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Identification of Non-Value Adding Activities using Lean Technology in Construction

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***Abstract*— There are many non-value adding activities in construction sector and many of them are left unattended that ultimately cause loss of quality and profits in quantitative or qualitative terms to construction projects. Lean Technology applies towards identifying non-value adding activities and by using the same philosophy itself, eliminating it. There are many Lean tools that are helpful in determining waste in construction sector but the very first priority of Lean Adaption is to identify non-value adding activities on a construction project. This research paper uses a simple tool for identifying non-value adding activities based on 7 Mudas in construction sector by means of a sophisticated detailed survey and providing possible mitigation measures to eliminate such wastes**

Keywords*— *Lean Construction, 7 Mudas, Relative Importance Index

I. INTRODUCTION

The Indian Construction Industry is highly diversified in nature. Most of the Indian Contractors are not well equipped to determine the potential demands and hence the projects are always swayed towards low quality and cost-overruns. In this global competition, one must be able to seek potential market changes and at the same time must keep a keen observance on developing their own manufacturing practices. Prominent occurrence of wastes on construction sites are a contingent problem since many years in Indian Construction Sector whether it is large scale or small scale. Introduction of concepts like Lean Ideology in construction sector has found its way as an opportunity to address the existing problem in local construction sector.

Lean construction is concerned with the holistic approach of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging, and recycling (Abdelhamid 2007). This approach tries to manage and improve construction processes with minimum cost and maximum value by considering customer needs. (Koskela et al. 2002). The term "Lean Construction" was coined by the International Group for Lean Construction in its first meeting in 1993. (Gleeson et al. 2007).

Lean construction is a philosophy based on the concepts of lean manufacturing. It is about managing and improving the construction process to profitably deliver what the customer needs. Lean construction is a new paradigm in construction planning that uses lean concepts that approach value rather than cost, and efficiency rather than schedule. The best way to achieve value is to incorporate lean in early planning practices before the project is approved.

The 7 Mudas which is a Japanese term for 7 waste of Lean Manufacturing are what we tried to identify in this research paper according to various construction sector participants. For ease of understanding, one can term these 7 Mudas as **WORMPIT,** as follows;

- **W**aiting i.e., waiting for raw materials, resources, etc.
- **O**verproduction i.e., producing more than necessary
- **R**ework (defects) i.e., doing activities again and again due to non-compliance with quality or maybe due to frequent changes in design and specifications
- **M**otion i.e., irrelevant movement of labors, materials, equipments from one place to another
- **P**rocess (over) i.e., doing too much a job, processing too high a specification even if it is not necessary
- **I**nventory i.e., too much or too little inventory is a waste, better to have in required amount than exceeding or being inferior
- **T**ransportation i.e., moving equipments, labors, etc. from long distances, etc.

This research is proposed to fulfill the purpose of evaluating the status of existing wastes by perception of various construction project participants. Since the data collection format of this research is comprehensive therefore it is very easy for lean practitioners or non-practitioners to understand it in terms of Lean Philosophy.

II. OBJECTIVES OF THE STUDY

This research paper seeks to confirm these following objectives, which are;

1. Examine the perception of local construction project participants with respect to Lean Technology.
2. Identify waste in local construction industry and relate them under Lean Construction and also rank them.
3. Study the potential results of research and providing recommendable measures to eliminate such wastes and controlling such wastes.

III. METHODOLOGY

To determine the perception of various project participants a questionnaire was developed and is quantified according to the tool. This questionnaire was distributed to various sites and in personal to identify wastes from general views. After the

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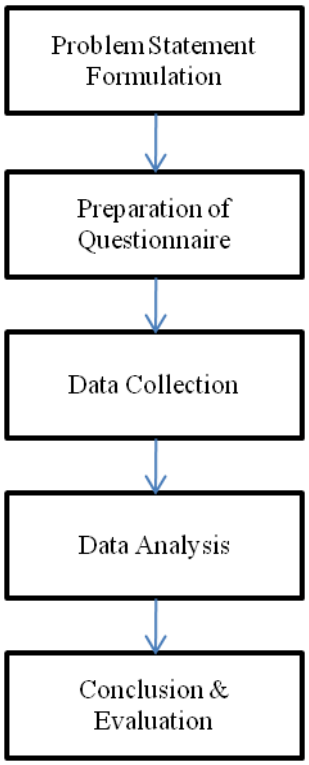
collection of data, it is quantified and is ranked according to the tool used which is Relative Importance Index and lastly giving remedial and control measures for those factors which causes more than 60%.



IV. RELATIVE IMPORTANCE INDEX

Relative Importance Index (RII) is a method which is used to identify relative importance of each factors and parameters included in the survey. This tool is widely used for delay analysis and identification of occupational health risks. Since this statistical tool is very much helpful in ranking the factors, it has been widely used by field experts and organizations to identify their priority factors for which the survey is adopted.

The data is collected and is processed in tabular form and the sum of weights of each factor is divided by product of highest point (in our case 5) and number of respondents participating.

In our research, the five-point scale is as follows:

- Never – 1
- Very Rare – 2
- Seldom – 3
- Frequent – 4
- Very Frequent – 5

RELATIVE IMPORTANCE INDEX

$$RII = \frac{\sum W}{A*N} (0 \leq RII \leq 1)$$

where W = weights given to each factor by the respondents and will ranges from 1 to 5 where '1' is less significant and '5' is extremely significant.
A = highest weight (i.e. 5 in this case), and N = total number of respondents.

V. DATA COLLECTION & ANALYSIS

A total of 45 respondents were selected and were also provided with brief idea of Lean Construction. Each participant was provided with questionnaire survey designed specifically for participants either knowing about Lean or vice versa. Every question is evaluated by giving marks ranging from 1-5. With the help of RII, data was analyzed and ranked according to the responses collected.

TABLE I. DATA COLLECTED

Sr. No	Description	Scores					Total	R.I.I	Rank
		Never	Very Rare	Seldom	Frequent	Very Frequent			
		1	2	3	4	5			
1	Waiting for Raw Materials	1	5	7	12	20	180	0.8	4
2	Labor/Resources idle for long time	0	2	8	5	30	198	0.88	1
3	Equipments idle for long time without processing	0	0	9	12	23	190	0.84	2
4	Lack of available space for labor gang to work on site	1	3	15	18	8	164	0.73	5
5	Overproduction of cement mortar	0	2	8	16	19	187	0.83	3
6	Too early fabrication of steel reinforcements	1	13	21	6	4	134	0.6	12
7	Frequent changes in drawings and specifications	0	15	18	8	4	136	0.6	10
8	Poor design and specifications	1	22	17	2	3	119	0.53	20
9	Lack of planning and control	3	17	12	9	4	129	0.57	15
10	Excessive thickness of plastering, door or window frames, etc.	10	12	8	7	8	126	0.56	16
11	Unnecessary movements done by workers on job site	5	6	10	12	12	155	0.69	6
12	Poor work site-layout	11	12	16	3	3	110	0.49	22

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13	Travelling too far on a work site to accomplish the work assigned to workers	10	13	9	7	6	121	0.54	18
14	Over processing on surface finishes	0	23	8	8	6	132	0.59	14
15	Concreting and cleaning of mixer/pump	2	12	11	12	8	147	0.65	7
16	Concrete pump line choke up	1	18	22	3	1	120	0.53	19
17	Cement mortar waste during brick shifting	21	11	4	6	4	99	0.44	24
18	Due to inadequate stock conditions on site	11	12	9	8	5	119	0.53	20
19	Due to robbery, theft or vandalism	8	22	11	3	1	102	0.45	23
20	Deterioration of stocked materials like cement, sand, steel, etc.	2	15	13	11	4	135	0.6	11
21	Ordering materials and resources more than requirement	2	10	16	8	9	147	0.65	7
22	Breaking of fragile materials like glass	3	11	15	9	7	141	0.63	9
23	Bad conditions of pathway for movement of materials from one place to another	5	13	17	9	1	123	0.55	17
24	Stockyard at far distance from installation point	3	17	11	7	7	133	0.59	13

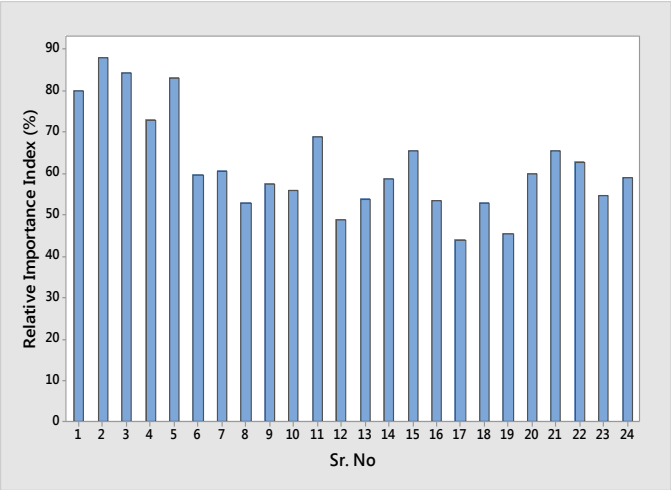

Fig. 1. *Graphical illustration of analyzed RII*

VI. CONCLUSION

In this research paper, we have analyzed different perceptions of project participants on Lean and waste that are generated and got an overwhelming response. The tool which has been used for analyzing data is very easy and sophisticated to use for top management also. Moreover, participants were also very much keen and eager to adapt Lean Construction on their project sites for its very own special purpose and also many of them decided to use RII for analyzing data and setting priorities. The following conclusion is drawn by using our tool and by perception of project participants:

- RII is a simple and easy to use tool.
- Each and everyone from top management to bottom most can find it easy to understand and conclude.
- This tool can be used for qualitative improvement in an organization.
- Value Stream Mapping can be a critical success factor in strategically tracking processes on construction sites and eliminating non-value adding activities.
- Employers/Stakeholders will feel empowered in decision making for betterment of project activities.
- Management can keep continuous tracking on wastes that are generated on sites with respect to Lean Philosophy.
- From problems of Inventory waste, top management can decide to implement Just-in-Time tool to improve inventory control and on time delivery of raw materials to the site.
- Comparison of Current State Map and Future State Map can help the project participants in identifying non-value adding activities and thereby controlling or eliminating it.
- By using Lean, organization can specify value from customer's perspective, implement pull and work towards perfection.
- By using planning software, proper synchronization can be done over project activities.
- Proper resource allocation can help in reducing waiting time for labors on project sites.
- For betterment of project activities, labors can be suggested by the end of the day by the Project Managers or equivalents that what prior activities that are to be done first so that the labors and workers can have a prior mindset before starting work.
- By thorough feedback and identifying demands of customer, waste of rework can be eliminated or controlled.
- By thoroughly updating and observance on Daily Progress Report one can eliminate waste of over production and also inventory control can be achieved.

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