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ENHANCE LABOUR PRODUCTIVITY THROUGH APPLICATIONS OF WORK STUDY PRINCIPLES FOR A RESIDENTIAL SITE

Mayuri Sanjay Doiphode[*1], Prof. Uday. J. Phatak[2]
Civil Engineering Department, Imperial college of Engineering and Research, Wagholi,Pune-412205,India

ABSTRACT

The construction industry is one of the largest industries, because of its large presence; it makes a significant contribution to the national economy and provides jobs to large no of peoples. In recent year India's construction sector has investment in both not only public but also in private sector enterprises. Large amount of investment made in construction roads, ports, power plants, urban infrastructural development etc. Number of approaches has been developed to improve the efficiency and effectiveness of construction process by applying statistical analysis. There is no proper definition for the labour productivity. It is a very important factor that affects the overall productivity of construction. Different labours shows different level of productivity and that affects the overall time and profit of construction.

Method study and work measurement study is carried out to asses human effectiveness by improved planning and sound incentives scheme to its employees and this used for increase productivity and reduce waste. The purpose of this work is to know the benefits of time and motion study employed in construction sector. For measure productivity of various construction activities are using by the time and motion study and work sampling. Enhance improvement of the productivity apply time and motion study and statistical analysis to various construction processes to the observations data sets generated for various construction process on site and determine their productivity and establishes regression equation using statistical analysis

KEYWORDS: Time and motion, Productivity, Work sampling, Statistical analysis, Regression equation etc.

I.   INTRODUCTION

Productivity is the relation between output and input. It actually means adding value to input to enhance value of output. Work study is used to improve the construction productivity that is output per worker hour, used to set up the standard of the performance for which that activities are carried out. In work study principles the word "efficiency" began in the 19th to 20th century and the work measurement and motion study are the two principles of work study, which are originated work of F.W.Taylor (Frederick Winslow Taylor 20 march 1856-21 march 1975). F.W.Taylor is called as the father of scientific management. Frank Bunker Gilbreth and his wife Lillian moller Gilbreth was industrial engineers and efficiency expert who contributed to the study of industrial engineering in field such as motion study and human factors.

The goal of this project is to understand the skills required to perform a work and to provide correct training to the workers. The work study concept issued to increase the output, quality of labour productivity and reduce cost etc. Work measurement is direct and homogenous observation of task using a time keeping device e.g. decimal stopwatch, videotape camera and electronic stopwatch are used to record the task to have time taken for completing that particular job. Most of this device used for the repetitive cycles for short to long duration. Aim of this project to find out the difficulty in the job and device and for that what the best solution is. Basic purpose of this project is to improve the quality of labour productivity and ultimately quality of production.

II.   LITERATURE REVIEW

According to Kanawaty (1992) work study is the step by step examination of the method of carrying out activities, so as to improve the effective use of resources and to set up standard performance for the activities

being carried out. It is one of the most powerful tools that management can use to improve productivity. The term 'work study' embraces method study or motion study and work measurement or time study the terms are used interchangeably. Method study is the systematic recording and examination of way of doing things in order to make improvement, work measurement involves time for a qualified worker to carry out a task at a defined rate of working.

H.Randolph Thomas (1991) explains the relationship between labour productivity and direct work. According to Michael.J.Horman and H.Randolph Thomas (2006) the fundamental principles for time study are as work assignment, daily work schedule, performance measure etc. Construction project are mostly depends on labour with basic equipment and hand tools and its affect all over the construction.

III.   DEFINATION AND OBJECTIVES
A.   Definition of method study-
Method study is systematic recording and critical examination of way of doing thing in order to make improvements. Motion studies are performed to eliminate waste.

B.   Definition of work measurement-
Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out a task at a defined rate of working.

C.   Objective of productivity study-
1.   Study of literature review of work study from various papers.
2.   Analyze the task selected.
3.   Apply work study principles to enhance task performance.
4.   Apply and analyze the performance enhancement foe selected work.

IV.   WORK METHODOLOGY
1.   Background of productivity
2.   Literature review
3.   Select task for study.
4.   Collecting the equipment and arrange machinery required to conduct time study and ensure accuracy in recording time.
5.   Explaining to the workers the improved working procedure and use of tools and fixtures.
6.   Breaking the jobs into operations and operations into elements and writing them in a proper format.
7.   Conducting the observations and recording them on the time.
8.   Conducting work sampling.
9.   Determining the productivity.

V.   GRAPH
Relation Between Components Of Material Handling Of Sand
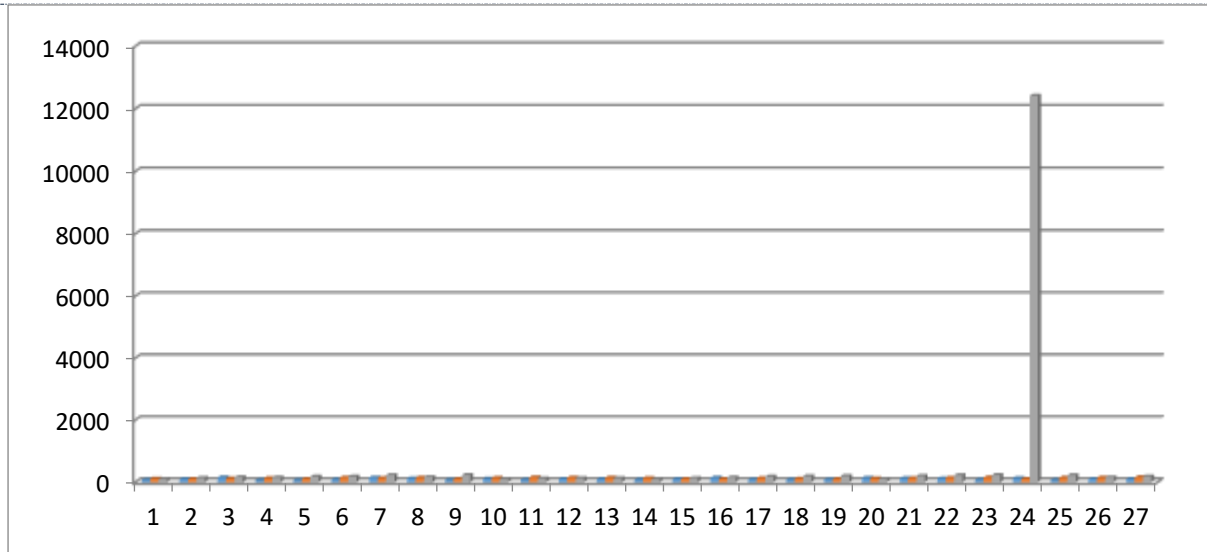
Where,

- ▪ Loading of sand (time in seconds)
- ▪ Lifting of sand to the 1th floor (time in seconds)
- ▪ Unloading of sand (time in seconds)

The above graph shows the relation between various components of material handling of sand. Here maximum time required is for the lifting the sand to 1st floor. This was due to lack of communication skill between the operator and the labour. Where X axis represent the no of observations and the Y axis represent the time in seconds.

VI.   DATA COLLECTION

Site Details
Type-Residential site
Name- Sagar Shashikant Phalake.
Address-At post Umbraj, Tal –Karad, Dist- Satara. Pin code-415109
No. Of floors completed- G+2 floors.
Cost of project- 20 lakh/-
Contractor- Vasim Inamdar
Grade of concrete- M20
Grade of steel- Rajuri 500
Section of major activity-Material handling (Sand)

Sand

Table 1: Data collection for material handling of sand

NO OF OBSERVATION	LOADING OF SAND(TIME IN SECONDS)	LIFTING THE SAND TO THE 1TH FLOOR (TIME IN SECONDS)	UNLOADING OF SAND(TIME IN SECONDS)
1	70.05	104.26	97.23
2	75.40	92.04	96.05
3	72.12	96.72	88.02
4	69.09	105.02	105.04
5	80.02	101.01	110.81
6	81.01	98.05	99.46
7	59.24	94.72	112.09
8	85.09	99.76	89.24
9	71.02	102.09	101.64
10	70.34	110.91	98.54

11	76.70	102.08	108.32
12	75.56	95.78	120.49
13	74.49	104.64	97.34
14	75.02	99.24	118.08
15	73.69	108.48	129.45
16	70.64	101.88	143.34
17	69.94	104.26	113.39
18	74.14	98.68	89.24
19	58.19	106.32	101.64
20	78.02	101.04	104.78
21	68.19	102.40	89.40
22	82.64	104.49	99.47
23	84.32	99.90	101.52
24	79.78	98.41	102.58
25	80.44	95.39	99.04

Table 2: Statistical Analysis

SD(A)	SD(B)	SD(C)
6.731301	40441892	12.98691
MAX(A)	MAX(B)	MAX(C)
85.09	110.91	143.34
MIN(A)	MIN(B)	MIN(C)
58.19	92.04	88.02
VAR(A)	VAR(B)	VAR(C)
45.31042	19.7304	168.6598
MEDIAN(A)	MEDIAN(B)	MEDIAN(C)
74.49	101.04	101.64
CORREL C12	C13	C23
-0.23313	-0.15304	0.136666

Table 3: Work Sampling

Time observed	Worker 1	Worker 2	Worker 3
9.00	DW	DW	DW
9.10	DW	DW	DW
9.45	DW	DW	DW
10.00	DW	DW	DW
10.30	DW	DW	DW
11.15	DW	DW	DW
11.45	DW	DW	DW
12.30	IW	IW	DW
1.00	IW	DW	IW
2.30	DW	DW	DW
2.45	DW	IW	SW
3.00	SW	DW	SW
3.30	DW	SW	DW
3.45	SW	SW	DW
4.00	DW	DW	DW
4.15	DW	DW	DW
4.30	DW	SW	DW
4.45	DW	DW	SW
5.00	DW	DW	IW

5.30	IW	DW	DW

Work sampling procedure can be divided in following 3 phases:
1. Preparing for work sampling.
2. Statement of the main objective of study, obtaining approval of supervisors.
3. Establishing quantitative measurement of activity, selection of training of personnel and making a detailed plan for taking observations.

Here DW denotes direct work and IW represents inefficient work. SW means the workers have stop working.

Table 4: Productivity

Observation no. Time observed	1	2	3	4
9.00 AM	PW	PW	PW	PW
9.30 AM	PW	PW	PW	PW
10.00 AM	PW	PW	NP	PW
10.30 AM	PW	PW	PW	PW
11.00 AM	PW	PW	PW	NP
11.30 AM	NP	NP	PW	PW
12.00 PM	PW	PW	PW	NP
12.30 PM	NP	PW	PW	PW
1.00 PM	NP	PW	NP	NP
1.30 PM	NP	NP	PW	PW
2.00 PM	NP	NP	NP	PW
2.30 PM	PW	PW	PW	NP
3.00 PM	PW	NP	NP	PW
3.30 PM	PW	NP	PW	PW
4.00 PM	PW	PW	PW	NP
4.30 PM	PW	PW	PW	NP
5.00 PM	NP	NP	NP	PW
5.30 PM	NP	NP	PW	PW

According to Md.Salim and Leonhard E. Bernold labour productivity is the important function in any construction industry, achieved maximum productivity over a period of time and reduce waste. Labour productivity is the output per worker hour and can be higher or lower depending upon factors like work efficiency, material, availability of work load, availability of power, level of training etc. According to Adnan Enshassi labour productivity can be measured in terms of hours or money. From the above observation, Non productivity-31.94 %, productivity-68.06%

VII.   REGRESSION EQUATION FOR MATERIAL HANDLING (SAND)-

By statistical analysis

Summary Output

Regression Statistics	
Multiple R	0.263272
R Square	0.069312
Adjusted R Square	-0.0153
Standard Error	6.782586
Observations	25

ANOVA

	df	SS	MS	F	Significance F
Regression	2	75.37372	37.68686	0.819218	0.453778
Residual	22	1012.076	46.00347		
Total	24	1087.45			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	114.0361	32.29078	3.531538	0.001876	47.06913	181.0031	47.06913	181.0031
LIFTING THE SAND TO THE 1TH FLOOR (TIME IN SECONDS)	-0.32771	0.314641	-1.04155	0.308933	-0.98024	0.324812	-0.98024	0.324812
UNLOADING OF SAND(TIME IN SECONDS)	-0.064	0.107616	-0.59473	0.558094	-0.28718	0.15918	-0.28718	0.15918

Regression equation is
$114.0361X_1 = -0.32771X_2 + 0.064X_3$

Where
X_1= loading the sand
X_2= lifting the sand to 1th floor
X_3= unloading of sand

Regression equation establishing using various mathematical terms such as standard deviation, variance, range, mean, median and correlation etc.

VIII.   CONCLUSION

Work sampling technique reduces the rework, so that experienced personnel must be assigned for the job. Direct work percentage from work sampling can be used to predict labour productivity measured as the work hour per unit or money. Productivity of sand is 68.06% and the non productivity is 31.94%. This was due to lack of communication skill between operator and the labour. Required proper guidelines for the operator for operating tools increase productivity of construction site and reduce the waste. Regression equation is established using various mathematical terms such as standard deviation, variance, range, mean, median etc. Work sampling has been achieved employed to measure productivity is the output per worker hour of various construction activities

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