ASSESSMENT OF WASTE MANAGEMENT FACTORS IN INFRASTRUCTURE PROJECTS

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ABSTRACT. *The goal of this study was to compile information on construction waste management. The study divided them into categories, figured out how they related to one another, and then offered suggestions for cutting down on construction waste. These variables were utilized to choose an online survey to gather the necessary information to start this research, and approximately 167 participants replied. The organizations in charge of managing construction waste for infrastructure projects were then graded according to their effective weight. The most successful group was Management, which was followed by the Execution, Others, Procurement, and Design groups, in that order. Ultimately, suggestions are made to businesspeople based on the findings of the investigation.*

INTRODUCTION

One of the sectors with the greatest impact on the growth of nations and the world economy is construction. Given that it employs about 7% of the world's workforce, it is essential to both the expansion of the global economy and employment. Building, infrastructure, and industrial sectors can be used to categorize the construction industry. Each sector can be further broken down into numerous different sectors. For example, the infrastructure sector can be further broken down into the sub-sectors of highways, railroads, wastewater, utilities, etc. The development of modern human life, the improvement of facilities for meeting human requirements, and the provision of an easy and opulent lifestyle are all results of these construction industries.

Over 35% of the construction industry is devoted to infrastructure projects, so the waste generated by these projects must be adequately managed. It has to do with the difficulties in implementing these projects' nature.

The significance of this study can therefore be attributed to the fact that the amount of construction waste produced throughout the construction process is increasing significantly, which has a detrimental impact on the environment, costs, and project delivery. As a result, this study will help to highlight the effects of construction waste, identify the factors that contribute to construction waste, and provide recommendations for limiting this behavior. By doing this, details on waste from building projects and construction waste management will be shared with the entire construction community, helping to increase awareness of CWM. Many nations adopted the Construction Waste Management (CWM) method in the form of institutions in AICs. The primary goals of CWM implementation are to reuse materials that might be suitable for reusing, eliminate waste when feasible, and minimize waste where practical. By implementing the plan, countries' economies, environments, climates, and resource use will all benefit because fewer trash will be produced throughout the construction and demolition C&D processes.

LITERATURE REVIEW

This section includes a thorough analysis of various previous studies on the subject of the current research study that have been carried out by numerous researchers. According to a study by Narayanamurthy and Gurumurthy [1], a literature review is an examination of scholarly materials that adds value to an overview of a particular topic. Since the literature review is presented in a descriptive and analytical manner, it has been acknowledged in this context as both the process and the outcome..

A major contributor to the global production of garbage in large quantities is the construction industry. This claim has been considered in light of another research investigation carried out by Islam *et al* [2]. It has been determined that infrastructure projects produce construction trash, but they also play a significant role in boosting economic activity.

Due to their significance to a project's success, infrastructure, and building construction issues have drawn the attention of numerous scholars over the past few years. Similarly, CWM is crucial in minimizing construction waste from the project's viability all the way through maintenance. A construction company can build up a CWM system to assign the right number of materials to the project in order to successfully complete it, according to a research report by Mubarak [3]. This assertion has been taken into account. According to a study by Abu, Abudi, and Bukari, building trash is frequently used in place of materials that must be purchased in order to minimize harm [4]. According to an analysis of this claim, the building sector is able to preserve the environment in a way that is both economical and environmentally responsible. According to a study by Ajayi et al. [5], building waste happens when more resources are used than are necessary to finish a project. Construction waste has been determined to have a substantial negative impact on society and the environment, which negatively impacts day-to-day life.

It has been noted that over the past few decades, the building industry has experienced substantial growth. Many academics have carried out several studies to investigate and assess the influence of construction operations on perceptions of social life for this goal. In this way, the section gave a thorough review of the importance of managing construction trash. Reviewing several research exercises also revealed that waste has been identified as a serious issue in the building sector in terms of its financial and environmental impacts. This is why many construction businesses use different waste reduction strategies. Debris from construction and demolition projects has drawn the attention of scientists and specialists from all over the world. The segment also focused on factors that cause construction waste and, consequently, have a bad effect on the construction industry. To lessen these risks, other

waste management strategies are also discussed in this section.

DATA COLLECTION AND METHODOLOGY

After researching the primary causes of construction waste production in infrastructure projects, 26 elements were chosen as the focus of this study since they are thought to be the main causes of construction waste production. Six categories—Design, Logistics, Execution, Management, Procurement, and Others—were used to group these aspects. Table 1 lists the major entities for factors.

Table 1 Waste Factors

Group	Factors
Design	Frequent Design Changes
Design	Design Errors
Design	Lack of Design Information
Design	Uneconomic Design or Shapes
Logistics	Improper Storage of Materials
Logistics	Poor Handling of Materials
Logistics	Improper transportation causing damages to materials
Logistics	Using Unsuitable Tools Leading to Material Damage
Execution	Inexperienced Workers
Execution	Improper installation techniques causing damages to on-going work
Execution	Inappropriate Construction Works Execution Strategy for Site Activities
Execution	Rework
Execution	Contractors Working on Site Without Approval by Client or Consultant
Management	Poor communication among project parties
Management	Lack of Construction Waste Management Knowledge
Management	Poor Planning of Site Layout
Management	Poor Quality Management System
Management	Improper Controlling and Supervision Strategy to monitor and guide workers
Management	Improper daily site management leading to leftover materials on site
Procurement	Wrong ordering of materials by procurement team
Procurement	Quantity Take-off Error by Contractor
Procurement	Minimum Order Requirement by Suppliers
Others	Extreme Weather Conditions Damaging Completed Works
Others	Unforeseen Incidents Damaging Site and/or Completed Works
Others	Poor Subcontractor performance causing damages to completed works by others
Others	Theft and Vandalism

An online survey built using Survey Monkey software was used to gather research data. The poll received responses from about 196 people globally. Only 167 of the 196 replies were taken into account, and 29 were rejected since the survey wasn't comprehensive.

DATA ANALYSIS AND DISCUSSION

The management of construction waste in infrastructure projects in Qatar will be assessed in this section. The information acquired in part 2 of the questionnaire illustrates the importance level of each indication in each area based on the experiences of the respondents.

The results for the indicators connected to the first group, "Design," are summarized in Table 2. When it comes to the development of construction waste, it was found that the indicator "Lack of Design Information" ranked highest, with an Extremely Important rating from 45.51% of respondents. The least significant indicator, according to respondents, is

"Uneconomic Design & Shapes," which received a total of 29.34%.

Table 2 Design Factors

Factor	Level of Importance				
	NI	SI	MI	VI	EI
DES-1	0.00%	3.59%	16.77%	46.11%	33.53%
DES-2	0.00%	1.20%	13.77%	43.11%	41.92%
DES-3	0.00%	4.79%	14.37%	35.33%	45.51%
DES-4	1.20%	5.99%	23.95%	39.52%	29.34%

NI: Not at all Important SI: Slightly Important MI: Moderately Important VI: Very Important EI: Extremely Important

"Improper Storage of Materials" was discovered to be a Very Important Indication for generating CWM for the Logistics group, receiving 46.11% responses (Table 3). As indicated in the table below, the three indicators relating to logistics are all too near to one another, with a difference of less than 5%.

Table 3. Logistics Factors

Factors	Level of Importance				
	NI	SI	MI	VI	EI
LOG-1	0.00%	2.40%	13.17%	38.32%	46.11%
LOG-2	0.00%	2.40%	11.98%	42.51%	43.11%
LOG-3	0.00%	5.39%	14.97%	37.72%	41.92%

Table 4 displays the responses from the execution-themed third group. About half of respondents rated "Rework" as Extremely Important, making it the indicator from the Execution group that is most crucial for producing CWM. Also, with a difference of only three responses.

Table 4. Execution Factors

Factors	Level of Importance				
	NI	SI	MI	VI	EI
EXC-1	0.60%	4.79%	19.76%	42.51%	32.34%
EXC-2	0.00%	3.59%	18.56%	41.32%	36.53%
EXC-3	0.60%	4.19%	9.58%	44.31%	41.32%
EXC-4	0.60%	2.99%	20.96%	40.72%	34.73%
EXC-5	0.00%	4.79%	14.37%	29.94%	50.90%
EXC-6	0.60%	10.78%	13.17%	26.35%	49.10%

In terms of management, "Poor Communication Among Project Parties" was the primary factor in the production of construction wastes, and more than half of the respondents agreed. The importance of the remaining five indicators in producing construction wastes, on the other hand, was nearly equal. Table 5 lists management-related factors.

Table5. Management Factors

Factors	Level of Importance				
	NI	SI	MI	VI	EI
MNG-1	0.00%	4.19%	13.17%	30.54%	52.10%
MNG-2	0.00%	2.99%	13.77%	41.92%	41.32%
MNG-3	0.00%	6.59%	13.77%	40.72%	38.92%
MNG-4	0.00%	2.99%	18.56%	40.12%	38.32%
MNG-5	0.00%	5.99%	16.77%	41.92%	35.33%
MNG-6	0.00%	3.59%	19.16%	41.32%	35.93%

The relative weights of each indicator in the "Procurement" Group are shown in Table 6 as percentages. It was determined that "Wrong Ordering of Material by Procurement Team" was the main cause of the production of construction wastes. However, because just 20% of respondents viewed it as an extremely essential aspect and about 30% as a somewhat important one, the "Minimum Order Requirement by Supplier" indicator was considered to be the least important signal in this category.

Table6. Procurement Factors

Factors	Level of Importance				
	NI	SI	MI	VI	EI
PRC-1	0.60%	1.80%	12.57%	29.34%	55.69%
PRC-2	1.20%	4.79%	20.36%	31.14%	42.51%
PRC-3	0.60%	9.58%	29.94%	38.92%	20.96%

The final group, "Others," was made up of a few indicators that are unrelated to the previous groups but contribute to the development of construction waste (Table 7). All indications were deemed to be Very Significant in causing construction wastes, however, the indicator "Poor Subcontractor Performance Creating Damages to Finished Works by Others" was deemed to be the most significant, as shown in the table below.

Table7. Other Factors

Factors	Level of Importance				
	NI	SI	MI	VI	EI
OTR-1	1.80%	10.18%	24.55%	35.33%	28.14%
OTR-2	1.80%	12.57%	25.15%	35.33%	25.15%
OTR-3	1.20%	2.40%	19.16%	41.32%	35.93%
OTR-4	6.59%	13.17%	27.54%	31.74%	20.96%

CONCLUSION

The importance of this study can therefore be linked to the fact that more construction waste is being produced during construction, which has a negative influence on the environment, project costs, and project delivery. This study will therefore contribute to highlighting the effects of building waste, identifying the contributing elements, and offering suggestions for minimizing this practice. This will help to increase awareness of CWM by spreading information about construction waste and construction waste management throughout the building industry.

The results of this study may be useful for designing, consulting, and contracting firms that are interested in reducing construction waste generated during the development of infrastructure projects. This goal will eventually result in a greener environment and a better planet.

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