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"IMPLEMENTATION OF LEAN CONSTRUCTION TECHNIQUES FOR MINIMIZING PROJECT CONSTRUCTION TIME"

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Abstract: The Indian construction industry is a pillar of the Indian economy, contributing to roughly 10% of the GDP. For years the cost of construction in India has increased faster than inflation making it more and more expensive to build. Presently, the construction industry and all other organizations face various problems because of the uncertainties of the global economic climate, including labour redundancies, delayed projects and zero margin contract bids. Applying Lean thinking has transformed many industries and its implementation in construction has now started to show the potential benefits. The concept of lean construction is concerned with the application of lean thinking to the construction industry. Lean construction focuses on delivering precisely what the client and end-user want. Certain tools and methods have been conceptualized in the field of Lean Construction, which lacks research based on quantitative data. It is therefore objective of this project is to study lean concepts and apply these in planning of a construction project, minimize waiting time about time planning in the project and develop a more optimized schedule which relates to the benefits of applying Lean principles to a construction project. The aim of this project is to test the effectiveness of some lean construction tools, particularly those tools that can be applied in medium size construction firms. Due to the success of the lean production system in manufacturing, the construction industry has adapted lean techniques to eliminate waste and increase profit.

Keywords: Indian Economy, GDP, Lean Construction, Construction Industry.

INTRODUCTION

Construction is a very old industry. The problems of construction are well-known. Construction productivity lags than that of manufacturing. Occupational safety is notoriously worse than in other industries. Due to inferior working conditions, there are work force shortages in many countries construction sector. The quality of construction is insufficient. A few solutions or visions have been offered to relieve the chronic problems in construction. Solutions are in the form of development of various specialized tools like CPM (Critical Path Method), Gantt charts, EVA (Earned Value Analysis), etc to plan and control projects which have proved to be ineffective for fast paced and change prone construction projects.

What Is Lean?

Lean is producing what customer needs, when he needs and in what quantities he needs while optimizing resources. Lean construction is a translation and adaption of lean manufacturing principles and practices to the end-to-end design and construction process. Lean construction emphasizes on process improvement rather than concentrating on the final product by increasing Value Adding activities (VA) and reducing Non-Value Adding activities.

Principles Of Lean:

- Specify Value in the Eyes of Customer.
- Identify Value Stream and Eliminate Wastes.
- Make Value Flow at the Pull of Customer.
- Involve and Empower Employees.
- Continuous Improvement in the Pursuit of Perfection.
- Minimize variances.
- Consider time a key element of all processes.

- Eliminate waste of materials, poor communication, duplication of efforts, and design errors.
- Create a clean, safe, and efficient working environment, and communicate safely.

Need for lean in construction:

The construction process is a set of activities, each of which is controlled and improved. Conventional managerial methods, like the sequential method of the project realization or the CPM network method, deteriorate flows by violating the principles of flow design and improvement. They concentrate on conversion activities. The resultant problems in construction to compound and self- perpetuate. In project control, fire-fighting current or looming crises consumes management resources and attention so totally that there is a little room for planning, let alone improvement activities. Therefore, it leads to non-optimal flows and an expansion of Non- Value Adding activities.

OBJECTIVES

- The main objectives of implementing Lean in construction are Business objectives and Operational objectives.
- The Business objective includes the growth and profitability of the company. Whereas the Operational objectives includes Revenue acceleration by reducing the cycle time.
- Increase Productivity by reducing wastage.
- Improve the Quality by Continuous improvement in the processes.
- Achieve Safety of the workmen on the working site and last but not the least optimization of Cost by attaining above aspects.

LITERATURE REVIEW

Implementing Lean Construction Concepts in a Residential Project Article ·

The study presented in this paper was carried out in a project that comprised the construction of 18 houses financed by a private investor. The project was constructed north- eastern Brazil. During the study, the project managers implement lean construction concepts, tools, and techniques aiming at organizing the construction company's production planning and control system worked on the design of the suggested by Schramm et al.'s (2004) model for production system design. The company decided to embark on a lean journey after the crews had almost finished the first of the 18 houses in the complex. The project started at house number 09, in the front part of to be presented to potential customers 2001) for the management to evaluate actual productivity rates at the site. duration had been estimated in 10 months according to the experience of director. After the first house was finished analyzed, the project managers realized that the entire complex could be months. The original estimates were far off the mark as the duration indicated in the contract had too much slack in it. The main goals of this paper are to present a case in which Lean Construction concepts were implemented and to discuss the benefits achieved during the process. The case study was developed during the construction phase of a residential project in the urban area of Fortaleza, Brazil. The project comprised the construction of 18 houses financed by a private investor, and it was constructed and managed by a small sized construction company. Finally, after analyzing the benefits achieved in this pilot project the company's upper management has decided to use Lean concepts in other projects, and the private investor wants to make sure Lean is used in other projects financed by his company. The paper aims at contributing to the literature on Lean Construction in the industry papers section by presenting a success story experienced by a small- sized construction company.

Site Implementation and Assessment of Lean Construction Techniques.

O. Salem, J. Solomon2, A. Genaidy3, and M. Luegring4-A case study

The goal of this paper is to test the effectiveness of some lean construction tools, particularly those tools that can be applied in medium size construction firms. Due to the success of the lean production system in manufacturing, the construction industry has adapted lean techniques to eliminate waste and increase profit. A field study was conducted to evaluate the effectiveness of some lean construction techniques including last planner, increased visualization, daily huddle meetings, first run studies, the 5s process, and fail safe for quality. The data collection methods included direct observations, interviews, questionnaires, and documentary analysis. The effectiveness of the lean construction tools was evaluated through the lean implementation measurement standard and performance criteria. It was found that the last planner, increased visualization, daily huddle meetings, and first run studies achieved more effective outcomes than expected. However, the results of implementation of 5s process and fail safe for quality did not meet the expectations of the tool champions and the research team. It was found that there is a need for behavioral changes and training for effective use of lean tools. Most of the lean construction tools selected for the project are either ready to use or are recommended with some modifications. A summary of the results is provided, and future research needs are outlined.

Implementation of Lean Concepts in the Construction Engineering Project

Harsha N. Dr. A. V. Suresh and Mr. Nagaraj N.-A Case Study

The Indian construction industry is a pillar of the Indian economy, contributing to roughly 10% of the GDP. For years the cost of construction in India has increased faster than inflation making it more and more expensive to build.

Presently, the construction industry and all other organizations face various problems as a result of the uncertainties of the global economic climate; including labor redundancies, delayed projects and zero margin contract bids. Applying Lean thinking has transformed many industries and its implementation in construction has now started to show the potential benefits. The concept of lean construction is concerned with the application of lean thinking to the construction industry. Lean construction focuses on delivering precisely what the client and end-user want. Certain tools and methods have been conceptualized in the field of Lean Construction, which lacks research based on quantitative data. It is therefore this research paper's purpose to develop a tool in how to identify and measure waste, guide in how to prioritize eventual waste reduction activities. An exploratory method of investigation is adopted in achieving.
the aim of this paper by critically reviewing, exploring, and synthesizing literature related to the subject matter. This paper reviews the basic components of lean construction, with references to the development of lean production systems by manufacturing organizations and the advances of lean construction research. It discusses the implications on the implementation of lean construction about a firm's strategic planning as well as to the conditions for the industry to lesser the barriers for lean construction implementation. Adopting lean principles, this paper reports a study that identified the presence of value and waste in a construction engineering project. Finally, the paper describes the objectives and anticipated contributions of current research conducted at the construction site.

METHODOLOGY

The steps followed in the methodology adopted for this research are explained sequentially in order to provide a total picture of the thesis.
The aim of the study was to learn more about the subject under study and with an anticipation of generating insight within the field of lean and the construction industry. The chosen investigation design was the study of construction processes at a construction engineering project.

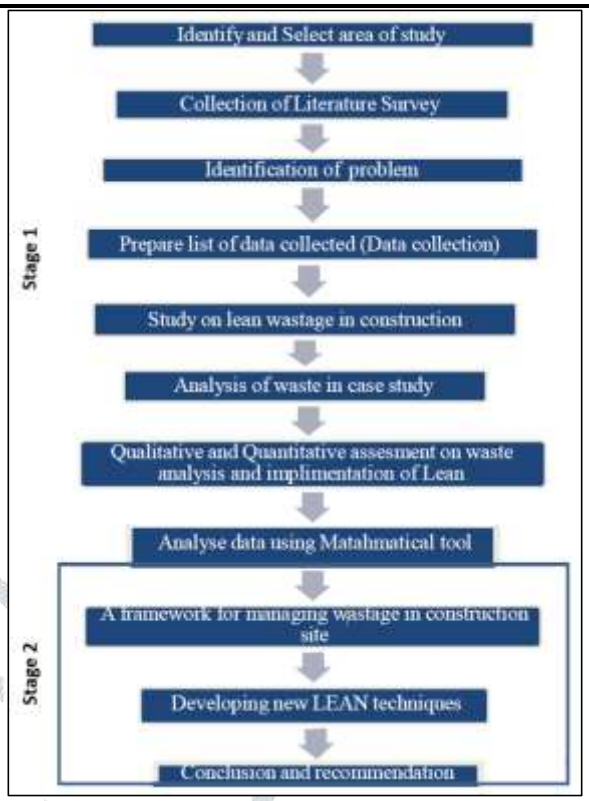

Fig 1: Flow Chart of Project work

THEOROTICAL CONTENT

Construction activity is an integral part of a country's infrastructure and industrial development. It includes hospitals, schools, townships, offices, houses and other buildings; urban infrastructure (including water supply, sewerage, drainage); highways, roads, ports, railways, airports; power systems; irrigation and agriculture systems; telecommunications etc. Covering as it does such a wide spectrum, construction becomes the basic input for socioeconomic development. Besides, the construction industry generates substantial employment and provides a growth impetus to other sectors through backward and forward linkages. It is, essential therefore, that, this vital activity is nurtured for the healthy growth of the economy. In the past, researcher has indicated that the waste in construction can occur at any stage of the construction project. Waste in the construction industry has been the subject of several research projects around the world in recent years. Several researchers have stated that there are numerous waste in the construction now a days. Since construction has a major and direct influence on many other industries by means of both purchasing inputs and providing the products to all other industries, eliminating or reducing waste in the construction industry could yield great cost savings to the society. Waste can be classified as unavoidable waste (or natural waste), in which the investment necessary for its reduction is higher than the economy produced, and avoidable waste, in which the cost of waste is higher than the cost to prevent it. Waste can also be categorized according to its source; namely the stage in which the root causes of waste occur. Waste may result from the processes preceding construction, such as materials

manufacturing, design, materials supply, and planning, as well as the construction stage. Some of the main classification of waste in construction is in design, procurement, material handling, operation, and residual. This study mostly concentrates on the material waste which is generated in the construction project. Building material waste is mostly defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials.

Case Study Referred in a project.

The study presented in this paper was carried out in a project that comprised the construction of 18 houses financed by a private investor. The project was constructed and managed by a small-sized construction company based in the city of Fortaleza in north-eastern Brazil. During the study, the project managers implement lean construction concepts, tools, and techniques aiming at organizing the construction company's production planning and control system worked on the design of the suggested by Schramm et al.'s (2004) model for production system design.

The company decided to embark in a lean journey after the crews had almost finished the first of the 18 houses in the complex. The project had started at house number 09, in the front part of

To be presented to potential customers 2001) for the management to evaluate actual productivity rates at the site. Duration had been estimated in 10 months according to the experience of director. After the first house was finished analyzed, the project managers realized that the entire complex could be months. The original estimates were far off the mark as the duration indicated in the contract had too much slack in it.

CASE STUDY

The case study for the project study is an ongoing on Residential Project located on Nasik. The details of case study are as follows:

- **Type of Construction:** Residential Construction Work.
- **Project Cost:** Rs 1.40 Cr.
- **Project Duration:** 18 Months
- **Date of Commencement:** 25/8/2023
- **Scheduled Completion Date:** 26/3/2024 Extended Completion Date: 26/5/2024 Builder / Owner: Er, Ashok Pagar.
- **Consultant:** SANKET DEVOLOPERS.Pvt..Ltd. Check Proof Consultant: PRASANNA BHORE Designer/Architect: DHIRAJ PATIL Site Engineer: Kanti Bhai Patel
- **Type and no. of Footing:**
  1.Isolated Step Footing – 25. No's
  2. Combined Step Footing – 02. No's
  3. Lift Pit – 01.nos
- **No of Excavation Pits:** 28.nos
- **Type of foundation/Footing:** Isolated Step and Combined Footing.
- **Site Condition:** unleveled (soft ground)
- **Hard Strata:** 3 to 4 foot
- **Type of Structure:** R.C.C Structure. (G+4 Story Building)
- **Location of the project:** Plot No. (P.No.63+64+65), Beside Ramlila lawns, Behind Jatra Hotel, Adgaon Nasik-422003
- **Activity** – EXCAVATION WORK.(BY USING JCB – TEREX VECTRAO 760)

Analysis by using lean techniques.

The concept of Lean can be applied to the construction sector by considering the project phases as repetitive. For this purpose, the flyover has been grouped into number of products in which one product consists of one foundation, one pier, pier cap and one span and then the remaining are considered repetitive. The project came across various problems during its execution which has delayed the project by nearly eight months because of its inefficient planning, if the planning would have been done effectively the execution delays would have been adjusted within the total duration specified. So, the main consideration here is given on the optimization of planning of the case study taking in which the focus is only on the construction phase of the case study which is the main value adding activity. The concept of Lean construction is applied to the case study where we have proposed three options as below to optimize the time and hence reducing the total project cost.

- The product moves along a line, so bottlenecks (stations that need more time than planned) are easily identified when the product does not move on in time.
- Correspondingly, stations that don't operate reliably (suffer frequent breakdown, etc.) are easily identified.
- The Takt leaves only a certain amount of time to perform the actual value-added work. Therefore, there is a strong motivation to get rid of all non-value-adding tasks (like machine set-up, gathering of tools, transporting products, etc.)
- Workers and machines perform sets of similar tasks, so they don't have to adapt to new processes every day, increasing their productivity.
- As all products are "stuck" in the line and cannot leave it; they cannot be "lost" somewhere on the shop floor.

For Site 01 -

= Available time/ customer demand
=6.hrs/127.43.cu.m
=6 x 60/127.43.cu.m
=2.83.min/m3

For Site 02 -

= Available time/ customer demand
=6.hrs/129.672.cu.m
=6 x 60/129.672.cu.m
=2.776.min/m3

For Site 03 -

= Available time/ customer demand
=5.hrs/66.3462.cu.m
=5x 60/66.3462.cu.m
=4.521.min/m3

RESULT AND DISCUSSION

Different pie chart and bar charts shows the simple results of the excavation work. All the analytical and mathematical calculations show the extra work done during excavation work and it may leads to wastage of money through cost overrun of project. Data and calculations shows that the poor planning and execution techniques in construction leads to delay in construction and wastage of recourses and money. By using lean techniques wastage controlled and also the cost and time controlled / minimized. Lean tools and techniques used in projects help to control and run construction project in a efficient manner by minimizing wastage. After lean concepts were implemented the project achieved a more stable flow of work and the number of emergency requests for resources decreased dramatically. The project was completed a month in advance and allowed the investor to recover his investment sooner than expected. Besides the qualitative data collected for this project, hard numbers were also collected. to prove the efficiency of the new concepts and tools used by the company. After the company owner decided to implement Lean concepts and tools, the project management team revised the project duration once more. Data collected and analysed shows the extra excavation done during excavation because. of improper planning. about more than 40% of planned cost is waste on a extra excavation that occurs because of poor planning .by using lean techniques and tools on a construction project. that 40% extra cost is being controlled. Overall study shows that how lean techniques helps to controlled delays and wastage on construction site and develop lean construction by implementation of lean tools.

CONCLUSION

- The industry struggles with inefficient processes leaving much to be desired in order to meet this challenge the construction industry must become more efficient by using fewer resources. Small changes in the operational costs by reducing waste, which improves the efficiency, can make substantially changes in profit.
- Previous researchers have identified the problems of how the construction industry works. today and pointed to possible solutions by using the lean philosophy and tools along with solutions that are part of what is known as ‘lean construction’.
- We have filled a part of the identified gap but there are still parts that need more research. in order to fully remove the gap. More quantitative data is needed as well as metrics to facilitate continuous improvements and benchmarking within the industry.
- Wanted to develop more lean techniques to develop construction industry and to improve efficiency of the construction work.
- The inhibiting factors were seen to be lack of well-established planning and control systems, poor inclusive culture or strong existing systems coming in the way of formal Lean implementation.

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