This study demonstrates the effectiveness of using REBA for rapid ergonomic risk assessment in manual logistics tasks. REBA provides quick insights into physical workload and posture-related risks without requiring complex equipment. It is particularly suitable for labor-intensive logistics operations.

However, REBA has limitations, such as potential inaccuracies in posture angle estimation and inability to measure muscle exertion directly. Despite these, it remains a practical tool for improving occupational safety in logistics.

6. Discussion

The findings from the REBA assessment reveal that manual handling of gas cylinders poses a moderate ergonomic risk, particularly affecting the lower body regions such as the legs and trunk. This aligns with previous studies in logistics and warehouse environments, where repetitive lifting, awkward postures, and forceful exertions are common risk factors

The elevated scores in Group A (neck, trunk, legs) suggest that interventions should prioritize posture correction and mechanical assistance during lifting tasks. For example, introducing adjustable carts or lift-assist devices could significantly reduce strain on the lower body. Additionally, administrative controls such as job rotation and scheduled breaks may help mitigate cumulative musculoskeletal stress

It is also important to consider the limitations of REBA. While it provides a rapid and practical assessment, it may not capture dynamic muscle exertion or psychosocial factors influencing worker fatigue. Integrating REBA with other tools such as EMG or heart rate monitoring could offer a more comprehensive risk profile

Overall, the study supports the need for ergonomic interventions in manual logistics tasks and highlights REBA as a valuable tool for identifying high-risk postures in real-world settings.

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SMART TRANSPORTATION MANAGEMENT IN NIMMAN AREA: A STRATEGIC FRAMEWORK FOR URBAN MOBILITY ENHANCEMENT

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Abstract
Purpose: This study analyzes transportation challenges in Chiang Mai's Nimman-Hemin area to develop a strategic framework for intelligent transportation management that enhances safety and stimulates economic growth within Thailand's smart city development initiative.
Design/methodology/approach: A mixed-method research design was employed, combining quantitative surveys (n=401) across four stakeholder groups (residents, tourists, commuters, business operators) and qualitative focus groups with 20 policy makers and practitioners. Data collection utilized validated questionnaires with Likert scales and in-depth interviews to assess traffic problems, root causes, and development priorities.
Findings: Traffic congestion (3.35/4.0) and insufficient parking (3.25/4.0) emerged as primary problems. Root cause analysis identified vehicle volume exceeding road capacity (3.12/4.0) and inadequate parking facilities (2.98/4.0) as principal factors. Strong stakeholder support exists for technology-based solutions including traffic information platforms and intelligent traffic management systems.
Research limitations/implications: The study focuses on a single urban district, limiting generalizability. However, findings provide foundation for smart city template development applicable to other Thai commercial areas. Future longitudinal studies should track implementation outcomes.
Practical implications: Results inform phased implementation strategies including short-term infrastructure improvements, medium-term system integration, and long-term regional coordination. Policy recommendations address budget constraints, stakeholder coordination, and technological readiness gaps identified through stakeholder consultation.
Originality/value: This research provides the first comprehensive stakeholder analysis of transportation challenges in Thailand's designated smart city pilot area, contributing empirical evidence for national smart city policy development and offering replicable methodological approaches for similar urban contexts.
Keywords: Smart City, Transportation Management, Urban Mobility, Traffic Congestion, Smart Parking

1. Introduction

The rapid advancement of technology has fundamentally transformed urban development approaches worldwide. Thailand's National Strategy 2018-2037 emphasizes leveraging modern technology to create livable, safe urban environments with efficient transportation systems (National Economic and Social Development Office, 2018). Chiang Mai province, designated as a pilot area for smart city development, represents a critical case study for urban transformation (Provincial Office of Chiang Mai, 2019).

The Nimman-Hemin Road area has evolved from a residential subdivision into one of Chiang Mai's most significant cultural and economic hubs within just over a decade. Its strategic location connects major institutions including Chiang Mai University, Maharaj Nakorn Chiang Mai Hospital, and Maya Shopping Center, making it a primary transit route with approximately 13,000 vehicles passing through daily. However, this transformation has created persistent congestion that discourages local residents, particularly after COVID-19 reduced international tourism (Office for Promotion of Digital Economy, 2023).

This study aims to (1) analyze spatial data for developing intelligent transportation management strategies, and (2) elevate collaborative mechanisms among stakeholders for economic stimulation in the Nimman area. The research adopts smart city development concepts focusing on Smart Mobility and Living and Safety components.

2. Literature Review

Thailand's National Economic and Social Development Plan (2023-2027) identifies smart city development as a priority, with Chiang Mai as a pilot area (National Economic and Social Development Board, 2023). International best practices demonstrate successful implementations: Singapore's GPS-tracked public transport with real-time mobile applications, and New York City's MOVES program emphasizing area-wide real-time operations (Vilmate, 2023).

Research identifies traffic problems including speed-related issues, right-of-way violations, and dangerous maneuvering (Kitamura et al., 2018). Root causes include limited road space, insufficient traffic information, and inadequate public transportation (Bull & CEPAL, 2003). Intelligent Transportation Systems (ITS) provide solutions through data collection, transmission, analysis, and distribution to end-users via mobile applications (Vilmate, 2023). Key technologies include connected vehicles, smart traffic signals, and integrated payment systems enabling proactive network management (Faria et al., 2017).

3. Methodology

This study employed a mixed-method approach combining quantitative surveys and qualitative focus groups. The questionnaire comprised four sections: personal information, traffic problems (4-point Likert scale), root causes (15 factors), and development needs. Using Yamane's formula (1973) with 95% confidence, a sample of 400 respondents was determined across four stakeholder groups.

Data collection occurred through field surveys and online distribution. Content validity was established through expert review (IOC > 0.5), and reliability testing yielded Cronbach's alpha of 0.94. A focus group session with 20 participants representing government agencies, academics, and service providers addressed development goals, obstacles, and policy recommendations.

4. Results

4.1 Sample Characteristics

The study collected 401 responses: tourists (29.7%), commuters (39.7%), business operators (13.7%), and residents (15.2%), with good gender balance (52% male) and primary age concentration of 21-40 years (67.3%).

4.2 Traffic Problems and Root Causes

Traffic congestion emerged as the most critical issue (3.35/4.0), followed by insufficient parking (3.25/4.0), accidents (2.37/4.0), and pollution (2.01/4.0) (Figure 1). Business operators prioritized parking over congestion, while residents showed greater concern for accidents.

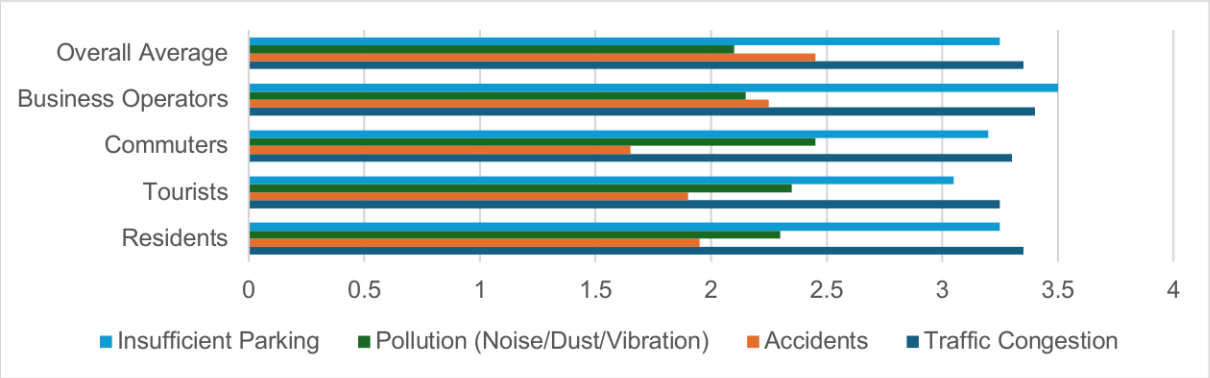

Figure 1: Traffic Problem Severity Rankings

Root cause analysis identified vehicle volume exceeding road capacity (3.12/4.0) as primary, followed by insufficient parking facilities (2.98/4.0), traffic rule violations (2.77/4.0), absent public transportation (2.74/4.0), and ineffective law enforcement (2.74/4.0) (Figure 2).

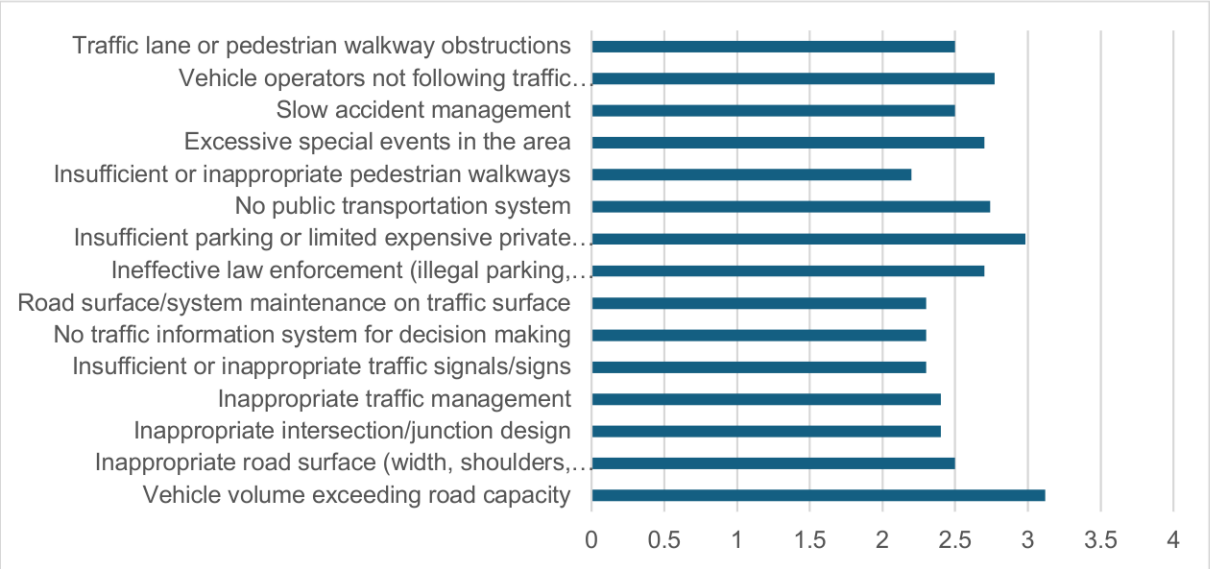

Figure 2: Root Cause Analysis of Traffic Problems

Private automobiles and motorcycles were identified as primary contributors, while commercial vehicles, bicycles, and pedestrians were minor contributors (Figure 3).

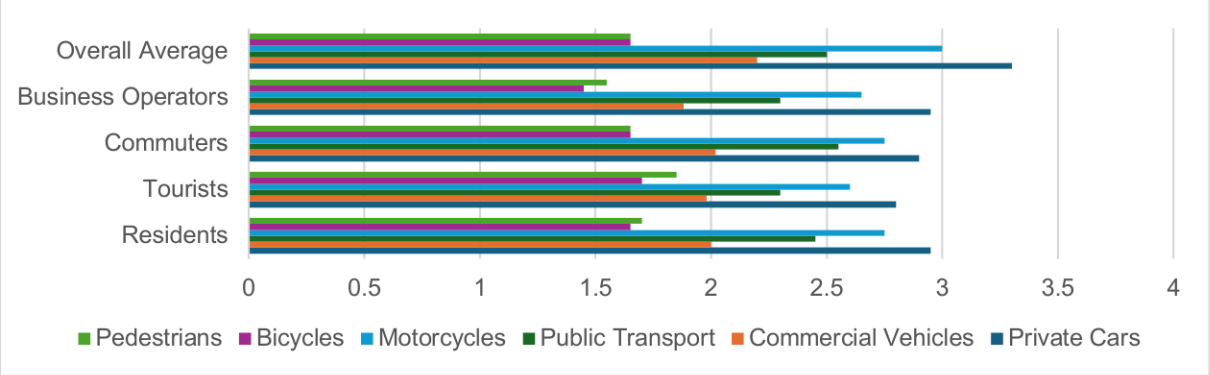

Figure 3: Vehicle Type Contribution to Traffic Problems

4.3 Development Priorities and Focus Group Insights

Strong support existed for technology-based solutions, particularly traffic information platforms, traffic routing management, and intelligent traffic management systems (Figure 4).

Figure 4: Support Levels for Development Initiatives

Focus group participants prioritized residents over other stakeholders and identified key development goals including intelligent traffic management systems, data-driven decision making, and sustainable transportation. They confirmed survey findings regarding root causes and proposed solutions including smart city infrastructure, traffic management systems, and data platforms.

Traffic flow analysis revealed congestion patterns on both Nimman-Hemin and Sirimangkalajarn Roads (Figures 5-6).

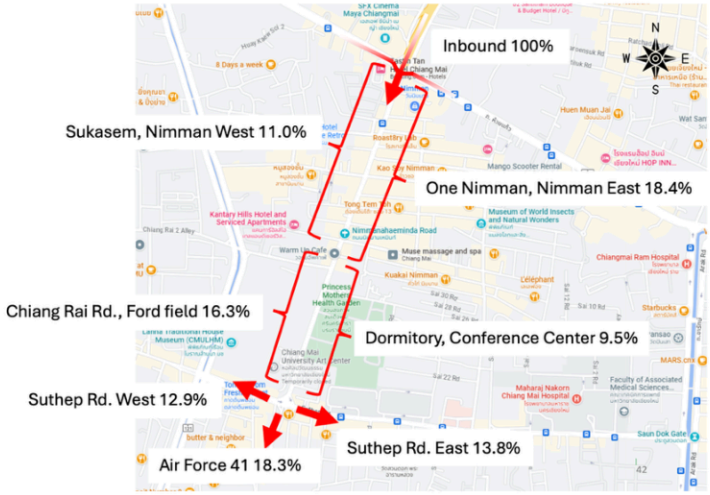

Figure 5: Current Traffic Flow Analysis - Nimman Road

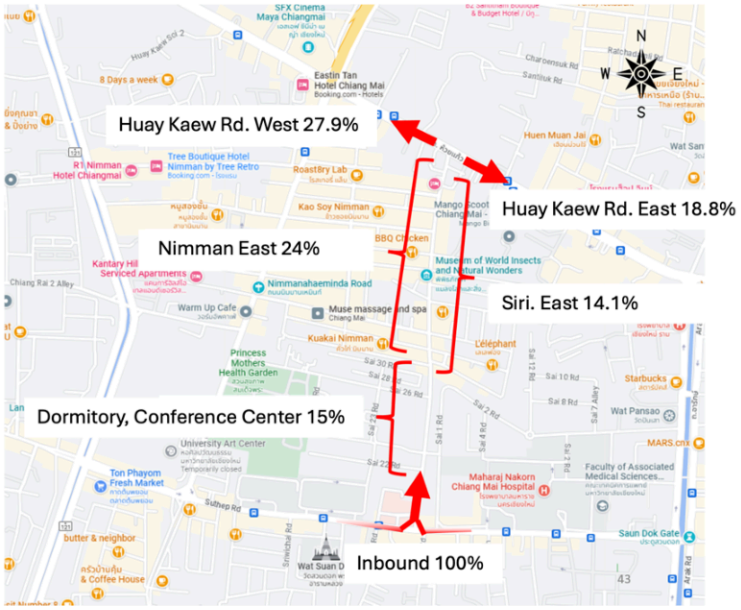

Figure 6: Current Traffic Flow Analysis - Sirimangkalajarn Road

5. Discussion

The research reveals traffic congestion and parking insufficiency as critical issues requiring immediate attention. Vehicle volume exceeding road capacity as the primary root cause aligns with international research, suggesting solutions must address both infrastructure and behavioral factors. Stakeholder-specific perspectives highlight the need for tailored approaches balancing multiple needs.

Strong support for technology-based solutions indicates readiness for smart city implementation, though identified challenges including budget constraints and technological gaps require phased implementation with comprehensive capacity building (Papa & Lauwers, 2015). The connection between transportation problems and economic vitality demonstrates how traffic challenges can undermine sustainability, while proposed solutions could create positive feedback loops attracting more visitors and generating improvement funding (IMD, 2023).

6. Recommendations

A phased implementation approach addresses immediate needs while building toward comprehensive smart city integration (Figure 7).

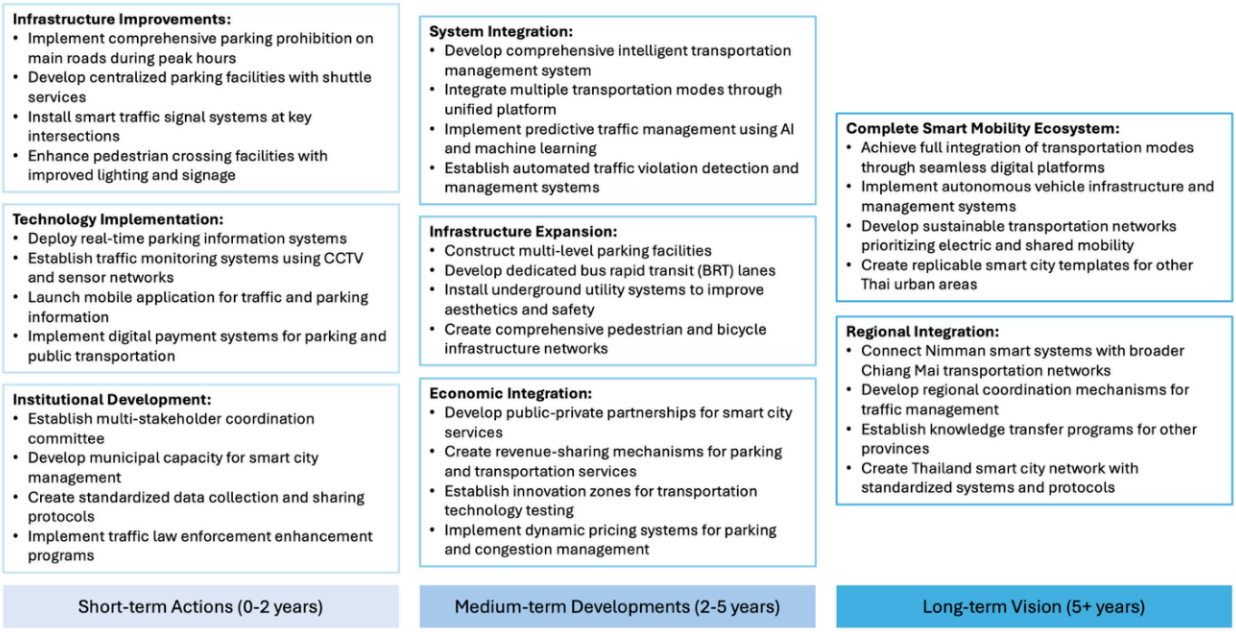

Figure 7: Phased Implementation Strategy for Nimman Smart City Development

Short-term actions include parking prohibition during peak hours, centralized parking with shuttle services, smart traffic signals, real-time parking information systems, and multi-stakeholder coordination committees. Medium-term developments involve comprehensive intelligent transportation systems, multi-level parking facilities, BRT lanes, AI-powered predictive management, and public-private partnerships. Long-term vision encompasses full transportation mode integration, autonomous vehicle infrastructure, sustainable networks prioritizing electric mobility, and regional coordination mechanisms.

7. Conclusion

This research provides comprehensive evidence for intelligent transportation management in Chiang Mai's Nimman area. Traffic congestion and insufficient parking, driven by excessive vehicle volume and inadequate infrastructure, require coordinated responses combining technological innovation, infrastructure development, and stakeholder engagement.

Strong stakeholder support for technology-based solutions creates favorable conditions for smart city implementation, though success depends on addressing budget constraints, technological gaps, and coordination difficulties. The phased approach provides a realistic transformation pathway emphasizing stakeholder engagement and capacity building.

The Nimman area's potential as a smart city template extends beyond local benefits to national urban development goals. Success could demonstrate scalable approaches for other Thai cities, supporting the country's broader smart city agenda. Future research should focus on implementation planning, cost-benefit analysis, and performance monitoring systems to refine approaches and document lessons for broader application.

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