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RESEARCH TITLE

Pursuing Behavioural Dynamics for Socially Sustainable Urban Transport: The Case of Amman, Jordan, in Developing Countries - A Multi-Indicator AHP Approach

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Abstract

Examining the intricate interplay between urban transportation systems and human behavioral dynamics within the framework of sustainable urban development, this study probes the social sustainability dimensions inherent in urban transport systems, with a focus on developing nations. Employing the Analytic Hierarchy Process (AHP) methodology, we meticulously evaluate the social sustainability indicators embedded within Amman's urban transport network in Jordan. Guided by expert appraisals, we dissect the triad of accessibility, safety, and livability, affording weighted significance to the pertinent indicators.

The findings unveil pronounced challenges, spanning disparities in accessibility to public transportation, prevalent safety apprehensions, and the multi-faceted constituents of livability. Unveiling a methodical blueprint for assessing social sustainability, our contribution seamlessly aligns with the pursuit of advancing theoretical comprehension and empirical research across the behavioral sciences spectrum. The study underscores the pivotal role of assimilating cross-disciplinary perspectives to enrich the amelioration of urban transport systems.

Based on the insights gleaned, future initiatives stand to harness the Adaptive Total Sustainable Social Indicator (ATSSI) framework, amplifying endeavors in urban transport planning to foster more inclusive, equitable, and habitudinal urban milieus. In this quest, our research encapsulates the thematic scope, enmeshing research, praxis, experiences, and ongoing dialogues at the confluence of behavioral sciences and urban development. Offering a pragmatic and insightful approach to navigating the intricacies of urban transport challenges, our study substantiates the pursuit of scholarly discourse, enunciating both theoretical apprehension and pragmatic panaceas to propel societal advancement.

Key Words: urban transportation, social sustainability, Analytic Hierarchy Process (AHP), developing countries, interdisciplinary research

Introduction:

In the contemporary era of rapid global urbanization, urban transportation systems have emerged as central players in shaping the dynamics of modern cities. The swift expansion of urban populations, particularly evident in developing countries, has brought forth a distinct set of challenges that necessitate innovative strategies for ensuring sustainable and efficient mobility (Gutierrez-Franco et al., 2021). This study turns its focus toward Amman, Jordan, as a case study, in order to delve into the intricate relationship between urban transportation and the dimensions of social sustainability.

The phenomenon of urbanization is an undeniable global trend, with a significant majority of the world's population currently residing in urban areas (Wu et al., 2022). This ongoing shift toward urban living holds great promise for economic advancement, cultural exchange, and technological progress. Yet, it also introduces a host of urban predicaments, such as traffic congestion, air pollution, inadequate infrastructure, and disparities in access to essential services (Smith & Woodcraft, 2020). Among these challenges, the operational efficacy of urban transportation systems emerges as a pivotal concern. In this context, it is often in developing countries that the impacts of these shifts are most keenly felt, as they grapple with limited resources and infrastructural constraints (Becerra et al., 2013; Farrell, 2017).

Amman, the capital of Jordan and a rapidly expanding city in the region, stands as a microcosm of the complexities inherent in urban transportation within developing nations. The city's burgeoning population and swift urban growth have underscored the need for robust and efficient transportation networks. Challenges of accessibility, safety, and livability have been accentuated, demanding a delicate equilibrium between economic advancement and the well-being of residents (UN-Habitat, 2021; Shbeeb, 2018). Amman's experience underscores the imperative of a nuanced comprehension of urban transportation's role in shaping societal dynamics and emphasizes the significance of integrating social sustainability considerations.

Fundamental to the discourse on urban transport is the concept of social sustainability, which encapsulates dimensions of equity, inclusivity, and quality of life. As urban areas expand, it becomes paramount to ensure that transportation systems not only serve as functional conduits but also contribute to societal well-being. Access to transportation options, especially for marginalized populations, becomes an ethical imperative (Ruiz-Montañez, 2017). Additionally, ensuring safety for all road users, encompassing pedestrians and cyclists, assumes a central role in fostering sustainable transport systems (Makarova et al., 2018; Vrábel et al., 2022). Moreover, the notion of livability gains prominence, emphasizing the creation of urban environments conducive to a high quality of life (Saeed et al., 2022).

To dissect the intricate interactions between urban transport and social sustainability, this study employs the Analytic Hierarchy Process (AHP) methodology. AHP offers a systematic approach to assessing complex systems by involving experts in assigning weights to various components. Through the application of this methodology, this study endeavors to elucidate the social sustainability indicators embedded within Amman's urban transport system. Through rigorous analysis, the research seeks to uncover both challenges and potential avenues for harmonizing urban transportation systems with societal well-being.

The forthcoming sections of this paper are organized as follows: A review of pertinent literature on urbanization, transportation systems, and social sustainability; an explication of the methodology employed in this study, including the rationale for adopting the AHP

approach and its application to the context of Amman; a detailed presentation of the outcomes of the AHP analysis, delineating the dimensions of accessibility, safety, and livability alongside their corresponding weights; a comprehensive discussion of the findings, their implications, and the encountered limitations; actionable recommendations derived from the research, offering strategies to bolster the social sustainability of urban transportation systems; and finally, a synthesis of the study's contributions and advocacy for a multidisciplinary approach to address the multifaceted challenges posed by urban transport toward sustainable urban development.

Literature Review

The Concept of Social Sustainability in Urban Transport

Social sustainability has emerged as a multifaceted and vital concept within the realm of urban transport. Rooted in the notion of meeting the present needs while ensuring the well-being of future generations, social sustainability integrates dimensions of equity, inclusivity, and quality of life (Ersoy & Alberto, 2019; Paidakaki & Lang, 2021). In the context of urban transportation, this concept goes beyond mere functional efficiency to encompass the societal implications of mobility systems. As cities expand and diversify, the imperative to establish transportation networks that foster accessibility for all, promote safety, and enhance community well-being gains prominence (Makarova et al., 2018; Lu et al., 2022).

Urban Transport, Social Sustainability, and Developing Countries

The intersection of urban transport, social sustainability, and developing countries creates a complex web of challenges and opportunities. Rapid urbanization in developing countries intensifies the demand for efficient transportation systems to cater to burgeoning populations (Horak et al., 2019). However, these very systems can also exacerbate existing social inequalities, as marginalized communities often face limited access to transportation services (Ruiz-Montañez, 2017; Huang et al., 2016). As such, understanding the intricate interplay between urban transport and social sustainability is crucial in developing countries, where mobility can either perpetuate disparities or serve as a vehicle for inclusive progress.

The Analytic Hierarchy Process (AHP) Methodology and Its Role in Sustainability Assessment

The Analytic Hierarchy Process (AHP), introduced by Saaty (1980), offers a systematic framework for evaluating complex systems by hierarchically structuring decision criteria and alternatives. AHP involves pairwise comparisons to assign relative weights to components and criteria, enabling a comprehensive assessment of intricate phenomena (Puzović et al., 2019). This methodology's unique ability to combine subjective expert judgments with objective data makes it an ideal tool for evaluating multifaceted issues such as social sustainability in urban transport (Lu et al., 2022).

Previous Studies Using AHP in Urban Sustainability Evaluation

AHP has been widely employed for assessing sustainability across various urban contexts. Within urban transport, AHP has proven invaluable in integrating diverse indicators to comprehensively evaluate economic, social, and environmental dimensions of sustainability (Hodicky et al., 2020; Liu et al., 2012; Bargueño et al., 2021; Zito & Salvo, 2011). Past studies have harnessed AHP to prioritize transportation projects, guide urban planning, and optimize resource allocation (Li et al., 2017; Al-Atawi et al., 2015). Its effectiveness in accommodating expert insights and capturing intricate interrelationships between indicators has contributed to its success in urban sustainability assessments (Bargueño et al., 2021; Al-Atawi et al., 2015).

In summary, the literature review underscores the paramount importance of social sustainability within urban transport systems, particularly in the context of developing countries. It accentuates the Analytic Hierarchy Process (AHP) methodology's role in tackling multifaceted sustainability challenges and illustrates its application through prior urban sustainability assessments. Building upon this foundation, the subsequent sections of this paper delve into the methodology's application in this study and unveil the results obtained through its implementation within the urban transport landscape of Amman, Jordan.

Methodology

Research Design and Case Study Selection

This study adopts a case study approach to investigate the social sustainability dimensions within urban transport, focusing on Amman, Jordan, as the case study location. Amman, emblematic of the rapid urbanization challenges in developing countries, offers a pertinent context to examine the intricate dynamics between urban transportation and social sustainability. The city's population growth, coupled with its expanding urban landscape, exemplifies the pressing need for sustainable transportation systems that address accessibility, safety, and livability concerns.

The Rationale for AHP Methodology

The Analytic Hierarchy Process (AHP) methodology is employed due to its capacity to systematically assess complex systems and integrate diverse criteria, aligning well with the multifaceted nature of social sustainability. By hierarchically structuring decision elements and employing pairwise comparisons, AHP enables the incorporation of both quantitative data and expert judgments, a pivotal factor in evaluating intricate urban phenomena (Saaty, 2008). Given the subjectivity inherent in assessing social sustainability, AHP's ability to capture expert insights ensures a comprehensive evaluation.

Application of AHP Methodology

The AHP methodology involves a sequence of steps tailored to this study's objectives. Firstly, the identification of relevant indicators for assessing social sustainability is conducted through a comprehensive review of the literature and expert consultation. These indicators, aligned with accessibility, safety, and livability dimensions, form the foundational elements for subsequent analysis.

To solicit expert opinions, a panel of experts with expertise in transportation systems, urban planning, and sustainability is engaged. The experts participate in pairwise comparisons, systematically evaluating the relative significance of indicators within each dimension. The Comparative Judgment Matrix, derived from these comparisons, facilitates the calculation of weights for each indicator.

Exploration of Accessibility, Safety, and Livability

The study explores three primary dimensions: accessibility, safety, and livability. Accessibility entails equitable access to transportation services, catering to marginalized communities, and fostering inclusivity. Safety encompasses the security of all road users, including pedestrians and cyclists, and the mitigation of hazards. Livability pertains to the creation of urban environments that enhance the quality of life, encompassing factors such as reduced pollution and supportive infrastructure for active transportation modes.

Through the systematic application of the AHP methodology, this study delves into the intricate tapestry of urban transportation's implications on social sustainability. By discerning the weights assigned to various indicators within the accessibility, safety, and livability

dimensions, this research seeks to provide a comprehensive understanding of the critical components underpinning socially sustainable urban transport systems in Amman.

The ensuing sections of this paper will present the findings derived from the AHP analysis, highlighting the specific indicators within each dimension and their respective weights. This empirical evidence will be accompanied by an in-depth discussion of the implications and limitations of the study, guiding the formulation of recommendations to enhance the social sustainability of urban transportation systems.

Results

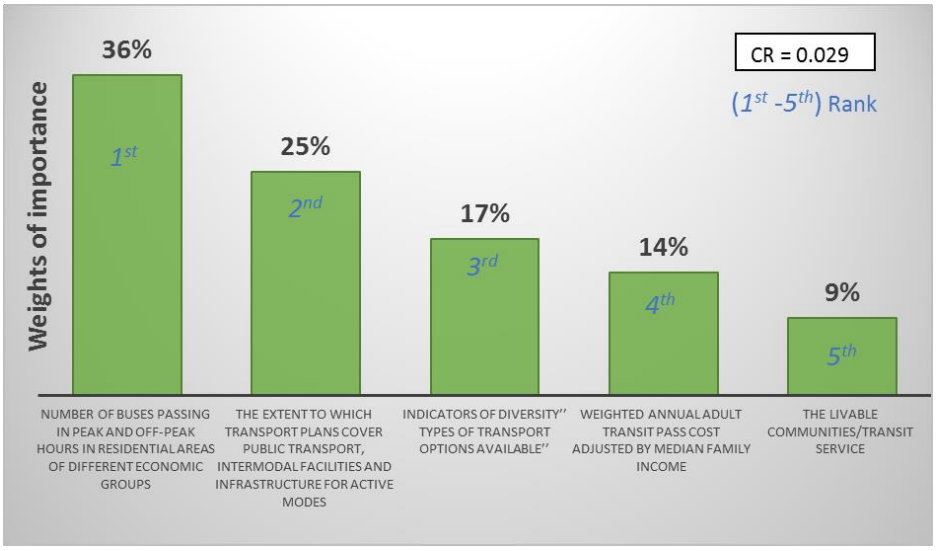
Outcomes of AHP Analysis

The application of the Analytic Hierarchy Process (AHP) methodology yielded insightful results regarding the social sustainability indicators within Amman's urban transport system. Through expert evaluations, the study uncovered the relative weights assigned to indicators across three dimensions: accessibility, safety, and livability.

Accessibility Dimension

Fig. 1 illustrates the weights assigned to accessibility indicators by experts, providing a comprehensive view of the indicators' significance in fostering social sustainability. The analysis revealed noteworthy challenges in Amman's public transportation, exposing disparities across neighborhoods and affordability issues for marginalized groups. While some indicators received lower importance, it is evident that holistic improvements are necessary for a comprehensive, efficient, and socially sustainable transport network in the city. Enhancing accessibility through diversified transportation modes, increased public transport frequency, and affordability policies emerged as potential solutions.

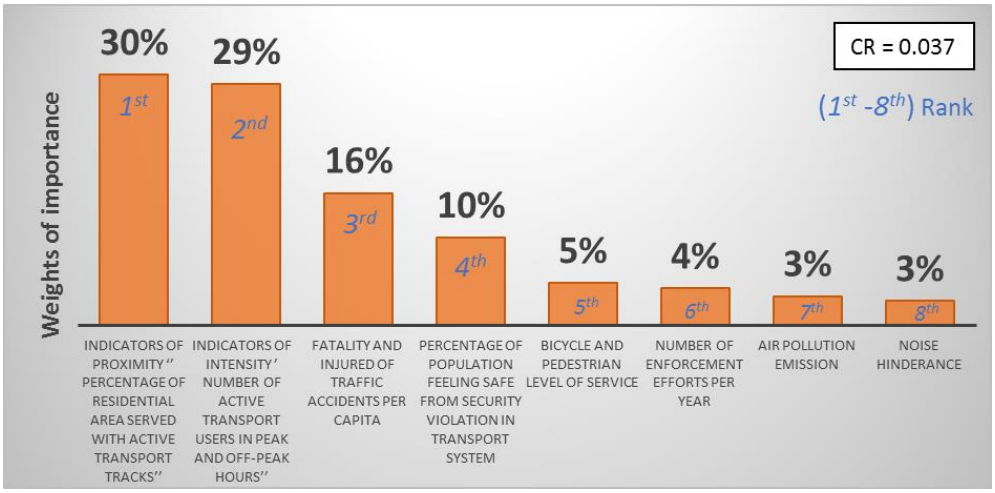
Fig. 1 Weights Assigned to Accessibility Indicators



Safety Dimension

Fig. 2 showcases the weights assigned to safety indicators by experts, offering insights into the dimensions' priorities in the realm of social sustainability. Safety concerns in Amman's transport landscape, including traffic accidents and pollution, were evident. Experts identified areas such as noise and air pollution as undervalued, despite their substantial impact on urban well-being. Addressing these challenges necessitates a comprehensive approach involving public transport promotion, emissions regulation, and enhanced infrastructure for pedestrians and cyclists. While safety ranks fourth in importance, the proximity of active transport tracks emerges as a critical consideration.

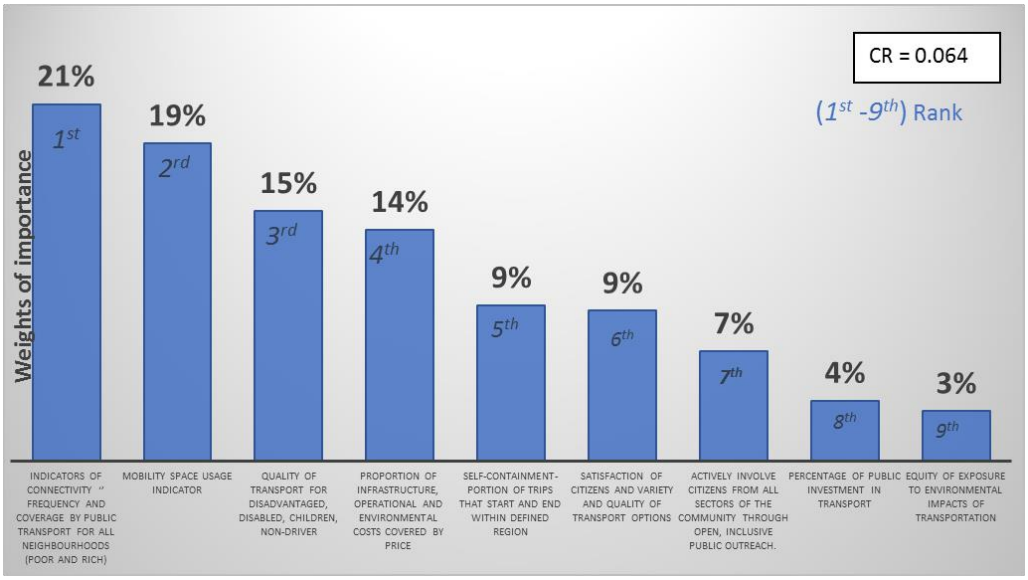
Fig. 2 Weights Assigned to Safety Indicators



Livability Dimension

Fig. 3 depicts the weights assigned to livability indicators by experts, delineating the dimensions' role in fostering social sustainability in urban transport. Challenges within Amman's livability were evident, ranging from environmental impacts and public participation to security concerns and inadequate infrastructure. While noise and air pollution were undervalued, they bear significance in fostering socially sustainable urban transport systems. To enhance livability, promoting public transport, active modes, and emissions regulations emerges as pivotal. The proximity of active transport tracks and public participation emerged as vital considerations, underscoring the need for continuous monitoring and community involvement.

Fig. 3 Weights Assigned to livability Indicators.



Implications of Results

The outcomes of the AHP analysis underscore both achievements and challenges in the pursuit of socially sustainable urban transport in Amman. While some indicators received due attention, others were overlooked, highlighting the need for comprehensive solutions that consider diverse dimensions of social sustainability. The study emphasizes the importance of fostering equitable access, ensuring safety for all road users, and nurturing livable urban environments.

The significance of the results extends beyond academic exploration; they provide valuable insights for policymakers, urban planners, and transportation authorities. The identified challenges prompt a reevaluation of current policies, indicating a necessity for strategic interventions that enhance accessibility, safety, and livability. These findings guide the formulation of actionable strategies aimed at fostering sustainable urban transport that not only caters to functional needs but also advances the well-being of Amman's residents.

In the subsequent section, the study engages in an in-depth discussion of the implications arising from the results, elucidating the challenges identified and offering a nuanced understanding of the intersections between urban transport and social sustainability.

Discussion

Navigating the Path to Socially Sustainable Urban Transport: Interpreting Findings and Unveiling Opportunities

Interpreting Results in the Context of Developing Country Challenges

The revealed outcomes of the Analytic Hierarchy Process (AHP) analysis intertwine with the complex tapestry of urban transport challenges encountered by developing countries. Rapid urbanization in such contexts often ushers in a confluence of opportunities and obstacles, presenting a unique platform for reimagining urban mobility. Amman, Jordan, encapsulates this duality, offering insights into the intricate relationship between urban transportation and social sustainability.

The Lens of Accessibility and Safety Disparities

The findings unearthed by our study cast a spotlight on the poignant issues of accessibility and safety. These dimensions, pivotal for equitable urban development, assume amplified significance in developing countries like Jordan. As accessibility gaps persist, marginalized communities bear the brunt of transportation inadequacies, impeding social cohesion and economic progress (Sun et al., 2021; Raza et al., 2022; Lorenzo et al., 2015). Moreover, safety concerns, often exacerbated by inadequate infrastructure and increasing traffic volumes, impose pronounced challenges (Raza et al., 2022). The undervaluation of noise and air pollution indicators underscores a critical blind spot, signifying the imperative to holistically assess the myriad dimensions of urban well-being.

Unveiling Opportunities Amidst Limitations

While the study brings forth valuable insights, it does not come without limitations. The scope of indicators considered is inherently constrained by available data and expert perspectives, potentially excluding certain dimensions critical to the holistic understanding of urban transport's impact on social sustainability. Moreover, inherent biases in expert judgments, albeit minimized through the AHP methodology, remain an intrinsic challenge. Nevertheless, these limitations offer fertile ground for future research, encouraging the incorporation of additional indicators and diverse viewpoints to paint a more comprehensive picture.

Unveiling a Path Forward for Urban Planning and Sustainable Development

The implications of this study extend far beyond Amman's city limits, resonating with urban planners, policymakers, and researchers striving for sustainable urban futures. The multidimensional nature of social sustainability necessitates an integrated approach, fusing transportation planning with social equity considerations (Budnyk et al., 2019; Ghorbanzadeh et al., 2018). The study's outcomes advocate for a paradigm shift, promoting strategies that amplify access, mitigate safety hazards, and cultivate livable environments. Rethinking urban

transportation as a vehicle for fostering inclusivity and community well-being holds the potential to recalibrate urban trajectories and pave the way for sustainable urban futures.

In the broader landscape of developing countries, where urbanization juggles aspirations and challenges, our study's findings signify a clarion call for transformative action. Integrating accessibility-enhancing measures for marginalized groups, amplifying safety through comprehensive road design, and advocating for livability-focused urban planning emerge as proactive steps toward forging socially sustainable urban transport systems. Amman's case serves as both a cautionary tale and an inspiring narrative of navigating the complex fabric of urban dynamics to carve pathways to prosperity.

In the ensuing sections, our study culminates in actionable recommendations stemming from the comprehensive evaluation of accessibility, safety, and livability dimensions. By addressing these facets, our research aspires to catalyze meaningful change and inspire a new wave of urban transportation initiatives that prioritize not only movement but also the human experience.

Recommendations

Unveiling the Canvas of Possibilities

Armed with the insights garnered from the Analytic Hierarchy Process (AHP) analysis, this study unfolds a tapestry of recommendations that transcend the confines of research papers, aiming to spark transformation in urban transport systems. The journey towards socially sustainable urban mobility, as illuminated by Amman's case, beckons us to reimagine our cities as vibrant, inclusive, and resilient havens for all.

Fostering Equitable Access: Bridging the Accessibility Divide

The call to action commences with accessibility, a pillar on which urban inclusivity stands. Reducing disparities necessitates an integrated approach that embraces both infrastructural enhancements and strategic policy interventions. Collaborative efforts between urban planners, transportation authorities, and community stakeholders can channel resources into expanding public transportation networks, particularly in underserved areas. Moreover, revisiting fare structures and implementing targeted subsidies can render transportation affordable, dismantling economic barriers that inhibit access for marginalized communities.

Navigating Towards Safety: Pioneering Roadways of Security

Safety, an inalienable right of all road users, demands an assertive stance. Intersection redesigns, pedestrian-friendly crosswalks, and dedicated cycling lanes can usher in a new era of road safety. Harnessing technology for intelligent traffic management and surveillance systems can mitigate hazards and alleviate congestion, thereby enhancing road safety. Additionally, partnerships between schools and urban planners can foster safe routes for children, nurturing a culture of pedestrian safety from a young age.

Cultivating Livable Environments: Blueprinting Urban Oases

Livability, the cornerstone of harmonious urban life, necessitates a conscious shift towards environmentally conscious urban planning. Green spaces, pedestrian promenades, and cyclist-friendly infrastructure can permeate urban landscapes, creating spaces that prioritize well-being over vehicular dominance. Regulations curbing noise and air pollution, coupled with incentives for electric and shared mobility, can herald a new era of sustainable urban transportation. Engaging communities in co-designing public spaces and transportation routes can foster a sense of ownership, invigorating urban environments.

Leveraging the ATSSI Framework: Pioneering Progress

Our study introduces the Adaptive Total Sustainable Social Indicator (ATSSI) framework as a versatile tool for shaping socially sustainable urban transport systems. This framework, amalgamating social, economic, and environmental dimensions, offers a compass for urban planners and policymakers. Its adaptability allows it to resonate across diverse contexts, enabling tailored approaches that cater to the unique challenges of each city. Leveraging technology for data collection and engagement platforms, such as crowdsourcing, can harness the collective wisdom and democratize decision-making, breathing life into the ATSSI framework.

Charting a Path Forward: From Reflection to Realization

As the sun sets on our exploration, the horizon of possibilities stretches wide. Amman's journey towards socially sustainable urban transport mirrors the global endeavor to sculpt cities that foster well-being, equity, and resilience. Our recommendations cast a guiding light, reminding us that urban transformation is not confined to blueprints but forged through bold actions. Urban planners, policymakers, and citizens alike hold the brush to paint the canvas of tomorrow's cities – cities where mobility is not just a journey but a celebration of human connections.

As the echoes of Amman's story resonate, the future beckons and our responsibility magnifies. The transformative potential lies within our collective will to implement change. By embracing these recommendations, cities can transcend mere functionality and embrace the art of urban living, crafting spaces where every journey contributes to the symphony of social sustainability.

In the final stretch of our journey, our study transcends theory and steps into the realm of implementation, advocating for urban transformation through actionable recommendations. The chapters ahead breathe life into these recommendations, offering a glimpse of how Amman's urban transport landscape can evolve, a beacon of hope for cities striving to redefine mobility and weave the threads of social sustainability.

Conclusion

In the final strokes of our exploration, the journey culminates in the embrace of conclusions that reverberate beyond the pages of research. Through the meticulous application of the Analytic Hierarchy Process (AHP) methodology, the study unfurled a panoramic view of social sustainability within Amman's urban transport fabric, revealing insights that transcend geographical boundaries and resonate with the global endeavor toward holistic urban transformation.

A Symphony of Insights

The study's compass led us through the dimensions of accessibility, safety, and livability, unraveling a tapestry of indicators that orchestrate the symphony of social sustainability. The disparities in accessibility and safety uncovered within Amman's transport ecosystem mirror the challenges encountered in developing countries worldwide. These findings reiterate the urgency to bridge the gaps, making urban mobility a conduit for cohesion, inclusivity, and well-being.

The AHP Methodology: A Beacon of Clarity

At the heart of this endeavor lies the Analytic Hierarchy Process (AHP) methodology, a beacon that illuminated the path toward understanding and enhancing social sustainability indicators. Through expert insights and rigorous analysis, AHP transcended the conventional

boundaries of assessment methodologies, offering a holistic perspective that fuses objective data with subjective expertise. Its power lies in its adaptability, making it not merely a tool but a bridge between theory and action, between academia and policy, catalyzing a transformational journey.

The Interdisciplinary Tapestry: Weaving Urban Dreams

The study's voyage underscores the indispensable role of interdisciplinary collaboration in addressing urban transport challenges. The intricate dance of urban mobility touches the realms of urban planning, environmental science, social equity, and beyond. As the boundaries between disciplines blur, the imperative to cultivate collective wisdom and channel it toward sustainable solutions becomes resounding. The study serves as a testament to the art of collaboration, uniting various domains to sculpt socially sustainable urban horizons.

An Overture to Sustainable Urban Futures

As the final curtain descends, the study's echoes continue to reverberate, underscoring its role in shaping a future where cities pulsate with life, connectivity, and well-being. The journey through Amman's urban transport landscape serves as an overture to the broader narrative of urbanization and its intricate interplay with social sustainability. It invites urban planners, policymakers, researchers, and citizens to step onto the stage and assume their roles as protagonists in the story of change.

In this symphony of conclusions, the notes resound with the fervor of possibility. The study's findings, the AHP methodology, and the interdisciplinary tapestry converge to weave the fabric of urban dreams – dreams of cities where mobility is an expression of equity, roads echo with safety, and environments brim with livability. The canvas is vast, the hues are varied, and the symphony is ours to compose.

In the grand finale of our expedition, we bid adieu not to an end, but to a new beginning – a beginning where social sustainability transcends theory, permeating the very essence of urban existence. As Amman's story interweaves with the global narrative of urbanization, we part ways with gratitude, holding the baton of change, ready to usher in the harmonious chords of socially sustainable urban horizons.

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Declarations

Ethics Approval and Consent to Participate:

This research project received ethical approval from the Ethics Review Committee at the University of Tours.

Informed consent was obtained from all participants, and data collection procedures were designed to ensure the strict confidentiality of all participants' information. These procedures are in accordance with the ethical guidelines and protocols established by the University of Tours and its Ethics Review Committee.

Consent for Publication:

I, the sole author of this research, provide my consent for the publication of this work. Additionally, consent for the publication of any potentially identifying information about participants or stakeholders involved in this study has been obtained.

Availability of Data and Materials: The data and materials used in this study are available upon request. Please contact the corresponding author, M.T, at Mohammad.daher22@gmail.com , for inquiries regarding data and materials.

Competing Interests:

The author, M.T, declares that there are no competing interests to declare in relation to this research.

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