

Integrating Local Context into Smart Mobility Planning for Developing Tourism Cities: Reflections from Labuan Bajo

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Abstract. Smart mobility has become a central component of sustainable infrastructure development, particularly in developing tourism cities where rapid growth often challenges environmental and social balance. This paper explores how local context can be integrated into smart mobility planning to ensure equitable, adaptive, and sustainable transportation systems. Using a qualitative and conceptual approach, this study draws on structured literature review and contextual analysis of Labuan Bajo, Indonesia—a developing tourism city designated as a national super-priority destination. The analysis examines urban scale, local mobility patterns, travel behavior, infrastructure constraints, and institutional capacity as key contextual dimensions influencing mobility planning. The findings highlight that incorporating local socio-spatial dynamics, infrastructure limitations, and community participation is crucial in formulating smart mobility strategies suited to developing contexts. Rather than directly adopting global models, mobility planning must be context-sensitive, reflecting local culture, geography, and governance capacity. This study contributes to smart mobility discourse by offering a context-based analytical framework for sustainable mobility planning in emerging tourism destinations.

Keywords: smart mobility, sustainable infrastructure, local context, developing tourism cities, Labuan Bajo

1 Introduction

Smart mobility has become a central theme in contemporary urban transport planning, particularly in relation to sustainability, accessibility, and technological innovation. The concept is commonly associated with the integration of digital technologies, data-driven systems, and intelligent transport solutions aimed at improving efficiency and reducing environmental impacts. While such approaches have demonstrated significant benefits in large metropolitan areas, their applicability and effectiveness in smaller cities—especially tourism-driven urban areas—remain less clearly understood. Developing tourism cities often face distinct spatial, social, and institutional conditions that challenge the direct transfer of technology-intensive smart mobility models. [1]

In many developing tourism cities, rapid tourism growth generates unique mobility pressures, including seasonal travel peaks, short-distance repetitive trips, and intensive interactions between tourists and local residents. [2] These dynamics are frequently accompanied by constrained road infrastructure, compact urban forms, and strong reliance on informal or semi-formal transport modes. [3] Despite these contextual characteristics, existing smart mobility initiatives tend to prioritize standardized technological solutions, often overlooking local travel

behavior, institutional capacity, and spatial limitations. [4]As a result, smart mobility planning risks becoming disconnected from everyday mobility realities in developing tourism contexts.

A growing body of literature acknowledges the importance of contextual sensitivity in transport planning. However, most smart mobility studies continue to focus on large cities with advanced technological and institutional capacities. [5]Research addressing small and medium-sized tourism cities remains limited and often descriptive, emphasizing case reflections rather than analytical frameworks that systematically link local context to planning strategies [6]. Consequently, a clear research gap exists regarding how smart mobility concepts can be analytically adapted to the specific conditions of developing tourism cities rather than applied as generic technology-driven models.

This study positions itself as a conceptual contribution that advances a context-based framework for smart mobility planning in developing tourism cities. Rather than treating smart mobility as a purely technological intervention, this study emphasizes the role of local context—including urban scale, tourism-induced mobility patterns, travel behavior, infrastructure constraints, and institutional capacity—in shaping feasible and sustainable mobility strategies. By foregrounding human-scale mobility and planning adaptability, this paper offers an analytical perspective that bridges the gap between abstract smart mobility concepts and the practical realities of tourism-driven urban environments.

Accordingly, the objective of this study is to develop a conceptual framework that explains how local contextual characteristics influence smart mobility planning in developing tourism cities. Using Labuan Bajo, Indonesia, as an illustrative case, this study synthesizes relevant literature and contextual analysis to identify key dimensions and planning implications. The proposed framework is intended to support planners and policymakers in designing smart mobility strategies that are context-sensitive, feasible, and aligned with the socio-spatial conditions of developing tourism destinations. Despite the growing body of literature on smart mobility and sustainable transportation, existing studies remain largely concentrated on large metropolitan contexts and technologically advanced urban environments. While recent research has acknowledged the importance of contextual factors in mobility planning, these discussions often remain fragmented and descriptive, without offering a structured framework that systematically integrates local conditions, tourism dynamics, and smart mobility principles, particularly in developing tourism cities.

This study offers a novel contribution by proposing a context-based conceptual framework for smart mobility planning specifically tailored to developing tourism cities. Unlike prevailing approaches that emphasize technology-driven solutions or replicate large-city mobility models, this framework positions local context as a foundational element, encompassing tourism-driven mobility demand, spatial constraints, institutional capacity, and technological readiness. By synthesizing insights from smart mobility theory, tourism mobility characteristics, and lessons from comparable destinations, the framework demonstrates how smart mobility components can be adapted to local capacities rather than imposed as standardized solutions. The contributions of this study are threefold. First, at the theoretical level, it advances the smart mobility discourse by shifting the focus from universal technological applications toward a context-sensitive planning paradigm for tourism-oriented cities in developing regions. Second, at the conceptual level, it provides an integrative analytical framework that bridges gaps between smart mobility literature, tourism studies, and urban planning in small and emerging

cities. Third, at the policy and planning level, the framework offers practical guidance for local governments and planners by outlining scalable and feasible smart mobility strategies aligned with local institutional and infrastructural realities. In doing so, this study contributes to ongoing debates on sustainable mobility by demonstrating how smart mobility principles can be operationalized beyond large metropolitan contexts.

Research Questions

Based on the identified research gap, this study addresses the following research questions:

1. How do local contextual characteristics—such as urban scale, tourism-induced mobility patterns, travel behavior, infrastructure constraints, and institutional capacity—influence smart mobility planning in developing tourism cities?
2. What key planning dimensions can be derived from the literature to construct a context-based smart mobility framework suitable for developing tourism destinations?
3. How can the proposed context-based smart mobility framework be applied to illustrate planning implications in the case of Labuan Bajo as a developing tourism city?

While smart mobility has been widely discussed in the context of large metropolitan areas and technologically advanced cities, existing studies predominantly emphasize technology-driven solutions and system optimization. This study offers a novel contribution by reframing smart mobility as a context-adaptive planning approach specifically tailored to developing tourism cities. Rather than proposing generic smart mobility models, this paper develops a structured analytical framework that explicitly links local spatial characteristics, tourism-induced mobility dynamics, informal transport practices, infrastructure constraints, and institutional capacity to mobility planning strategies. By positioning local context as the central determinant of “smartness” in mobility planning, this study extends current smart mobility discourse beyond technology-centric narratives and provides a transferable conceptual tool for tourism-driven urban environments that remain underrepresented in existing literature.

2 Literature Review

2.1 Smart Mobility: Concepts and Evolution

Smart mobility has emerged as a comprehensive approach to improving transportation systems through the integration of digital technologies, sustainable practices, and strategic urban planning. Early interpretations of smart mobility were strongly technology-oriented, emphasizing Intelligent Transportation Systems (ITS), traffic automation, and real-time information systems aimed at improving efficiency and network performance [7].

Over time, scholarly discourse has shifted toward a broader and more holistic understanding of smart mobility. Rather than focusing solely on technological sophistication, recent studies highlight the importance of accessibility, inclusivity, environmental sustainability, and user-centered design [8]. In this perspective, smart mobility encompasses multimodal integration, data-driven decision-making, shared mobility services, low-emission transport modes, and behavioral change toward sustainable travel patterns [1].

This evolution indicates that smart mobility is not merely a technological upgrade of transport systems but a policy-oriented framework that aligns mobility provision with broader urban sustainability objectives [9].

2.2 Smart Mobility in Developing and Small Cities

Despite its conceptual maturity, the empirical application of smart mobility has been largely concentrated in large metropolitan areas. Small and developing cities differ substantially in terms of institutional capacity, financial resources, and technological readiness [5].

Consequently, the direct transfer of “big-city” models to smaller urban contexts often results in limited effectiveness. Previous studies report that such mismatches lead to underutilized infrastructure and high maintenance costs [7]. In developing regions, additional constraints include unreliable digital infrastructure and the dominance of informal transport systems [10].

2.3 Mobility Characteristics of Tourism Cities

Tourism cities constitute a distinct category due to highly fluctuating travel demand. Unlike conventional cities, mobility patterns are shaped by visitor behavior and seasonal variability [11]. Travel demand tends to peak during tourist seasons, leading to intense congestion periods [12]. Spatially, movement is often concentrated around limited destinations such as waterfronts and scenic viewpoints [13]. Additionally, tourism cities accommodate diverse user groups—residents and visitors—each with different mobility expectations [11].

2.4 Importance of Local Context in Mobility Planning

Successful mobility planning must be grounded in local context, including geographical conditions, socio-cultural behavior, and institutional capacity [14]. From a socio-technical perspective, mobility systems function as complex interactions between technology, policy, infrastructure, and user practices [14]. When designed without adequate consideration of these dimensions, interventions often fail due to institutional mismatch or lack of community acceptance.

2.5 Lessons from Previous Smart Mobility Applications

Empirical evidence shows that technology-driven solutions alone are insufficient without governance capacity and stakeholder engagement [12]. In some regions, mobility initiatives struggled due to poor integration with informal transport systems [10]. Conversely, pedestrianization policies and micro-mobility can be successful when supported by local government capacity and appropriate urban design [2].

2.6 Relevance to Labuan Bajo

Labuan Bajo reflects many characteristics discussed in the literature, including rapid tourism-driven growth, narrow and constrained road networks, mixed travel patterns between tourists and local residents, reliance on informal or small-scale transportation, strong walkability potential along the waterfront, and institutional coordination challenges. Recent tourism statistics further illustrate increasing mobility pressure in the city, as detailed in Table 1. Based on the data, Labuan Bajo recorded 413,349 tourist visits in 2024, including both domestic and international travelers, while visits to Komodo National Park reached 334,206 in the same year. Early 2025 data also indicate continued growth in tourist arrivals. Despite this rapid increase in visitor flows, transport infrastructure remains limited, reinforcing the need for context-based smart mobility strategies emphasizing accessibility, integrated small-scale public transport, and digital tools aligned with local readiness.

Table 1. Tourism Growth Indicators in Labuan Bajo

Indicator	Year/Period	Value
Total tourist visits to Labuan Bajo	2024	413,349 visitors
International visitors	2024	229,763 visitors
Domestic visitors	2024	181,586 visitors
Visits to Komodo National Park	2024	334,206 visitors
Tourist visits (Jan–Apr)	2025	58,926 visitors
Passenger arrivals at Komodo Airport	April 2025	47,093 passengers

2.7 Terminology Clarification

The terminology related to smart mobility has evolved across multiple disciplines, resulting in overlapping and sometimes inconsistent usage of key concepts. In the existing literature, terms such as smart transportation, intelligent transportation, intelligent mobility, and smart mobility are frequently applied interchangeably, despite referring to different analytical emphases and policy orientations [15]. This lack of terminological clarity may lead to ambiguity in conceptual framing and analytical interpretation.

Smart transportation and intelligent transportation systems (ITS) are traditionally associated with technology-oriented interventions aimed at improving operational efficiency and traffic control through digital infrastructure and automation [4]. These approaches primarily emphasize system performance and technological capability, often with limited attention to social, institutional, and contextual dimensions. Similarly, intelligent mobility refers to the application of advanced technologies—such as real-time information systems and sensor-based monitoring—to enhance mobility services [7]. While this concept extends beyond traffic management, it remains largely focused on technological intelligence rather than broader planning considerations.

In this study, the term smart mobility is deliberately adopted as the primary analytical framework. Smart mobility is defined as an integrated mobility planning approach that combines technological support with sustainability objectives, multimodal accessibility, user-centered design, and, critically, sensitivity to local contextual conditions [8]. This perspective reflects recent shifts in international scholarship that recognize mobility as a socio-technical system shaped by spatial constraints, institutional capacity, travel behavior, and governance structures [14]. Accordingly, references to other terms within this manuscript are limited to discussions of prior studies and are used strictly in accordance with the terminology employed by the original authors. All conceptual development in this article is grounded explicitly in the smart mobility paradigm as defined above.

3 Conceptual Framework: Context-Based Smart Mobility Planning for Developing Tourism Cities

This study adopts a context-based smart mobility planning framework to address the unique mobility challenges faced by developing tourism cities. The framework is constructed on the premise that smart mobility solutions cannot be universally applied across different urban contexts, particularly in tourism-oriented cities characterized by fluctuating demand, spatial constraints, and limited institutional capacity [5]. Instead, smart mobility must be understood as

an adaptive planning approach that aligns technological interventions with local conditions [14]. As illustrated in Figure 1, the conceptual framework is structured into four interrelated components: local context factors, context-based adaptation mechanisms, smart mobility components, and mobility outcomes. These components collectively form a sequential yet iterative planning logic, where local conditions serve as the primary input shaping smart mobility strategies and expected outcomes [16]

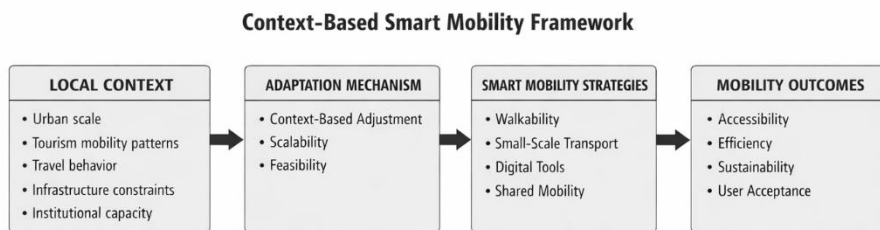


Fig 1. Conceptual framework of context-based smart mobility planning in developing tourism cities

3.1 Framework Rationale

Existing smart mobility frameworks predominantly originate from metropolitan contexts and prioritize advanced digital infrastructure, high-capacity public transport systems, and complex data integration platforms. As highlighted in Section 2, such approaches often prove unsuitable for small and developing tourism cities due to limited institutional capacity, constrained infrastructure, and distinct mobility patterns. The proposed framework responds to this gap by repositioning smart mobility as a context-responsive planning approach, where technological interventions are selected and scaled according to local geographical, socio-cultural, and institutional conditions rather than applied uniformly.

3.2 Core Dimensions of the Framework

As shown in Figure 1, the conceptual framework is structured around three interrelated dimensions: local context, smart mobility strategies, and desired mobility outcomes.

3.2.1 Local Context Dimension

The first dimension captures the local conditions that shape mobility planning decisions in tourism cities. This includes:

1. Spatial and geographical characteristics, such as coastal settings, limited road width, and topographical constraints.
2. Tourism-driven mobility patterns, including seasonal demand fluctuations and attraction-oriented travel.
3. Socio-cultural travel behavior, particularly walking preferences, motorbike dependency, and the presence of informal transport.
4. Institutional and governance capacity, reflecting coordination among agencies, regulatory enforcement, and planning capability.

These contextual factors serve as the foundation of the framework, ensuring that mobility strategies are grounded in local realities rather than imported models.

3.2.2 Smart Mobility Strategy Dimension

The second dimension represents a set of context-adaptive smart mobility strategies derived from the literature and adjusted for developing tourism cities. As summarized in Table 1, these strategies include:

1. Walkability and human-scale mobility, emphasizing pedestrian infrastructure in scenic and high-activity tourism areas.
2. Integrated small-scale public transport, such as shuttle services and feeder systems aligned with tourist attractions and residential areas.
3. Appropriate digital tools, including basic real-time information systems, signage, and simple mobile applications that match local digital readiness.
4. Shared and low-emission mobility options, prioritizing electric micro-mobility and shared services where feasible.
5. Stakeholder coordination mechanisms, integrating local government, transport operators, tourism actors, and community groups.

Importantly, technology is positioned as an enabler rather than a driver, reinforcing the context-based orientation of the framework.

3.2.3 Mobility Outcome Dimension

The third dimension defines the intended outcomes of context-based smart mobility planning in tourism cities. These outcomes include:

1. Improved accessibility for both residents and visitors.
2. Enhanced mobility efficiency during peak tourism periods.
3. Reduced environmental impact, particularly in sensitive coastal or heritage areas.
4. Increased user acceptance and system usability.
5. Strengthened institutional sustainability through manageable operational requirements.

These outcomes reflect both sustainability objectives and practical implementation considerations in developing city contexts.

3.3 Integrative Mechanism of the Framework

The framework operates through an iterative relationship between context, strategy, and outcomes. Local context informs the selection and scaling of smart mobility strategies, while observed mobility outcomes provide feedback for policy adjustment and refinement. This dynamic mechanism distinguishes the proposed framework from static, one-size-fits-all models. Figure 1 visually represents this integrative process, illustrating how local context directly shapes strategic choices and, ultimately, mobility performance in tourism cities.

3.4 Contribution of the Framework

The primary contribution of this conceptual framework lies in its explicit integration of tourism characteristics and local contextual constraints into smart mobility planning. While existing studies acknowledge the importance of context, few provide a structured framework that operationalizes this principle for developing tourism cities [5].

By shifting the focus from technological sophistication to contextual suitability, the framework offers:

1. A theoretical contribution to smart mobility scholarship by extending the concept beyond metropolitan settings [6].
2. A practical planning tool for policymakers in emerging tourism destinations.
3. A bridge between sustainability discourse and implementable mobility strategies [16].

This framework therefore provides a foundation for future empirical testing and policy-oriented applications in similar tourism-driven urban contexts. This study contributes to the ongoing discourse on smart mobility by demonstrating that mobility planning in developing tourism cities requires a fundamentally different analytical approach from that commonly applied in large metropolitan contexts [8]. The proposed context-based smart mobility framework responds to gaps in existing literature that often emphasize technological sophistication while underestimating local capacity, tourism dynamics, and institutional constraints [4].

4 Discussion

4.1 Positioning the Framework within Smart Mobility Scholarship

The proposed context-based smart mobility framework extends existing literature by shifting the analytical focus from technology-driven optimization toward contextual adaptability and institutional feasibility. While earlier studies emphasize digital infrastructure and big data integration as core components of smart mobility [7], the findings of this study suggest that such approaches may be inappropriate in developing tourism cities. Consistent with recent shifts in the field, this study supports the argument that smart mobility should be understood as a policy-oriented framework rather than a purely technological solution [8]. The proposed framework explicitly operationalizes context as a primary determinant, addressing a gap in models that fail to integrate it systematically [17].

4.2 Contribution to Tourism-Oriented Mobility Planning

Within tourism mobility research, transportation is frequently treated as a supporting system rather than a central planning concern [11]. This study demonstrates that mobility systems in tourism cities require distinct planning logics due to seasonal demand and diverse user groups. The framework reinforces findings that walkability and small-scale transport systems are particularly effective in tourism contexts [2]. Unlike conventional models, the proposed framework aligns mobility strategies with tourism-specific spatial patterns, enhancing both system efficiency and user experience.

4.3 Relevance for Developing Cities and Policy Implications

For developing cities, smart mobility initiatives often fail due to institutional constraints, limited financial resources, and technological [5]. The proposed framework addresses these challenges by prioritizing scalable solutions that align with local governance capacity. From a policy perspective, it provides a practical reference for local governments seeking to improve mobility

without relying on capital-intensive investments, emphasizing stakeholder coordination and appropriate digital tools [10].

4.4 Theoretical Contribution and Research Implications

The primary theoretical contribution lies in advancing a context-based interpretation for non-metropolitan settings. Drawing on socio-technical transition theory [14], the framework conceptualizes smart mobility as an evolving interaction between technology, governance, and user practices. Furthermore, this study highlights the importance of aligning mobility strategies with local socio-spatial conditions, offering a conceptual bridge between smart mobility theory and sustainability-oriented transport planning in developing regions.

4.5 Limitations and Directions for Future Research

Despite its contributions, this study has limitations. The framework is developed primarily through literature synthesis without empirical testing. Future research should validate the framework through case studies or pilot implementations. Additionally, while Labuan Bajo serves as a representative context, variations across different tourism typologies—such as island destinations or heritage cities—would enhance the generalizability of the proposed model.

5 Conclusion

This study has developed a context-based conceptual framework for smart mobility planning in developing tourism cities, responding to the limitations of technology-driven and large-city-oriented mobility models. By positioning local context as the primary foundation of smart mobility planning, the framework demonstrates that sustainable and effective mobility solutions depend not on technological sophistication alone, but on alignment with spatial constraints, institutional capacity, tourism dynamics, and technological readiness. The conceptual framework contributes to the smart mobility literature by offering a structured analytical approach that integrates local context factors, adaptation mechanisms, smart mobility components, and expected mobility outcomes. This approach advances existing scholarship by moving beyond descriptive discussions of context and providing an operational planning logic that explains how smart mobility strategies can be adapted to developing tourism cities. In doing so, the study addresses a critical gap in the literature, which has largely overlooked small and emerging tourism destinations in favor of metropolitan case studies. From a policy and planning perspective, the framework highlights the importance of prioritizing human-scale mobility, flexible public transport solutions, and modest digital support systems that can be realistically implemented and maintained by local governments. Rather than replicating complex smart city technologies, policymakers in developing tourism cities are encouraged to focus on scalable and context-appropriate interventions that enhance accessibility, manage tourism-related demand fluctuations, and balance the mobility needs of residents and visitors. Institutional coordination and stakeholder engagement are also emphasized as key enabling conditions for successful smart mobility implementation. While this study is conceptual in nature, it provides a robust foundation for future empirical research. Subsequent studies may apply and test the proposed framework across different tourism destinations to assess its adaptability and effectiveness under varying contextual conditions. By offering a transferable yet flexible planning framework,

this study contributes to ongoing debates on sustainable mobility and provides practical insights for policymakers seeking to implement smart mobility strategies in developing tourism cities.

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