

Practical Labor Productivity Measurement And Its Importance In Construction Projects

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ABSTRACT

Construction productivity is main issue to researchers and practitioners because of its impact on the performance of construction projects. Efficient management of resources can lead to higher productivity which can help to achieve cost and time saving. Construction is labor oriented industry and therefore labor is the industry's most valuable asset. It is important to improve the efficiency of labor productivity in construction projects. Increasing or decreasing of labor productivity of project has major concern with construction industry. The aim of this research project to determined the practical measurement of labour productivity and its importance in construction industry of Peshawar Khyber Pakhtunkhwa Pakistan after finding the factors affecting construction labor productivity. Factors affecting labour productivity were analysed using (RII) method. Measurement of labour productivity is done using field work method. RII method revealed twenty three ranked factors which affect labour productivity. The data collection is done by field work method shows poor management system and lack of site supervision as highly important factor affecting labour productivity. From the analysis of data collected it is observed that measurement of labour productivity is helpful to safe the project from cost overrun without hampering the quality of work.

Key words: Construction, Factors, Labor Productivity, Measurement

INTRODUCTION

Construction industry plays an important role in the development of an economy of a country. It also provides basis for the growth of other sectors in the economy, by building the physical infrastructure which provides production of goods and delivery of services. According to [10] the construction industry accounts for 6 to 9 percent of the Gross Domestic Product (GDP) in many countries. The construction industry of Pakistan adds 2.45 percent to the total Growth Domestic Product (GDP). It is facing continuous competition, cost escalation, lacking behind from schedule and decrease in profit margins. Productivity is one of the key mechanisms to every company's success and its effectiveness in the industry. Productivity results directly into profitability and cost benefits ratio. Labor productivity usually related to manpower in terms of labor cost or work hours to the quantity of outputs produced [11].

Labor productivity = Output/Labor Input

LITERATURE REVIEW

In today's competitive market across the world, construction industry requires better productivity achievements. Extra saving and contractors profit in such industry, directly relate to achieving higher productivity [1]. The top most productivity improving elements on site that interact directly are management of materials, equipment and work force [2]. Attempted to improve work force productivity occurs when craftsmen and supervisor start addressing to workers instead of management [3].

Another more general definition of productivity is total factor productivity which is the combination of Labor, material capital, energy and equipment [4],[5]. Due to its significance in affecting cost and duration of the project, construction professionals and owners are agreed on its importance. In the last twenty years, attention towards productivity improvement has been increased. In this regard, record keeping has become the priority of the contractors to overcome its adverse effects. Usually the data of productivity is in terms of average productivity i.e. Average amount of delays, average job site conditions, average weather record etc.

A study conducted [6] the most important factor which require special attention that is health and safety on site which improves motivation and loyalty of the workers. Another study conducted [7] on the ranking of factors affecting labor productivity in Trinidad and Tobago, shows that lack of labor supervision is the top most productivity affecting factor followed by unrealistic scheduling, shortage of experienced skilled labors, lack of construction management experience, delay in request for information, delay in wages payment, poor communication on site and bad weather conditions. In a study [8] the top factors negatively affecting labor productivity are country's political situation, shortage of equipment, insufficient & outdated equipment, lack of labor experience and poor management at sites. A study conducted [9] states that the top factors affecting labor productivity are over timing, clarification of technical documentation, fatigue of labor, labor payment delay, change order variation delay, poor communication between site management and manager and lack of training for labors.

METHODOLOGY AND DATA COLLECTION

In applied social research most of the data collection takes place using interviews and questionnaire surveys [15]. Data required to carry out the research was collected by questionnaire survey. On basis of previous studies on labour productivity and suggestions from Local Industry Professionals, total 23 factors were identified which are having influence on construction labour productivity in Peshawar Khyber Pakhtunkhwa Pakistan. The target population included Clients, Contractors, Consultants and Civil Engineers. The distributed questionnaires recollected from respondents for analysis of data. The total numbers of questionnaires were 150 and received 103 feedbacks only 03 were rejected due to overwriting and errors. The total number of valid responses from all the stakeholders is 100 out of 150 and percentage is 66. The total 100 numbers of questionnaires were finalized for final data analysis by using Likert scale from 1-5 having 5 represented "very high" and 1 represented "very low". After compilation of the data, the following percentage score equation applied and calculated to find out its significance and provided the ranking of twenty three (23) numbers of factors affecting construction labor productivity [12, 13 and 14].

$$\text{Percentage Score} = \frac{\sum W}{A \times N} \times 100$$

Where

ΣW = score of respondent, A =maximum score on Likert scale, N = total respondent numbers.

Table1. Ranking of Productivity Factors Affecting Construction Labor Productivity

S.NO	Factor	RII	Percentage Score	Rank
1	Follow up the actual work plan / activity chart etc.	0.872	87.2	1
2	Supervisor's behavior/Attitude towards his crew has also an impact on labor productivity	0.82	82	2
3	Skilled labor hired to get more progress	0.78	78	3
4	Poor managerial system	0.78	78	4
5	Good communication amongst the client, consultants and contractor	0.776	77.6	5
6	Lack of supervision	0.772	77.2	6
7	Non-availability of material on site	0.756	75.6	7
8	Main contractor should execute the work himself and avoid subletting	0.744	74.4	8
9	Site congestion	0.718	71.8	9
10	Accidents to labor at site due to no proper safety	0.676	67.6	10
11	Inadequate safety precaution on working site	0.67	67	11
12	Less technical knowledge of workers	0.636	63.6	12
13	Labor low wages	0.63	63	13
14	Shortage of procurement planning	0.626	62.6	14
15	Design errors	0.604	60.4	15
16	Physical fatigue	0.58	58	16
17	Lack of transport facility	0.548	54.8	17
18	Interim demands of client regarding change in design	0.546	54.6	18
19	Domestic issues with labors	0.532	53.2	19
20	Weather condition	0.528	52.8	20
21	Lack of labor law implementation	0.526	52.6	21
22	No benefits for best working labors	0.522	52.2	22
23	Conflicts with natives	0.514	51.4	23

PRACTICAL LABOR PRODUCTIVITY MEASUREMENT

Productivity Ranked Factors 04, 06 and 07: The poor management system, lack of site supervision and non-availability of material on site highly impact the construction labor productivity with time and cost of construction project.

Aim of the Question: The field work activity provided in this study to find out the possibility of increasing or decreasing labor productivity which caused by factors affecting labor productivity.

Table 2.
Measurement Of Labor Productivity(RCC) (1:2:4) Raft Foundation upto Plinth Beam (Private Health Center Building Project District Mardan (Khyber Pakhtunkhwa) Pakistan

Details Of Construction Site: The (RCC) (1:2:4) raft foundation upto plinth beam activity was under construction on site during my personal visit to private health center building project district Mardan (Khyber Pakhtunkhwa) Pakistan. The total quantity of concrete was 2918 cft and collect detailed engineering estimate from there site: When the concrete activity started on site that was going smoothly but after 03 hours the activity halted unfortunately due to non-availability of cement material, the reason was **poor management due to lack of site supervision**:The remaining activity started after 02 hour time interval when provided the required number of cement bags to working area from market: The activity delay upto 02 hours due to non -availability of material on site caused by site supervision.

MEASUREMENT DETAILS FOR (RCC) (1:2:4) RAFT FONDATION UPTO PLINTH BEAM

S. NO	Item Description	No	MEASUREMENT			QUANTITY (CFT)
			L	W	H	
1	boundary wall 1	1	109	2	2	436
2	boundary wall 2	1	90	2	2	360
3	boundary wall 3	1	70	2	2	280
4	boundary wall 4	1	50	2	2	200
5	external building area long walls	1	72.5	2	2	290
6	Back side wall	2	54	2	2	432
7	Two rooms wall to verandah face	1	47.5	2	2	190
8	Short walls of other rooms	5	16	2	2	320

9	Doctor room short wall	1	12	2	2	48
10	Doctor room long wall	2	14	2	2	112
11	Long wall doctor room to other room	1	38	2	2	152
12	Doctor washroom	1	9	2	2	36
13	Toilet Wall	1	5.5	2	2	22
14	Toilet Wall	1	7	2	2	28
15	Toilet Wall	1	3	2	2	12
TOTAL						2,918

DETAILS OF REQUIRED MATERIAL FOR (RCC) (1:2:4) RAFT FOUNDATION UPTO PLINTH BEAM

1	Cement				514	no's
2	Sand				1284	Cft
3	Crush				2568	Cft
4	Mason (skilled)				29	no's
5	Labors (unskilled)				175	no's
6	Concrete Mixer				41	Hr's

PRODUCTIVITY CALCULATION

(a). Details of construction site before any delay on site

To find out the labor productivity of under construction private health center building project district mardan (Khyber Pakhtunkhwa) by using activity oriented model as labor productivity rate equal to Work hour/Quantity: Before any delay in activity onsite, the total quantity of reinforcement cement concrete (RCC) (1:2:4) was 2918 cft for raft foundation up to plinth beam and the activity to be completed by 204 nos of labor both (skilled & unskilled) in 10 working hours a day as per approved estimation. Calculation of labor productivity (RCC) (1:2:4) raft foundation upto plinth beam before any delay on site as shown in the table 03.

Table 3

Calculation of activity (RCC) (1:2:4) before any delay on site				
Item Description	Quantity	Formula For Calculation	Unit	Remarks
Total Concrete	2918		Cft	
Labors (skilled)	29	Nos Of labor (skilled)=1/100 cft x quantity of concrete in cft	Nos	As per rate analysis calculation
Labors (unskilled)	175	Nos Of labor (unskilled)=6/100 cft x total concrete quantity in cft	Nos	As per rate calculation analysis
Total labors :	204	Sum of skilled and unskilled labors	Nos	
Total labor hours:	2040	Total Labor hrs=Total nos of labor x 10 hrs working in a day to complete the activity	Hrs	Applied thumb rule's ratio proportional. As per previous project if qty of concrete 3500 cft completed in 12 hours while 2918 cft will be completed in 10 hours.
Cost of labor on activity (Rs):	71400	Rate of labor @ Rs.35 cft per hour in a day to complete the activity	35	skilled and unskilled labors wages
Labor productivity rate	0.70	Labor productivity rate=Labor hours/ total quantity of concrete		0.70 labor hrs per cft

(b). Details of construction site after delay (02) hours time interval

When activity of concrete (RCC) (1:2:4) started on site that was going smoothly but after 03 hours the ongoing activity halted unfortunately due to non-availability of cement material, the reason was poor management system due to lack of site supervision on site: The remaining activity started after 02 hours time interval when provided the required number of cement bags to working area from market: The activity delay upto 02 hours on site due to non-availability of material on site caused by site supervision: Calculation of labor productivity (RCC) (1:2:4) raft foundation upto plinth beam after delay on site as shown in the table 04 and prior actual calculation of the activity changed in new due to time variation.

Table 4

Calculation of activity (RCC) (1:2:4) after delay (02) hours time interval				
Item Description	Quantity	Formula for Calculation	Unit	Remarks
Labor hours:	2040	Total Labor hrs=Total nos of labor x 10 hrs working in a day to complete the activity	Hrs	Labor hours before any delay in activity
Additional labor hours	408	The prior calculated labor hours for activity were 2040 while the additional labor hours due to delay are 2 hrs & will be added as extra for completion of activity on site	Hrs	Labor hours after delay in activity
Total labor hours:	2448	Sum of hours (before and after the delay in activity)		Accumulation of hours
Cost of labor on activity in pak (Rs):	85680	Rate of labor @ Rs.35 cft per hour in a day to complete the activity	35	skilled and unskilled labors wages
Labor productivity rate	0.84	Labor productivity rate=Labor hours/ total quantity of concrete		0.84 labor hrs/cft

4.2 Labor Productivity Percentage Ratio

Labor Productivity Percentage Ratio= $(0.7 - 0.84) = -0.14/0.70 \times 100 = -20$ percent. The negative sign indicating decrease in labour productivity for activity of reinforcement cement concrete (RCC) (1:2:4) raft foundation up to plinth beam: Furthermore, this decrease ratio of labor productivity caused both losses of cost and time in activity.

4.3 Loss of time and cost due to delay in activity of (RCC) (1:2:4) raft foundation up to plinth beam

Table 5

I- Loss of time in activity (RCC) (1:2:4) raft foundation upto plinth beam				
Item Description	Quantity	Formula for Calculation	Unit	Remarks
Prior the delay	2040	Labor hours @10 hrs in a day for completion of activity	Hrs	
After delay	2448	Labor hours @10 hrs with 02 additional hours due to delay in activity	Hrs	
Loss in time after delay	-408	Prior the delay - After delay in activity	Hrs	(-) 408hrs negative sign indicating there is loss in time -408/204= (-) 02 hours is actual delay in activity on site
II- Loss of cost in activity (RCC) (1:2:4) raft foundation upto plinth beam				
Prior the delay	71400	Cost of labor on activity	Rs	
After delay	85680	Cost of labor on activity	Rs	
Loss in cost after delay	-14280	Prior the delay - After delay in activity	Rs	The negative sign in amount indicating there is loss in cost due to delay in activity

RESULT AND DISCUSSION

Labor is one of the basic requirements in construction industry all over the world and Pakistan. Despite of time consuming techniques work study and work measurement are the techniques useful for data collection of labor and improvement in labour productivity.

The labor productivity rate in field work activity was 0.7 labor hours per cft before any delay in activity which to be completed in 2040 hours by the required estimated labors. But later on the activity delay due to poor management system and lack of site supervision, labor productivity rate reached to 0.84 labor hours per cft after delay of activity and completion become with additional (-) 408 hours as extra, finally spends total 2448 hours while before the delay actual hours were 2040. The result obtained from calculation (-20) percent showed decrease in labor productivity rate which caused both losses time and cost of activity. It observed from the result that the impact of poor management system, lack of site supervision and non-availability of material on site affecting highly the construction labor productivity with time and cost of construction project.

CONCLUSION

The field work provided in this study for measurement of labor productivity to find out the possibility of increasing and decreasing of labor productivity which come out due to factors affecting construction labor productivity. The importance of labor productivity measurement by field work study is useful for data collection of labor and improvement in labor productivity. All analyzed ranked factors are explained in the table # 01 which highly affecting the labor productivity. Such as poor management system, lack of site supervision and non-availability of material on site are factors of table # 01 with serial nos 04, 06 and 07 which highly affect the

labor productivity with time and cost of the construction project. The calculation showed before the delay there was no impact on cost and time of the project but after delay which highly impact the labor productivity rate and found (-20%), negative sign showed decrease caused both losses of 02 hours delay from actual completion time and loss of Rs.14280 in actual cost.

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