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A Framework to Evaluate Regional Construction Hubs Establishment

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Abstract: The establishment of Construction Hubs is pivotal to catalyzing regional development, providing avenues for economic growth and job creation, and supporting expanding populations. Despite their significance, a comprehensive framework for systematically evaluating these hubs remains absent in scholarly and industry dialogues. This paper aims to bridge this gap by proposing a framework that integrates insights from a broad spectrum of sources, including academic literature and industry reports. This framework is enriched by a series of stakeholder's workshops, encompassing industry professionals, government officials, and academics. The framework outlines key factors- sustainability, infrastructure, resource management, and market dynamics - accompanied by specific sub-criteria tailored to the nuanced needs of regional areas development. The framework aids policymakers, industry stakeholders, and investors in making informed decisions that not only spur economic development but also enhance local employment prospects and address demographic changes. Accordingly, this contribution equips stakeholders in the construction sector with a strategic instrument to enhance the establishment and operational efficacy of Construction Hubs, fostering a more resilient and sustainable regional development paradigm.

Keywords: Construction Hubs, Regional Development, Evaluation Framework, Sustainability

1 INTRODUCTION

In the evolving landscape of the global construction industry, the concept of Construction Hubs has emerged as a pivotal element, influencing not just local economies but also shaping the dynamics of urban development, infrastructure advancement, and environmental sustainability (Tsui et al. 2024). The establishment of these hubs is a complex interplay of various factors, ranging from market demand (Kim, Cho & Kim 2021) to resource availability (Liu, Kasturiratne & Moizer 2012), each contributing to their success and efficacy. Recognizing the need for a systematic approach to evaluate these multifaceted aspects is paramount in establishment of Hubs with context-based location factors (Marovic & Hanak 2017).

The significance of Construction Hubs extends beyond mere sites of construction activity; they are catalysts for economic growth, innovation, and sustainable development (Ortiz, Castells & Sonnemann 2009). Their strategic establishment can lead to the creation of employment opportunities, stimulation of local economies, and advancement in construction technologies and practices (Erol, Dikmen & Birgonul 2016). However, the challenges in realizing such benefits are equally formidable, encompassing aspects like environmental sustainability (Brusselaers, Fufa & Mommens 2022), efficient resource utilization, and adaptation to local market dynamics and infrastructure realities (Erdogan, Šaparauskas & Turskis 2019).

Despite the important role of such Hubs in fostering innovation, collaboration, and sustainability within the sector, there is a significant lack of systematic understanding of the nature, operation, and

establishment of Hubs in the literature, industry, and government reports. Therefore, this research aimed to develop a systematic approach to identify factors to assess the multifaceted aspects influencing the establishment and success of Construction Hubs. This framework is the culmination of extensive collaborative efforts involving key stakeholders - industry partners, state government representatives, and academics from multiple disciplines. Through extensive literature and industry reports review followed by a series of workshops and discussions, a comprehensive set of criteria and evaluation factors was developed. The framework addresses crucial factors such as sustainability (encompassing social, environmental, and economic dimensions), infrastructure adequacy, resource management, and market dynamics. In offering this framework, the paper seeks to contribute to the broader discourse on sustainable urban development and construction practices. It aims to serve as a guiding tool for policymakers, investors, and industry practitioners, offering insights for establishing and managing Construction Hubs. The framework enables stakeholders make informed decisions that not only align with regional specifics but also resonate with global sustainability goals.

2 RESEARCH CONTEXT

The construction industry involves a diverse array of projects, ranging from infrastructure and large buildings to smaller-scale domestic renovations and land development, engaging a complex network of actors (Chan, S.-L. 2002; Liu and He 2016; Sharrard, Matthews, and Roth 2007; Adedeji, Opeyemi, and Rapheal 2020; Dubois and Gadde 2002; Gan et al. 2018). Despite its economic significance, the industry still faces challenges such as increasing costs, uncertainties, and delays (Dehdasht et al. 2022), prompting the need for closer industry-research collaboration and the adoption of innovative technologies to create high-value products (Arif et al. 2012; Barile et al. 2020; Chauhan et al. 2022; Koskela and Vrijhoef 2001; Minunno et al. 2018).

Construction Hubs have been identified in government discourses as vital connectors within the construction sector (AMGC 2020; AusGov 2020; Tsui, Furlan et al. 2023a). However, academic literature lacks a formal definition, complicating advocacy for their value within the entrepreneurial landscape of the construction industry, especially in the era of Industry 4.0. The absence of a clear definition underscores the importance of explicating what constitutes a Hub and its primary functions, emphasizing the potential benefits such as enhanced efficiency and effective management of change through collaborative resource and skill sharing.

The development of Construction Hubs is fraught with challenges, primarily due to the construction industry's complexity and the varied nature of projects. Key factors influencing hub development include technological advancement, workforce development, and collaborative networking among stakeholders. Developing a skilled workforce adept in modern construction methods and prefabrication processes is essential for maintaining quality and meeting production timelines. Furthermore, fostering collaboration among various industry players is vital for innovation and knowledge exchange (Camarinha-Matos, Luis M., Rocha, and Graça 2022; Camarinha-Matos and Afsarmanesh 2005; Huang, Biqing, and Xue 2012).

Addressing these challenges necessitates a multi-dimensional approach, integrating stakeholders across the supply chain, streamlining regulatory processes, enhancing resilience, and optimizing transportation efficiency. Emphasizing a low-carbon, circular building strategy further aligns with the industry's need for sustainable practices (Kouhirostami and Chini 2022; Oliveira, de Oliveira, and Fonseca 2021; Tsui, Duarte, et al. 2023; Neligan et al. 2023; Ruiz-Ocampo, Katusic, and Papakyriakou 2023). This examination of Construction Hubs, informed by academic and industry literature, aims to clarify the concept within the construction context, advocating for their role in promoting efficiency, innovation, and sustainability within the industry. Table 1 summarizes the key factors in establishing hubs as extracted from the review of the literature.

Table 1: Key factors for establishing Construction Hubs extracted from the literature

Reference	Key Factors for Establishing Construction Hubs
(Tsui et al., 2023)	Factors such as infrastructure, skilled labor, and government support
(Suleman, 2023)	Logistics, supply chain management, and technological innovations
(Ruiz-Ocampo et al., 2023)	Availability of resources, transportation networks, and policy incentives

(Rane et al., 2023)	Collaboration, knowledge sharing, and sustainable practices
(Neligan et al., 2023)	Talent attraction, research and development, and industry partnerships
(Barakat et al., 2023)	Regulatory environment, financial incentives, and workforce development
(Szafranko and Harasymiuk, 2022)	Urban planning, infrastructure development, and local economic conditions
(Rotimi et al., 2022)	Governance, financing, and capacity building
(Ramesh et al., 2022)	Innovation, sustainability, and cross-industry collaboration
(Papadonikolaki, 2022)	Digital technologies, data-driven decision making, and ecosystem integration
(Nunes, 2022)	Cluster formation, knowledge exchange, and international connectivity
(Lin et al., 2022)	Talent attraction, entrepreneurship, and industry-academia collaboration
(Kraatz et al., 2022)	Sustainability, resilience, and community engagement
(Kouhirostami and Chini, 2022)	Regulatory frameworks, supply chain optimization, and workforce development
(Gupta et al., 2022)	Technological innovations, sustainability, and industry-academia partnerships
(Chauhan et al., 2022)	Entrepreneurship, government support, and access to financing
(Camarinha-Matos et al., 2022)	Collaborative networks, digital transformation, and ecosystem development
(Boyacioglu et al., 2022)	Talent attraction, industry-academia collaboration, and international partnerships

3 EVALUATION METHODS EXAMPLES IN BUILT ENVIRONMENT RESEARCH

Understanding and evaluating Construction Hubs is crucial due to their potential to enhance efficiency, sustainability, and collaboration in the construction industry. Systematic evaluation is essential to maximise their benefits for sustainable practices. Evaluation methods in the built environment (BE) assess various aspects of construction projects, including sustainability, stakeholder management, and technological integration. These methods identify strengths, weaknesses, and areas for improvement, ensuring projects meet their objectives and contribute positively to their surroundings. Furthermore, these methods serve to measure the performance and impact of projects across economic, environmental, and social dimensions. This facilitates benchmarking, improves sustainable practices, and supports informed decision-making by considering factors like material selection and resource allocation.

While there are no established methods specifically tailored for assessing Construction Hubs, existing sustainability assessment frameworks offer valuable insights that can be adapted. Building Sustainability Assessment Tools (BSAT), for instance, focus on material selection, resource management, stakeholder management, and high-technology applications (Liang et al., 2021). However, their applicability to Construction Hubs is limited, as they do not fully address the unique complexities and integrated nature of these hubs. Life Cycle Assessment (LCA), a key component within BSAT, provides a comprehensive view of a project's environmental impact from inception to demolition (Ortiz et al., 2009). Yet, it often overlooks socio-economic impacts and long-term sustainability considerations, which are crucial for holistic evaluations. Integrating BSAT with advanced technologies like Building Information Modelling (BIM), Artificial Intelligence (AI), and Big Data can enhance evaluation accuracy and productivity (Liang et al., 2021). Nonetheless, such technological integrations require significant investment and expertise, which may not be readily available in all contexts.

Other studies have explored alternative approaches to sustainability assessments. For example, Brusselaers et al. (2022) developed a framework using External Cost Calculations (ECC) and LCA to measure construction logistics impacts. While this approach highlights the economic and environmental costs, it may neglect broader social implications and stakeholder engagement, which are critical considerations for Construction Hubs.

Within sustainability assessments, the social dimension, involving multifaceted social values and stakeholder influence, is crucial but often overlooked (Edum-Fotwe & Price, 2009). This oversight can lead to incomplete evaluations and undervaluation of critical social factors in hub development. The Social Network Analysis (SNA) method offers a robust framework for evaluating stakeholder performance and social sustainability. Almahmoud and Doloi (2016) developed an SNA-based assessment model to evaluate

construction projects' contributions to social sustainability, applied in real-life cases to identify and address underperformance (Press et al., 2015). However, while SNA provides valuable insights into stakeholder interactions, it may not capture the full range of factors affecting Construction Hub performance, such as technological and economic dimensions.

Decision-making in the construction industry is inherently complex, often supported by mathematical methods and models (Szafranko & Harasymiuk, 2022). Multi-Criterion Decision-Making (MCDM) models, like the one developed by Erdogan, Šaparauskas, and Turskis (2019), offer systematic approaches to addressing construction management problems. The Analytic Hierarchy Process (AHP) is a key MCDM approach for evaluating construction performance, including sustainability and stakeholder participation (Alam, 2013; Erdogan et al., 2019; Lee et al., 2020; Rane et al., 2023). These models provide structured decision-making frameworks, yet they can be limited by their reliance on predefined criteria and weighting systems, which may not be flexible enough to accommodate the dynamic nature of Construction Hubs.

These methods highlight the need for comprehensive, multi-dimensional evaluations integrating environmental, social, and economic factors. However, existing methods often overlook the interplay between dimensions and require significant adaptation to address Construction Hubs' specific challenges and opportunities adequately.

Various evaluation and decision-making methods are available in the built environment research, offering insights into best practices and areas for improvement. However, the concept of Construction Hubs is still not well understood, necessitating systematic methods tailored to evaluate their establishment comprehensively. While beneficial for assessing Construction Hubs from different dimensions, existing methods require enhancement to meet their specific needs fully.

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4 EVALUATING REGIONAL AREAS FOR CONSTRUCTION HUBS ESTABLISHMEN

Evaluating the establishment of Construction Hubs requires an in-depth assessment across different dimensions. Many research efforts have been undertaken to identify these dimensions in various contexts. Tsui et al. (2023) identified four main perspectives to consider when establishing a circular Construction Hub: resources (such as material type and business model), accessibility (including logistics, scale of accessibility, transportation mode, and scale), land use (e.g., land use restrictions, plot sizes, and diversity), and socio-economic factors (such as labor availability and proximity to other companies). Additionally, Liu et al. (2012) developed a model for evaluating sustainable supply chain management and marketing by integrating six dimensions: product (innovating and managing products sustainably to meet customers' demands), promotion (ensuring all stakeholders contribute to sustainable products), planning (having sustainable strategies including resource management), process (developing practices to increase sustainability, including technology utilization and new knowledge generation), people (stakeholder management for sustainable production, including social benefits and workforce management), and project (setting up new projects or using existing contexts to practice the above dimensions). Another study by Rydin (1992) identified environmental dimensions for evaluating the residential development process and their implications for local planning practices. The dimensions include location (with environmental significance and impact), site layout, infrastructure (including energy supply, water and sewage disposal, and transport), building materials, building design, and building process. Similarly, Sahely et al. (2005) developed a framework for the sustainability assessment of infrastructure development systems, identifying sustainability criteria, sub-criteria, and respective indicators. Key criteria include environmental criteria with sub-criteria such as resource use and residuals; economic criteria with sub-criteria like expenditures and revenues, investment in innovation, research, and development; engineering criteria with sub-criteria like performance; and social criteria with sub-criteria including accessibility, health and safety, and acceptability.

According to Marovic and Hanak (2017), when establishing any particular entity, location is one of the major criteria to be considered, which is a complex, unstructured, and multi-criteria problem. Therefore, the authors proposed a decision analysis approach within the context of construction project development, allowing for the selection of the best location for construction projects. A significant number of key criteria were identified in this context, such as land use, initial cost, infrastructure-related factors, constructability, significance of the land, and environmental feasibility. Accordingly, different dimensions/criteria that can be utilized for evaluating the performance of a particular entity could be identified from different contexts such as residential development, supply chain management, infrastructure development, and construction

management. Although they are from different contexts, these findings can be utilized as a starting point for the establishment of Construction Hubs, summarized in Table 2.

Table 2: Key dimensions for evaluating Hubs establishment

Key Dimension	Description	Sub Dimensions	References
Economic feasibility	Focusing on financial viability and sustainability across the expected lifecycle when establishing Construction Hubs	Infrastructure availability	(Alam, 2013)
		Investment in innovation	(Gupta et al., 2022)
		Initial cost	(Barakat et al., 2023)
		Cost efficiency (expenditures/ revenues)	(Brusselaers et al., 2022)
Strategic location	Focusing on selecting the best location that optimizes the entire process of Construction Hub establishment	Accessibility	(Marovic & Hanak, 2017)
		Transportation modes/ scales	(Tsui et al., 2023)
		Proximity to other locations	(Alam, 2013)
		Significance of the location	(Camarinha-Matos et al., 2022)
		Site layout/ landscape	(Erdogan et al., 2019)
		Utility infrastructure availability	(Sahely et al., 2005)
		Constructability	(Boyacioglu et al., 2022)
Environmental feasibility	Focusing on potential environmental impacts of Construction Hubs establishment process	Land use	(Ortiz et al., 2009)
		Diversity of land use	(Rydin, 1992)
		Material use	(Huang et al., 2018)
		Residuals	(Huang et al., 2018)
		Environmental impacts	(Ortiz et al., 2009)
Social impact	Focusing on potential social impacts from all the stakeholders of Construction Hubs establishment process	Stakeholder engagement	(Almahmoud & Doloi, 2016)
		Social benefits	(Press et al., 2015)
		Workforce management	(Edum-Fotwe & Price, 2009)
		Research and development	(Gupta et al., 2022)
Resource planning/ management	Focusing on strategic allocation and efficient use of potential resources throughout the entire process of Construction Hub establishment	Material use	(Liu et al., 2012)
		Labor availability	(Edum-Fotwe & Price, 2009)
		Infrastructure availability	(Sahely et al., 2005)
		Technology availability	(Gupta et al., 2022)
		Financial availability	(Barakat et al., 2023)
Technology/ innovation	Focusing on applying new technologies, methods, and knowledge throughout the entire process of Construction Hub establishment	Adoption of new technologies	(Queiroz et al., 2021)
		Applying new knowledge	(Neligan et al., 2023)
		Investment in innovations	(Boyacioglu et al., 2022)

5 METHODS

This research adopts a qualitative approach, combining an extensive literature review and stakeholder workshops analyses to understand the factors influencing Construction Hubs' evaluation. Data collection is multi-dimensional, encompassing secondary data from existing academic publications and industry reports, and primary data from interviews and workshop discussions with stakeholders involved in Construction industry.

The stakeholders' workshop sessions were conducted including participants from:

- **Industry**: Building services companies, steel providers and manufacturers, housing and property developers, technology solution companies, prefab and offsite manufacturers.
- **State Government**: Director, Senior Manager, Project Manager (2).
- **Academia**: Experts in Urban History, Economy, Urban Design, Construction Management, Business, and Architecture (2).

The insights and recommendations from stakeholder workshops were crucial in shaping the evaluation framework. Key criteria for the evaluation framework were derived from these insights, focusing on sustainability, infrastructure adequacy, resource management, and market dynamics. These criteria were tailored to capture the multifaceted nature of Construction Hubs.

Data Analysis

Data analysis was conducted through thematic analyses, identifying common patterns, differences, and unique factors across the data. The synthesis of these findings formed the basis of the evaluation framework. To validate this framework, it underwent a rigorous process of expert peer review and stakeholder feedback. The methodology's emphasis on qualitative analysis and stakeholder input ensures that the framework is empirically grounded and reflective of diverse perspectives, enhancing its applicability in various regional and situational contexts. Table 3 summarizes the key outcomes from each session of the expert review sessions.

Table 3. Summary of the workshops

	Main Focus	**Key Outcomes**
1	Initial criteria identification	- Identified the factors: Sustainability, Resources, and Infrastructure - Brainstormed sub-factors for each main factor - Discussed the relevance and importance of each factor and sub-factor in the context of regional Construction Hubs
2	Refining sustainability and market dynamics	- Explored circularity and environmental considerations as key drivers for hub location and operations - Discussed the importance of consistent demand, market access, sector colocation, and collaboration in ensuring the success of regional hubs (added market demands) - Refined sub-factors related to market dynamics, such as categorizing demand and manufacturing capacity, and trialing new partnerships
3	Refining resources and infrastructure	- Discussed the significance of labour access, re-skilling, and future skills development in regional areas - Highlighted the role of government support, grants, and tax incentives in overcoming initial hurdles - Refined sub-factors related to infrastructure, such as logistics, digital connectivity, and the capacity to trial components in controlled environments
4	Finalizing and validating the criteria	- Reviewed the refined list of main factors and sub-factors - Sought consensus among the expert panel on the comprehensiveness and relevance of the criteria - Finalized the evaluation criteria for establishing regional Construction Hubs

A data matrix was created including the extracted factors from the literature review and expert panel reviews, organizing factors by rows and their attributes by columns. This enabled pattern identification and factor grouping. A k-means clustering algorithm grouped these factors based on similarities into seven distinct clusters, with the optimal number determined using the elbow method, which plots the within-cluster sum of squares (WCSS) against the number of clusters to identify the point of diminishing returns. The clusters are divided as follows:

- Cluster 1: Infrastructure, Transportation, Urban Planning, Local Economic Conditions

- Cluster 2: Skilled Labour, Talent Attraction, Workforce Development, Industry-Academia Collaboration
- Cluster 3: Government Support, Policy Incentives, Financing, Capacity Building, Regulatory Environment, Financial Incentives
- Cluster 4: Logistics, Supply Chain, Supply Chain Optimization, Technological Innovation
- Cluster 5: Resources, Collaboration, Knowledge Sharing, Sustainable Practices, Innovation, Cross-Industry Collaboration
- Cluster 6: Stakeholder Engagement, Technology Adoption, Cross-Sector Coordination, Digital Technologies, Data-Driven Decision Making, Ecosystem Integration
- Cluster 7: R&D, Industry Partnerships, Cluster Formation, International Connectivity, Entrepreneurship, Resilience, Community Engagement, Sustainability

6 KEY CRITERIA OF EVALUATION FRAMEWORK

The results led to the development of a multi-criteria framework for evaluating key factors in establishing successful Construction Hubs, with a particular emphasis on regional considerations. The framework categorizes the factors into four main dimensions:

1) Sustainability

This criterion is subdivided into social, environmental, and economic factors, considering:

- The availability of a skilled and adequate workforce.
- The presence and potential of latent skills within the community.
- The cost of the workforce and its implications on the economic viability of construction projects.
- The demographic dynamics, population density, and employment rates within the region, influence social sustainability.
- The impact on and strategies for environmental protection, such as overlays and the management of agricultural and natural resources.
- Economic factors like housing affordability, rental and energy costs, and overall material costs, assess the economic balance and sustainability.

2) Infrastructure

Infrastructure focuses on accessibility, logistics, and location, including:

- Transportation systems like roads, rails, airports, and ports.
- The geography of the region and strategic reference points.
- Workflow efficiency and the optimization of distribution flows.
- Material flow, ensuring efficient management from sourcing to final use.

3) Resources

Resources are categorized into services and materials, emphasizing:

- The availability of serviced sites, buildings, and the readiness of the region to support construction activities.
- Educational and research institutions that can contribute to innovation and workforce development.
- The role of trades and the availability of essential construction materials like timber, steel, and concrete.

4) Market Dynamics

Market Dynamics assess the supply and demand within the construction market, considering:

- Energy and material costs that affect the operational expenses of construction projects.
- Land use policies and the presence of internet infrastructure.
- The current landscape of construction material providers, key industries, prefab companies, and construction companies.
- The efficiency of delivery, distribution, and logistics companies.

- The demand factors such as the target market, future pipelines, housing gaps, and major investments that will influence the hub's activities.

This structured framework, demonstrated in Figure 1, aims to serve as a guide for assessing the potential and performance of Construction Hubs. It considers the intricate balance between the available resources, market needs, and sustainable practices, ensuring that the establishment of a Construction Hub aligns with the long-term development goals of the region. The outcomes and impacts are measured against these criteria to evaluate the success and identify areas for continuous improvement.

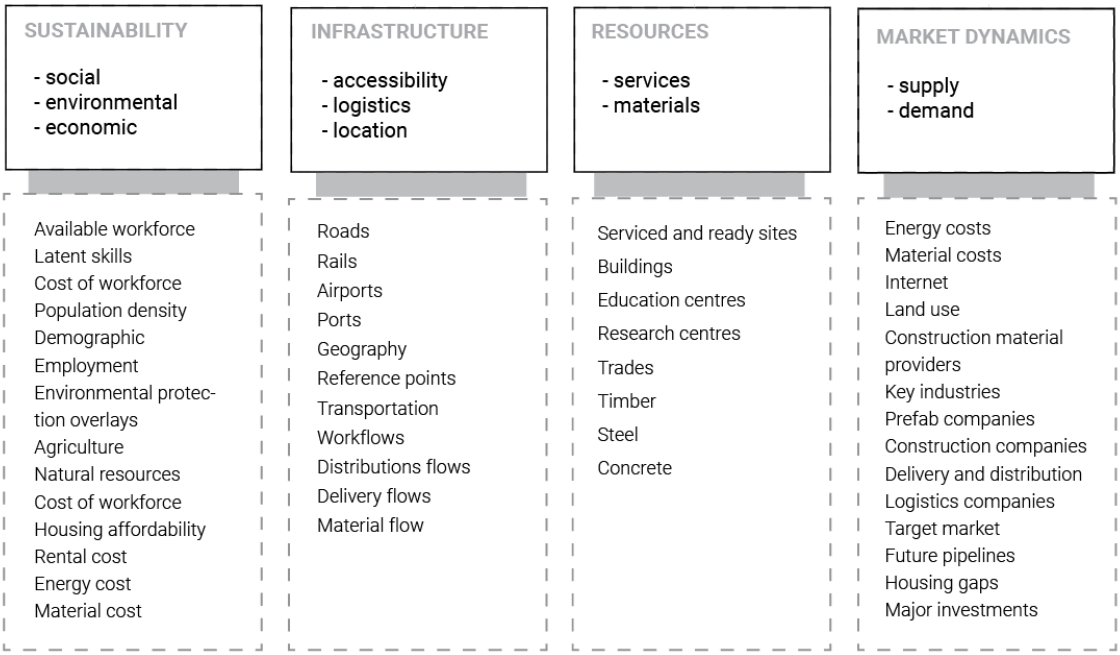

Figure 1: Evaluation framework for establishing Construction Hubs. Source: Authors

7 DISCUSSION

The evaluation framework presented in this study provides a tool for assessing the potential and efficacy of Construction Hubs, with a strong emphasis on regional considerations. Its development was guided by the necessity to understand the multifaceted nature of these hubs and the complex interplay of factors that determine their success. This discussion will reflect on the key findings of the framework's application, its implications for the construction industry, and the potential avenues for future research.

The framework identifies sustainability as a critical factor, corroborating the literature that emphasizes the need for construction projects to move towards greener practices (Camarinha-Matos et al., 2022; Chauhan et al., 2022; Tsui et al., 2023). The inclusion of social and economic dimensions within sustainability highlights the framework's recognition of the broader impact of Construction Hubs beyond environmental considerations. It is evident that the long-term success of these hubs is contingent upon their ability to contribute positively to the local community and economy, with the regional context playing a crucial role in shaping these sustainability factors.

Infrastructure emerged as a pivotal component, underscoring the fact that accessibility and robust logistics are fundamental to the viability of Construction Hubs. The importance of transportation, utilities, and technological infrastructure aligns with the current push for smart cities and the integration of digital technologies in construction. The framework's regional focus emphasizes the need to analyse the specific infrastructure capabilities and development opportunities within each target location (Huang et al., 2018; Rane et al., 2023; Szafranko & Harasymiuk, 2022). Instead, resource management within the framework extends beyond mere material and financial considerations; it encompasses the strategic management of human capital and the nurturing of a skilled workforce, which are essential for innovation and competitive advantage in the construction industry (Barakat et al., 2023; Neligan et al., 2023; Queiroz et al., 2021). The

regional perspective highlights the importance of understanding the availability and quality of local resources, as well as the strategies for their effective utilization.

The analysis of market dynamics through the framework underscores the complexity of supply and demand factors in the construction sector. The findings suggest that a nuanced understanding of these dynamics is essential for the strategic positioning and competitiveness of Construction Hubs (Boyacioglu et al., 2022; Gupta et al., 2022; Ruiz-Ocampo et al., 2023). Instead, the regional focus enables the evaluation of market opportunities, target segments, and competitive landscapes specific to the local context, informing the development of tailored strategies.

The interconnections between the framework's dimensions (Sustainability, Infrastructure, Resources, Market Dynamics) further emphasize the need for a holistic and integrated approach to the establishment and management of successful Construction Hubs. Optimizing across these dimensions requires careful consideration of the synergies and trade-offs, with the regional perspective serving as a crucial lens for balancing the diverse factors.

The framework sets the stage for future empirical studies to validate and adapt it across various regions and contexts. It highlights the need for its application in diverse settings to determine its versatility and identify any necessary modifications. The framework also underscores the importance of interdisciplinary research, combining urban planning, environmental science, and socio-economic studies to deepen the understanding of Construction Hubs and their regional impacts.

The framework serves as a powerful tool for strategic planning and decision-making, helping industry professionals evaluate potential Construction Hubs using comprehensive criteria tailored to regional specifics. It promotes sustainability by urging practitioners to adopt greener practices and technologies, thereby enhancing the environmental, social, and economic benefits of Construction Hubs. Additionally, the framework emphasizes the importance of strategic human capital development, advocating for investment in training and development to support Construction Hub growth through a skilled workforce.

It encourages community engagement and development by aligning Construction Hub projects with local needs, ensuring they positively contribute to the socioeconomic fabric of the community. It also highlights the role of Construction Hubs in stimulating economic growth and job creation, which can lead to more resilient and prosperous communities by enhancing skills and fostering a competitive environment.

8 CONCLUSION

The application of the proposed framework has significant implications for the construction industry. It provides stakeholders with a systematic approach to evaluate the viability of potential sites for Construction Hubs. By considering a wide array of factors, from market conditions to the availability of resources and the state of infrastructure, the framework allows for informed decision-making that can lead to more successful and sustainable outcomes. Additionally, it suggests that the construction industry must foster collaborative relationships with all stakeholders, including government, private sector, and local communities, to ensure the success of Construction Hubs. This approach can facilitate the alignment of Construction Hubs with local and regional development goals, thereby enhancing their acceptance and support.

The study's qualitative approach, while providing detailed insights, faces limitations such as potential subjectivity and bias in data interpretation, challenges in generalizability, and data collection constraints. While the framework provides a robust basis for evaluating Construction Hubs, it also opens several avenues for future research. For instance, one potential area is the empirical validation of the framework through longitudinal studies that can track the performance of Construction Hubs over time. Such studies could provide deeper insights into the long-term impacts of these hubs on local development and sustainability. Another area for exploration is the adaptation of the framework to different cultural and regulatory environments. As construction practices and market conditions vary widely across regions, further research could customize the framework to address these variations effectively. The integration of emerging technologies and innovation in construction processes within the framework warrants further study. As the construction industry evolves, so too must the evaluation tools used to assess the strategic development of Construction Hubs. The framework’s application and subsequent refinement through continued research and industry feedback will be crucial in shaping the future of Construction Hubs and, by extension, the construction industry as a whole.

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