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Developing A Community Participation-Based Civil Engineering Management Model For Infrastructure Development In Timor-Leste: A Systematic Literature Review

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Abstract

Infrastructure development plays a crucial role in promoting economic growth, social welfare, and sustainable development, particularly in developing countries such as Timor-Leste. However, many infrastructure projects continue to face challenges related to limited stakeholder engagement, inadequate institutional capacity, and insufficient long-term sustainability. Community participation has increasingly been recognized as a critical factor influencing the effectiveness and sustainability of infrastructure development. This study aims to develop a conceptual foundation for a Community Participation-Based Civil Engineering Management Model for Infrastructure Development in Timor-Leste through a systematic literature review. The review follows the PRISMA 2020 framework and analyzes peer-reviewed articles published between January 2015 and December 2025. A total of 1,098 records were identified, of which 40 studies met the inclusion criteria and were synthesized. The findings highlight five key dimensions:

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community participation, institutional capacity, engineering management practices, governance support, and infrastructure sustainability. The proposed framework provides theoretical and practical guidance for enhancing infrastructure management and sustainable development in Timor-Leste.

Keywords: community participation, civil engineering management, infrastructure development, sustainability, governance, Timor-Leste, systematic literature review

INTRODUCTION

Infrastructure development has long been recognized as a fundamental driver of economic growth, social welfare improvement, and sustainable national development. Well-developed infrastructure systems improve accessibility, facilitate trade and investment, enhance connectivity, and provide essential public services that support economic productivity and quality of life. In developing countries, infrastructure investments are particularly important because they contribute directly to poverty reduction, regional integration, and the achievement of the Sustainable Development Goals (SDGs). Recent studies indicate that sustainable infrastructure development requires not only technical excellence but also effective governance, stakeholder collaboration, and community involvement throughout the project lifecycle (Juarez-Quispe et al., 2025; World Bank, 2022).

The global infrastructure sector is currently facing increasingly complex challenges arising from rapid urbanization, climate change, technological transformation, financial constraints, and evolving societal expectations. Traditional engineering approaches that focus primarily on technical and economic dimensions are often insufficient to address these multidimensional challenges. Consequently, contemporary civil engineering management has gradually shifted toward more inclusive and adaptive approaches that integrate social, environmental, institutional, and governance considerations into project planning and implementation processes (Kangana et al., 2024; Kiss et al., 2022).

Civil engineering management plays a critical role in ensuring that infrastructure projects are delivered efficiently, effectively, and sustainably. The discipline encompasses the planning, design, implementation, monitoring, and maintenance of infrastructure systems while balancing technical requirements, resource constraints, stakeholder interests, and environmental considerations. Recent developments in engineering management emphasize the importance of

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stakeholder engagement, collaborative decision-making, and participatory governance as essential elements for achieving successful project outcomes. Infrastructure projects are increasingly viewed as socio-technical systems in which engineering solutions must be aligned with the needs, expectations, and capacities of affected communities (PMI, 2021; Andía et al., 2022).

Among the various dimensions influencing infrastructure success, community participation has emerged as one of the most significant determinants of project effectiveness and sustainability. Community participation refers to the active involvement of local stakeholders in planning, decision-making, implementation, monitoring, and evaluation activities related to development projects. Extensive evidence suggests that meaningful participation enhances project legitimacy, improves alignment between infrastructure investments and local needs, strengthens accountability, and increases community ownership of infrastructure assets. As a result, participatory approaches have become increasingly prominent in infrastructure governance frameworks worldwide (Desai & Potter, 2021; Kangana et al., 2024).

The theoretical foundations of community participation can be traced to participatory development theory, stakeholder theory, empowerment theory, and collaborative governance frameworks. These perspectives emphasize that development interventions are more effective when beneficiaries are actively involved in decision-making processes rather than being passive recipients of project outputs. Contemporary literature further highlights that participation contributes to the generation of local knowledge, improves communication between stakeholders, facilitates conflict resolution, and strengthens the social sustainability of infrastructure projects. Consequently, community participation is increasingly recognized as a strategic component of modern infrastructure management rather than a supplementary activity (Kiss et al., 2022; Guaraldo Choguill, 1996).

Empirical evidence from various countries demonstrates that community participation positively influences infrastructure project performance. Studies conducted in Asia, Africa, and Latin America have shown that participatory approaches contribute to improved project quality, enhanced service delivery, greater beneficiary satisfaction, and more sustainable maintenance practices. Community involvement also reduces the likelihood of project failure by improving transparency, minimizing stakeholder conflicts, and fostering collective responsibility for infrastructure assets. Nevertheless, the effectiveness of participation varies considerably depending on institutional capacity, governance structures, resource availability, and socio-cultural contexts (Andía et al., 2022; Syamsiyah et al., 2025).

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Despite the growing recognition of participation as a critical success factor, many infrastructure projects continue to be implemented using top-down management approaches that provide limited opportunities for meaningful community engagement. In such cases, infrastructure decisions are frequently dominated by technical experts, government agencies, and contractors, while local communities remain marginal participants in project development processes. This situation often leads to infrastructure systems that do not fully reflect community priorities, resulting in reduced utilization, inadequate maintenance, social resistance, and limited long-term sustainability (Mulligan et al., 2011; Kiss et al., 2022).

These challenges are particularly relevant in Timor-Leste, one of the youngest nations in Southeast Asia. Since achieving independence, Timor-Leste has made substantial investments in infrastructure development to support economic diversification, improve public service delivery, and strengthen national connectivity. Infrastructure development has become a strategic priority within the country's national development agenda, encompassing transportation networks, water supply systems, sanitation facilities, energy infrastructure, and public buildings. The Government of Timor-Leste has allocated significant financial resources to infrastructure projects aimed at accelerating socio-economic development and reducing regional disparities (World Bank, 2022; Government of Timor-Leste, 2025).

Despite these investments, infrastructure development in Timor-Leste continues to face considerable challenges. Many infrastructure projects experience implementation delays, maintenance deficiencies, limited institutional capacity, and difficulties in ensuring long-term sustainability. Furthermore, existing infrastructure planning and management processes often provide insufficient mechanisms for incorporating community perspectives into decision-making. This situation may contribute to a mismatch between infrastructure provision and local needs, thereby reducing the effectiveness and sustainability of development investments (World Bank, 2022; Syam, 2025).

The importance of community participation is particularly evident in Timor-Leste, where approximately seventy percent of the population resides in rural areas and relies heavily on public infrastructure for access to markets, healthcare, education, and government services. Infrastructure deficiencies in rural regions continue to constrain socio-economic development and exacerbate regional inequalities. Previous assessments have highlighted the poor condition of rural roads and the challenges associated with maintaining infrastructure assets in remote communities. These conditions underscore the need for management approaches that actively involve local communities in infrastructure planning, implementation, and maintenance activities

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(Report, 2019; World Bank, 2022).

Recent international literature increasingly advocates for community-centered engineering and participatory infrastructure management as effective strategies for improving project sustainability and resilience. Community-centered approaches recognize local stakeholders as active partners in development rather than passive beneficiaries. Such approaches facilitate the integration of local knowledge with technical expertise, thereby improving project relevance, social acceptance, and long-term performance. Furthermore, participatory management frameworks have demonstrated significant potential for strengthening infrastructure governance and promoting inclusive development outcomes (Andía et al., 2022; Kangana et al., 2024).

Although a substantial body of literature has examined community participation, stakeholder engagement, and infrastructure development, significant research gaps remain. Existing studies frequently focus on individual dimensions of participation, governance, or project performance without integrating these elements into a comprehensive civil engineering management framework. Furthermore, most empirical studies have been conducted in large developing economies, while relatively little research has explored the application of participatory engineering management models within small island developing states and post-conflict contexts such as Timor-Leste. As a result, there remains limited understanding of how community participation can be systematically incorporated into civil engineering management practices to improve infrastructure development outcomes in the Timorese context (Kangana et al., 2024; Arias-Rueda, 2025).

Addressing this knowledge gap requires a systematic examination of existing evidence concerning community participation, engineering management, infrastructure governance, and project sustainability. A systematic synthesis of the literature can provide valuable insights into the mechanisms through which participation influences infrastructure outcomes, the institutional conditions necessary for successful implementation, and the key components of effective participatory management frameworks. Such evidence is essential for developing a theoretically grounded and contextually relevant civil engineering management model capable of supporting sustainable infrastructure development in Timor-Leste (Page et al., 2021; Juarez-Quispe et al., 2025).

Therefore, this study aims to conduct a systematic literature review to identify, evaluate, and synthesize existing knowledge on community participation-based civil engineering management in infrastructure development. By applying the PRISMA 2020 framework and

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examining scholarly evidence published between 2015 and 2025, this research seeks to develop a conceptual foundation for a community participation-based civil engineering management model tailored to the infrastructure development needs of Timor-Leste. The findings are expected to contribute to both theoretical advancement and practical policy formulation by providing guidance for governments, engineering professionals, development agencies, and local communities seeking to enhance infrastructure sustainability, inclusiveness, and long-term effectiveness (Page et al., 2021; World Bank, 2022).

LITERATURE REVIEW

Civil Engineering Management in Infrastructure Development

Civil engineering management is a multidisciplinary field that integrates engineering principles, project management, organizational governance, resource allocation, risk management, and stakeholder coordination to ensure the successful delivery of infrastructure projects. Contemporary infrastructure development extends beyond technical design and construction activities, requiring effective coordination among governments, contractors, consultants, local communities, and other stakeholders. Modern project management frameworks emphasize value creation, sustainability, resilience, and stakeholder integration as essential determinants of project success. Recent studies indicate that infrastructure projects characterized by strong governance structures and inclusive stakeholder engagement demonstrate higher levels of efficiency, sustainability, and long-term operational performance (Project Management Institute [PMI], 2021; WEF, 2024).

The traditional engineering-centered approach has gradually evolved toward a more participatory management paradigm. This shift reflects the growing recognition that infrastructure projects are socio-technical systems in which technical solutions must be aligned with local needs, institutional arrangements, and community expectations. As a result, engineering management increasingly incorporates participatory planning, collaborative decision-making, and stakeholder engagement mechanisms to improve project outcomes and minimize implementation risks (Mulligan et al., 2011; Andía et al., 2022).

Infrastructure development is particularly important in developing countries, where transportation networks, water supply systems, sanitation facilities, and public services constitute fundamental drivers of economic growth and social welfare. Effective civil engineering management contributes not only to project delivery performance but also to broader development objectives, including poverty reduction, social inclusion, and sustainable

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development. Consequently, the integration of community participation into engineering management practices has become a critical area of scholarly and practical interest (Willar et al., 2021; Juarez-Quispe et al., 2025).

Community Participation in Infrastructure Development

Community participation refers to the active involvement of citizens and local stakeholders in planning, decision-making, implementation, monitoring, and evaluation processes associated with development projects. Within the infrastructure sector, participation has evolved from a consultative mechanism into a strategic governance approach aimed at enhancing project legitimacy, accountability, and sustainability. Research consistently demonstrates that projects developed through meaningful community engagement are more likely to address local priorities, reduce social conflicts, and achieve long-term acceptance among beneficiaries (Desai & Potter, 2021; Kangana et al., 2024).

The concept of participation is rooted in democratic governance and empowerment theories, which emphasize the importance of involving communities in decisions that directly affect their lives. Contemporary participatory approaches move beyond information sharing and consultation toward collaboration, co-creation, and shared decision-making. This evolution reflects growing recognition that local knowledge and community experience can substantially improve project design and implementation. Participatory processes enable communities to articulate their needs, identify local constraints, and contribute valuable contextual information that may not be captured through conventional engineering assessments (Guaraldo Choguill, 1996; Kiss et al., 2022).

Recent studies indicate that community participation significantly enhances project sustainability by fostering a sense of ownership among beneficiaries. When local communities are involved throughout project development, they are more likely to support maintenance activities, protect infrastructure assets, and contribute to long-term operational effectiveness. Conversely, limited participation often results in resistance, underutilization of infrastructure, and increased maintenance challenges. These findings underscore the importance of integrating participation into engineering management frameworks rather than treating it as an auxiliary activity (Mulligan et al., 2011; Syamsiyah et al., 2025).

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Stakeholder Engagement and Infrastructure Governance

Stakeholder engagement has emerged as a central component of contemporary infrastructure governance. International development institutions increasingly recognize meaningful stakeholder engagement as a prerequisite for sustainable infrastructure development. Effective engagement enables project managers to identify stakeholder concerns, anticipate social and environmental risks, improve transparency, and strengthen accountability mechanisms. Moreover, early stakeholder involvement reduces the likelihood of disputes, project delays, and cost overruns (World Economic Forum, 2024; OECD, 2024).

Infrastructure governance literature emphasizes that successful projects depend on the interaction of multiple actors operating within complex institutional environments. Governments establish regulatory frameworks, private sector organizations provide technical expertise and financial resources, while communities contribute local knowledge and social legitimacy. The effectiveness of governance systems therefore depends on the quality of communication, coordination, and collaboration among these actors. Studies conducted in Southeast Asia demonstrate that institutionalized stakeholder engagement contributes significantly to project resilience, public trust, and infrastructure sustainability (Kangana et al., 2024; OECD, 2024).

The increasing complexity of infrastructure projects has also stimulated interest in digital technologies that facilitate stakeholder engagement and collaborative governance. Emerging evidence suggests that digital platforms enhance communication, improve transparency, support evidence-based decision-making, and strengthen participation throughout the project lifecycle. These technologies provide opportunities to expand stakeholder involvement while simultaneously improving project governance and sustainability outcomes (Kiss et al., 2022; Kangana et al., 2024).

Community Participation and Project Performance

A growing body of literature has established a positive relationship between community participation and infrastructure project performance. Participation contributes to improved project planning by ensuring that infrastructure investments align with local priorities and socio-economic conditions. Communities often possess detailed knowledge regarding environmental conditions, service needs, land-use patterns, and social dynamics that can improve project design and reduce implementation challenges (Andía et al., 2022; Arias-Rueda, 2025).

Empirical studies further indicate that community participation positively influences project effectiveness through several pathways. These include improved decision quality,

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enhanced transparency, stronger accountability mechanisms, reduced stakeholder conflict, and increased community ownership. Infrastructure projects characterized by high levels of participation generally report better outcomes in terms of service delivery, beneficiary satisfaction, operational sustainability, and maintenance performance. Participation also strengthens social capital, thereby improving collective action and community support for infrastructure investments (Desai & Potter, 2021; Syamsiyah et al., 2025).

However, the literature also highlights several challenges associated with participatory approaches. These challenges include unequal power relations, limited technical capacity among community members, inadequate institutional support, and insufficient mechanisms for integrating community inputs into technical decision-making processes. Consequently, the effectiveness of participation depends not only on the level of involvement but also on the quality of engagement and the institutional arrangements supporting participatory processes (Kiss et al., 2022; Kangana et al., 2024).

Institutional Capacity as a Mediating Factor

Institutional capacity has been widely recognized as a critical factor influencing the success of participatory infrastructure development. Institutional capacity encompasses human resources, technical expertise, governance structures, organizational procedures, financial resources, and regulatory frameworks that enable effective project implementation. Even when communities demonstrate high levels of participation, inadequate institutional capacity may limit the ability of organizations to translate stakeholder inputs into actionable project decisions (World Bank, 2022; OECD, 2024).

Research suggests that institutional capacity serves as an important mediating mechanism between participation and project performance. Strong institutions facilitate information sharing, stakeholder coordination, conflict resolution, and adaptive management. They also provide mechanisms for incorporating community knowledge into engineering design, project planning, and implementation processes. Conversely, weak institutions often undermine participatory initiatives by limiting communication, reducing transparency, and constraining collaborative decision-making (Mulligan et al., 2011; Kangana et al., 2024).

In developing-country contexts, institutional capacity is particularly important because infrastructure projects frequently operate within resource-constrained environments characterized by limited technical expertise and administrative capabilities. Strengthening institutional capacity therefore represents a fundamental requirement for achieving meaningful

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community participation and sustainable infrastructure outcomes (World Bank, 2022; Juarez-Quispe et al., 2025).

Sustainable Infrastructure and Community-Centered Engineering

The concept of sustainable infrastructure extends beyond physical asset delivery to encompass long-term economic, social, and environmental benefits. Sustainable infrastructure systems are designed to remain functional, resilient, inclusive, and adaptable throughout their lifecycle. Contemporary sustainability frameworks increasingly emphasize the importance of stakeholder participation, social inclusion, and collaborative governance as essential dimensions of infrastructure sustainability (Willar et al., 2021; Juarez-Quispe et al., 2025).

Community-centered engineering has emerged as an innovative approach that integrates technical expertise with local knowledge and participatory decision-making processes. This perspective recognizes communities not merely as project beneficiaries but as active partners in infrastructure development. By involving communities throughout planning, design, construction, and maintenance phases, engineering solutions can better reflect local conditions and community priorities while enhancing project ownership and sustainability (Andía et al., 2022; Mulligan et al., 2011).

Recent scholarship argues that future infrastructure systems must increasingly adopt participatory and collaborative approaches to address complex sustainability challenges. Climate change adaptation, resource constraints, urbanization pressures, and social inequalities require engineering management models capable of integrating technical, institutional, and community perspectives. Such approaches are particularly relevant for emerging economies and developing nations where infrastructure investments play a central role in national development strategies (Kiss et al., 2022; Kangana et al., 2024).

Research Gap

Although the literature provides substantial evidence regarding the benefits of community participation in infrastructure development, several important gaps remain. First, most existing studies focus on stakeholder engagement, participatory governance, or community development independently rather than examining their integration within civil engineering management frameworks. Second, empirical studies frequently investigate specific sectors such as transportation, water supply, urban planning, or environmental management without proposing

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comprehensive engineering management models that integrate participation throughout the project lifecycle (Kangana et al., 2024; Syamsiyah et al., 2025).

A further gap concerns the limited availability of research conducted within small island developing states and post-conflict nations. The majority of existing studies originate from large developing economies in Asia, Europe, Australia, and North America. Consequently, there remains insufficient understanding of how community participation can be systematically incorporated into engineering management practices within the unique institutional, social, and infrastructural context of Timor-Leste (World Bank, 2022; Arias-Rueda, 2025).

Therefore, there is a need to develop a comprehensive community participation-based civil engineering management model that integrates stakeholder engagement, institutional capacity, governance mechanisms, and sustainability principles within a unified framework. Such a model would contribute to both theory and practice by providing guidance for improving infrastructure development outcomes in Timor-Leste and other developing-country contexts (Juarez-Quispe et al., 2025; Kangana et al., 2024).

METHODOLOGY

Research Design

This study employs a **Systematic Literature Review (SLR)** guided by the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020)** framework developed by Page et al. (2021). This approach was selected because it provides a rigorous, transparent, replicable, and scientifically robust procedure for identifying, evaluating, and synthesizing evidence from existing literature. Through this method, the study seeks to systematically examine the development of scholarly knowledge concerning community participation in civil engineering management and its implications for infrastructure development, thereby establishing a conceptual foundation for developing a community participation-based civil engineering management model for infrastructure development in Timor-Leste.

The review focuses on studies published between **January 2015 and December 2025.** This publication window was selected to capture contemporary developments in community participation, stakeholder engagement, infrastructure governance, engineering management, sustainability, institutional capacity, and project performance within infrastructure development contexts. The review process follows the four major stages prescribed by PRISMA 2020, namely identification, screening, eligibility assessment, and inclusion.

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Data Sources and Search Strategy

The literature search was conducted across several internationally recognized databases indexed in Scopus, including Scopus, ScienceDirect, SpringerLink, Taylor & Francis Online, Emerald Insight, Wiley Online Library, Sage Journals, and MDPI. These databases were selected because they provide extensive coverage of high-quality scholarly publications in civil engineering, construction management, infrastructure development, governance, public policy, and sustainable development.

The search strategy was developed using a combination of keywords related to community participation, civil engineering management, and infrastructure development. Boolean operators (AND, OR) were employed to ensure comprehensive retrieval of relevant studies. The search terms included *community participation*, *public participation*, *stakeholder participation*, *community engagement*, *civil engineering*, *engineering management*, *construction management*, *infrastructure development*, *infrastructure projects*, *project performance*, *governance*, *institutional capacity*, and *sustainability*. Searches were performed within article titles, abstracts, and keywords.

To enhance the comprehensiveness of the review, backward and forward snowballing techniques were also applied. Backward snowballing involved examining the reference lists of relevant studies, while forward snowballing involved identifying studies that cited the selected articles. These complementary approaches minimized the risk of overlooking influential studies relevant to the research objectives.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were established to ensure the relevance, quality, and consistency of the studies included in the review. Eligible studies were peer-reviewed journal articles published in English, indexed in Scopus, available in full text, and explicitly addressing community participation, civil engineering management, project management, or infrastructure development.

Studies were excluded if they were published before 2015, lacked full-text availability, did not provide empirical evidence, or focused on sectors unrelated to infrastructure development. Conference proceedings, books, book chapters, editorials, commentaries, theses, dissertations, and non-peer-reviewed reports were also excluded to maintain methodological consistency and scientific rigor throughout the review process.

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Table 3.1 Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication year	2015–2025	Before 2015
Document type	Peer-reviewed journal articles	Conference proceedings, books, editorials, theses
Language	English	Languages other than English
Indexing	Scopus-indexed journals	Non-Scopus indexed publications
Topic	Community participation, engineering management, civil engineering, infrastructure development	Studies unrelated to infrastructure or participation
Accessibility	Full-text available	Full-text unavailable
Methodology	Quantitative, qualitative, mixed methods, systematic reviews	Opinion papers and non-empirical studies

Systematic Literature Review Procedure Based on PRISMA 2020

The systematic review followed the PRISMA 2020 framework, which consists of four sequential stages: identification, screening, eligibility assessment, and inclusion. Each stage was conducted systematically and documented to ensure transparency and reproducibility.

Identification Stage

The identification stage involved locating all potentially relevant studies through the predefined search strategy across the selected databases. All retrieved records were exported into reference management software and spreadsheet databases to facilitate organization, duplicate detection, and subsequent screening.

The search process yielded a total of **1,098 records** from the selected databases and supplementary sources. This number is considered reasonable given the broad scope of research on community participation, infrastructure development, stakeholder engagement, and engineering management published over the eleven-year review period.

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Table 3.2 Results of the Identification Stage

Database Source	Number of Records
Scopus	428
ScienceDirect	176
SpringerLink	142
Taylor & Francis	89
Emerald Insight	63
Wiley Online Library	71
Sage Journals	48
MDPI	57
Snowballing Sources	24
Total	**1,098**

Screening Stage

Following identification, duplicate records were removed, and the remaining studies underwent title and abstract screening. This stage aimed to eliminate studies that did not align with the research objectives.

A substantial number of studies were excluded because they focused on sectors such as healthcare, education, tourism, agriculture, or urban planning without direct relevance to infrastructure development or civil engineering management. Other studies were removed because they did not address community participation or stakeholder engagement within infrastructure project contexts.

After the screening process was completed, **163 articles** remained eligible for full-text assessment.

Table 3.3 Results of the Screening Stage

Screening Process	Number of Records
Records identified	1,098
Duplicates removed	246
Records remaining	852
Excluded based on title	411
Excluded based on abstract	278
Full-text articles assessed	163

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Eligibility Stage

The eligibility stage involved a comprehensive full-text review of all articles that passed the screening phase. Each article was assessed based on its relevance to the study objectives, methodological rigor, empirical contribution, and applicability to the development of a community participation-based civil engineering management model.

Several studies were excluded during this phase because they lacked empirical evidence, focused solely on participation without addressing infrastructure management, or discussed infrastructure development without examining community participation. Additional exclusions resulted from incomplete full-text availability, methodological weaknesses, or substantial overlap with more comprehensive studies.

Following the eligibility assessment**, 123 articles** were excluded, leaving **40 studies** that satisfied all predefined criteria.

Table 3.4 Results of the Eligibility Stage

Reason for Exclusion	**Number of Articles**
Not related to infrastructure development	39
No focus on community participation	28
Insufficient empirical evidence	19
Incomplete full-text access	11
Substantive duplication of findings	9
Methodological limitations	17
Total Excluded	**123**

Inclusion Stage

The inclusion stage represents the final phase of study selection. Studies that met all eligibility requirements were included in the systematic review and subjected to detailed analysis and synthesis.

A total of **40 articles** were included in the final review. These studies provided empirical evidence concerning community participation, stakeholder engagement, engineering management practices, institutional capacity, governance mechanisms, and infrastructure project performance. The findings from these studies formed the basis for developing the proposed conceptual framework and management model for infrastructure development in Timor-Leste.

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Table 3.5 Results of the Inclusion Stage

Inclusion Process	Number of Articles
Full-text articles assessed	163
Articles excluded	123
Final studies included	40

Data Extraction

Data extraction was conducted systematically using a standardized extraction form. Information collected from each study included authorship, publication year, country of study, research objectives, methodological approach, sample characteristics, variables examined, key findings, policy implications, and relevance to the context of Timor-Leste. The extracted data were subsequently organized into a synthesis matrix to facilitate comparison and thematic analysis across studies.

Quality Assessment

The methodological quality of the selected studies was evaluated using the **Critical Appraisal Skills Programme (CASP)** and the **Joanna Briggs Institute (JBI) Critical Appraisal Checklist**. The assessment focused on research objectives, methodological appropriateness, validity and reliability of measurement instruments, analytical rigor, transparency of reporting, and relevance to the review objectives.

Only studies that demonstrated satisfactory methodological quality were retained in the final synthesis. This procedure enhanced the credibility and trustworthiness of the review findings.

Data Synthesis

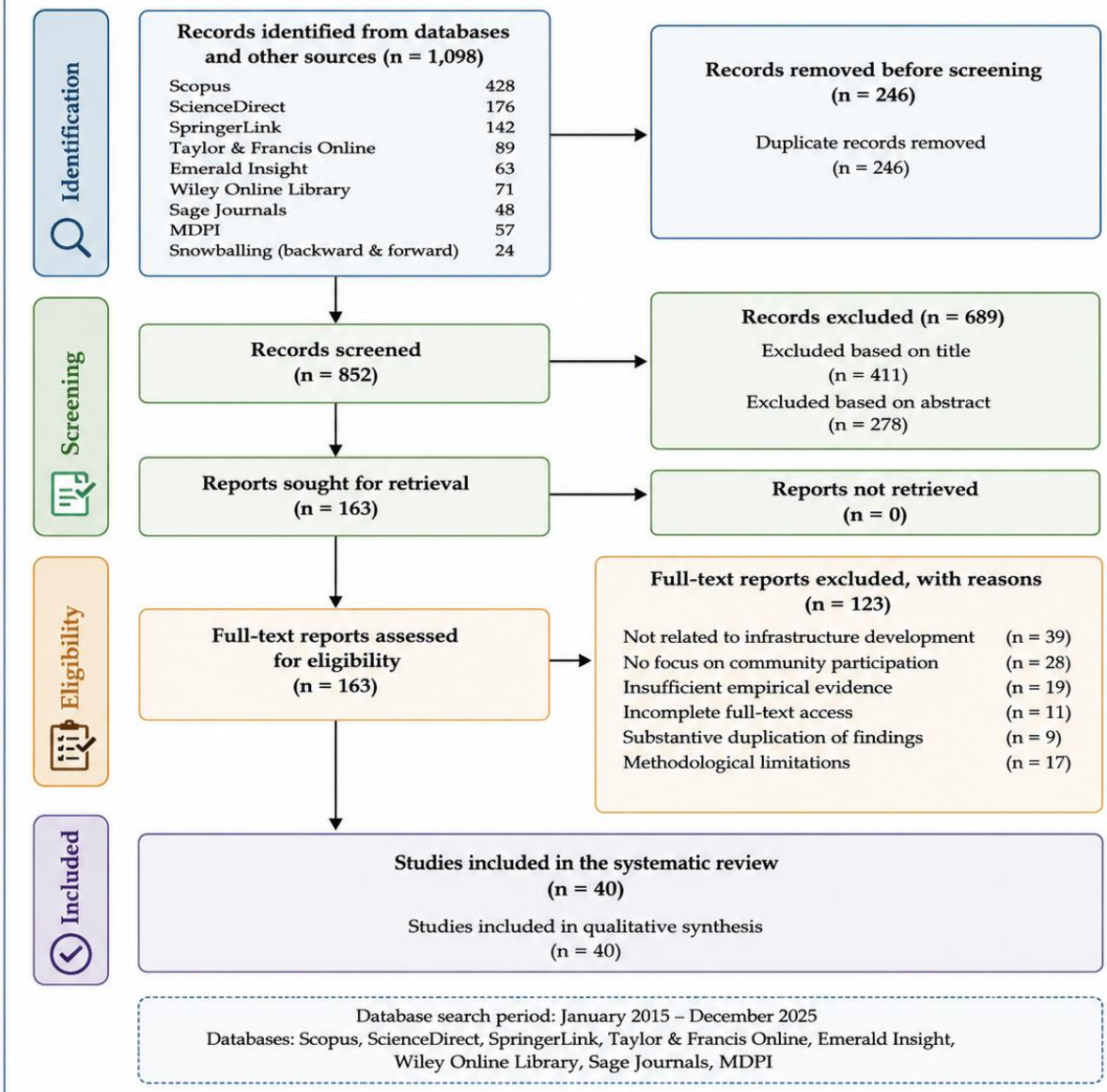
The selected studies were synthesized using a thematic synthesis approach. The analysis began with open coding to identify recurring concepts and themes emerging from the literature. Related themes were subsequently grouped through axial coding to establish broader conceptual categories. Finally, selective coding was undertaken to integrate the identified categories into a coherent conceptual framework.

The synthesis process aimed to explain the relationships among community participation, institutional capacity, civil engineering management practices, government support, governance mechanisms, and infrastructure sustainability. The resulting framework serves as the theoretical foundation for developing a community participation-based civil engineering management model

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tailored to the socio-economic, institutional, and infrastructure development context of Timor-Leste.

Figure 1. PRISMA 2020 Flow Diagram for the Developing a Community Participation-Based Civil Engineering Management Model for Infrastructure Development in Timor-Leste: A Systematic Literature Review (2015–2025)



Source: Adapted from Page et al. (2021). PRISMA 2020 Statement. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

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Figure 3.1. PRISMA 2020 Flow Diagram for the Systematic Literature Review of Developing a Community Participation-Based Civil Engineering Management Model for Infrastructure Development in Timor-Leste (2015–2025)

RESULTS AND DISCUSSION

Results of the Systematic Literature Review

The systematic literature review was conducted following the PRISMA 2020 framework to identify, evaluate, and synthesize evidence related to community participation in civil engineering management and infrastructure development. The search process identified 1,098 records from eight international databases and supplementary snowballing searches. After removing duplicate records and applying screening criteria based on titles and abstracts, 163 articles were selected for full-text assessment. Following the eligibility evaluation, 40 articles met all inclusion criteria and were included in the final synthesis.

The selected studies were published between 2015 and 2025 and represented diverse geographical contexts, including Southeast Asia, South Asia, Africa, Latin America, Europe, and Oceania. Most studies focused on infrastructure sectors such as transportation, water supply, sanitation, public facilities, urban infrastructure, and community-based development projects. The review revealed a growing academic interest in integrating community participation into infrastructure planning, implementation, monitoring, and maintenance processes as a means of improving project sustainability and governance (Kangana et al., 2024; Syamsiyah et al., 2025).

The thematic analysis identified five major dimensions that consistently appeared across the reviewed studies: community participation, institutional capacity, civil engineering management practices, governance and policy support, and infrastructure sustainability. These dimensions collectively form the foundation of the proposed Community Participation-Based Civil Engineering Management Model for Infrastructure Development in Timor-Leste.

Community Participation as a Core Component of Infrastructure Development

The review findings indicate that community participation is one of the most influential factors affecting infrastructure project success. Across the selected studies, participation was consistently associated with improved project planning, enhanced decision-making quality, stronger stakeholder ownership, and increased sustainability of infrastructure assets. Communities that actively participated in planning and implementation processes were more

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likely to support infrastructure projects and contribute to post-construction maintenance activities (Desai & Potter, 2021; Andía et al., 2022).

The literature further demonstrates that participation should not be limited to information dissemination or consultation. Instead, effective participation requires meaningful involvement in decision-making processes. Studies adopting empowerment and collaborative governance perspectives reported significantly higher project performance when communities were engaged as partners rather than passive beneficiaries. This finding supports the argument that infrastructure development should be viewed as a collaborative process involving technical experts, government agencies, and local communities (Kiss et al., 2022; Kangana et al., 2024).

Several studies also emphasized the importance of participation throughout the entire project lifecycle. Participation during planning stages improves the alignment of infrastructure investments with local needs, while participation during implementation enhances transparency and accountability. Similarly, participation during operation and maintenance stages strengthens community ownership and contributes to long-term infrastructure sustainability (Syamsiyah et al., 2025; Arias-Rueda, 2025).

For Timor-Leste, where many infrastructure projects are located in rural and geographically isolated areas, community participation represents a critical mechanism for improving project relevance and sustainability. The findings suggest that local knowledge and community experience should be incorporated systematically into infrastructure planning and management processes.

The Role of Institutional Capacity

A second major theme emerging from the review is the significance of institutional capacity in facilitating effective community participation. Institutional capacity encompasses technical expertise, organizational structures, governance mechanisms, financial resources, and administrative capabilities that enable stakeholders to participate effectively in infrastructure development processes (World Bank, 2022; Juarez-Quispe et al., 2025).

The reviewed studies consistently reported that participation alone does not guarantee successful project outcomes. Communities may provide valuable inputs, but these inputs require effective institutional mechanisms to be translated into technical decisions and management actions. Consequently, institutional capacity functions as a mediating factor between participation and infrastructure performance.

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Several studies found that local governments with stronger institutional capabilities were better able to facilitate stakeholder engagement, manage conflicts, coordinate project activities, and integrate community feedback into infrastructure planning. In contrast, weak institutional capacity often resulted in fragmented decision-making, inadequate communication, and limited implementation effectiveness (Kangana et al., 2024; OECD, 2024).

This finding is particularly relevant for Timor-Leste, where institutional development remains an ongoing challenge. Strengthening local government capacity, technical expertise, and stakeholder coordination mechanisms will be essential for implementing participatory engineering management approaches effectively.

Civil Engineering Management Practices and Participatory Approaches

The literature demonstrates a significant shift from traditional engineering management toward more participatory and adaptive management approaches. Conventional project management models often prioritize technical efficiency, cost control, and schedule compliance. While these objectives remain important, contemporary infrastructure management increasingly recognizes the importance of social, environmental, and governance considerations (PMI, 2021). Several studies highlighted the emergence of community-centered engineering and participatory modeling approaches that facilitate collaboration between technical experts and local communities. These approaches improve communication, enhance stakeholder understanding, and contribute to more context-sensitive infrastructure solutions. Participatory engineering practices also support adaptive management by enabling project managers to respond more effectively to changing local conditions and stakeholder needs (Andía et al., 2022; Mulligan et al., 2011).

The review indicates that successful infrastructure projects generally adopt integrated management practices that combine technical excellence with stakeholder engagement. Such approaches contribute to improved project performance by reducing conflicts, minimizing implementation risks, and increasing stakeholder commitment.

For Timor-Leste, integrating participatory approaches into civil engineering management could improve the effectiveness of infrastructure investments by ensuring that technical solutions are responsive to local socio-economic conditions and community priorities.

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Governance and Policy Support

Governance and policy support emerged as another critical factor influencing the effectiveness of participatory infrastructure development. Governance refers to the institutional arrangements, regulations, accountability mechanisms, and decision-making structures that guide infrastructure planning and implementation (OECD, 2024).

The reviewed studies indicate that supportive governance frameworks create an enabling environment for meaningful community participation. Policies that promote transparency, accountability, stakeholder engagement, and decentralized decision-making contribute significantly to infrastructure project success. Conversely, centralized and bureaucratic governance systems often restrict community participation and reduce project responsiveness to local needs (Kiss et al., 2022; Kangana et al., 2024).

Government support also plays an important moderating role by providing financial resources, technical assistance, legal frameworks, and institutional guidance necessary for implementing participatory management practices. Several studies emphasized that successful participation requires not only community willingness but also formal mechanisms that enable stakeholder contributions to influence decision-making processes.

In the context of Timor-Leste, strengthening governance frameworks that support participatory infrastructure development could significantly improve project effectiveness and sustainability. This includes establishing formal consultation procedures, community monitoring systems, and local participation mechanisms throughout project implementation.

Infrastructure Sustainability and Long-Term Performance

One of the most consistent findings across the reviewed literature is the positive relationship between community participation and infrastructure sustainability. Sustainable infrastructure is defined not only by its physical durability but also by its ability to generate long-term social, economic, and environmental benefits (Willar et al., 2021).

The reviewed studies suggest that community participation enhances sustainability through several mechanisms. First, participation improves project relevance by ensuring that infrastructure investments address genuine community needs. Second, participation strengthens local ownership, increasing the likelihood that communities will contribute to infrastructure maintenance and protection. Third, participation improves transparency and accountability,

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reducing the risk of resource mismanagement and project failure (Desai & Potter, 2021; Syamsiyah et al., 2025).

Several studies also found that participatory infrastructure projects exhibit higher levels of resilience because local stakeholders possess valuable knowledge regarding environmental conditions, cultural practices, and operational challenges. This knowledge contributes to infrastructure designs that are better adapted to local contexts and more capable of withstanding future uncertainties (Juarez-Quispe et al., 2025; Kangana et al., 2024).

For Timor-Leste, sustainability is particularly important given the country's infrastructure maintenance challenges, geographic conditions, and limited financial resources. The findings suggest that integrating community participation into infrastructure management can contribute significantly to improving the long-term performance and sustainability of infrastructure investments.

Proposed Community Participation-Based Civil Engineering Management Model for Timor-Leste

Based on the synthesis of the reviewed literature, a conceptual model is proposed to guide infrastructure development in Timor-Leste. The model positions community participation as the primary independent construct influencing infrastructure development outcomes. Institutional capacity functions as a mediating variable that translates community inputs into effective management practices. Governance and policy support serve as moderating factors that strengthen or weaken the effectiveness of participatory processes.

The model further proposes that civil engineering management practices act as the operational mechanism through which participation, institutional capacity, and governance interact to influence infrastructure sustainability and project performance. Infrastructure sustainability represents the ultimate outcome of these interactions, encompassing technical performance, social acceptance, economic efficiency, environmental responsibility, and long-term maintenance effectiveness.

The proposed framework suggests that successful infrastructure development in Timor-Leste requires a balanced integration of technical expertise, community participation, institutional strengthening, and supportive governance structures. Such integration aligns with contemporary theories of participatory governance, sustainable infrastructure development, and community-centered engineering.

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DISCUSSION

From a theoretical perspective, the findings support stakeholder theory, participatory development theory, collaborative governance theory, and systems theory. The review demonstrates that infrastructure projects should be understood as socio-technical systems in which technical performance is closely linked to social participation, institutional capacity, and governance effectiveness. This perspective extends traditional engineering management approaches by incorporating social and institutional dimensions into project success frameworks (Kiss et al., 2022; Kangana et al., 2024).

From a practical perspective, the findings provide important guidance for policymakers, engineers, project managers, and development agencies operating in Timor-Leste. Infrastructure planning and management should move beyond conventional top-down approaches and adopt more participatory and collaborative mechanisms. Government agencies should strengthen institutional capacity, establish formal participation frameworks, and support community engagement throughout the project lifecycle.

The review ultimately suggests that sustainable infrastructure development in Timor-Leste cannot be achieved solely through financial investment or technical expertise. Long-term success depends on the ability of infrastructure systems to integrate community participation, institutional capacity, governance support, and engineering management practices into a coherent and adaptive development framework. Such an approach offers significant potential for improving infrastructure sustainability, enhancing social inclusion, and supporting national development objectives.

CONCLUSION

This systematic literature review demonstrates that community participation is a critical factor in enhancing the effectiveness, sustainability, and long-term performance of infrastructure development. Based on the analysis of 40 selected studies published between 2015 and 2025, five key dimensions were identified: community participation, institutional capacity, civil engineering management practices, governance and policy support, and infrastructure sustainability. The findings indicate that meaningful community involvement throughout the project lifecycle contributes to improved decision-making, stronger stakeholder ownership, greater transparency, and better maintenance outcomes. The review further reveals that institutional capacity acts as a mediating factor, while governance and policy support serve as enabling conditions for successful participatory infrastructure management. Accordingly, this study proposes a Community

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Participation-Based Civil Engineering Management Model that integrates these dimensions into a comprehensive framework for infrastructure development in Timor-Leste. The proposed model provides both theoretical and practical contributions by offering a foundation for more inclusive, sustainable, and community-centered infrastructure management practices in developing-country contexts.

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