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ANALYSIS OF EFFECTIVE PRODUCTIVITY MEASUREMENT IN CONSTRUCTION INDUSTRY

G. K. Awandkar[1]
Dr. A. R. Mundhada[2]
[1]Master of Engineering student, Prof. Ram Meghe College of Engineering and Management, Badnera
[2]Professor, Prof. Ram Meghe Institute of Technology and Research, Badnera-444701

ABSTRACT
The construction industry in India has a share of about 8% of its GDP and provides employment to around 5 million people. Although the construction industry is a major component of the economy, it has experienced a prolonged period of decline in productivity. Due to the critical lack of measurement methods, however, the magnitude of the productivity problem in the construction industry is largely unknown. The construction industry is characterised by the cost and time overrun. Whilst the causes are innumerable, labour productivity control, through use of effective work measurement techniques, is paramount as labour constitutes a considerable portion of any construction project. The study also focuses on how the effective measurement of productivity can be done by controlling the factors affecting productivity. To improve productivity, qualified and skilled workers are required for minimizing resources as well as time overrun form different activities of the construction project. In construction industry productivity management and control on performance time of labour and actual cost measurement is very difficult.
In this project, factors influencing construction labour productivity in construction industry was assessed. The aim of the project was to identify those factors that affect productivity in construction industry. This information will aid site managers and the construction professionals on decisions to take in-order to limit these controlling factors thereby leading to an improved level of efficiency in labour force, increase labour productivity and reduce cost and time over runs on construction projects. The research adopted a quantitative research approach with the use of questionnaires as an instrument for data collection from site managers at construction sites. The Questionnaire sought to assess the perception of site managers on factors affecting construction labour productivity. This can be attributed to the fact that the site engineers can control site factors and human labour factors while the external factors cannot be really controlled by the site engineers. The survey also revealed that rain, conflict with project stakeholders, skill of labour, and financial crisis had a very high severity in affecting construction labour productivity on the construction sites.

Keywords: Effective Productivity, Construction Labour Productivity, Perception, Direct measurement of Productivity.

INTRODUCTION

Productivity of workers plays an important role in overall performance of onsite construction project. In India, after agriculture construction industry has given second highest employment. Since construction projects are based on repetitive processes, for example bricklaying and plastering, successful planning of these processes can result in time and cost savings over the duration of the project. To achieve this, companies have to undertake productivity measurement and improvements through implementation of various work measurement techniques.
Work measurement is the periodic or continuous application of different techniques designed to establish the time for a qualified skilled worker to undertake a task at a defined rate of working or at a defined level of performance, time and quality being critical elements. Increasing the overall productive use of labour hours, by application of process productivity measurement, analysis and improvement, results in accurate productivity standard output rates at task level.
Productivity increases as the required skilled labour resources are minimized and non-productive time is reduced from the tasks within a construction project. However, a major challenge facing the industry is that it is difficult to obtain a standard method to measure labour productivity as construction projects are complex in nature, having their own unique characteristics.
Productivity, especially in the construction industry, has been very difficult to measure and control and every error in productivity estimation causes an inverse effect in the actual cost and time of labour to perform a scope of work. The average productivities are usually available as an aid for estimation, but these averages must often be modified in light of the special conditions of a job or site. Therefore, it is firmly believed that going back to the basics of effectively measuring labour productivity at the task level would be necessary in facilitating improvements and also deal with those factors that affect the specific sites.

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METHODOLOGY

Data required to carry out the research was collected by Questionnaire Survey. On the basis of previous studies on labour productivity & suggestions from local industry professionals, factors were identified which were having influence on construction labour productivity. The Questionnaire prepared was distributed amongst respondents. Respondents were required to rate using their experience how all factors affects labour productivity. In this study activity oriented model was used to calculate the productivity. Various construction sites were visited to calculate the work done by the team of labours at site. Also the factors that influence the average output of the labour are pointed out. The output of various construction activities shall be compared to the task work of each activity. Remedial measure to control the factors that influenced the productivity were found out to improve the productivity.

Task Work

The capacity of Doing work by skilled labor in the form of quantity per day is called task or out turn work.
Some of the task of major construction activities has been listed below:

	Particulars of Item	**Qty**	**Unit**	**Per Day**
A.	**Brickwork**			
1	Brickwork in Lime or Cement Mortar (Foundation & Plinth)	1.25	Cum	Per Mason
2	Brickwork in Lime or Cement Mortar (Super structure)	1	Cum	Per Mason
3	Brickwork in Mud Mortar (Foundation & Plinth)	1.5	Cum	Per Mason
4	Brickwork in Mud Mortar (Super structure)	1.25	Cum	Per Mason
5	Brick in Cement or lime mortars in arches	0.55	Cum	Per Mason
6	Brick in Cement or lime mortars in Jack arches	0.55	Cum	Per Mason
B.	**Stone Work**			
8	Course Rubble Stone Masonry in lime/cement mortar + dressing	0.8	Cum	Per Mason
9	Random Rubble Stone Masonry in lime/cement mortar + dressing	1	Cum	Per Mason
10	Ashlar Masonry in lime/cement Mortar	0.4	Cum	Per Mason
11	Stone Arch Work	0.4	Cum	Per Mason
C.	**Concrete Work**			
12	Lime concrete in foundation/ floor	8.5	Cum	Per Mason
13	Lime concrete in roof terracing	6	Cum	Per Mason
14	Cement concrete (1:2:4)	5	Cum	Per Mason
15	R.B. work	1	Cum	Per Mason
16	R.C.C work	3	Cum	Per Mason
D.	**Plastering work**			
17	Plastering (12mm) with cement/ lime mortar	8	Cum	Per Mason
18	Pointing with Cement/ Lime mortar	10	Cum	Per Mason
E.	**Whitewashing or Painting**			
19	Whitewashing or Colour Washing - 1 coat	200	sqm	per White Washer
20	Whitewashing or Colour Washing - 3 coats	70	sqm	per White Washer
21	Door / Windows painting or varnishing- 1 Coat	25	sqm	per painter
22	Painting large surface -1 Coat	35	sqm	per painter
23	Distempering - 1 coat	35	sqm	per painter
F.	**Flooring**			
24	2.5 cm (1 inch) C.C. floor	7.5	sqm	Per Mason

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International Journal of Engineering Technology Research & Management

25	Flagstone floor laying with lime/cement mortar excluding L.C.	10	sqm	Per Mason
26	Terrazzo flooring (6mm thick mosaic work) over 2 cm thick Cement concrete (1:2:4)	5	sqm	Per Mason
27	Brick on edge in floor lime/cement mortar excluding L.c.	7	sqm	Per Mason
28	Brick flat floor lime/cement mortar excluding L.c.	8	sqm	Per Mason
G.	**Door Frame**			
29	Timber Framing (Sal/ Teak wood)	0.07	cum	per carpenter
30	Timber Framing (Country wood)	0.15	cum	per carpenter
	D/W Shutters			
31	Door/ window shutters panelled or glazed	0.15	sqm	per carpenter
32	Door/ window shutters battened	0.8	sqm	per carpenter
33	Sawing Hard wood	4	sqm	per pair of sawers
34	Sawing Soft wood	6	sqm	per pair of sawers
H.	**Tiling**			
35	Single Allahabad/ Mangalore tiling	6	sqm	Per Tile layer
36	Double Allahabad tiling	4	sqm	Per Tile layer
37	Breaking of brick ballast			
a	40 mm Gauge	0.75	Cum	Per Labour
b	25 mm Gauge	0.55	Cum	Per Labour
38	Breaking of Stone ballast			
a	40 mm Gauge	0.4	Cum	Per Labour
b	25 mm Gauge	0.25	Cum	Per Labour
I.	**Dressing Work**			
43	Ashlar Stone dressing	0.7	cum	Per stone cutter
44	Flag stone dressing	1.5	sqm	Per stone cutter
J.	**Earth Work**			
45	Earthwork in excavation in ordinary soil	3	cum	per labour
46	Earthwork in excavation in hard soil	2	cum	per labour
47	Excavation in rock	1	cum	per labour
48	Sand filling in plinth	4	cum	per labour

CASE STUDY

At this site, productivity of column casting, brickwork, slab casting and plastering was studied. The number of masons and labours deployed at the work was noted down and the work done by the crew of labours was measured as on site. Here to calculate the productivity activity oriented model was used. The work done by the crew of labours and time required to complete the work in hours was measured.

CASE STUDY 1: A small house of 450 sqft was taken for the case study. The house was proposed to be constructed at Moti Nagar, Amravati. At this site the productivity of column casting with footing was studied and various factors that influenced the productivity were identified.

Here column size 0.3mx0.3mx4.3m with footing of size 1.2m x 1.2m x 0.8m was constructed by one mason and 2 labours. The total time required by the crew measured was 24 hours (3 days of 8 hours working). The work also consisted of

reinforcement bending, hooking, binding, placing in position with line and level, centring and formwork, etc. There were 9 number of columns with footings. The quantity of 9 columns with footings was measured out to be 4.527 cum. Thus the productivity of the casting column with footing was calculated to be 0.189 cum/hour.

CASE STUDY 2: The bank building situated at Shegaon-Rahatgaon road, Amravati. Name of bank is Mahatma Phule Co-operative Bank Ltd. Amravati. The total area of construction is about 3200 sqft. At this site the productivity of casting of Slab with beams was studied and various factors that influenced the productivity were identified.

For the construction of slab of 3050 sqft. area out of total 3200 sqft. construction area is casted by 3 mason and 15 labours. Ready mix concrete was used to construct the slab with beams. The total time required by the crew was measured to be 56 hours (7 days of 8 hours working). The work also consisted of reinforcement bending, hooking, binding, placing in position with line and level, centring and formwork, etc. The quantity of slab with beams was measured out to be 39.26 cum. Thus the productivity of the casting column with footing worked out to be 0.701 cum/hour.

CONCLUSION

Labour productivity is one of the least studied areas within the construction industry in India. Despite being time consuming techniques, Work study and work measurement are the techniques useful for data collection of labour and improvement in labour productivity. In this study, it has been seen that techniques used for the construction highly affects the productivity. Also the size and type of work also has impact on productivity. Further study is needed to identify factors which are responsible for variation in the productivity in construction industry. More case studies are needed to compare the same size and pattern of work to find out actual comparison for the productivity calculations.

Analysis questionnaire showed that top ranked factors affecting labour productivity are Labour Supervision, Skilled Labour, Scheduling of work, Training of labour, Payment, Communication between site management and labour, Climatic condition, Unscheduled extra work, Construction method, Availability of material, Availability of tools, Numbers of labours on site, Temperature on site, Safety conditions on site, Meetings with labour contractor, Motivation to labour, Project manager's leadership, Miscommunication in site management etc.

Above literature concluded that there are many methods of work measurement for improving productivity in construction industry. Work measurement techniques are used for controlling cost and time overrun, factors affecting on productivity of works. Different methods consist martial tracking and procurement, effective management system, motivation and safety to workers, external issues and other factors to improve onsite productivity. Some effective methods to improve onsite productivity and to control cost and time overrun are as follows:

1. Work measurement by estimating and work sampling technique.
2. Automation in material taking.
3. Collaboration in different industries/ Agencies.
4. Controlling activities onsite with the help of CPIF.

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