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Enhancing building construction projects delivery: Identifying critical success factors

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Abstract - The study is aimed at development of critical success factors for enhance building construction projects delivery using South East Nigeria as a study area. The problem of the study is failure to identify and prioritize critical success factors (CSFs). The specific objective is to identify and evaluate the critical success factors (CSFs). The basic sources of data collected for the study are secondary data which include brainstorming, published relevant information and primary data gotten by the respondents/professionals. The researcher reviewed related literature which enabled him to develop a questionnaire. Data was collected through email, questionnaire and interview approach which was distributed among the stakeholders. Analysis of data was carried out with Descriptive Statistics and Structural Equation Modeling (SEM). The results and finding shows that design, pre-construction, construction, post construction phase have an influence on constructability. The researcher concluded that lack of quality control and client dissatisfaction have an influence on constructability. Early involvement of contractors in the design stage and improving the spirit of teamwork have a direct impact on improving constructability and reducing duplication.

Keywords: critical success factors (CSFS), building construction projects, constructability, structural equation modelling (SEM), project delivery, quality control, stakeholder involvement

1. Introduction

Critical success factors (CSFs) are indispensable elements or conditions that determine the success of a project, initiative, or organization. These factors play a pivotal role in achieving desired objectives and outcomes by providing a framework for strategic planning and effective management. By focusing on CSFs, organizations can ensure alignment between goals, resources, and efforts, thereby increasing their chances of success. This paper delves into the various dimensions of CSFs, highlighting their significance, contextual variability, and practical implications for project management and organizational development.

CSFs are the essential areas of activity that must be performed well to achieve an organization's mission, goals, and objectives. The concept, introduced by Daniel (1961) and further developed by Rockart (1979), underscores the need for organizations to identify and prioritize the most impactful areas of focus. According to Daniel (1961), the identification of CSFs enables organizations to direct their efforts where they matter most, ensuring optimal use of resources and enhanced decision-making.

Rockart (1979) expanded this framework by emphasizing the alignment of CSFs with organizational strategy and stakeholder needs. For instance, a company focused on customer satisfaction might prioritize CSFs related to service quality, while a technology firm might emphasize innovation and research capabilities.

CSFs vary across industries and organizational contexts but generally encompass the following key dimensions:

(1) Clear Objectives: Clearly defined and comprehensible project goals are fundamental for success. Objectives act as a guiding light for teams, ensuring alignment between individual contributions and overarching organizational aims. Projects with ambiguous goals often face inefficiencies and miscommunication, which can lead to resource wastage and delays. For example, SMART goals—Specific, Measurable, Achievable, Relevant, and Time-bound—provide a structured approach to setting objectives, ensuring clarity and focus (Locke & Latham, 2002).

(2) Effective Leadership: Strong and capable leadership is a cornerstone of success. Leaders play a vital role in guiding teams, fostering a positive work environment, and making critical decisions under pressure. Leadership theories, such as transformational leadership (Bass, 1985), emphasize the importance of inspiring and motivating employees to exceed expectations. Effective leaders are also adept at conflict resolution, ensuring that team dynamics remain productive and aligned with project goals.

(3) Stakeholder Satisfaction: Stakeholders, including clients, investors, and team members, significantly influence the success of a project. Ensuring that their needs and expectations are met fosters trust and cooperation, which are crucial for long-term success. Effective communication and regular feedback loops are essential tools for understanding stakeholder priorities and addressing concerns promptly (Freeman, 1984).

(4) Resource Management: Efficient allocation and utilization of resources—including time, budget, and personnel—are critical for achieving project goals. Poor resource management can lead to cost overruns, missed deadlines, and compromised quality. Tools such as project management software (e.g., Microsoft Project, Trello) aid in tracking resource allocation and ensuring that resources are directed toward high-priority activities (Kerzner, 2017).

(5) Risk Management: Identifying, analysing, and mitigating potential risks are essential to avoid disruptions and setbacks. Risk management involves proactive planning to address uncertainties and minimize their impact. Techniques such as SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) and risk matrices provide structured approaches to managing risks effectively (Hillson, 2002). For instance, in the construction industry, early risk identification can prevent costly delays and safety issues.

(6) Adaptability and Flexibility: In dynamic environments, the ability to adapt to changing circumstances is a key determinant of success. Organizations that are flexible can pivot strategies in response to unforeseen challenges or opportunities. Agile methodologies, commonly used in software development, exemplify the importance of adaptability by promoting iterative processes and continuous feedback (Beck et al., 2001).

(7) Quality Deliverables: Delivering outputs that meet or exceed expectations is critical for building trust and credibility. Quality assurance and control mechanisms ensure that products or services adhere to established standards. Tools such as Six Sigma and Total Quality Management (TQM) provide frameworks for maintaining and improving quality (Juran, 1988).

Identifying and prioritizing CSFs enables organizations to concentrate their efforts on areas that yield the greatest impact. This approach not only enhances efficiency but also fosters strategic alignment across all levels of the organization. For instance, a retail company aiming to

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improve customer satisfaction might prioritize training programs for front-line employees, while a manufacturing firm may focus on streamlining supply chain operations.

Moreover, CSFs serve as benchmarks for measuring progress and success. By continuously monitoring performance in critical areas, organizations can identify deviations and implement corrective actions promptly. This proactive approach minimizes risks and ensures that projects remain on track.

Organizations can apply the concept of CSFs in various contexts to achieve their strategic objectives. For example: (a) **Project Management**: Identifying CSFs helps project managers allocate resources effectively and set realistic timelines, ensuring project success. (b) **Strategic Planning**: CSFs provide a foundation for developing actionable strategies that align with organizational goals. (c) **Performance Evaluation**: By focusing on CSFs, organizations can establish performance metrics that reflect their priorities and objectives.

Critical success factors are indispensable for achieving project and organizational success. By focusing on clear objectives, effective leadership, stakeholder satisfaction, resource and risk management, adaptability, and quality deliverables, organizations can enhance their strategic planning and execution. The identification and prioritization of CSFs not only streamline operations but also provide a robust framework for long-term success. As Daniel (1961) and Rockart (1979) highlighted, the ability to focus on what truly matters is the hallmark of effective management and leadership. Future research could explore the evolving nature of CSFs in the context of emerging technologies and global challenges, further enriching this vital area of study.

1.1 Problem Statement

Building construction projects often face significant challenges, resulting in delays, cost overruns and quality issues. These problems can lead to dissatisfied clients and end –users, financial losses for contractors and stakeholders, damage to reputation and credibility, inefficient use of resources.

1.2 Objectives of the Study

This study is aimed to enhance building construction projects delivery. Identifying Critical Success Factors. The specific objective are as follows:

(1) To identify and prioritize Critical Success Factors for building construction projects,
(2) To develop a comprehensive framework for enhancing project delivery.

Research Questions

(1) What are the critical success factors for enhancing building construction projects delivery.
(2) How do these CSFs interact and impact project outcomes

Hypotheses Testing

H_{02}:The Critical Success Factors (CSFs) have no significant influence on constructability in different project phases in selected private and public building construction projects.

Critical success factors influencing constructability vary across project phases, but some common elements include:

(1). ***Design Phase:***

- Clear Specifications: Well-defined and detailed design specifications facilitate a smoother transition from design to construction.
- Collaborative Design: Effective collaboration among architects, engineers, and other stakeholders ensures that the design is constructible within realistic constraints.

(2). ***Pre-Construction Phase:***

- Accurate Cost Estimation: Precise cost estimates help in resource planning and prevent budget overruns during construction.
- Detailed Planning: Comprehensive project planning that considers logistics, scheduling, and risk management contributes to constructability.

(3). ***Construction Phase:***

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- Skilled Workforce: Competent and trained construction teams are crucial for executing plans efficiently.
- Effective Communication: Ongoing communication between on-site and off-site teams is vital to address challenges promptly and avoid disruptions.

(4). Post-Construction Phase:
- Quality Assurance: Ensuring the constructed project meets quality standards and adheres to specifications.
- Client Satisfaction: Meeting client expectations and ensuring that the constructed facility functions as intended.

(5). ***Technology Integration:***
- Building Information Modeling (BIM): Utilizing BIM technology enhances collaboration, visualization, and coordination, improving constructability.
- Advanced Construction Technologies: Incorporating innovations like drones, IoT devices, and automation can streamline processes and improve efficiency.

(6). ***Regulatory Compliance:***
- Adherence to Codes and Standards: Ensuring compliance with building codes and industry standards to avoid delays and legal issues.

(7). ***Risk Management:***
- Proactive Risk Identification: Identifying potential risks early on and implementing strategies to mitigate them is essential for constructability.

(8). ***Environmental Considerations:***
- Sustainability Practices: Incorporating sustainable construction practices and materials to meet environmental standards.

Understanding and addressing these factors at each project phase contributes to successful constructability and project outcomes (Mathar et al, 2020).

Constructability analysis is a crucial process in construction projects that aims to evaluate and enhance the feasibility and efficiency of the construction process. Several critical success factors contribute to the effectiveness of constructability analysis. Here are some key factors to consider:

(a). Early involvement: Incorporating constructability analysis at the early stages of a project allows for the identification of potential construction challenges and the development of proactive strategies to address them. It is essential to involve the construction team, including contractors, engineers, and architects, during the design phase to provide valuable input.

(b). Collaborative approach: Effective constructability analysis requires collaboration and communication among all project stakeholders. Encourage open dialogue and cooperation between the design team, construction team, and other relevant parties to ensure the integration of different perspectives and expertise.

(c). Experienced team: Having a team with diverse experience and expertise is crucial for successful constructability analysis. The team should include professionals with knowledge of construction methods, materials, sequencing, and potential challenges specific to the project type. Their expertise will help identify constructability issues and propose appropriate solutions.

(d). Constructability criteria: Establishing clear and comprehensive constructability criteria is essential. These criteria should outline the project's objectives, constraints, and performance standards. They serve as a benchmark to evaluate design alternatives and assess their constructability implications.

(e). Design reviews: Conducting regular design reviews with the construction team is critical to identify constructability issues early on. These reviews involve a thorough examination of the design documents, construction drawings, and specifications to ensure that they align with the project's constructability requirements.

(f). Simulations and virtual modeling: Utilizing advanced technologies like Building Information Modeling (BIM) and virtual simulations can enhance constructability analysis. These tools enable

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the visualization of the construction process, identification of clashes or conflicts, and optimization of construction sequencing and logistics.

It encourages a culture of learning and continuous improvement by documenting and sharing previous projects. Capturing best practices, innovative approaches, constructability analysis helps avoid recurring issues and improve future projects.

(g). Risk management: Identifying and mitigating potential risks during the constructability analysis phase is crucial. Evaluate the impact of different design decisions, construction methods, and materials on project risks, and develop strategies to minimize or eliminate them.

(h). Constructability training: Providing training and professional development opportunities for the construction team in constructability analysis techniques and best practices can enhance their skills and ensure a consistent approach across projects.

(i). Monitoring and feedback: Regularly monitor the effectiveness of constructability analysis efforts and seek feedback from the construction team to identify areas for improvement. Learn from the implementation of constructability recommendations during construction to refine future analysis processes.

By considering these critical success factors, project teams can effectively incorporate constructability analysis into their projects, resulting in improved construction efficiency, reduced costs, and enhanced project outcomes (Daniel, 2019).

The Resource Based View (REV) theory developed by Jay Barney (1991) and others explains how firms achieve sustained competitive advantage through strategic management of internal resources. Despite the importance of successful building construction projects, there is a lack of comprehensive frameworks identifying critical success factors (CSFs) that ensure timely, within budget and quality delivery.

2. Method

2.1 Research Design

The methods of research design adopted for this study are an ex-post facto and a survey which are defined by (Nworuh, 2004). Ex-post facto means after the facts (project) while survey means an investigation of the opinion behavior or project. One of the buildings in Abia, Ebonyi, & Anambra were used by the researcher as an ex-post facto data research. The information obtained from secondary data research was not manipulated hence the researcher only extracted what happened during the execution.

Building construction in Imo and Enugu were used as a survey, the researcher visited some of the building project sites and offices for on the site observation and assessment. A well-structured and standardized questionnaire on Enhancing building construction projects delivery / was used. The questionnaire was designed based on five-point Likert scale and was administered to professionals.

Personal interviews were also conducted with some project managers and professionals. However, interviews were used only when and where the efforts of the researchers to administer questionnaire proved unsuccessful.

2.2 The Study Area

South East Nigeria is one of the six geopolitical zones in the country, will be adopted for this study. It is made up of five States, namely:

Abia: Located in the southern part of the region, Abia State is known for its commercial activities, particularly in the city of Aba.

Anambra: Anambra State is situated in the central part of the South East. It is known for its rich cultural heritage.

Ebonyi: Ebonyi State is located in the southeastern part of Nigeria and is known for its agricultural resources, particularly rice production.

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Enugu: Enugu State is in the southwestern part of the South East. The city of Enugu, which is the state capital, was once the capital of Nigeria during the colonial era. It is known for its coal mining history and is often referred to as the "Coal City".
Imo: Imo State is situated in the southeastern part of Nigeria. The state capital, Owerri, is a major commercial and entertainment center.
The South East region is predominantly inhabited by the Igbo ethnic group, who are known for their entrepreneurial spirit, rich cultural heritage, and significant contributions to Nigeria's socio-economic development. The region has diverse economic activities, including trade, agriculture, manufacturing, and services.

2.3 Population of the Study

The study populations were public and private construction sectors such as Engineers, Architects, Project Managers, Quantity Surveyors, Contractors, Builders, etc. Project Owners was also among the population. These professionals engaged in planning, design, management and execution of projects and therefore formed the nucleus of the respondents for the study in their organizations. The researcher targets five (5) construction firms across the country with relevant capacity.

2.4 Sampling Design and Procedure

The simple random was used to administer questionnaires to staff and the judgmental sampling helped the researchers to select five building and five companies operating in South East and purposive sampling was used in selecting expats.

2.5 Method of Data Collection

The questionnaire was designed as multi-choice five grade points (1-5) known as Likert scale (Likert, 1974) and open-ended pattern in order to give respondent the flexibility to express their views and as such provide alternative set of answers which best represents the actual situation in their respective organizations. The data which was generated was further substantiated by observations and oral interviewers in some cases.

2.6 Method of Data Analysis and Presentation

The main tools employed in the analysis of the primary data collected for the study are:
(1) Descriptive Statistics Analysis and Structural Equation Modelling were used to identify and evaluate the critical success factors influencing constructability in different project phases in selected private and public building construction projects.

3. Results and Discussion

The descriptive analysis of the data, which included the use of tables and percentages, was utilized to provide a full description of the respondents' characteristics and opinions.

3.1 Critical Success Factors (CSFs) influencing constructability

Table 1 Critical Success Factors (CSFs) influencing constructability
in different project phases in selected private and public building construction project ($\bar{x}$ & sd)

Code	**Critical Success Factors**	**1**	**2**	3	**4**	**5**	$\bar{x}$	**Sd.**
CSF1	Design phase.	2	4	2	24	20	4.08	1.045
CSF2	Pre-construction phase.	0	0	6	24	22	4.31	.673
CSF3	Construction phase.	0	2	6	22	22	4.23	.807
CSF4	Post construction phase.	0		10	24	18	4.15	.724
CSF5	Resource mis-management can cause cost overrun.	0	2	10	18	22	4.15	.872
CSF6	Lack of quality control can cause poor quality.	0	2	12	12	26	4.19	.930
CSF7	Client dis-satisfaction can cause chaos.	0	2	6	18	26	4.31	.829

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In building construction projects, there are critical success factors associated with each phase. Table 1 reveals these factors and their influence on constructability, which are: design phase (M=4.08, sd=1.04), pre-construction phase (M=4.31, sd=0.67), construction phase (M=4.23, sd=0.80), post construction phase (M=4.15, sd=0.72), resource mis-management can cause cost overrun (M=4.15, sd=0.87), lack of quality control can cause poor quality (M=4.19, sd=0.93), client dis-satisfaction can cause chaos (M=4.31, sd=0.82). From the result, these seven identified factors were all acknowledged as having an impact on constructability in different phases of building construction projects.

3.2 Critical Success Factors (CSFs) influencing constructability

Table 2 Critical Success Factors (CSFs) influencing constructability
in different project phases in selected private and public building construction project ($\bar{x}$ & sd)

Code	**Critical Success Factors**	**1**	**2**	3	**4**	**5**	$\bar{x}$	**Sd.**
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In building construction projects, there are critical success factors associated with each phase. Table 2 reveals these factors and their influence on constructability, which are: design phase (M=4.08, sd=1.04), pre-construction phase (M=4.31, sd=0.67), construction phase (M=4.23, sd=0.80), post construction phase (M=4.15, sd=0.72), resource mis-management can cause cost overrun (M=4.15, sd=0.87), lack of quality control can cause poor quality (M=4.19, sd=0.93), client dis-satisfaction can cause chaos (M=4.31, sd=0.82). From the result, these seven identified factors were all acknowledged as having an impact on constructability in different phases of building construction projects.

3.3 Hypotheses Testing

H_{02}:The Critical Success Factors (CSFs) have no significant influence on constructability in different project phases in selected private and public building construction projects

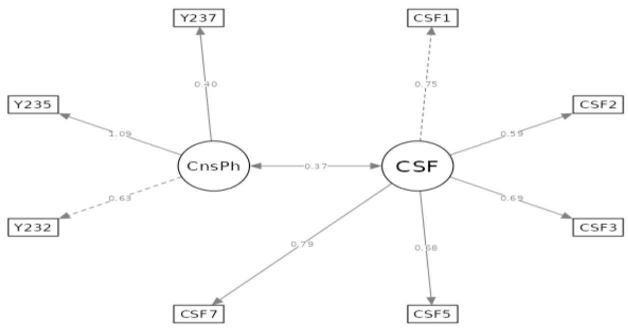

Fig. 1 Structural equation for critical success factors effect on constructability in different phases of projects

Table 3 Model tests

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Label	χ^2	df	P
User Model	23.5	19	0.215
Baseline Model	340.5	28	<.001
Scaled User	30.3	19	0.049
Scaled Baseline	224.0	28	<.001

Table 3 shows the absolute model fit. Parsimony was established since χ^2/df (1.24) < 5.0, which implies the model is fit. This is further supported by the baseline fit indices of CFI, TLI, NNFI, RNI and NFI which are above 0.90 with RMSEA (0.06) < 0.08 as shown in Tables 4.

Table 4 Fit indices

			95% Confidence Intervals		
Type	SRMR	RMSEA	Lower	Upper	RMSEA p
Classical	0.114	0.068	0.000	0.147	0.345
Robust	0.091	0.245	0.159	0.334	<.001
Scaled	0.091	0.108	0.008	0.177	0.107

Table 5 Measurement model

Latent	Observed	Estimate	SE	β	Z	P
CSF	CSF1	1.000	0.000	0.754		
	CSF2	0.784	0.148	0.591	5.30	<.001
	CSF3	0.910	0.203	0.686	4.48	<.001
	CSF5	0.903	0.160	0.681	5.63	<.001
	CSF7	1.043	0.183	0.786	5.69	<.001
ConsPhase	Y232	1.000	0.000	0.627		
	Y235	1.735	0.635	1.087	2.73	0.006
	Y237	0.640	0.239	0.401	2.68	0.007

Table 5 shows the standardized regression weights indicating the critical success factors have significantly and positively influence constructability in different project phases ($\boldsymbol{\beta} = 0.75, 0.59, 0.68, 0.68, 0.78;\ p - val < 0.05$). Hence, the rejection of the null hypothesis and the conclusion that, critical success factors significantly influence constructability in different project phases.

3.4 Discussion of Findings

3.4.1 *Critical Success Factors (CSFs) influencing constructability*

Findings revealed that design phase, pre-construction phase, construction phase, post construction phase, resource mis-management, lack of quality control, and client dis-satisfaction, have an influence on constructability. This finding depicts that the planning and preparation stages greatly impact how well a construction project can be executed and its overall outcome. In the design phase of a project it is important to incorporate building knowledge select suitable materials. For the construction phase which involves constructability reviews, scheduling, coordination and site logistics it aids in turning the design into a feasible construction plan that

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reduces risks and uses resources effectively. Both of these stages work together to establish a basis, for a seamless and effective construction process through focusing on the feasibility of construction, in both the planning and pre-construction phases, which could boost productivity, cut expenses and enhance project completion. This finding is congruent with Jadidoleslami et al. (2022) who asserted that, early involvement of contractors in the design stage, and improving the spirit of teamwork, have a direct impact on improving constructability and reducing duplications.

In the same vein, the construction and post-construction phases are crucial in establishing the overall constructability of a project. During the construction phase, on-site coordination, labor efficiency, quality control, and safety management are critical to ensuring that the project is completed efficiently, on schedule, and within budget. This finding is similar to (Ogbu & Ebiminor 2021) who observed that constructability practices are considered to have their influences on project schedule, cost, quality and safety. Poor management of these issues can cause delays, errors, and greater costs, reducing constructability. Commissioning, inspections, documentation, and maintenance planning all take place during the post-construction phase to guarantee that the building continues to work properly and can be easily maintained over its lifetime. The insights learnt during this phase help to improve the constructability of future projects. Together, the construction and post-construction phases ensure that a project not only accomplishes its initial objectives, but also stays functional and efficient long after completion.

Furthermore, it was noted that resource mis-management could cause cost overrun, just as lack of quality control could result to poor quality of projects. Which is in consonance with Shash and Almufadhi (2021) who noted that, when collaboration with stakeholders led to implementation of constructability resulting a reduction in engineering cost and construction cost. This is because resource mismanagement and a lack of quality control have a significant detrimental impact on the constructability of building projects. Resource mismanagement causes inefficiencies, delays, and cost overruns, making it difficult to finish projects on schedule and under budget. Poor distribution of materials, personnel, equipment, and funds can lead to a chaotic building process that jeopardizes the project's overall viability. This connotes with Albtoush and Doh (2019) who pointed out that major causes of cost overrun in many projects are ineffective construction management and poorly established cost control systems. Similarly, a lack of quality control can result in faults in materials and workmanship, rework, safety issues, and noncompliance with rules, all of which reduce constructability. However, effective quality control guarantees that the project is built to the requirements, decreasing the chance of errors, delays, and long-term performance difficulties.

4. Conclusion

This study has critically examined the factors affecting constructability and proposed actionable insights for enhancing efficiency in building construction projects. The findings lead to the following conclusions:

(a) Phases and Factors Influencing Constructability: (i) The constructability of building projects is heavily influenced by the interplay of phases throughout the project lifecycle: design, pre-construction, construction, and post-construction. (ii) Issues such as resource mismanagement, lack of robust quality control measures, and client dissatisfaction emerge as recurring challenges. These issues not only hinder project progress but also contribute to cost overruns, delays, and suboptimal outcomes, underscoring the need for comprehensive management strategies at every stage.

(b) Strategic Interventions for Enhanced Constructability: (i) The study highlights the critical role of early contractor involvement during the design phase. By engaging contractors at this stage, design plans can incorporate practical and cost-effective solutions that align with on-site realities, reducing potential rework and inefficiencies. (ii) Fostering a spirit of teamwork

among project stakeholders—designers, contractors, and clients—significantly enhances collaboration and minimizes duplication of efforts. Such an approach ensures streamlined communication and alignment of goals, ultimately contributing to the project's success.
(c) Holistic Perspective: (i) A systemic view of constructability reveals that its improvement is not just a technical endeavour but also requires addressing cultural and organizational issues. The lack of synergy between phases often stems from misaligned priorities and poor stakeholder engagement. Therefore, addressing constructability demands both technical solutions and organizational reform.

This research makes a significant contribution to the field by identifying critical success factors (CSFs) essential for enhanced constructability in building construction projects. These CSFs provide a framework for: (a) Understanding the systemic issues that hinder constructability. (b) Proposing integrative approaches to tackle challenges such as resource mismanagement and poor quality control. (c) Offering actionable strategies that promote collaboration and innovation in construction practices.

The study's emphasis on early contractor involvement and teamwork underscores the need for a paradigm shift in traditional project management practices. By framing constructability as a multi-dimensional issue that spans technical, managerial, and interpersonal domains, this research offers a holistic perspective for both academia and industry.

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