International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 03 | March – 2025 DOI: 10.55041/ISJEM02443
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

Minimization of Waste using Lean Construction

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Keyword
lean construction
lean design
Lean principles
wastes

Abstract

Waste within the industry has been the topic of many analyses comes round the world in recent years. The lean manufacturing is a popular means of continuous improvements that has reshaped manufacturing process, practices and principles globally. Originating from the construction industry, the approach has been used extensively in the manufacturing sectors. Lean producing focused round the philosophy of unceasingly up performances by consistently eliminating wastes. Lean construction considers construction wastes as potential wastes that hinder flow of values to the client and should be eliminated. The aim of the study is to advance knowledge in construction site waste minimization through the lean principles. The main objective of this study is to assess the impact of lean principles in construction using key performance indicators. KPI can be used to help a group to describe their ideas in a pictorial form which has been applied in many different areas; elimination of waste, shifts in organizational behaviour, procurements, quality, and delivery as fast as possible, continuous improvements. The main tool for the collection of data is structured questionnaire. The target population for the data collection is projects managers, supervisors of the construction firms. SPSS will be employed to analyse the data obtained. After this step the KPI will be evaluated using those results from which, it will be concluded that, how the construction companies can apply in construction firm its continuous improvements.

1. Introduction

Construction industry consumes natural resources to an unbounded exempt. It also generates large amount of construction waste which causes significant impacts on the environment. So construction manufacturers give more importance in recycling and reusing of the waste generated. The main causes of waste generation are: • Lack of waste management plans • Poor supervision and attitude of workers • Inaccuracy in quantity surveys • Complications in order-taking • Issues in material storage • Inferior quality of materials • Poor materials handling Construction waste includes soil and aggregate, sand, cement, bricks, concrete, gypsum board, metal, ceramics, tiles, wood etc. The advantage of using recycled waste materials includes, the enabling of recovery metabolism and thereby, protect the environment and natural resources. It also aids in cost reduction, benefit to industry and economy and reduction of space requirement for landfill uses. [1] By using life cycle analysis, resource consumption was evaluated which integrates the ecological footprint indicator in the construction techniques. It is required to determine the building construction and

then to calculate the methodology, so that the impacts that are produced by the industry could be defined. This method is applicable to both resources and waste generation in construction industry, but it is difficult to describe the eco-efficiency index to assess the efficiency of the ecological footprint indicator. [2] Minimisation of waste at the design stage is an essential one. It focuses on some significant indicators like large-panel metal frameworks, pre-fabricated components, molecular design, waste reduction investment and economic incentive for waste minimisation. Presentation of potential design strategy in waste reduction should have been made clearer. [3, 4] proposed to identify the construction waste and then to express the physical waste generated. Finally the waste management plan was applied. If the implemented waste plan management was successfully capable to solve the issues, then this process would have been really reliable. [5] Proposed the construction and demolition waste management to maximise the waste reduction along with recycling procedures and to minimise the construction waste disposal by life-cycle analysis. Due to its reduced accuracy it seems to be complicated in dealing with the sustainability index. [6] Rock materials and sand are the main sources of the raw construction material. In order to protect natural resources, country's economy and to minimise waste disposal, the recycled aggregates are used as an alternate for natural aggregates in concrete construction. [7, 8] Unavailability of policy, standards or specification acts as a barrier, which limits the usage of recycled aggregates. [9] Presented a field scale methodology for developing a generalised waste management plan. The waste management plan is applied to city, regional or country level. This methodology is also used to estimate the total waste generation rates at a larger scale to develop more effective waste reduction strategy. No quantification methodology can fulfil all of the potential scenarios and so an appropriate methodology should be generated. [10] Discussed the causes of problems in construction industry and proposed a strategy that could mitigate the problem. It has also evaluated economic feasibility of waste minimisation in terms of cost savings. An appropriate methodology is recommended to do significant cost savings. [11] Presented a new plan to quantify the waste generated at new residential constructions. In previous published research works, there is an existence of 1-10% of mean deviation between the models predicted and the data's collected. But in the proposed model the maximum deviation is found to be -38.48% in volume and -15.97% in weight. This model is an important tool for construction companies to optimize construction and demolition waste management.

METHODOLOGY

Lean construction concept in this paper, a Lean Construction (LC) concept is used. This LC technique improves the construction project by reducing the waste of resources and at the same time it increases the productivity and secures a healthy and safer environment. The core concept of lean production is to enable the flow of valuable steps and eliminate the non-value steps. Lean production management leads to revolution in manufacturing design, supply and assembly. The benefit of incorporating lean construction in construction process is to reduce the construction cost by using precise materials and to diminish the amount of waste generation. In addition, by having a proper strategic planning, the construction period will be shortened. Moreover, the productivity, profitability and job satisfaction of the clients are greatly enhanced by the use of lean construction technique.

3. Last planner system of lean construction

To attain waste reduction, an instant growth in productivity and a reduction in unpredictability of lean goals during every part of a social process must be enhanced. This increases the reliability of commitments of the team members and thus creates a mutual attempt plan. As a key concept of LC, only smaller number of accidents will occur and it will increase the safety in workplaces. The principal schedule to synergise the LC concept is at the construction and pre-construction stages. Both of this process are critical due to the removal of construction waste during construction and examination of material, equipment and labour service throughout the pre-construction process. The lean production concept has been identified as a clever stratagem in designing, controlling and improving construction processes. This also improves planning process and safety management in order to consider hazard rates and their counter measures. The benefits gained from LC concept compete with other approaches by its effective use of resources, cost reduction, quality improvement and by its immediate response. Key reported barriers of adopting other techniques include (i) Lack of lean awareness amongst workers and management. (ii) Current financial crisis. (iii) Inadequate training and high cost. (iv) Work pressure and fear of failing in the implementation. (v) Multi-cultural workforce and language barrier. (vi) Worker's attitude and resistance to change. The advantages of lean techniques include i) Generation of a smooth work flow without waste ii) Reduction of wastes generated from the project activities.

iii) Increasing the profit and the market share IV) Improving the safety and workers morale IV) Increasing team empowerment v) Improving customer satisfaction VI) Delivering the projects at the stipulated time.

Classification of Construction waste through lean construction approach

Construction waste is classified on the basis of different features such as quantity, type, etc. Excess materials, delays, defects and rework are the most common wastes. The nonphysical wastes from the construction processes are the basis of waste concept from lean construction approach. Actually, the lean construction concept recompense special attention to construction process waste, which is further divided into two main categories i) waste due to nature of processes ii) waste due to non-value adding work. The wastes mentioned in construction process category are not entirely due to nature of process or due to non-value adding works.

Lean Construction Key Performance Indicators

a. Sigma Rating (SR): The degree of excellence i.e. the quality of work is measured to highlight the complementary function of sigma and lean methods through sigma rating. The SR value thus obtained is compared with benchmark value of sigma rating to conclude whether DMAIC (Define, Measure, Analyse, Improve and Control) sigma betterment survey is required or not. b. The key aspects in LC are the speed of the project and the efficacy of the cost. The representative measures in the Earned Value Management System (EVMS) are the schedule performance index and the cost performance index are the representative measures in the Earned Value Management System (EVMS). EVMS is a technique which relates the project resources to schedule and technical performance in the project status.

Lean design

Design includes not only product design, but also process design. Product design describes what is to be produced and used, while process design describes how to produce it or use it. Designing provides information to distinguish positive and negative reiteration and also to reduce negative iteration. The challenges of lean design includes i) governing the time and cost, and the target of the waste reduction of the project objectives without reduction in the value ii) producing, evaluating and recognizing alignment between causes, ideas and criteria; the necessity for transferring a project from project definition into proper design iii) capturing and producing accessible design reasoning of a

facility iv) reducing the utility loss, the project proceed through its stages.

Benefits of lean design

The value generation and waste reduction is improved by acquiring a lean design approach. Value is produced for the identification, inspiration and clarification for stakeholder purposes by a set-based strategy. Waste is minimized by the superior product design of the lean approach. The advantages of product design are i) can be more economically and satisfactorily manipulated and retained ii) They are easily, securely and quickly built to a greater extent iii) They are easily unchanged and produces environmental damage to a lesser extent throughout apprehension and demolition.

RESULTS AND DISCUSSION

The efficiency of the construction industry is increased by means of proper planning and control. The dynamic processes in lean construction are planning and control. Planning points out the criteria and develop strategies so as to reach the project objectives while control confirms the events of the planned sequence. If the planned sequences are not convenient re-planning has to be done. One of the best-known lean techniques is the Last Planner System (LPS). It is an important tool for construction management process and a monitor for planning efficiency in order to assist the smooth workflow variations, reducing the uncertainties plaguing in construction processes and development of foresight. It also consists of work flow control and production unit control. Work flow control is accomplished through look-ahead process, while production unit control is accomplished through weekly work planning. The lean production management is devoted to minimize and to regulate variability and unpredictability in the implementation of the project plans. The potential variability is eliminated by the removal of the constraints. The implementation of the entire Lean Project Delivery System (LPDS) is achieved through shielding.

CONCLUSION

Research focuses on the minimization of waste generation. Upon comparing several methods, the proposed method based on lean design results in better performance, where the increased values prove that this proposed strategy is productive and the trade-off between time and cost has been enhanced by increasing the work flow variability. Design of last planner system in lean design assists in waste management at the construction site besides keeping check of other factors that makes the productivity getting lowered.

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