

Identification of the Sources of Overall Waste Generation that Affects the Well Being of the Environment



B.Vidyasekar, K.G. Selvan

Abstract: *In the old urban regions, major reconstruction operations are taking place on a fast scale throughout the world, which gives rise to large quantities of Construction and Demolition Waste (CDW). There is a gradual decline in available landfill space, while demand for quarry products is increasing. Because of its non-degradable features, CDW is a significant problem in many nations. Proper CDW management and recycling helps alleviate these issues. The contribution rates from various waste sources improve knowledge-based decision-making in the development of appropriate construction waste reduction strategy. This paper is focused on investigating the rate of recurrence and the seriousness of the contribution of waste sources that affect the well-being of the environment.*

Keywords: *Source of CDW, non-degradable features, Waste reduction, Knowledge-based decision-making, Environmental impacts.*

I. INTRODUCTION

The CDW has several impacts on the environment, which includes water contamination, soil contamination, and landscape erosion. It also has an adverse economic impact due to the need to replace waste products by offering increased construction costs. On one side, the massive market for providing raw materials has been a significant issue in the construction industry, and on the other, the handling of waste from the demolition of the building is another problem. The social norm in the construction sector creates waste where commercial constructors are appreciated for fast work completion rather than bothering about their work that impacts the environment [Sullivan et al., 2010]. Construction work contributes to land development, land degradation, depletion of resources, and generation of waste and different types of pollution. The enormous waste generated by construction operations, however, produces adverse effects on the environment, economy and society. As an additional cost material waste is

generated in construction site because purchases are made to restore old products; rework costs, disposal and delays that cause financial losses to the contractor [Ekanayake and Ofori, 2000]. The social image of the construction industry and the health, as well as the safety of the workers, are socially affected by the waste. Therefore, there is a requirement to limit waste by management activities such as reduce, recycle and employing reuse of waste. Inadequate knowledge of the source of waste makes it impossible to manage or reduce waste. By waste reuse, it is feasible to use inert worn-out material as land reclamation filling material. Construction waste disposal has also become a social and environmental issue, as there is an acute shortage of landfill spaces [Yu et al., 2013].

II. RESEARCH INTEREST IN CDW

Even though considerable research has been done to identify construction waste sources, there is a need for studies targeted for analysing the ecological impacts. An analysis is made for the contribution rates of the construction waste sources identified in previous research. Analysing such rates will improve a more precise estimate of the cost of waste and develop an appropriate waste mitigation strategy. A detailed literature retrieval procedure was performed based on the indexed databases: ScienceDirect to provide a deep understanding of the present C&D waste quantification methods. Potentially related papers were searched from a period of 2004-2019 in the designated databases, as shown in figure 1.

III. SOURCES AND TYPES OF CONSTRUCTION AND DEMOLITION WASTES

A. Construction Wastes

Design, logistics, and physical construction processes result in construction material waste. Operational procurement, design, and material handling attributes contribute to construction site waste, according to [Ekanayake and Ofori, 2000]. Regarding design demands the client and designer can agree on the eco-friendly choices. Therefore, it is not the individual responsibility of the construction company in waste management [Bossink and Brouwers, 1996].

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QUALITY CHECK

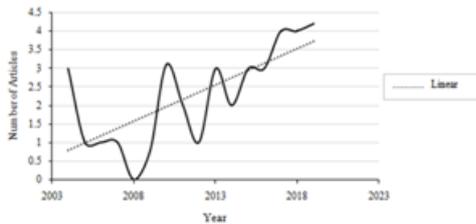


Figure 1: Trend of research interest in CDW

Most of the previous studies on quantification of waste focused on the volume of waste generated and the segregation of waste for specific materials. [Bossink and Brouwers, 1996] performed research on waste segregation at construction sites, and the study showed that from 1% to 10% of each type of material delivered to the sites was wasted. To estimate the quantity of waste that would be produced, [Formoso et al., 2002] performed an observational study of materials delivered to construction

sites and the study indicated an average of 27.6% waste quantity sources, which include labour error, handling, and lack of quality control. [Solis-Guzman et al., 2009] created a waste quantification model that allows the waste quantity to be determined and categorised into packaging, demolish and debris waste. On a typical new construction project, the model was tested and showed that wreckage forms 82% of the waste that the project would generate. This paper focuses on the seriousness of the waste contribution and its impact on the ecology. [Gavilan and Bernold, 1994] classified the source of waste into six different categories: (1) procurement; (2) design; (3) operations; (4) handling of materials ; (5) residuals; and (6) others. were supported by [Ekanayake and Ofori, 2000] and similarly regrouped into categories: design, procurement, handling of materials, and operation. Also, waste is generated due to external factors such as vandalism and robbery [Bossink and Brouwers, 1996]. Therefore, in this study, the sources of waste mentioned above were combined and categorised, as shown in Table 1. The amount of C&D waste generated depends on various facts like the level of urban economic growth and urban construction scale.

Table 1: Sources of construction waste

Sources of Waste	Causes
Procurement	Unnecessary materials on-site as a result of ordering and supplier’s error
Design	The error resulting from documentation and design changes
Material handling	Improper storage, improper on/off-loading, and Harsh transport
Operations	Error as a result of wrong installation/reinstallation from trade persons
Weather	Disaster as a result of climate change
Vandalism	Lack of supervision
Misplacement	The error resulting from material getting lost or deserted
Residual	The material being resized to shape that gets unfit to use
Others	Lack of waste management plan

B. Types of Construction Waste

The construction industry, as known is not eco-friendly. Besides solid waste; the poor quality that causes rework, waiting for decisions, swapping within the job, scheduling delays, double handling of materials, and defects in construction are regarded as other types of waste. It is categorised into two components [Anis et al., (2001)]; Time wastes that include waiting periods, stoppages, clarifications, data variations, rework, ineffective work, abnormal equipment wear, and delays in planning operation. Material wastes that include over-production, over-ordering, incorrect handling, incorrect storage and production defects.

IV. WASTE GENERATION FACTORS

Based on the project dimension, their activities and site of operation, the waste generating factors differ. Factors like site clearing that occurs at the beginning of the construction process by the handover of projects also contribute to construction waste. [Gavilan and Bernold, (1994)] the main causes of waste were design, procurement, and handling of materials, operation and leftover scraps on-site. The material flow design for onsite construction is shown in figure 2. [Faniran and Caban, (1998)] studied the waste reduction strategy by conducting surveys in companies, in which most companies had inadequate waste reduction policy while companies with clear policies tried to reduce waste at

source. The results recognized that the five main causes of waste are design changes, leftover material, distress climatic conditions, detailing errors, and packaging waste. The construction industry experienced that design; operation and handling of materials were critical sources of waste from the site [Ekanayake, (2000)]. During design and construction, the last-minute changes had the highest rating of waste

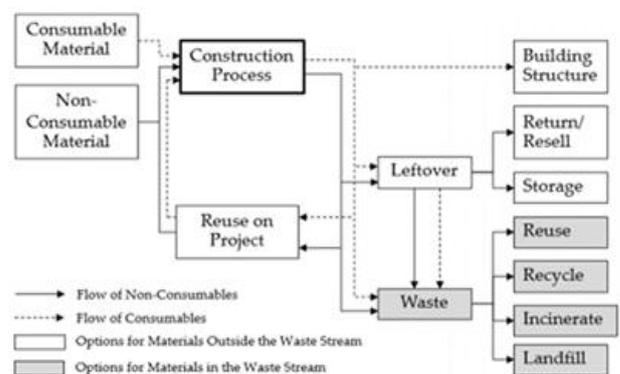


Figure 2: On-site material flow diagram. Source Gavilan and Bernold (1994)

contribution from both architects and contractors. [Bekr., (2014)] indicated that the main causes of waste materials on construction sites were changes in design, rework, poor documentation, improper and inadequate storage of materials, poor waste management strategy, lack of skilled workers, poor site conditions, damaged material during transportation, mistakes in quantity estimation and over allowance estimation, and theft and vandalism. [Domingo, (2015)] researched on constructing waste generation factors. The findings revealed that the causes of construction waste were incorrect drawings, imperfect update, complex designs, non-standard designs, and poor management in the building lifecycle.

A. Categorization of Waste Generation Factors

For years, studies were conducted on factors generating waste in construction. Significant factors have been identified and grouped that contribute to constructing waste generation. Categorizations of waste generation factors were attained from the past researches. It includes the design and documentation of the construction process. In actual construction, materials unused may result in waste. Designers may shape the materials by not taking into account the standard dimension and may end up as waste. The cause of construction waste [Karim and Marosszeky, (1999)] is also due to the absence of understanding of the market about the standard size of the real construction products. Waste generation in the design phase is caused by flawed details and modifications [Gavilan, R.M and Bernold, L.E ., (1994)]. Throughout the construction process, design and documents play a significant role. The main sources of material waste were inadequate handling and improper transportation [Formoso.et al., (2002)]. [Karim and Marosszeky, (1999)] stated that pre-construction preparations mainly caused waste during the construction phase, but in the construction process, there were still many other factors that caused waste. Waste could be produced during the construction process due to bad coordination and control [Khanh, H.D and Kim, (2014)], the wrong choice of construction methods and reworks [Bekr, (2014)].

Environmental Implications of Construction and Demolition Waste

The amount of waste generated depends on labour and personnel factors. Natural resources are limited on earth, but it is unsustainable in perspective of the uncontrolled consumption of construction material. Consumption of construction materials has increased in the past century compatibly with production. This trend of use of unregulated construction materials will lead to worldwide environmental degradation, indicating extinction for humanity. [WHO, (2006)], ecosystem and humans always have associations with each other. These affect the quality of life and wellbeing. Therefore, issues need to be identified with regards to the construction project. Due to congestion, debris, and constructing operations, roadways have become narrower and less parking spaces. Due to the uncontrollable use of structural construction materials, it is evident that this present consumption trend will result in severe environmental hazards worldwide. Steel has the worst effect

on the environment with the highest emission per unit weight and very high energy content. Concrete output is much better than steel per unit weight in comparison. Even though cement consumption and its global emission are enormous compared to steel consumption, mitigating these environmental impacts will assist with new materials that have less effect on the environment and are more environmentally friendly.

V. CONCLUSION

The source and the amount of waste produced in construction projects depend on various factors. It can be concluded that inadequate knowledge/experience in the construction site, purchase of non-specific material, improper storage are the main factors contributing to waste generation. Further research also conducted to attain a deep understanding of other practices being implemented on construction sites for sustainable waste management. Improved knowledge of environmental benefits and barriers to C&D waste recovery and recycling in remote communities may assist policymaking, including developing a regulatory framework for C&D waste management. It is suggested that there will be scope for future research on creating awareness through efficient training on the proper method of waste management.

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