A STUDY ON LABOUR PRODUCTIVITY IN CONSTRUCTION SITES OF KODAGU REGION

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Abstract— **In this rapid moving constructional era it is a major challenge all across the globe to achieve the desired labour productivity. Many of the project aims for higher productivity and the people involved strive hard to achieve it even but still they fail in it, for a simple reason that just working hard is not enough; to be more précised working smart yields higher productivity than working hard.**

The main aim of this paper is to study the labour productivity in construction sites based on two methods one is by a lean construction principle and another one is by questionnaire survey. Through which an effort is made by adopting these methods available which helps to improve the labour productivity and aims to give the better performance in construction projects.

Keywords—**Labour productivity, Lean construction principle, Questionnaire survey**

I. INTRODUCTION

Construction is an emerging industry in the world of urbanization. As people are getting globalised their standard of living is been modernized. Every company gazes at achieving high productivity. Productivity is achieved when the work done are actually planned in a smarter condition than to make the labour force work harder. Construction projects mainly involve men, material and machines which play a vital role in achieving productivity. So then effective utilization of the available resource, men and equipments yield in productivity.

II. SCOPE AND OBJECTIVES

- To compare the factors affecting the variation in labour productivity in to different region between actual productivity and baseline productivity.
- To identify the severity impact of the factors causing the fluctuation in Labour productivity.
- To have an overview on Labour productivity in construction site.
- Develop construction industry in particular; uplift economic development and welfare of the country.
- To suggest a suitable Labour productivity plan considering all the characteristic condition been involved.

III. METHODOLOGY

The purpose of this chapter is to present the complete methodology involved in the study during the process involved. It involves the methods followed i.e. it's mainly done on basis of lean construction principle and the improvements techniques are based on the questionnaire survey.

A. Questionnaire survey

1) General

A questionnaire is preferred as the best and effective mode of data-collection technique for the study. It is concluded that the questionnaire described as a self-administered tool with certain set of questions and factors, which fetch an appropriate response. A questionnaire is in a survey format comparatively it requires less time and saves cost for the fellow, while permits respondents to response the questionnaire at their personal ease.

Around 51 factors have been taken into account for the formation of questionnaire. These 51 factors have been analyzed for Chance of occurrence and Impact. With these response, the factors have been ranked, analyzed and suitable conclusions has been evolved to achieve the Labour Productivity in Construction Projects.

These are the 51 factors involved in questionnaire concerned to labour productivity

1) Currency fluctuation
2) Legal issues
3) Political issues
4) Change in regulations
5) Cash shortage
6) Delay in work awarding after tendering
7) Delay in approval of work done
8) Dispute between stake holders
9) Poor planning and scheduling
10) Wrong estimation method
11) Complexity of design
12) Mathematical error
13) Survey mistakes
14) Site Conditions
15) Weather conditions

16) Improper construction method
17) Lack of construction technology available
18) Equipment shortage
19) Delay in equipment transportation
20) Delay in final inspection
21) delay due to rework
22) Poor supervision
23) Lack of skilled and experienced labour
24) Labour strike
25) Shortage of labour
26) Safety issues
27) Delay in material transportation
28) Import/ export restrictions
29) Change of material price
30) Bad weather
31) Unexpected site conditions
32) Accidents
33) Unfavorable location of project
34) Efficiency of manpower
35) Safe work practices
36) Lack of skills for workers
37) Quality and efficiency of resources
38) Wrong procurement of materials
39) Rework due to change in government policies
40) Government lag in approving plans
41) Improper acquisition of land by owners causes delay
42) Labour absenteeism
43) Labour turnover
44) Labour commitment
45) Poor health of labour
46) Poor relation among workers
47) Frequency of working overtime
48) Poor condition of camping
49) Low amount of pay
50) Working days per week without taking holiday
51) Labour age

The number of factors was kept as small as possible for effective response of the questionnaire.
- It is what the general public understanding research, particularly social research, to be about.
- That the data collection process is fit for purpose
- That the design and content of the data collection process or instrument is appropriate for the research
- That personal data collected are relevant and not excessive

3) Format of the questionnaire The form of questionnaire consist of four sections as follow
1. A cover page that expresses the project title followed by the name of the institution.
2. Letter of interest

Section A: General information about the project which respondent has involved,
Including name of project, position in project of respondent, type of project, ownership
Of project, budget of project and the difference between total actual labor hours and
Planned labor hours of project.

Section B: Including 51 factors, Probability of occurrence and its impact on duration which is done based on likert scales on affecting the Labour Productivity.

B. Lean construction principle
According to the lean construction method it is very easy to adopt this method which has the ideology through which one can work on the labour, working hours, equipments used, project start period and the end period. The definition given below signifies few constraints involved in the lean method.

1) Definition The word lean as defined by Howell (2001) [8] states "Give customers what they want, deliver instantly, with no waste."One of the main objectives of lean production is to eliminate non value-adding activities, "waste", in production process (Koskela 1992) [10]. Lean construction is a new way to manage constructional activities.

2) Principle The principle of lean construction defines a complete production unit of a particular project as a system of labour force, information relate to working time, machines, equipment and raw material to obtain a final deliverable The overall efficiency of production is attributable either to the efficiency of the conversion or to the activities performed. The core idea of lean construction is to reduce value-added activities and increase efficiency of value-added activities.

3) Project entities
The definition given below signifies few constraints involved in the lean method.
- Project: It defines the type of project selected to adopt the above stated method, since the construction industry.
- Daily work hours: It states the working hours of a labour per day in the construction sites. In the present study the work hours differ according to the company involved. It is specified including a lunch break of 1 hour and a tea break of 30 minutes per day.
- Estimated work hours: This factor actually defines the work hours which was planned initially during the planning stage of the project.
- Charged work hours: It involves the actual working hours which were involved in the project. It might fluctuate compared to the estimated work hours it may either lag or lead. Maximum occurring in this region is a Lag that happens for a reason of delay caused due to rain so that no construction activity can exist. Sometimes it affects a lot in sorts of months together. It is the product of total charged days and the working hours per day.
- Disrupted working days: These are the days which elapse the estimated working hours
- Actual working days: It refers to the working days in which all the activities regarded to project are done at site without any hurdles.
- Quantities ordered: These refer to the number of variables which are ordered as a requirement for the project. It mainly consists of men, material and machine. Here in this concept the above constraint is

taken in a form of numbers which comprises the above said entities.

• Quantities installed: It is the amount of things which are been actually used or installed in the project.

4) Project attributes
The measures of labour productivity measures include Actual cumulative productivity, Disruption index, and Baseline productivity. It also includes Performance parameters such as Performance ratio (PR), Project management index (PMI) and Project Waste Index (PWI).

1) Actual cumulative productivity
The actual cumulative productivity is defined as a ratio of total estimated work hours and total quantity installed for a project.
Cumulative Productivity = Total estimated Work Hours Charged to a Task/Total Quantities Installed   (1)

2) Disruption index (DI)
The disruption index is defined as the ratio of disrupted work days and total number of work days
Disruption Index = Number of Disrupted Work Days/Total Number of Work Days.   (2)

3) Baseline productivity
The maximum productivity achieved during a particular project is said to be the baseline productivity.
The results of baseline productivity are mainly based on the 10% of workdays which has the highest output.
Baseline productivity = Total working days* hours/Quantity installed.   (3)

4) Performance ratio (PR)
The performance ratio is defined as the ratio of actual cumulative productivity to baseline productivity
Performance Ratio = Actual Cumulative Productivity/Baseline Productivity   (4)

5) Project management index (PMI)
The project management index is the ratio of (actual cumulative productivity – baseline productivity) to baseline productivity
Project management index = (Actual cumulative productivity – baseline productivity) / baseline productivity   (5)

6) Project waste index (PWI)
The project waste index is defined as the ratio of the quantity of material ordered to the quantity of material been installed.
Project waste index = quantity of material ordered– Quantities Installed   (6)

B. Data collection
The primary data will be collected via direct interview or indirect through email or Online survey. The secondary data sources are from extent literature, international Business journals, articles, books or expertise Web site.

D. Data analysis
The official survey was done with the questionnaire by face to face interview, online survey and sending email to experienced people in construction industry. In order to get the high rate of response, face to face interview is the best way to fetch the answer and extract relevant data's regarding present study.

IV RESULTS AND DISCUSSIONS

A. Questionnaire survey
Based on the questionnaire survey done for the Kodagu region in various construction sites the factors which impose certain drawbacks in the labour productivity has been mentioned. The factors been listed are according to the results of questionnaire survey and also based on the experience of the respondents (i.e. contractors, engineers etc) in construction industry. The mode of affect might vary on basis of region, climatical condition and advanced technologies involved in the construction sites.

Sl.no	Factors related to labour productivity	Mode of the affect in %
1.	Safety issues	90%
2.	Lack of construction technology available	75%
3.	Weather condition	70%
4.	Shortage of labour	65%
5.	Site condition	60%
6.	Efficiency of manpower	60%
7.	Lack of skilled and experienced labour	55%
8.	Change of material price	45%
9.	Unfavorable location of project site	45%
10.	Quality and efficiency of resource	40%
11.	Equipment shortage	40%
12.	Govt lag in approving plan	40%
13.	Poor condition of camping	25%
14.	Poor health of labour	25%
15.	Wrong estimation	25%
16.	Cash shortage	25%
17.	Legal issue	24%

B. Lean construction principle

The results of this method are based on the project entities and the project attributes as discussed in the methodology (no. 3 and 4 explained under *B. Lean construction principle).*
Based on the different construction sites in Kodagu region the results vary from site to site.

Project	Training centre	Bitumen road	Concrete road	Commercial building	Residential building	Ayush hospital
Daily work hours	8 hours	8 hours	8 hours	7 hours	7 hours	8 hours
Estimated work days	300 days	170 days	170 days	365 days	330 days	365 days
Charged work days	180 days	320 days	110 days	275 days	245 days	545 days
Disrupted work days	120 days	150 days	60 days	60 days	55 days	90 days
Total working days	180 days	320 days	110 days	275 days	245 days	180 days
Quantities ordered	45	11	11	66	70	17
Quantities installed	40	7	7	59	62	12

Table no.1 Entities of Lean construction principle

Table no 1 and Table no.2 represents the entities and project attributes involved in the construction sites used for the study later on the calculations are done in which the project performance parameters are obtained.

Project name	Training centre	Bitumen road	Concrete road	Commercial building	Residential building	Ayush hospital
Actual cumulative productivity	60	194.290	226.666	43.30	37.25	37.4
Disruption index	0.66	0.46	0.54	0.21	0.22	0.33
Baseline productivity	36	365.714	146.6	32.62	27.66	55.8
Project waste index	0.11	0.36	0.45	0.10	0.11	0.08
Performance ratio	1.67	0.53	1.54	1.32	1.34	0.67
Project management index	0.66	0.46	0.54	0.32	0.34	0.33

Table no. 2 List of project attributes.

The calculation procedure is shown for the project Training centre. The same is applied for the rest of the project involved.

- Actual cumulative Productivity = Estimated Work days* Hours /Total Quantities Installed
  Actual cumulative Productivity = 300*8 / 40 = 60
- Disruption Index (DI) = Disrupted Work Days/Total Number of Workdays
  Disruption Index (DI) = 120 / 180 =0.667
- Baseline productivity = Total working days* hours/Quantity installed.
  Baseline productivity = 180 * 8 / 40 = 36
- Project waste index(PWI) = Quantities ordered – Quantity installed / Quantity ordered
  Project waste index = 45 - 40 /45 =0.111
- Performance Ratio (PR) = Actual Cumulative Productivity/Baseline Productivity.
  Performance Ratio = 60 / 36 = 1.67
- Project management index (PMI) = (cumulative productivity – baseline productivity)/ baseline productivity
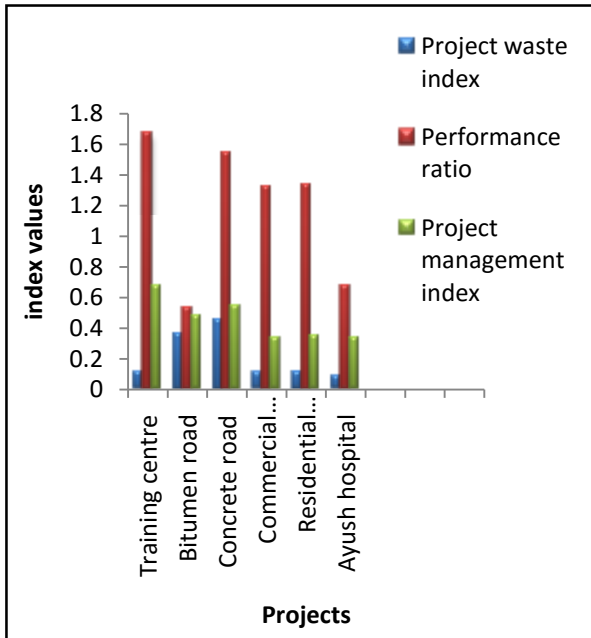 Project management index = (60 – 36) /36 = 0.667

Fig no.1 Variation of PWI, PR and PMI for various projects.

The above graph [fig no.1] shows a pictorial representation of the Project attributes say PWI, PR, PMI with reference to the project concerned. This sort of representing the results helps us to easily understand the concept involved in the study. All the entities explained in [Lean method principle] affect these attributes in one or the other way. Here are some key points listed through which it becomes clear to understand the graph,

- Lesser the PWI, the concerned project has utilized the resources in well manner with less wastage.
- Lesser the PR better is the performance.
- As PMI reduces the performance increases.

[NOTE: the values on the graph depends on the entities [Lean method principle] specified. The results vary with reference to those entities observed in different projects adopted in the present studies.
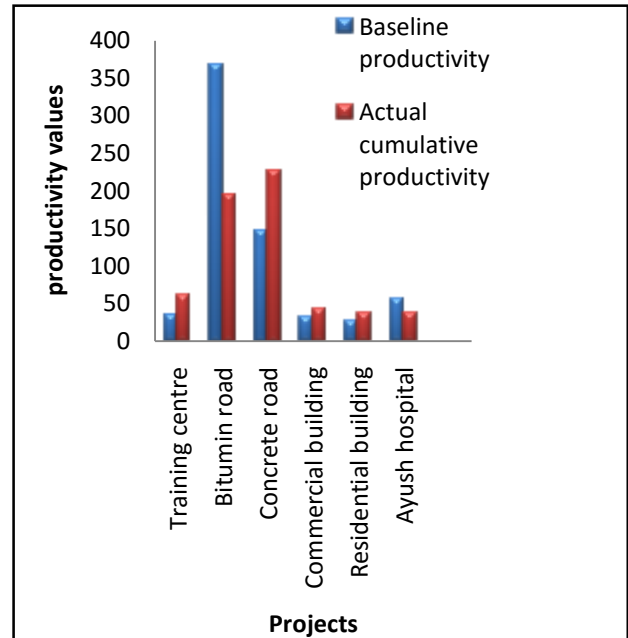

Fig no.2 Variation in Actual cumulative productivity and Baseline productivity.

The (fig no.2) graph shows the variation caused between actual cumulative productivity and baseline productivity of different projects. It varies with reference to the delay due to rain, non- availability of resources in time, disrupted days etc.

V. CONCLUSIONS

- The study highlights the basic concepts of construction productivity and its characteristics through work study then summarize how and where it can be improved through construction management concepts especially performance measurements etc.
- The project attributes are the sort of issues that are discussed related with time interval available for the activity and labour skills needed for implementation of the same scope in site.
- The purpose of this study is to attain better labour productivity so that it relates to improve the unemployment problems arising in our country by giving the opportunities for more projects to start, grow and employ labour.
- In addition, it is also necessary to improve the quality of education and training skills of workers so that they become expertise and fetch higher productivity and also they can be aware of the usage of new automated equipments or any new techniques included regarding the construction aspects.

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