

MANAGING SUSTAINABLE CONSTRUCTION PROJECTS UNDER
COMPLEXITY: KEY FACTORS INFLUENCING PROJECT
PERFORMANCE

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Abstract: The construction industry plays an important role in economic development, employment, and infrastructure growth, but it also faces increasing environmental, economic, technological, and organizational pressures. As sustainability requirements become more demanding, construction projects are expected not only to be completed within the planned time and budget but also to achieve environmental and social objectives. At the same time, construction projects are becoming increasingly complex due to the involvement of multiple stakeholders, changing regulations, technological uncertainty, resource constraints, and unpredictable external conditions. These challenges make traditional project management approaches insufficient for ensuring sustainable project performance. This paper examines the key factors that influence the performance of sustainable construction projects under complex conditions. Attention is given to stakeholder coordination, effective communication, leadership, risk management, technological integration, resource efficiency, and organizational flexibility. The study argues that sustainable construction project performance depends not on a single managerial factor but on the interaction between technical, organizational, environmental, and human dimensions. Understanding these relationships can help project managers develop more flexible and integrated approaches to managing sustainable construction projects.

Keywords: *Sustainable construction, project management, project complexity, project performance, sustainability, risk management, stakeholder management, construction projects.*

Introduction:

The construction sector is increasingly expected to contribute to sustainable development by reducing environmental impacts, improving resource efficiency, and creating safer and more socially responsible working environments. This shift has changed the traditional understanding of successful construction projects. In the past, project success was often assessed primarily through three criteria: cost, time, and quality. Although these indicators remain important, contemporary construction

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projects require a broader understanding of performance that also considers environmental and social outcomes.

At the same time, construction projects are rarely implemented under stable and predictable conditions. Changes in material prices, labor availability, environmental regulations, technological requirements, client expectations, and market conditions can significantly influence project outcomes. In large-scale projects, the situation becomes even more complicated because different stakeholders may have different priorities and expectations.

Therefore, managing a sustainable construction project requires more than applying standard project management procedures. Project managers need to coordinate different interests, respond to uncertainty, manage risks, and maintain sustainability objectives throughout the project lifecycle. The ability to adapt to changing conditions has consequently become an important element of project performance.

The purpose of this paper is to identify and discuss the major factors influencing the performance of sustainable construction projects under complex conditions and to highlight the importance of an integrated approach to project management.

Key Factors Influencing Project Performance:

Stakeholder Management and Coordination.

One of the most important factors affecting construction project performance is effective stakeholder management. Construction projects usually involve clients, contractors, subcontractors, architects, engineers, suppliers, government authorities, local communities, and other interested parties. Their expectations and responsibilities may differ considerably.

In sustainable construction projects, coordination becomes even more important because environmental and social requirements often involve several participants simultaneously. For example, achieving energy efficiency may require cooperation between designers, engineers, contractors, and suppliers. Poor coordination can lead to delays, additional costs, misunderstandings, and compromises in sustainability objectives. Effective stakeholder engagement should therefore begin at the early stages of project planning and continue throughout implementation. Regular communication, clearly defined responsibilities, and transparent decision-making can reduce conflicts and improve project performance.

Leadership is another critical factor in complex construction projects. Sustainable construction often requires changes in established practices, investment in new technologies, and greater attention to long-term outcomes. Without effective

leadership, sustainability objectives may remain secondary to short-term cost or schedule considerations.

A competent project leader should be able to balance economic, environmental, and social priorities. In complex environments, decision-making should also be flexible enough to respond to unexpected developments. Rather than relying exclusively on predetermined procedures, project managers need to evaluate changing circumstances and adjust their strategies accordingly. Thus, leadership in sustainable construction should be understood not simply as administrative control but as the ability to coordinate people, manage uncertainty, and maintain a clear sustainability-oriented direction.

Risk Management: Complexity increases the number and variety of risks associated with construction projects. These may include financial risks, supply-chain disruptions, technological risks, environmental risks, regulatory changes, and delays caused by external factors. Traditional risk management approaches often focus on identifying individual risks and developing responses to them. However, complex projects require greater attention to the relationships between different risks. A delay in material supply, for instance, may simultaneously affect project costs, construction schedules, labor utilization, and environmental performance.

Consequently, effective risk management should be continuous rather than limited to the initial planning stage. Regular monitoring, scenario analysis, contingency planning, and timely decision-making can help project teams respond more effectively to uncertainty.

Technological Integration: Digital technologies are increasingly influencing the management of construction projects. Building Information Modelling (BIM), digital project management platforms, data analytics, and other technological solutions can improve information sharing, planning, monitoring, and coordination. Technology can also support sustainability by helping project teams monitor material consumption, energy use, waste generation, and other environmental indicators. However, technological adoption alone does not guarantee better performance. Its effectiveness depends on employees' skills, organizational readiness, data quality, and the willingness of stakeholders to use shared digital systems. Therefore, technological integration should be accompanied by appropriate training and organizational support.

Resource Efficiency: Efficient use of resources is a fundamental element of sustainable construction. Construction projects consume significant quantities of materials, energy, water, and human resources. Inefficient resource management can increase project costs while also creating unnecessary environmental impacts. Project

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managers should therefore consider resource efficiency throughout the project lifecycle. This includes selecting appropriate materials, reducing construction waste, improving energy efficiency, and optimizing the use of labor and equipment. Importantly, resource efficiency should not be treated only as an environmental objective. In many cases, reducing material waste and improving energy use can also contribute to lower costs and better project performance.

Organizational Flexibility and Adaptability: Complex construction environments require organizations to respond quickly to changing conditions. A rigid management structure may make it difficult to react to unexpected risks or changes in stakeholder requirements. Organizational flexibility allows project teams to revise plans, redistribute resources, and modify implementation strategies when necessary. This does not mean abandoning project objectives; rather, it means finding alternative ways of achieving those objectives under changing circumstances. For sustainable construction projects, adaptability is particularly important because sustainability standards, technologies, and environmental requirements continue to develop.

The analysis suggests that sustainable construction project performance is determined by a combination of interconnected factors rather than by a single management practice. Stakeholder coordination, leadership, risk management, technology, resource efficiency, and organizational flexibility influence one another. For example, the successful implementation of a new digital technology requires effective leadership and employee skills. Similarly, efficient resource management depends on coordination between suppliers, contractors, designers, and project managers. Risk management also becomes more effective when stakeholders communicate openly, and project information is available in a timely manner.

This interdependence indicates that sustainable construction projects should be managed as complex systems rather than as a collection of independent tasks. A project may achieve its planned budget and schedule but still fail to meet sustainability objectives if environmental or social considerations are neglected.

Therefore, project performance should be evaluated through a broader set of indicators that combine traditional measures—such as cost, time, and quality—with sustainability-related indicators, including resource efficiency, environmental impact, stakeholder satisfaction, and long-term value.

Conclusion:

Managing sustainable construction projects under complex conditions requires a shift from traditional, relatively linear approaches to more integrated and adaptive

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forms of project management. The performance of sustainable construction projects is influenced by several interconnected factors, particularly stakeholder coordination, leadership, risk management, technological integration, resource efficiency, and organizational adaptability.

The central argument of this paper is that sustainability cannot be achieved effectively by adding isolated environmental measures to an existing project management system. Instead, sustainability should be integrated into planning, decision-making, risk management, resource allocation, and stakeholder relations throughout the project lifecycle.

In this context, project managers have a key role in balancing economic, environmental, and social objectives while responding to uncertainty and complexity. A more integrated and flexible management approach can not only improve project performance but also contribute to the long-term sustainability of the construction sector.

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