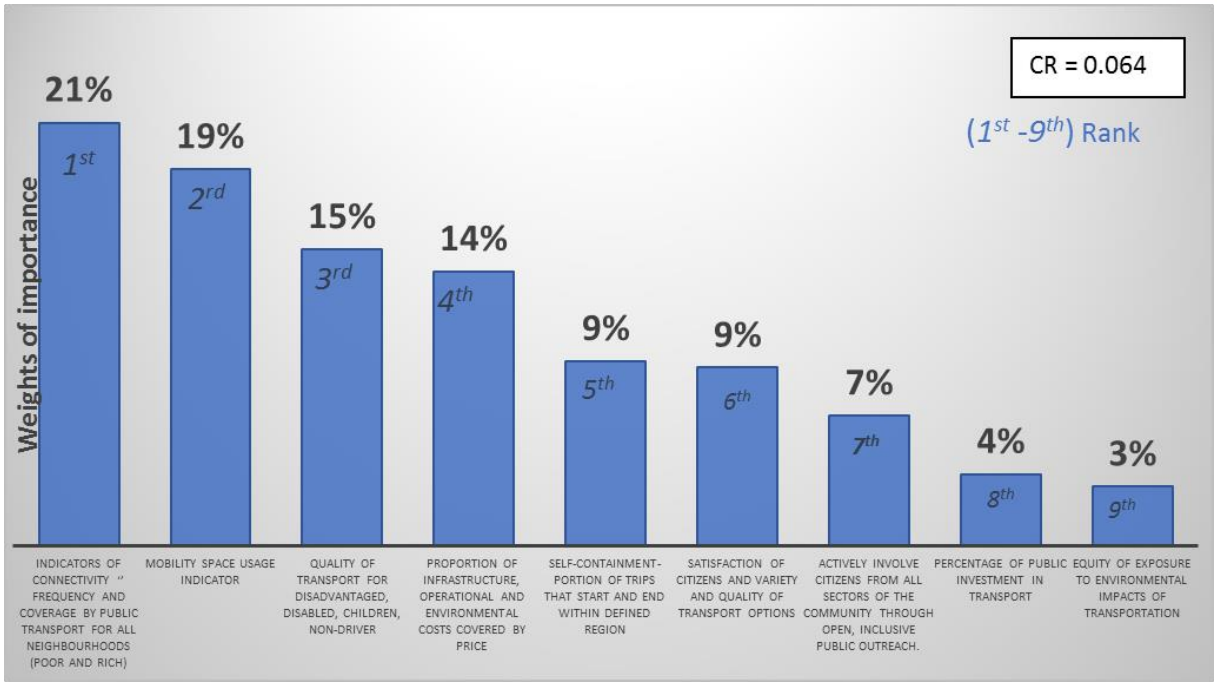

Figure 3: Weights Assigned to livability Indicators by Experts with Consistency Ratio
Source: Mohammad Thaher (Author).

In the context of Amman, several challenges related to livability indicators have been identified. One of the primary challenges is the lack of equity in exposure to environmental impacts, such as air quality and noise pollution, resulting from transportation. Additionally, limited public participation in infrastructure projects can lead to negative perceptions and undermine the success of such initiatives. The inadequacy of public transport, characterized by long wait times, weak transportation options, and inconvenience, further contributes to the challenges. Personal security concerns, particularly for women, have emerged as significant barriers to accessing public transport. Moreover, the lack of adequate infrastructure for pedestrians and cyclists has received insufficient attention in city planning efforts.

Although noise hindrance and air pollution emissions have been given relatively low importance in the livability indicators, it is crucial to acknowledge their significant implications for urban areas in Jordan. Noise pollution caused by road transport and air pollution from traffic, especially PM10, are major environmental and economic concerns. To address these issues, experts recommend promoting public transportation, and active modes of transportation, and implementing regulations on vehicle emissions. The establishment of the Ministry of Environment's efforts to monitor ambient air quality in Amman is commendable, but continuous endeavors are necessary to safeguard the well-being of Jordan's residents.

Further research and analysis are required to deepen the understanding of livability indicators and provide additional insights. The indicator of the "Number of enforcement efforts per

year" in urban transport, while important for ensuring safer practices, is given low importance within the overall safety indicators. Data availability poses a challenge for certain indicators, necessitating the use of alternative sources or proxy indicators. Transparency regarding data collection limitations is crucial for promoting understanding and encouraging further data collection and sharing.

The lack of prioritization of pedestrian and cycling infrastructure in Amman is a concern. Policymakers may not be allocating sufficient attention to these issues compared to road congestion and public transport ridership. Neglecting the development of safe and accessible infrastructure for pedestrians and cyclists perpetuates reliance on private vehicles and contributes to negative environmental and health outcomes. Policymakers should recognize the importance of investing in active transport modes and prioritize the enhancement of pedestrian and cycling infrastructure.

Safety in Jordan's transport system is a significant challenge and ranks fourth in terms of importance according to experts' assessments. Traffic accidents, low public transportation usage, and the predominance of private vehicles pose risks to life, and health, and result in economic costs. Improving safety and security in transport terminals, addressing personal security concerns, and promoting public transportation is crucial for enhancing the well-being of the population.

The fatality and injury rate in traffic accidents, along with the increasing number of registered vehicles, raise concerns regarding traffic congestion, air pollution, and accidents. Understanding the underlying causes of fluctuations in accidents and fatalities requires further analysis. Collisions and run-over incidents are the most prevalent types of accidents in Amman. The satisfaction level with public transport is low, and inadequate infrastructure, along with personal security concerns, hinders accessibility.

The indicator of proximity, which represents the percentage of residential areas served by active transport tracks, is of utmost importance for improving accessibility. Currently, only 41% of Amman is served by public transit within the 400-meter limit, exacerbating the accessibility problem. Prioritizing this indicator and addressing the demand for urban public transport is essential to improve accessibility and equity.

The relatively low importance given to the percentage of public investment in transport is due to the reliance on external funding sources and the lack of public trust in public transport systems. Despite efforts to involve the private sector through public-private partnerships (PPPs), challenges exist in the screening and preparation of feasibility studies. Prioritizing public participation in infrastructure projects is crucial for ensuring public satisfaction and successful outcomes. Actively involving citizens through inclusive public outreach enhances participation and supports infrastructure development.

The indicator related to Amman's transportation and mobility planning requires up-to-date data collection and analysis. Understanding travel patterns and public transport usage is

essential for informed decision-making and infrastructure investments. Despite the complexity and challenges associated with data collection, this indicator should be given moderate to high importance.

The indicator of the quality of transport for disadvantaged groups ranks third in importance. The lack of proper infrastructure, unreliable buses, and limited pedestrian and cycling infrastructure reduce public transport usage and increase reliance on private vehicles, resulting in congestion and economic losses. Addressing these issues comprehensively is crucial for improving accessibility, safety, and sustainability.

The indicator of mobility space usage, despite the lack of updated data, is considered highly important, emphasizing the need to measure the efficiency and effectiveness of urban mobility space. Comprehensive data collection is necessary for informed decision-making and to improve the transportation system in Amman. Despite the incomplete information, experts recognize the significance of this indicator and emphasize the importance of collecting current and comprehensive data.

Connectivity indicators, encompassing the frequency and coverage of public transportation for all neighborhoods, regardless of income level, are given the highest importance by most experts. These indicators provide a comprehensive understanding of the accessibility of public transportation for all residents, especially those from low-income areas who heavily rely on it. Improving public transportation coverage is crucial for ensuring equitable access to essential services and employment opportunities for residents in all parts of the city.

It is important to note that the importance assigned to these indicators by experts may vary based on their specific expertise, experiences, and the unique context of Amman. While these indicators have been identified as significant, ongoing research, data collection, and analysis are essential to continually monitor the effectiveness of transportation policies and identify areas that require attention and improvement.

Furthermore, involving stakeholders, including the public, in decision-making processes related to transportation infrastructure is crucial. Public participation ensures that the diverse needs and concerns of the community are considered and integrated into planning and implementation processes. Engaging citizens openly and inclusively enhances transparency, and trust, and ultimately leads to more satisfactory outcomes for the public.

In conclusion, although noise hindrance, public investment, public participation, and updated data may have been assigned relatively lower importance in the case study of Jordan, it is important to recognize the significance of these issues in creating a sustainable and livable urban environment. Continuous monitoring, data collection, and analysis, along with active public participation, are crucial for improving transportation systems, addressing environmental impacts, ensuring accessibility, and enhancing the overall well-being of residents in Amman and other developing countries.

Comparing the weights in a national and local hierarchy of the transport system

The development of sustainable transport indicators is essential for achieving social sustainability in urban areas. However, the process of developing such indicators can be complex due to the involvement of various stakeholders at different levels. In this study, the ATSSI (Advanced Transport Sustainability Indicator System) approach was developed and applied in conjunction with the transport planning approach to address this issue. The results of the validation process were compared between local municipality professionals and national ministry professionals to understand the consistency and agreement between the two levels.

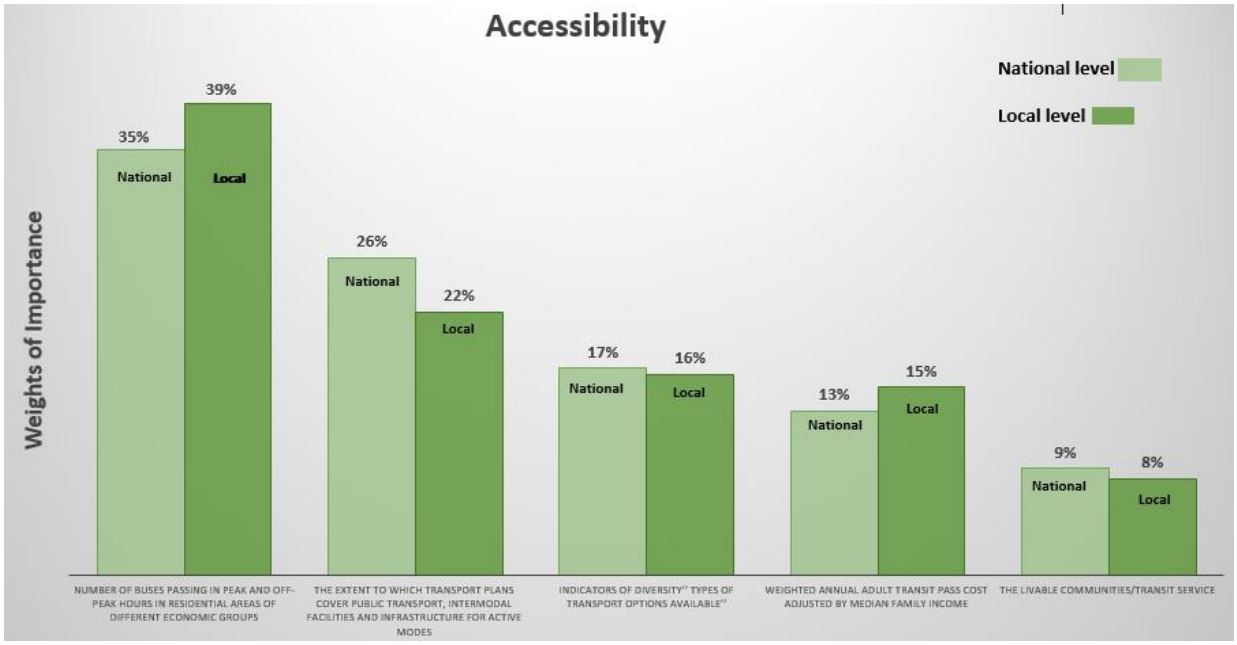

Figure 4: Accessibility Indicators Weight Comparison at Local and National Level

Source: Mohammad Thaher (Author).

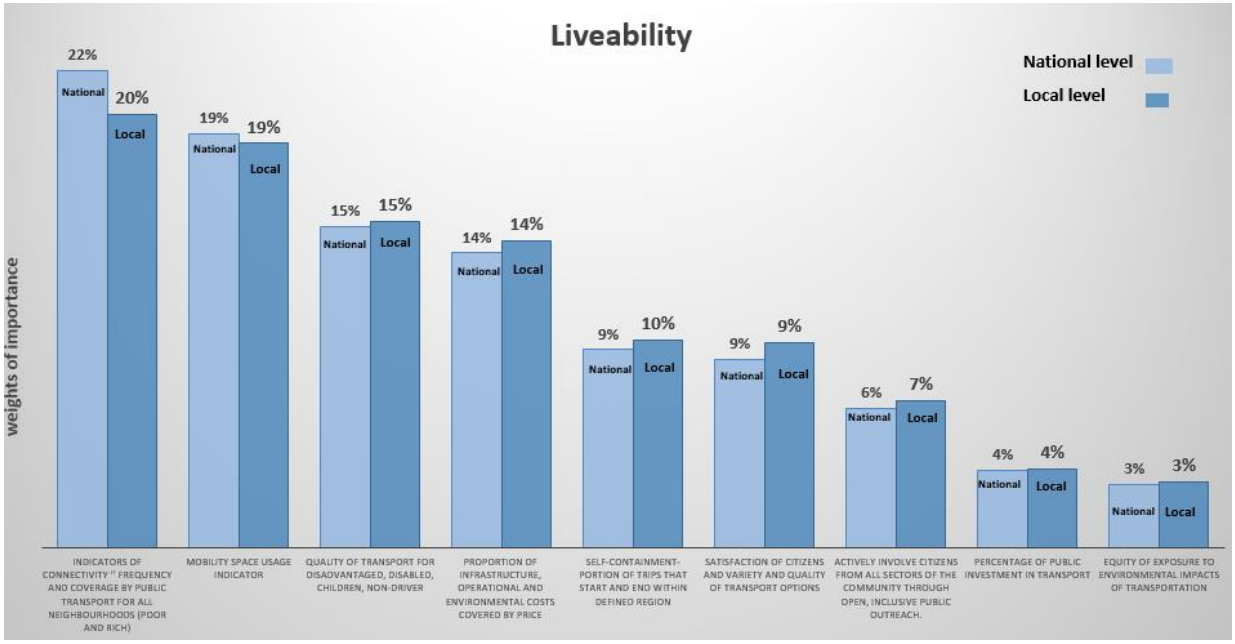

Figure5: Liveability Indicators Weight Comparison at Local and National Level
Source: Mohammad Thaher (Author).

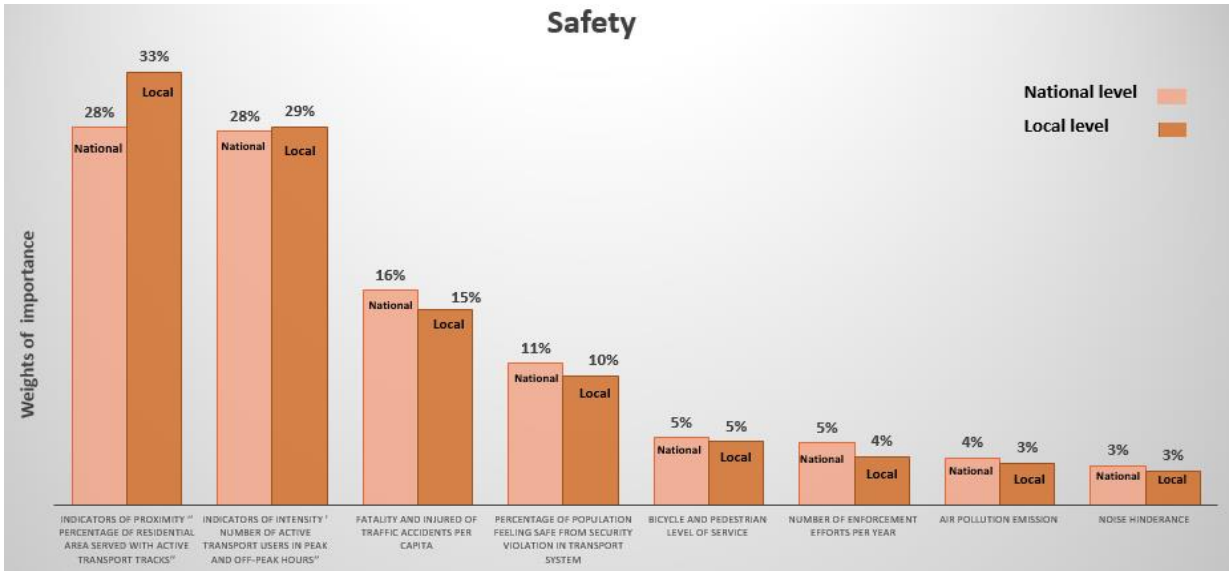

Figure6: Safety Indicators Weight Comparison at Local and National Level Source
Source: Mohammad Thaher (Author).

The study findings revealed that the weighting results of all expert groups from both the national and local levels were generally consistent for most indicators. While there were some dissimilarities observed for certain indicators, the lack of significant differences suggests that there is no conflict between the opinions of the professionals at both levels. This

demonstrates the success of the ATSSI approach in eliminating anticipated conflicts between stakeholders at different levels and fostering a harmonious understanding of sustainable transport indicators.

The comparison of weights between the national and local levels provides valuable insights into the agreement and alignment of priorities among professionals involved in transport planning. The consistency in weighting results indicates that there is a common understanding and consensus on the importance of various indicators in assessing the sustainability of the transport system. This finding is particularly significant as it highlights the effective collaboration and coordination between professionals from different levels of governance.

The graph highlights the agreement between professionals at the national and local levels, emphasizing the shared recognition of safety as a critical aspect of sustainable urban transport.

The ATSSI approach, which combines the Analytic Hierarchy Process (AHP) with the top-down transport planning approach, proves to be a valuable tool in overcoming limitations and ensuring the comprehensive development of sustainability indicators. By utilizing the ATSSI approach, the study successfully addresses the challenges associated with defining sustainable urban transport and mitigates the risk of neglecting crucial aspects of indicator development.

The findings of this study have broader implications beyond the specific context of the research. The successful application of the ATSSI approach in comparing weights at different levels of governance can serve as a model for other countries, regions, or developing nations. By adopting this approach, policymakers and professionals in transport planning can develop robust and valid urban transport indicators that align with the priorities and perspectives of stakeholders at all levels.

In conclusion, the comparison of weights in a national and local hierarchy of the transport system provides valuable insights into the agreement and consistency among professionals in assessing the sustainability of urban transport. The ATSSI approach, along with the graphical representation of the weight comparisons, demonstrates the effectiveness of this methodology in harmonizing the opinions of stakeholders at different levels. By employing the ATSSI approach, policymakers, and urban planners can develop comprehensive and valid sustainability indicators that contribute to socially sustainable urban transport systems.

5. Conclusion and Recommendations:

The ATSSI method proved to be a suitable research methodology for the development of a site-specific social sustainability indicator system for urban transport in Amman, Jordan. By integrating multiple approaches, such as sustainable development, social sustainability,

transport policies, and sustainability assessments, the ATSSI method facilitated the creation of a comprehensive indicator system. The utilization of the Analytic Hierarchy Process (AHP) and the inclusion of expert opinions ensured the credibility and reliability of the developed indicators. However, it is important to consider the potential limitations of the ATSSI method, including the accessibility of experts, cultural prejudice, data accessibility, and caliber, as well as the complexity of implementation.

Based on the findings and limitations of the ATSSI method, several recommendations can be made to enhance its application and overcome potential challenges:

1. Enhance the accessibility of expert insights: To address the time-consuming nature of gathering expert opinions, efforts should be made to establish effective communication channels and leverage technological tools that facilitate remote collaboration. Virtual meetings and online platforms can help overcome geographical barriers and ensure a more diverse range of perspectives.
2. Mitigate cultural bias through stakeholder involvement: To minimize cultural prejudice in indicator selection and measurement methods, it is crucial to involve stakeholders from diverse backgrounds in the development and testing of the ATSSI method. Their input can provide valuable insights and ensure that indicators are relevant and applicable across different cultural and socioeconomic contexts.
3. Improve data accessibility and quality: Recognizing the challenges associated with data availability and reliability, it is essential to invest in data collection and management systems. Collaborations with relevant organizations and institutions can help establish data-sharing networks and improve the overall caliber of the data used in the ATSSI method.
4. Simplify implementation through guidelines and training: Given the complexity of the ATSSI method, clear and comprehensive guidelines should be developed to support its implementation. These guidelines should provide step-by-step instructions, examples, and case studies to facilitate the use of the method by a wider range of users. Additionally, training programs and capacity-building initiatives can help equip individuals and organizations with the necessary knowledge and skills to effectively apply the ATSSI method.

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References

Ahmed, Waqas et al. (2020, July 22). Assessing and Prioritizing the Climate Change Policy Objectives for Sustainable Development in Pakistan. https://scite.ai/reports/10.3390/sym12081203

Alnsour, J. A. (2016). Managing urban growth in the city of Amman, Jordan. Cities, 50, 93-99.

Banister, D. (2008). The sustainable mobility paradigm. Transport Policy, 15(2), 73-80.

Bond, A., Morrison-Saunders, A., & Pope, J. (2012). Sustainability assessment: The state of the art. Impact Assessment and Project Appraisal, 30(1), 53-62.

Budnyk, V., Lernichenko, K., Korniiko, Y., & Valiavska, N.. (2019, July 25). Expediency of modification of city transport system by implementation of passenger water transport. https://scite.ai/reports/10.15587/2312-8372.2019.180853

Cervero, R., & Dai, D. (2014). BRT TOD: Leveraging transit-oriented development with bus rapid transit investments. Transport Policy, 36, 127-138.

Dempsey, N., Bramley, G., Power, S., & Brown, C. (2011). The social dimension of sustainable development: Defining urban social sustainability. Sustainable development, 19(5), 289-300.

Gudmundsson, H., Hall, R. P., Marsden, G., & Zietsman, J. (2016). Sustainable transportation. Heidelberg, Ger. Frederiksberg, Denmark, Spreinger-Verlag Samf.

Hsu, C. C., & Sandford, B. A. (2019). The Delphi technique: making sense of consensus. Practical assessment, research, and evaluation, 12(1), 10.

Huang, I. B., Keisler, J., & Linkov, I. (2011). Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. Science of the total environment, 409(19), 3578-3594.

Lindau, L. A., Hidalgo, D., & Facchini, D. (2010). Curitiba, the cradle of Bus Rapid Transit. Built Environment, 36(3), 274-282.

Litman, T. (2017). Evaluating accessibility for transport planning. Victoria, BC, Canada: Victoria Transport Policy Institute.

Lucas, K., van Wee, B., & Maat, K. (2016). A method to evaluate equitable accessibility: combining ethical theories and accessibility-based approaches. Transportation, 43(3), 473-490.

Makarova, I., Khabibullin, R., Shubenkova, K., & Boyko, A.. (2016, January 1). Ensuring sustainability of the city transportation system: problems and solutions (ICSC). https://scite.ai/reports/10.1051/e3sconf/20160602004

Marsden, G., & Rye, T. (2010). The governance of transport and climate change. Journal of Transport Geography, 18(6), 669-678.

Mihyeon Jeon, C., & Amekudzi, A. (2005). Addressing sustainability in transportation systems: definitions, indicators, and metrics. Journal of infrastructure systems, 11(1), 31-50.

Moniruzzaman, M., Olaru, D., & Biermann, S. (2017). Assessing the accessibility of activity centres and their prioritisation: a case study for Perth Metropolitan Area. Urban, Planning and Transport Research, 5(1), 1-21.

Nakase, R., Chou, C. C., Aoki, Y., Yoh, K., & Doi, K. (2021). Evaluating Hierarchical Diversity and Sustainability of Public Transport: From Metropolis to a Weak Transport Demand Area in Western Japan. Frontiers in Sustainable Cities, 3, 667711.

Nations, U. (2015). Transforming Our World: The 2030 Agenda for Sustainable Development United Nations.

Paez, A., Scott, D. M., & Morency, C. (2012). Measuring accessibility: positive and normative implementations of various accessibility indicators. Journal of transport geography, 25, 141-153.

Rabl, A., & De Nazelle, A. (2012). Benefits of shift from car to active transport. Transport Policy, 19(1), 121-131.

Shbeeb, L. (2018). A review of public transport service in Jordan: Challenges and opportunities. Al-Balqa Journal for Research and Studies, 21(1), 8-28.

Song, Y., Shao, G., Song, X., Liu, Y., Pan, L., & Ye, H. (2017). The relationships between urban form and urban commuting: An empirical study in China. Sustainability, 9(7), 1150.

Transportation Research Board. (2018). Critical issues in transportation 2019. Washington, D.C.: National Academies Press.

UN-Habitat. (2021). Mainstreaming Transport and Mobility into Jordan's National Urban Policy Thematic Guide: United Nations Human Settlements Programme.

United Nations Department of Economic and Social Affairs, 2007. Indicators of sustainable development: Guidelines and methodologies. Third Edition. New York: United Nations publication.

Van Acker, V., Van Wee, B., & Witlox, F. (2010). When transport geography meets social psychology: Toward a conceptual model of travel behaviour. Transport Reviews, 30(2), 219-240.

World Population Review. (2022). World Population by Country. Retrieved from https://worldpopulationreview.com/

Zeibots, M. E., & Bell, S. L. (2017). Safe and secure public transport environments: new challenges for technology, surveillance regimes and privacy. International Journal of Sustainability in Economic, Social and Cultural Context, 13(3), 19-33.