

# Incorporating Environmental Sustainability in Project Portfolio Management by Construction Contractors

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**Abstract**—The contribution of an organization in environmental sustainability is reflected in its processes, supply chain, operations, and services. A sustainable construction contracting organization leaves a positive impact on the environment and society since it does not limit its concerns to the border of its business but extends its considerations to the surrounding environment. Running projects and gaining business advantages should not be sought at the expense of endangering the ecological environment. Several contractors in the construction industry consider the relevant criteria to control their ethical impacts and sustainability practices. Such criteria can be considered in the pre-project evaluation and selection so that the sustainability goals are supported. Construction contracting organizations are facing complexities in selecting the right projects with respect to conflicting objectives and requirements. Consideration of all project selection criteria including resource capacity, budget constraints, risk, return, economic metrics, and corporate goals, when are coupled with sustainability requirements becomes even more complex for business leaders. Project portfolio management as a facilitating tool can be used to balance these criteria and help contractors choose to tender projects that they are capable of completing without generating massive waste and sacrificing the environment. There is a paucity of research on the application of the project portfolio management approach to factor in sustainability for the selection and oversight of a set of projects. This study aims to provide an understanding of the benefits of applying the project portfolio management in achieving sustainable development of construction contracting organizations. The findings in terms of 11 potential sustainability actions provide insight into the consideration of sustainability as an important factor in the selection and execution of projects regarding the contractors' level of capabilities and resource capacities.

**Index Terms**—sustainability, construction contractors, project portfolio management

## I. INTRODUCTION

Sustainable development is achieved by creating an environment in which the goals of ecological environment protection and the sustainability of natural resources are met [1]. From the perspective of sustainable development, construction contractors need to prevent environmental pollution by ensuring that they are capable of undertaking a construction business without harming the environment. The scope and scale of projects that they execute should be compatible with their abilities in waste management and resource control. Clients should also be aware of the contractor's sustainability development abilities [2]. Nevertheless, contractors themselves must equip themselves with waste management capabilities and undertake only projects that are compatible with their level of abilities in practicing sustainability. The incorporation of sustainability begins with the design and procurement stage and continues to handover. Thus, it is not only limited to the construction stages [3].

Consideration of sustainability capability as a key criterion in the selection of projects support the realization of sustainable development goals (SDGs) in a construction contracting organization [4]. The project portfolio management approach provides a platform for screening the projects that are compatible with the capabilities and resources of an enterprise and at the same time supports long-term business goals such as entering a new market or extending activities in an existing market [5].

One of the capabilities that need to be considered in the project selection is the sustainability management capacity of a contractor that reflects the ability to employ industry best practices to control the impact of operations on the ecological environment. Waste generation is an inescapable part of the construction work. However, if a contractor is not able to decontaminate and reuse the generated waste, serious risks would be posed to the surrounding environment of the construction site. Best practices have been introduced to be employed throughout the construction process towards waste minimization using advanced techniques [6]. Therefore,

an important criterion before undertaking the construction work is that whether a contractor can meet all environmental standards and waste concerns associated with a certain project. Performing a feasibility study in terms of the environmental risks that are associated with the execution of a project can provide insight into the consequences of embarking on certain projects with the existing sustainability management capacities of a contractor. Negative environmental impacts after completing a project may negatively affect a contractor's brand recognition and destabilize its position in the market [2]. Reduction and reuse of waste is an indispensable capability of a contractor to undertake construction work.

Minimization of waste should be planned in the early stages of construction projects. Osmani identified factors affecting construction waste minimization in the UK and found that identified three main sources of legislative, financial, and business drivers [7]. The development of guides and standards for reducing and recycling waste has significantly contributed to addressing the environmental impacts of construction work. Esin and Cosgun conducted a study in Turkey and suggested initiatives to prevent and decrease the waste generated in projects involving modifications in residences. It was found that floor covering (61%), exterior door (43%), and kitchen components (39%) respectively account for the majority of the waste in such projects. To minimize the generation of such waste, they recommended that practitioners use durable building materials in buildings, fit the final facility with the expectation of end-users to reduce the need for making further changes after the handover, employ flexible designs for buildings, and encourage standard and modular construction [8].

Previous research rarely considers sustainability as a criterion in the project selection process. Thus, this paper attempts to bridge the gap in the literature by reconciling the concepts of sustainability and portfolio management in order to explain how they can be employed by construction contracting enterprises towards environmental sustainability.

## II. THEORETICAL BACKGROUND

### A. An Overview of Previous Studies

Ghaffar et al suggested a pathway to circular construction via better resource recovery during construction activities. They revealed that legislation by the government is one of the most effective actions to be taken towards achieving circularity in the built environment. They recommended that future research focus on expanding the scale and quality of construction and demolition waste. As an effective measure, they asserted that planning for waste reduction needs to be considered by investors and clients [9]. Enforcing clients to adhere to waste management standards in outsourcing construction activities can be effective since capable contractors are more likely to deliver projects which are aligned with the expected thresholds for the generated waste.

Contractors must incorporate sustainability in all their construction processes and even in the behaviour of their staff, as well as, their organizational culture. Li et al argued that construction waste reduction should be embedded in the behaviour of contractors' employees and be reflected in their performance in construction projects. Contractors are responsible for improving the knowledge and awareness of their staff on practicing waste management in all steps of the construction work. It should be part of the personal norm of employees that contractors employ for undertaking a new project [10]. Thus, in this study, we try to explain how clients should ensure that they select the best contractors that are capable of adhering to environmental sustainability standards and are equipped with waste reduction and recovery tools, procedures, and instruments.

### B. An Overview of Project Portfolio Management

Business managers seek solutions to make more profit from running projects and meet their long-term business strategies towards advancing activities to a higher level of maturity. Project portfolio management enables them to employ weighted selection criteria for screening possible projects to be tendered. In the lack of a portfolio management system, the goals of projects are likely to be in contradiction with strategies, the balance between resources and undertakings is not guaranteed, and the numbers and workload of selected projects can exceed the overall capability of the organization. This approach helps to minimize such business risks and put necessary arrangements in place to ensure a proper link between operations and strategies [11].

Several frameworks have been proposed in the literature describing the sequence of steps for managing a project portfolio. Cooper et al suggested main stages that involve (1) determining the strategic objectives, (2) determining strategic buckets (the portfolios and sub-portfolios), (3) budgeting buckets, (4) gap analysis, and (5) prioritizing projects [12]. Archer and Ghasemzade argued that the steps include (1) pre-screening, (2) individual project analysis, (3) screening, (4) optimal portfolio selection, and (5) portfolio adjustment [13]. The most recent and globally recognized framework has been introduced by the Project Management Institute (PMI) in the form of three stages known as defining, aligning, and authorizing & controlling process groups. Each stage involves several steps which are discussed in the next section in more detail [14]. Overall, this framework has advantages over other frameworks in terms of comprehensiveness and broad application since it has been widely applied in different contexts in previous research. Thus, it is considered as a basis for studying the features of portfolio management in this paper [15].

## III. METHODS

The findings of the present paper are based upon a theoretical discussion driven by the literature on the incorporation of sustainability in project selection decisions. The framework of project portfolio management that is introduced by the Project

Management Institute (PMI) was adopted to discuss different aspects of sustainability throughout the process of selecting and monitoring construction projects. The study was conducted from a contractor point of view and provides guideline on how to incorporate sustainability in one of the most challenging decisions of senior managers in construction contracting organizations.

#### IV. RESULTS AND DISCUSSIONS

The necessary sustainability requirements associated with each step of the project portfolio management (PPM) are described based on the PMI framework in the following sections to highlight how practitioners can incorporate sustainability in the process of selection and management of their construction projects.

##### A. Portfolio Defining

This stage involves developing a portfolio strategic plan, charter, organization's portfolios, and roadmap to clarify the direction of the organization in selecting and monitoring projects. It is also necessary to develop a plan for executing PPM and a communication management plan for controlling the communication channels and speeding up the interactions between involved parties. A PPM performance management plan is also needed to track the outcomes and their compliance with the performance targets. PMI also added another process that has been neglected in other PPM frameworks. This process refers to planning portfolio-related risk management. These risks are different from operational project-level risks but are linked to them [15]. Sustainability requirements that should be incorporated in this process group are those related to strategies of a contracting organization in approaching environmental sustainability [16].

In this process group, sustainability goals should be defined and included in the PPM plan and roadmap. The process for screening projects against the sustainability criteria, environmental risks, integrating sustainability with other project selection criteria, and the final scoring model should be developed and communicated to the PPM team and stakeholders. the PPM team also needs to formulate metrics for tracking the performance of projects in meeting environmental sustainability standards. Collective information on such metrics at the portfolio-level shows the overall performance of portfolio components in meeting sustainability goals. For example, the quantity of waste generated in the construction phase, the percentage of recycled waste, the percentage of reused waste, and waste cost can be taken into account.

##### B. Portfolio Aligning

This process group consists of ongoing activities for selecting and optimizing the portfolio of projects. The activities in this stage aim to categorize, prioritize, select, and control the components of the portfolio. The plans that were developed in the defining stage are followed to ensure that the mix of portfolio components is aligned with business strategies [15]. First and foremost, the nominated projects should be screened against the

sustainability criteria. Most importantly, the possible environmental risks of the type of construction projects that a contractor intends to undertake should be identified and assessed using a checklist. The applicable risks for certain projects should be assessed before deciding to tender the project. The contractor should make sure of its capabilities in addressing those risks throughout the lifecycle and consider the relative score in the project weighing system. At the portfolio level, the relation between environmental risks of related projects should be analyzed and considered for future portfolio decision-making purposes.

##### C. Portfolio Authorization and Control

As an ongoing governance function, this stage reflects the activities required for portfolio oversight. This process enables a portfolio of projects to achieve metrics defined in the first stage. It involves tracking and reviewing PPM performance indicators [15]. The portfolios should be reviewed periodically to ensure that their components are on track in terms of sustainability performance targets. Any deviation and non-compliance such as the generation of massive on-site waste for a certain group of projects should be reported to senior managers for making decisions before the situation gets out of control. The level of environmental risks should be monitored continuously and response actions to those risks need to be recorded. The output of this stage is used for improving the contractor's sustainability goals and their incorporation in the PPM process.

The potential requirements that need to be included in each stage of the PPM process revealed that there are plenty of opportunities for incorporating sustainability in the portfolio management tasks in a construction contracting enterprise. In this study, the overlap of sustainability management and portfolio management demonstrates how they act together to help a contractor comply with the environmental protection standards. Previous research has applied the concept of sustainability in business strategies to consider sustainable development in the link between operational activities with causal chains of an organization's long-term strategy [17]. However, to the best of our knowledge, no study has been conducted to explain how sustainability can be incorporated from the first step of a business cycle (the selection of projects) through to all stages of execution. Our discussion revealed that the following actions can be taken by contractors to incorporate sustainability in the PPM process (Table I).

TABLE I. SUSTAINABILITY TASKS THROUGHOUT THE PPM PROCESS

Environmental sustainability tasks	Defining	Aligning	Authorizing & control
1) Clarify and communicate strategies in approaching environmental sustainability	✓		

Environmental sustainability tasks	Defining	Aligning	Authorizing & control
2) Incorporate environmental sustainability goals in the PPM plan and roadmap as a selection criterion.	✓		
3) Integrate sustainability criterion with other project selection criteria.	✓		
4) Formulate metrics for tracking the performance of projects in meeting environmental sustainability.	✓		
5) Identify possible environmental risks for the type of projects that are delivered by the contractor.		✓	
6) Screen nominated projects against the sustainability criteria		✓	
7) Capacity planning for sustainability to ensure that the contractor can tolerate and control environmental risks.		✓	
8) Analyze the collective impact of environmental risks of several projects at the portfolio-level.		✓	
9) Measure and track the overall performance of portfolio components in meeting sustainability goals.			✓
10) Report sustainability-related issues to senior managers for decision making.			✓
11) Monitor the response actions to environmental risks at the portfolio level.			✓

## V. CONCLUSION

This study contributes to an understanding of the project portfolio management process as a tool to consider sustainability requirements for project selection and oversight in construction contracting. We theorized that the PPM process helps to incorporate this concept from the beginning stage of the business lifecycle by screening possible business opportunities and select those projects that are compatible with the contractor's capability in managing the generated waste and addressing corresponding environmental risks.

This study was conducted based on a client's point of view and we highlighted the responsibility of clients in the tendering stages and when they make decisions regarding the supplier selection and choosing the qualified contractors to undertake the construction work. We argued that efforts for achieving a circular built environment should begin even before the planning and design of the project when contractors are invited to tender a construction project. Clients are responsible to adhere to legislation on environmental sustainability and incorporate its principles and requirements in tender documents and pre-qualification criteria. We found that selection of contractors who are equipped with the tools and methods to practice waste management and have access to experts in this field are more likely to result in delivering a quality facility while adhering to all standards of environmental sustainability.

This study has limitations due to its theoretical nature. We suggest that future research validates the list of environmental sustainability actions that have been proposed in Table I through an empirical study. The implication of this research includes describing potentials of the PPM process to help contractors align their business with today's sustainable development requirements that are considered as a prerequisite for those contractors who aim to stabilize their competitive position and improve their brand recognition in the construction market.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

Mahmoud Ershadi conducted the research and wrote the paper; Marcus Jefferies, Peter Davis, and Mohammad Mojtahedi revised the paper; all authors had approved the final version.

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