

COGNIZANCE ON THE IMPLEMENTATION OF LEAN CONSTRUCTION IN RECUPERATING A CONSTRUCTION PROJECT – A FACTUAL STUDY APPROACH

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Abstract - The construction industry is long-familiar combating with numerous uncertainties. Indefinites of uncertainty remains definite in this field. The major potential impediment for the faster construction is the acceptance of new concept from the traditional access. The significant effectuation of lean construction is constructed by recognizing the wastages that are being generated during the construction. The formulation of factors that influences the performance rate of the project by the progression of waste is made. Once the identification of these promising barriers is examined carefully and methodically, a successful management plan can be created for the lean journey. Lean implementation facilitates in achieving integrated planning with the help of pull scheduling that invokes the coordination among the planning and execution team. The percentage of time invested for carrying out the work activity can thus be measured. The prominence in the direction of lean construction serves in minimizing the wastages and obtaining the maximum outturn. The accomplishments of lean implementation are certainly made by the process of continuous improvement. Thus for enhancing the productivity, the transition from the conventional approach to the Lean approach is an essential requisite for the improvement in the construction industry to optimize and reduce the ineffectiveness of resources.

Keywords – Performance factors, Lean construction, Pull scheduling, Continuous improvement, Optimize

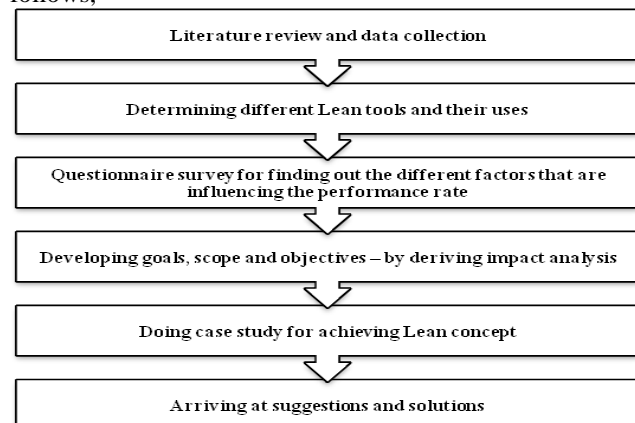
I. INTRODUCTION

The advancement in the infrastructural development has been achieved in leaps. The expansion of construction sector widely spreads out with an increased problem of wastages. Lean construction has been performing as an ultimate tool for improving the productivity and for optimizing the resources to a greater extent with the minimization of wastages in the construction industry. The flourishing adaption of lean concept and their principles were already in the process of research and being implemented in the construction field. The concept of lean construction was being generated from the lean manufacturing technology of Toyota. The entrant of lean construction helps in modification of conventional

management system. Once the wastages provoke, the performance rate considering 8M concept of Manpower, Machinery, Material, Money, Management, Modernization, Market and Maintenance influences the level of productivity. The integral part of the lean implementation stands in matching the problems that arises during the execution. Some of the identified factors were concentrated and the implementation of lean is being targeted on it. The employment of this technique on those promising factors will be difficult to achieve in all of the sudden. Since the continuous improvement which is of difficult in its characteristic property to achieve and change the acceptance of procedural format of the construction industry. Thus the process of continuous monitoring helps in reducing the deterrents. The sequencing support from the top level management to the bottom level management is the key ingredient to the success.

II. METHODOLOGY

The methodical process for the implementation of lean are given as follows,



III. SCOPE AND OBJECTIVES

The study examine scientifically that the lean construction tools are implemented to assess and mitigate the factors that are preventing in achieving the productivity and minimization of wastages suits are implemented on real construction sites. The process of pull scheduling helps in enforcing all the participants in the construction to expel out their involvement in improvising the productivity. Once the micro-level planning is executed, this helps in minimizing the wastages to a certain extent by clearly knowing about the usage and requirements of resources.

The objectives to satisfy the scope of this study are as follows:

- (1) Assess the different performance factors and its influence level to the productivity.
- (2) Concentrating on top ten barriers that are affecting the productivity in a greater manner.
- (3) Evaluate which lean concept will suit the particular barrier.
- (4) Implementation of lean concept to the anticipating barriers
- (5) Providing the suggestions/recommendations to palliate booming problems

IV. LITERATURE REVIEW

The stabilization of work environment is made by cutting down the inflow variation and meliorating the downstream performance. The difference between the conventional concepts of management to that lean concept of management brings out the control over the performance rate of the project by pull scheduling, improving the production system and process and targeting the customer satisfaction by cost reduction with help of wastage minimization. The conventional practice targets only on the optimization of a particular activity, where as the lean construction optimizes the entire project. The last planner helps to make commitments for what should be done only to the extent it can be done. If the activities are not noticed, uncertainties prevail. The shielding is done by measuring the degree of fit between completed work and weekly work plan, identifying root causes of failures to complete planned work and eliminate those causes to prevent repetitions. It improves accountability.

V. REASON TO SCHEME THE QUESTIONNAIRE REPORT TO IDENTIFY THE INFLUENCING FACTORS OVER THE PERFORMANCE

The construction is influenced by the different factors and it influence the performance rate considering the views of **8M** concept of Manpower, Machinery, Material, Money, Management, Modernization, Market and Maintenance. The following factors are having its impact in the performance that retards the productivity. They are described as follows and the

questionnaire is prepared accordingly with the mentioned factors.

Outlay factors

Money is always of special importance to those involved in construction project. Hence, completion of any project within the estimated cost of project is the basic criteria for success of any project. The provision of type and quantity of resources like material, manpower, machines can be decided only with the presence of finance. If planning phases of a construction project are not performed properly, it may result in construction cost overrun or inadequacy in budget. This will prevent its vital performance.

Time factors

Time delay in a construction is a pervasive phenomenon for a timely delivery of a project. It is the costliest and riskiest problems that are arising in the construction project which will completely drain out its image in the market that result in untrustworthy, voluntary delivering of a project before completion litigation and cash-flow problems. Thus it cuts down the maximized profit from the project. Once the delay is noted, the progress and the performance of the project get affected.

Value factors

Due to conceptual changes and ingress of innovations, the importance of value towards the quality and quality systems has grabbed its attention. The required standards should be achieved for yielding customer satisfaction and bringing out value for money. Higher the cost, ensuring of quality for a service will be more and at the same time, higher quality will afford more profit. If the quality is not attained in a fruitful manner, performance will be decreased resulting in major loss. The company's image in the competitive market will be lost when the various participants pops out.

Yield factors

Yield is one of the key elements of every organization's success. It ascertains the cost savings and profit outturn in a project. Win-lose situation depends on the company's productivity. The theory of yield is interlinked with the quality and quantity of input, output, and the work processes which helps in acquiring the affirmed position in the competitive market. For the long haul growth, yield is a key factor. A productive industry may be profitable, allowing for growth and innovation while having a positive effect on society.

Customer Satisfaction factors

Customer satisfaction is mandatory for building up the customer relationship and for creating sustainable vantage point over the other companies that are competing in the market. A customer is the owners of the projects who needs a completed constructed facility for their occupancy and are the buyers of the services that are being produced by the industry. Client satisfaction can be achieved by incorporating the

interests of prospective end user. Without any disruptions in quality and timely hand over of projects extracts more satisfaction from the user.

Health and safety factors

The construction industry is prone to many sources of danger and accident potential. Construction materials, tools, machinery and their handling techniques encompasses with its own dangers. Most accidents can be avoided by implementing stringent health and safety protocols. The incorporation of Health and Safety procedure will ensure that the construction site has good design and good planning, that yields the confidence to the workers without any panic. There should not be any excuses for slacking or cutting corners while considering health and safety in construction. Poorly implemented health and safety techniques, design and management can result in accidents, illness and even death. It results in affecting the performance rate of the project.

Improvement and knowledge factors

The construction industry has been characterized as a slow sector for the change sector where knowledge is underexploited. The mistakes are very common in any work activity and it is very crucial for the firm to accept and learn from the past-errors. These problems can be mitigated only with the help of new process or techniques that creates a pathway for improvement. It can be either a top-down process adopting information from external sources or a bottom-up process includes problem solving techniques through everyday constraints removal by creating the involvement among all the workers. This brings out innovation in every aspect that improves the performance rate of the project.

Environmental factors

Environmental protection helps to avoid and minimize pollution that derives a cost-effective state of things. Once a site is opted for construction, it is essential to conduct an environment assessment that helps in identifying the area that is vulnerable to get damaged from construction activities. If it is hazardous in nature, the workers should be provided with adequate safety protection and the work area should be liaison to the workers for making them adaptable into the different weather condition and surroundings. If the environment is in a favourable condition, the performance of the project will be magnificent.

VI. FACTOR ANALYSIS

$$\text{Sample Size} = Z^2 * (p) * (1-p) / C^2$$

For 90% confidence interval, Z-Value, Z=1.645 (Level of significance = 10%),

P – Percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

C – Confidence interval, expressed as decimal (0.10)

$$\begin{aligned} \text{Sample size} &= 1.645 * 0.5 * (1-0.5) / 0.10^2 \\ &= 41.125 \end{aligned}$$

New sample size,

$$\begin{aligned} &= \text{Sample size} / (1 + ((\text{Sample size}-1)/\text{Population})) \\ &= 41.125 / (1 + ((41.125-1)/60)) \\ &= 25 \text{ approx} \end{aligned}$$

Based on the eight factors, the questionnaire was derived and they are issued among the different respondents. The major impact were identified among the following factors,

Groups	PERFORMANCE FACTORS	Loadings	Eigen values	% of variance	Cum % of variance
I	Do the performance affected due negative cash flow of project?	0.678	9.924	18.043	18.043
	Does the escalation of material prices affect the performance?	0.615			
	Whether the performance is affected by the increase in absenteeism?	0.708			
	Whether any shortages/Insufficient quantity of resources occurs	0.742			
	To have improvisation, how will be the Specific activity training is required to achieve labour quality	0.681			
	If the design is not made clear or not arrived at right time	0.768			
	Frequent changes in the location of construction activity	0.644			
II	Do the rework / Poor quality of work affects the performance?	0.638	6.655	12.1	31.143
	Whether acceptance of more number of new projects/year affects the performance?	0.653			
	Is the coordination between owner and contractors are in a timely and correctly manner?	0.623			
	Is the performance is being affected by cultural differences?	0.793			
III	Is the best practices and other organization's experience is considered?	0.602	5.668	10.306	40.449
	Whether worker's participation in decision making is encouraged?	0.638			
IV	Is the material and equipment management is done properly?	0.647	5.186	9.43	49.878
	Whether the speed and reliability of service is reached?	0.654			
V	When the unclear information flow is obtained	0.698	4.621	8.402	58.28
	Whether the performance rate is affected by site Establishment time?	0.761			

Thus from the above inference, it is clear that the Group I is having higher impact comparing with that of Group II, III, IV

and V, that influences more on the performance of the project. Based on the accumulated variables in each groups, they can be named as follows,

Group I - Work-rate related factors

The work-rate depends on the availability of correct proportion of all the resources that are required to execute a work and also on the involvement of top-level and front-line management. Once the proper planning is made, it will result in higher yield.

Group II - Reliability related factors

The adoption of different regions and works (High-risk, Medium-risk and Low-risk) makes the work force unsophisticated to the work area. The concentration should be made towards them to avoid the poor quality services. The better relationship between the contractor and the client will create trustworthiness about the company and makes them to consolidate and study about the issues that are arising during the work process to mitigate it in the future.

Group III - Utilization factors

The effective participation and proper employment of resources helps in reducing the wastages

Group IV - Delay factors

When the communication transformation between the different levels of management lags and the faster mode of passing information is not made, it will result in time delay for delivering the project.

Group V - Mobilization factors

The pre-planned determination of requirement and storage of resources helps in timely completion of the work process.

Thus the eight factors were converged to above five main factors. The Lean tool called the "Last planner system" was targeted to improve the workflow process.

VII. REQUISITE CORNERSTONE OF WORK PROCESS

The majorly identified factors that are preventing the better performance rate are made with the help of questionnaire survey. They include complexity of work, speed and reliability, disputes between client and contractor, defective information flow, unclear information, environmental causes, design was not updated in right time. In order to overcome these issues, the entrant of Last planner system will help in bringing out the solution.

The concept of pull planning helps in reducing the functional conflicts that arises between the participants of the construction work. The toughest process is of moving backward when comparing it with frontward movement. Thus

it helps in holding us to restrain the every single milestone very cautiously. The enhancement in building relationship and team work thus results in productive outturn. It helps in increasing the reliability by reducing the variability. The effectiveness of the work activity is measured by determining PPC (Percentage planned completion). PPC can be measured by the following,

$$PPC = [(Number\ of\ completed\ tasks) / (Total\ number\ of\ assignments)] * 100$$

VIII. AGENDA FOR THE LAST PLANNER SYSTEM

- 1) Commencing of the meeting
- 2) Present status of task committed in the last review meeting
- 3) Discussion about the new tasks for the upcoming weeks (segregating the month status into four weeks)
- 4) Minutes of meetings – analysing the barricades
- 5) Confirming the next review meeting with the consideration of convenience of all participants
- 6) Closure of the meeting

IX. FINDINGS AND ANALYSIS

Higher the PPC; Higher will be the reliability of workflow and vice-versa if PPC is lesser than 100%. Thus it helps in targeting the activity that is lagging to extend its task performance by analysing the constraints. This results in improvement of the system. The main objective for this finding is to create "imagine at the forefront" and thus the failure in accessing the planned process can be able to be measured in order to ascertain the non-conformities that are being generated during the execution.

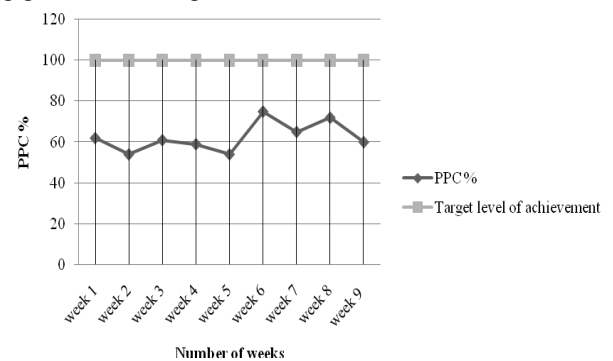


Fig.1- PPC obtained for the corresponding weeks

The constraint identification is the essential facet of constraint removal. Unless otherwise being noted, they may result in subsequent changes that induce the variability in the work process. The reason behind the delay of work was found mainly due to the following reasons,

- Dumping of wooden wastes occupies the work area more.
- Quality checking was not done on time
- Workforce productivity less

- Workforce shortfall
- Frequent changes in the drawing due to additional work
- Touch up/finishing problem
- Equipment unavailability

Among those constraints, the first and foremost problem was taken up and the corrective action was accomplished with the help of discussion driven from the senior management and most experienced employees of the site.

X. SUGGESTION FOR WASTE ELIMINATION

Formwork systems are among the key factors determining the success of a construction project in terms of speed, quality, cost and safety of works. In the project site, we found more plywood's and runners wasted. The Scraps were collected and reused for Beam sides and beam bottoms. This effective idea is to reduce and recycle the scraps of plywood, runners, etc. For completing one floor, the required coverage of 26,965Sq.m is needed. The repetition process is made for utilizing the resources for the upper floor construction. If the materials are used more than thrice times, the formation of honeycombs will result. This needs excess investment of cost in rectification process. Thus the obtained scraps from the resources are being reused or remade for the upper floors. The scrap obtained from 26,965Sq.m area coverage is 5000Sq.m. This helps in the utilization of work area where the scraps have been dumped unnecessarily. This furthermore prevents the hindrance to the progression of work at the particular work area.

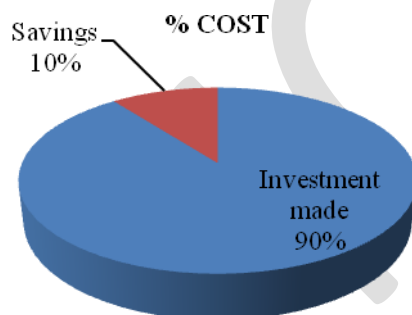


Fig 2 – Percentage saving of cost

XI. CONCLUSION

The basic study is thus made on identifying the major impacting factors that are influencing the performance rate of the project and the corresponding tools of lean construction were identified.

The convergence of elaborated factors into five main categories helps to accentuate its importance in the influence

level of the performance. The targeted issues were coherently matched with the lean tools for the improvement in workflow. Thus results in the minimization of wastages and improves the productivity by effective utilization of resources.

The subsequent details are the conclusions depicted from the lean construction implementation

- 1) The level of impact of the major problems faced by the construction company is identified and the awareness about the importance of lean implementation is imparted.
- 2) The improvements of coordination between the participants involved in the construction activity are thus achieved.
- 3) Daily upgradation of achieved and unachieved work by mentioning the requirement of needed resources to avoid delays in preceding the work.
- 4) Weekly meetings are regularly coping up for the effective optimization of planning and scheduling based on the suggestion of site in-charges/supervisors. Thus emphasizes the grandeur of pull scheduling process.
- 5) The analysis of PPC and determination of constraints helps in analyzing the root causes of the major barriers that are forbidding the productivity
- 6) The strong attention over understanding the importance of key roles and responsibilities of every individual in the project is made.

XII. RECOMMENDATIONS FOR LEAN IMPLEMENTATION

Based on the findings of this study, the following recommendations are offered to support the effort of continuous lean construction improvement.

- 1) The importance on the knowledge and awareness of lean construction should be insisted.
- 2) The hold on the area that affects the performance rate of the construction activity should be identified by surveying the requirements.
- 3) Training should be given to the site in-charges for bringing out their efficiency in monitoring the work process. The compounding of technical and practical knowledge is to be insisted by providing them the methodical procedure to implement at the site.
- 4) The consistent improvement should be made by effectual coordination of various participants to contribute their functionality in bringing out the timely completion of work activity without any delays.
- 5) The content of cognition on the area of reduction of wastages should be continuously generated in the minds of working people. This results in effective utilization of resources and reuse of waste products.

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