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# Performance Evaluation of project in Construction industry

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***Abstract-***

*Construction industry is usually allocated to computing the standard functionality indices as schedule and cost while the analysis of entire task efficiency is carried through in a subjective or structured less manner. An incorporated framework for project general performance measurement is necessary to formalize how contractors evaluate functionality of construction projects. The objective on this evaluation is examining the practical use of a few lean construction methods, especially, virtually all the tools which might be employed in moderate sizing construction companies. Due to the outcomes of the lean production procedure for creation, the structure business has brought lean strategies to get rid of waste in addition to improve revenue. This particular analysis comes with a historic past of evolution of concepts as well as output methods with the building sector via the standard techniques to existing lean manufacturing. The variants within manufacturing principles, the boundaries of theirs, as well as the impacts of theirs within the construction internet business might additionally be evaluated. An area analysis is carried out to look at the practical use of a few lean building techniques such as for instance final planner, enhanced visualization, regular huddle conferences, very first operate accounts, the 5s procedure, and also be unsuccessful shielded for successful task managing as well as website implementation.. The info compilation methods included immediate observations, interviews, questionnaires, as well as documentary evaluation. The practical use of lean building equipment is examined through the lean setup measurement standard format & general performance demands. Outcomes confirmed that by utilizing lean building reduced the amount of stages within the whole task by 57 %. The whole cycle period over the project was decreased by 75 %.*

***Keywords****: Lean Construction Mechanism, Last Planner, Implementation Framework,*

## I. INTRODUCTION

The standard functionality indicators within the construction business are conclusion time, quality, and cost. Nearly all present task management methods evaluate quantitatively schedule and cost condition as well as forget about different main facets of task overall performance as money flow, earnings, quality, brilliance, task staff fulfilment, and then customer pleasure which can be within many instances as vital as price and timetable. Not many project managing methods quantify the later on project attributes and so they do this on their own with no appropriate integration on the general project efficiency. The notion of success and failure of projects is generally influenced by the experience and personal indices on the project supervisor also it's not unusual that 2 undertaking managers would look at the overall performance of the very same project aided by the exact same information in a different way.

### 1.1 Lean Definition

Within price, time period, quality and safety all at once. Within truth, lean development has several definitions. In the end, lean building might be referred to as extra worth by decreasing the misuse of a few space floor, materials as well as furthermore, the output of all-natural online resources.

### 1.2 Background and Motivation

Alternatively, a task could be behind schedule and more than budget but still be regarded as a prosperous body since it had been completed with quality that is high, superb safety history, as well as towards the pleasure on the client. These indices cover: cost, client satisfaction,, project team satisfaction, safety, quality, profitability, billing and schedule. Applying this particular pair of general performance elements through the project construction phase will offer constant info that may allow undertaking managers to determine each elements of overall performance from an explicit and quantitative group of targets

### 1.3Scope of this paper

The range on the analysis tasks is often to degree the setup of lean creating as well as additionally to look at the influencing aspects of lean building.

### 1.4Objective of this paper

1. To provides an analytical platform for decisions making.
2. To develop clear method of communicating objectives in construction Industry.
3. To study lean tools for process improvement.
4. To study the performance evaluation and to provides a rationale for the quantification of the project.
5. To study lean tools and to study and explore the effect of lean practices.

## II. LITERATURE REVIEW

**David herranz Limon et al. (2015)**examined the creating industry in Norway pass at bay during a prior ten years a number of efforts inside the setup of lean methods. The techniques in which the business organizations are concentrated differ in addition to the altitude of installation as well as outcomes obtained; however with the omission of certain companies the setup is still restricted.

**Amin Nikakhtar and Abbasian Hosseini (2015)**carried out a searching on "Application of lean building concepts to reduce building method squandering dealing with laptop simulation: a situation when study". As time passes and also use the item as becoming a very first thing for so reshape with all the inclusion of loops & busting links.

**Remon fayek Aziz et al. (2014)** exposedthose three crucial fundamentals: moment allocated to advancement, improvement skills and mechanisms, and improvement viewpoint and goals. Plus mentioned potential study should also produce as well as validate a much more complete type of general performance enhancement as well as extra analyze the activities of improvement process.

**Rishav sarma bardalai and arunima jayakumar et al. (2014)** selected the last planner is a simple ways which might be implement within the website just for the lucrative execution of all of the initiatives.

Bottom part on the raps, a "look ahead" routine provide the pursuits getting finished over the forthcoming months & furthermore, the backlog of work which is prepared.

**Mohd arif marhani et al. (2014)** The full execution of its within the Malaysian building industry particularly isn't a simple task because it is going to need additional work from all the related people like the education business and also for the providers.

**Oguntona and Aigbavboa (2018)** A well-structured questionnaire was administered, with building professionals as respondents. A quantitative method of information analysis was followed making use of the mean item scores of the identified variables.

**Saad Sarhan (2018)** conducted an investigation on "Institutional Waste within the UK Construction Industry: An Exploratory Study". This particular analysis was aimed to examine the institutional, procurement and industrial locations surrounding the design and distribution of building projects as well as expose the consequential wastes.

**K P Ramaswamy and Satyanarayana N Kalidindi (2016)**conducted a searching on "Waste wearing Indian Building Construction Projects". The Indian structure industry is recognized by issues including lesser efficiency, not plenty of skilled labour, precious time frame as well as cost overruns and so on. The main objective on the evaluation is looking into misuse in Indian building segment, concentrating largely on creating tasks. 6 on-going projects are consumed spot for the study and the wastes identified are quantified around terminology of task expense by gathering info by way of immediate observations, documents as well as utilizing tools like for instance project sampling.

**Jay Shankar et al. (2013)**is analyses minimization within the common cost of the job, fall within whole second of the pastime in addition to simply around period (jit) stay in a place to applied, easy to understand from the finest to bottom portion of the construction pyramid also we're competent to place a conclusion to simply get it done policy of put into action activities. They look at the standard notion of creating industry as well as precisely how the lean building programs might be used to progress the setup of the points particularly in supervision building waste materials.

**Fiona Keru Mwacharo (2013)**talked about on "Challenges of Lean Management: Investigating the problems as well as developing a suggestion for Lean Management Techniques". This particular paper aims to be able to discover just how much the main issues of applying Lean management techniques as well as additionally to develop a suggestion about the way to handle the challenges. A qualitative exploration was carried out through questionnaire and interviews on businesses that are many in Finland.

**Abbasian Hosseini and Nikakhtar (2012)** talked about on "Flow creation of Construction Processes by means of Implementing Lean Construction Principles and also Simulation".

## III. METHODOLOGY

### 3.1 General:

This particular analysis offers an introduction of essential Lean resources & pursuits which happen to have proven to give real advantages on the general functionality as well as distribution of creating projects. Each

tool is going to be created & adequate info provided being aware of what it is, when and where to place it to make use of and also the connected advantages. A great deal of the materials in this particular report is usually employed in isolation to be able to help solve a specific matter and even making an enhancement. Nevertheless, the materials give biggest benefit just in case they are being utilized throughout a Lean end-to-end project shipping and delivery strategy as well as approach to improvement for creating businesses to better the individuals of theirs, the source chains of theirs as well as improving overall performance. Lean has wonderful synergy with collaborative managing the basis of establishing the really incorporated as well as substantial executing creating group. Project all round performance will probably be optimized exactly where Lean procedures & techniques are integrated with effective collaborative performing between every one of the individuals.

### 3.2 Research Methodology:

This particular evaluation supplies exploration of a building task exactly where particular lean building components are analyzed on a centre sized building business. Every & each strategy is analyzed around terminology of the effect of it's on the performance on the project. Largely according to the outcomes within the analysis, a completely new "lean evaluation tool" is recommended to learn the outcome of lean implementations via general performance managing framework. The analysis will test and evaluate 6 lean construction sources for prospective enhancements. They are extremely final planner, enhanced visualization, regular huddle conferences, for starters operate scientific studies, the 5s procedure, and also be unsuccessful risk-free for quality. The info compilation methods belonging in this specific evaluation include things like direct observation, interviews and questions, as well as documentary evaluation, along with these 3 techniques are used to each one of many materials. Observational specifics will probably be collected of surveys, as well as additionally huddle group meetings, and also the construction operation.

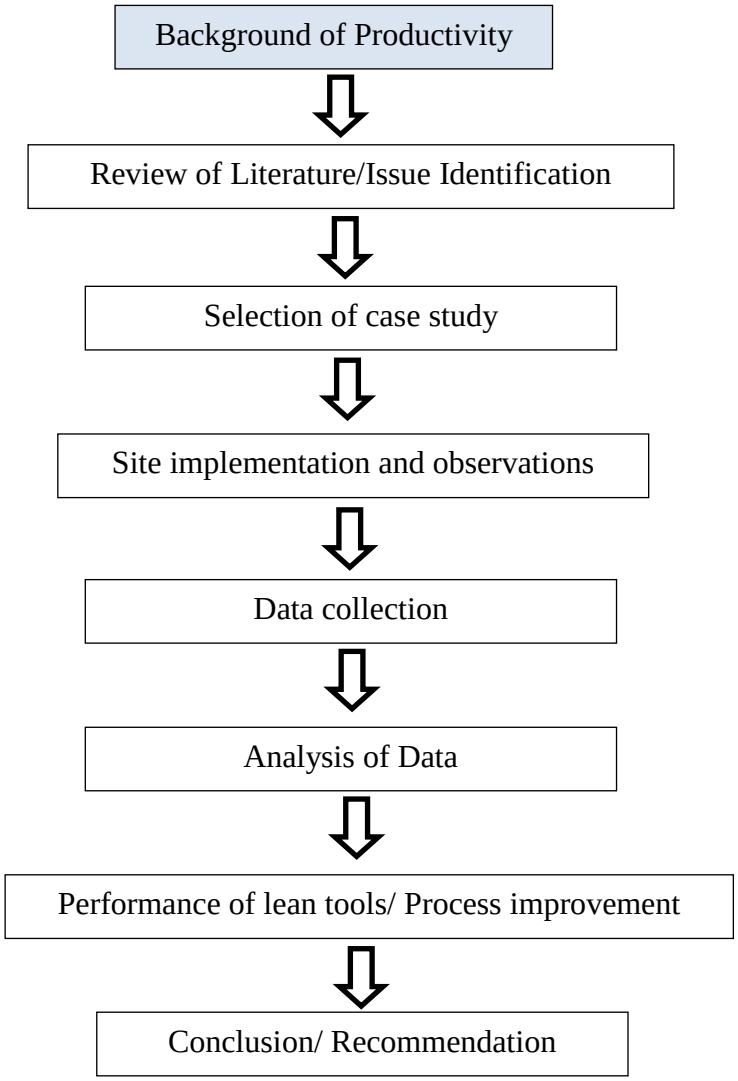



**Figure 3.1 Flow Chart Showing Research Structure**

### 3.3 Research Gap:

Although this method a lot consolidated around India, many spots around the globe at this point are within the quest of seeking a lot more importance with this specific believing. Nevertheless, telephone numbers of structural and cultural obstacles are now being observed that are militating against the effective implementation of its even with of geographical area. In spite of these continuous work, investigate research suggest that the existence of lean modern society inside the huge developing businesses in India is nonetheless under what is professed by literature. Far more during the analysis recognizes a huge gap within the LC in certain more acquiring nations when as opposed with UK, of that obvious the overwhelming room being elevated with LC around the globe within general

### 3.4 Data Collection

In order to get the goals of the present analysis, the researcher has utilized a few sources. These include:

### 3.4.1 Primary Sources

Efficiency information was from Company. Additionally 30 crafts men with a lot over 10 years' encounter were definitely interviewed. The last outcomes acquired occurred to remain as opposed with efficiency information present in SP construction Pune. Minimum, the majority of likely together with the best possible effectiveness of the substances are discovered.

**Table 3.1 Productivity of resources in company**

| MainActivity | Activity process | Unit | Unit hours | | |
|---|---|---|---|---|---|
| | | | Minimum | Most likely factor | Maxim |
| **Mobilization** | Excavation work | $M^3$ | 57.69 | 62.5 | 68.18 |
| **Plain concrete** | Form work | $M^3$ | 0.625 | 0.875 | 1 |
| | Cast plain concrete | $M^3$ | 0.75 | 0.875 | 1 |
| | Remove form Work | $M^3$ | 0.58 | 0.7 | 0.875 |
| **Foundation work** | Form work | $M^3$ | 0.625 | 0.875 | 1.125 |
| | Fix neck column | $M^3$ | 0.648 | 0.81 | 1.08 |
| | Cast foundation work | $M^3$ | 5.77 | 6.5 | 12 |
| | Remove form work | $M^3$ | 2.62 | 3.25 | 4.31 |
| **Neck column** | Form work | $M^3$ | 0.072 | 0.083 | 0.147 |
| | Cast concrete | $M^3$ | 0.083 | 0.1 | 0.125 |
| | Remove form work | $M^3$ | 0.31 | 0.375 | 0.46 |
| **Back filling** | First layer | $M^3$ | 17.85 | 20.8 | 22.3 |
| | Second layer | $M^3$ | 25 | 31.25 | 41.66 |
| | Final layer | $M^3$ | 25 | 31.25 | 41.66 |
| **Ground beam** | Form work | $M^3$ | 0.28 | 0.4 | 0.58 |
| | Cast concrete | $M^3$ | 0.083 | 0.1 | 0.125 |
| | Remove form work | $M^3$ | 0.7 | 0.93 | 1.125 |

| | | | | | |
|---|---|---|---|---|---|
| **Column work** | Fix steel column | $M^3$ | 1.81 | 2.26 | 3 |
| | Form work | $M^3$ | 0.176 | 0.2 | 0.35 |
| | Cast concrete work | $M^3$ | 0.4 | 0.48 | 0.6 |
| | Remove form work | $M^3$ | 1.51 | 1.81 | 2.26 |
| **Ground floor** | Preparation work | $M^2$ | 33.33 | 36.36 | 40 |
| | Steel work | $M^2$ | 14.28 | 14.81 | 15.38 |
| | Mechanic work relation | $M^2$ | 66.7 | 80 | 100 |
| | Cast concert | $M^2$ | 66.7 | 80 | 100 |
| **Slab work** | Form work | $M^2$ | 6.55 | 7.37 | 8.42 |
| | Hollow cement Block work | $M^2$ | 9.83 | 11.8 | 14.75 |
| | Steel work relations | $M^2$ | 6.55 | 7.37 | 8.42 |
| | Electric work relations | $M^2$ | 6 | 8 | 12 |
| | Cast concrete | $M^2$ | 8 | 9 | 10 |
| | Remove form work | $M^2$ | 4.91 | 5.9 | 7.37 |

## IV. RESULT AND DISCUSSION

Lean construction is a combination of operational research and practical development in design and construction with an adaption of lean manufacturing principles and practices to the end-to-end design and construction process.

### 4.1. Project Description

Below table showsdata about the selected site.

**Table 4.1 Details of project**

| No | SUBJECT | DATA |
|---|---|---|
| **1** | Company | SP Construction Pune |
| **2** | Location | Katraj Pune |

| | | |
|---|---|---|
| **3** | Owner | Mahesh Shinde |
| **4** | Contractor | Suresh Desai |
| **5** | Sub-contractor | Ganesh More |
| **6** | Design consultant | Ramesh Kude |
| **7** | Site consultant | Kirti Shah |
| **9** | Projectarea | 3200$m^2$ |
| **10** | Basement | 2370$m^2$ |
| **11** | Ground floor | 2508$m^2$ |
| **12** | First floor | 2420 $m^2$ |
| **13** | Commencement | 20 / 05 / 2017 |
| **14** | Last Day | 20/06/2019 |
| **15** | Project duration | Total 750days |
| **16** | Contract Time Span | 365 days in a year |
| **17** | Predicted cost of project | 16 Cr |

**4.2 Project Activities**

Lean development was used on the accompanying venture undertakings in assembly, essential solid, restorative establishment, neck section, detachment, refilling, ground pillar works, segment for ground floor, ground floor, ground floor chunk, first of all floor segment, second floor piece, working for ground floor, just as creating performs for exemplary deck. The transportation on the endeavour is part into 3 squares A, B and C.

**4.3 Lean Criteria Procedure**

- Removing the wastes and Identifying non-value added activities
- Improving the project until reaching perfection stage.

The following materials can be found throughout the entire project period Project manager (1), Site engineer (2), Foreman (1), Surveyor (1).
Calculation within the last column was conducted as follows:
Duration (hour) = Quantity/ (Number of resources x Productivity x 8 hours) Maximum period of the excavation process = 6000/ (1x 57x 8)= 13 hours.
Likely period of the excavation process = 6000/ (1x 62x 8) = 12 hours.
Minimum duration of the excavation process = 6000/ (1x 68x 8)= 11 hours.
The other processes were estimated in the exact same way.


**Figure 4.1 Procedure of the application of lean principle**

**Table 4.2 Productivity of the project activities**

| Main Activity | Process | Unit | Quantity | No. resource | Productivity/*hour | Duration 1 day=8h |
|---|---|---|---|---|---|---|
| **Mobilizationandexcavation** | Excavationwork | $M^3$ | 6000 | 1 Excavator | 57,62,68 | 11,12,13 days |
| **Plainconcrete** | Form work | $M^3$ | 140 | 5 workers | 0.6,0.8,1 | 3.5,4.5,5.5 days |
| | Cast plainconcrete | $M^2$ | 140 | 5 workers | 0.7,0.8,1 | 4,5,6 hours |
| | Remove formwork | $M^2$ | 140 | 5 workers | 0.6,0.7,0.9 | 3,4,5 days |
| **Foundation** | Form work | $M^2$ | 935 | 9 workers | 0.6,0.9,1 | 11.5,15,21 Days |
| | Fix neck column | $M^3$ | 935 | 9 workers | 6,8,10 | 1.5,2,2.5 Days |
| | Cast foundation | $M^3$ | 935 | 9 workers | 6,7,12 | 12,16,18 hours |
| | Remove formwork | $M^3$ | 935 | 9 workers | 2,3,4 | 3,4,5 Days |
| **Neckcolumn** | Form work | $M^3$ | 60 | 8 workers | 0.07,0.08,0.15 | 51,90,103 hours |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Cast concrete | $M^3$ | 60 | 8 workers | 0.08,0.1,0.12 | 60,75,90 Minutes |
| | Remove formwork | $M^3$ | 60 | 8 workers | 0.3,0.4,0.5 | 16,20,24 hours |

* This column shows the minimum, most likely and maximum productivities according to the bill quantity of the project.

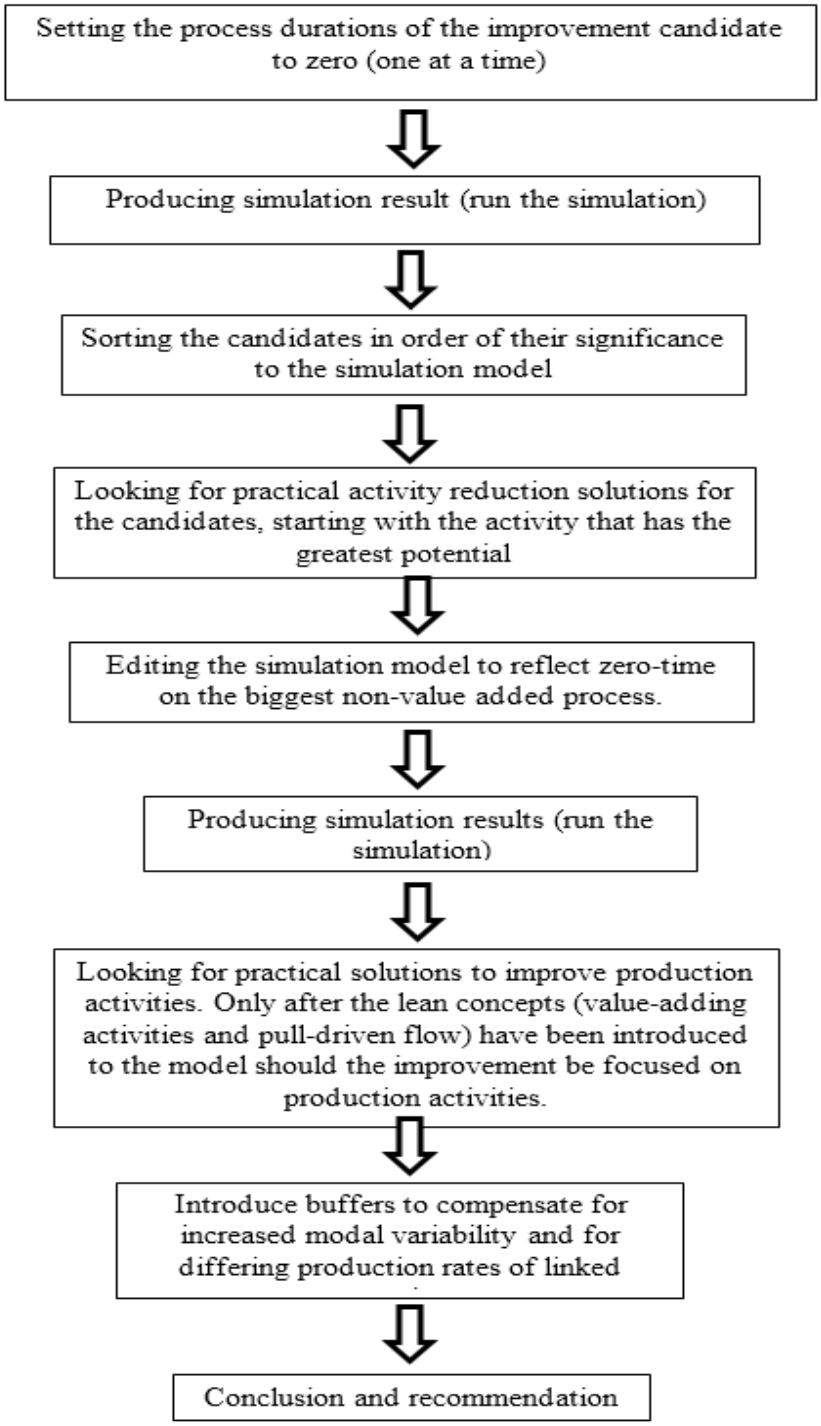


**Table 4.2 Productivity of the project activities (Cont.)**

| Main Activity | Process | Unit | Quantity | No. resource | Productivity/hour | Duration 1 day=8h |
|---|---|---|---|---|---|---|
| **Back filling** | First layer | $M^3$ | 1000 | 2 excavator s | 18,21,22 | 2.3,3,3.5 days |
| | Second layer | $M^3$ | 1000 | 2 excavator s | 25,31,41 | 1.5,2,2.5 days |
| | Final layer | $M^3$ | 1000 | 2 excavator s | 25,31,41 | 1.5,2,2.5 days |
| **Ground beam** | From work | $M^3$ | 180 | 8 week | 25,31,41 | 4.5,7,10 days |
| | Cast concrete | $M^3$ | 180 | 8 week | 0.3,0.4,0.6 | 60,75,90 hours |
| | Remove from work | $M^3$ | 180 | 8 week | 0.08,0.1,0.12 | 2.5,3,4 days |
| **Column work** | Fix steel column | $M^3$ | 145 | 4 week | 0.7,0.9,1 | 1.5,2,2.5 days |
| | From work | $M^3$ | 145 | 4 week | 1.8,2,3 | 102,180,206 hours |
| | Cast concrete | $M^3$ | 145 | 4 week | 0.1,0.2,0.3 | 60,75,90 minutes |
| | Remove from work | $M^3$ | 145 | 4 week | 0.4,0.5,0.6 | 16,20,24 hours |
| **Ground floor** | Preparation on work | $M^2$ | 2000 | 5 week | 1.5,1.8,2 | 10,11,12 hours |
| | Steel work | $M^2$ | 2000 | 5 week | 33,36,40 | 26,27,28 hours |
| | Mechanic work | $M^2$ | 2000 | 5 week | 60,80,100 | 4,5,6 hours |
| | Cast concrete | $M^2$ | 2000 | 5 week | 60,80,100 | 4,5,6 hours |

### 4.4. Non-Value Added and Value Added Process Identification

Activity which contributes to the customer's perceived value of the product or service (Convey et al., 1991).

**Table 4.3 Non-value added and value added processes in isolation processes**

| No. | Process | Steps | | Duration (hours) |
|---|---|---|---|---|
| | | Step number | Value added steps | |
| **1** | Cleaning | 1 | 0 | 8 |
| **2** | Cleaning, isolation work | 2 | 1 | 40 |
| **Total** | | 2 | 1 | 48 |
| **Percentage of value added steps** | | 50% | | |

### 4.5 Back filling

The six tasks which symbolize backfilling are revealed in Table (4.8). The variety of value added measures is 3 out of six steps (50 %) as well as the total duration in the day report is 112 hours.

### 4.6 Ground beam

The twelve processes which symbolize ground beam are revealed in Table (4.9). The variety of value added measures is 6 of 12 steps (fifty %) as well as the total duration in the daily report is 192 hours.

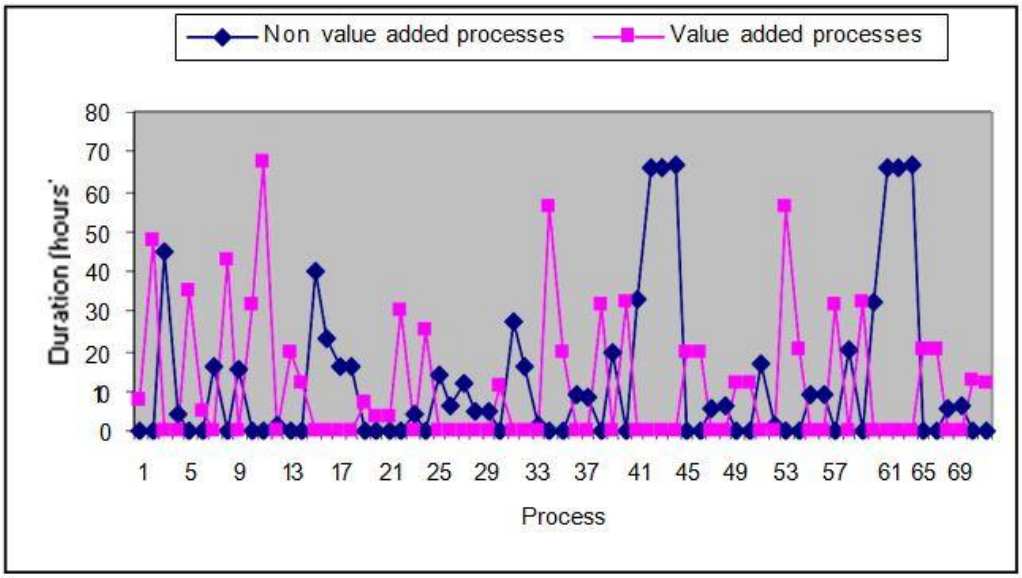
**Table 4.4 Non-value added and value added processes for ground floor**

| No. | Process | Steps | | Duration (hours) |
|---|---|---|---|---|
| | | Step number | Value added steps | 1 days = shours |
| **1** | **Mechanic work for part A, B, C** | **1** | **1** | **8** |
| **2** | **Preparation work for part A, B** | **2** | **0** | **4** |
| **3** | **Steel work for part A, B** | **3** | **1/2** | **12** |
| **4** | **Cast ground floor for part A, B** | **4** | **1/2** | **8** |
| **5** | **Preparation work for part C** | **5** | **0** | **16** |
| **6** | **Steel work for part C** | **6** | **1/2** | **8** |
| **7** | **Cast ground floor for part C** | **7** | **1/2** | **8** |

| | | | | |
|---|---|---|---|---|
| | **Total** | **7** | **3** | **64** |
| | **Percentage of value added steps** | | **43%** | |

**4.4.10 Ground floor slab**

The eleven processes which symbolize ground floor slab are revealed Table (4.12). We see the variety of value added measures is 4 of 11 steps (36 %) as well as the total duration in the daily report is 168 hours. 4.4.11 First floor columns Table (4.13) shows the twelve processes which comprise the very first floor columns. The variety of value added measures is 2 of 12 steps (16 %) as well as the total duration in the daily report is 300 hours.




**Source:** ***Own Calculation***

**Figure.4.5Duration variability after Introducing buffers**

**Table 4.19 Cycle time compared**

| **Activity** | **Actual duration hours** | **Application of lean tools** | | **Cycle time after introduction buffer** | |
|---|---|---|---|---|---|
| | | **Duration (hours)** | **%** | **Duration (hours)** | **%** |
| **Total duration** | 6000 | 3013.98 | 50% | 1503.43 | 75% |

Including the above mentioned elements on the mobilization as well as excavation pastime discussed in undertaking studied: scrubbing clean tasks, reducing forests, demolition pre-existing framework within the website, developing an engineering business office, excavation work very first fitness level, excavation subsequent fitness level, and then excavation third level. Dining room table 4.39 displays the treatment completed and also the job provided within the understand regime of a real task. During the 1st, 2nd, 3rd week

you will find two assigned procedure (cleaning, reducing trees) as well as only one was completed. In 4th week and the 5th you will find 3 assigned (cleaning, reducing forests, demolition) as well as simply 2 methods are finished. During the 6th and 7th week you will find four assigned and merely 3 procedures are completed. During the 8th and 9th week, you are going to find five given & simply 4 procedures are finished. Within the tenth week, you are going to find six given & simply five procedures are finished. Within the 11th week you are going to find seven given & simply five methods are completed.

## V. CONCLUSION

The standard functionality indicators within the construction business are completion time, quality, and cost. Alternatively, a task could be behind schedule and more than budget but still be regarded as a prosperous body since it had been completed with quality that is high, superb safety history, as well as towards the pleasure on the client. This specific exploration of Lean Construction Practices within the SP Construction suggests the outcome of utilizing the lean building. This specific evaluation was carried out by figuring out requirements of lean building in addition to applying standardization tools, 5 exactly why equipment, ten thing to complete the lean concept within reducing the process methods as well as period by decreasing the non-value added exercise within the pastime through the use of the spot simulation. Value added occasion increased from 49 % to 63 % as being an end result of utilizing lean resources. The pre-owned lean resources lessen the cycle period via 6000 many hrs to 1503.43 a long time (decreased by 75 %). The worth included could be much better to 74 % by improving the sort do the job substance in deep footing (using prefabricated) and also column pursuits (steel type deliver the results). The quantity of measures decreased through 161 to 69 (a reduced by 57 %). Non benefit extra time period of process that is complete was 4892.17 working hours (81 %) it decreased to 846.5 a long time (14 % decrease). Lean construction by using standardization certain resources slices lower on the variability of the job, instance the excavation process for only one hour (57m3, 62m3, 68m3). The speed of hardly any great extra procedure linked to the page layout mistake was 30.7 %. This's deemed the biggest really worth on the absolutely no great included to the job since it takes place throughout the purpose of design; for that reason, we've to make use of the lean within the turn to avoid misuse all through the structure.

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