

# Study on Productivity analysis of critical activity in construction project using Earned value Method

Hari.P<sup>1</sup>, Jamespraveen.R<sup>2</sup>

<sup>1</sup>Assistant professor, Department of civil Engineering, AVS Engineering College, Salem, India

<sup>2</sup>Assistant professor, Department of civil Engineering, AVS Engineering College, Salem, India

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**Abstract:** Construction is the world's largest and challenging industry. Productivity of every activity is important in determining the financial outcome of any construction project. Productivity tracking helps to higher cost savings. Planning manager to monitor the critical activity for successful completion of project within duration and budget this paper shows that productivity can be measured by monthly planned/targeted quantity of activity and actual quantity of work done at site. Whereas targeted quantity of activity is the input and actual quantity of work done is the output of the productivity. This analysis considers the earned value method as the monitoring system which can be used to monitor a construction project and improves productivity at site. The on-going project data is collected from the respective construction manager of the site and the planned and actual progress of site is analyzed in spread sheet. The result of this analysis shows the deviation of planned activity in site and warning sign to project manager from cost overrun and guidelines to improve productivity in site.

**Keywords:** Construction management, Earned value analysis, Monitoring, Productivity, Progress management.

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## I. INTRODUCTION

Productivity of critical activity will affects the overall performance of any construction site. In general terms, construction productivity can be defined as association between an input and an output. Productivity measurement at construction site enables companies to monitor their expected performance against their site performance. Construction productivity at site level can be grouped under major activities whose can affect entire construction the project. The effective system for monitoring and controlling project cost is the main reason for cost overruns and delays in the project. The Earned value analysis is basic tool to monitoring the critical activity of construction. The project becomes out of control when there is no control action taken at right place. This analysis method gives current and future state of project.

## II. EARNED VALUE ANALYSIS

Earned Value Analysis (EVA) is a method that required to analysis the project. Usually the amount of work actually carried out in a project and planned amount of work should to compare to track actual project status. In construction project tracking of time and cost is crucial to successfully complete the project within duration and capital cost. While tracking construction project, the productivity of critical activity monitored and control helps the planning manager to make necessary action for successful completion of project. The output of EVA is graphical representation of critical activity progress both time and cost.

## III. DATA REQUIRED FOR EARNED VALUE ANALYSIS

The analysis for productivity of critical activity requires the actual field data about the construction project. The following data should be collected from the planning manager.

- Detail planning of the project for the critical activity
- Monthly actual work done of the critical activity from progress report

- Daily progress report
- Monthly certified bills

After data collection analyzing the data for productivity of a critical activity and provide with a suggestion to eliminate the delay and cost overruns due to critical activity and increase productivity

#### IV. PRODUCTIVITY MEASUREMENT

Productivity of activity can be measured by quantity of work completed and quantity of work planned during construction. In this study we using simple equation used by the construction industry development board [CIDB] Singapore to compute the monthly productivity of activity. The Input and Output values are planned quantity and actual quantity for the period of a month.

$$\text{Productivity} = \text{Input/Output}$$

#### V. CASE STUDY

In order to compute actual productivity of critical activity, data was collected from the construction site. The list of important data about project is,

- Type of contract : 'Item Rate'
- Total cost of contract : 99.14cores
- Duration of the contract : 8 months
- Type of building : Industrial Building
- location : Pune, India

The scope of the project is civil and structural work and major activities are Earthwork, Formwork and staging, Reinforcement, concreting. The project is already delayed due to less productivity. The name of the company is not disclosed only study process data are analyzed. As it is item rate type of contract, major activities make impact on the project and productivity of the project. Below table 1.1 shows planned and executed quantity of the major activity like Earthwork, Formwork and staging, Reinforcement, Concrete of three months. The monthly executed quantity taken from monthly progress report of the site.

**Table 1.1 Planned and Executed quantity of Earthwork, Formwork, Reinforcement, concrete**

S.no	Month	Earthwork in 'CUM'		Formwork in 'SQM'		Reinforcement in 'MT'		Concrete in 'CUM'	
		Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
1	May	6788.00	1875.00	10680.10	3178.33	484.04	218.40	6233.87	2637.45
2	June	3009.00	0.00	8994.00	4850.00	317.00	145.00	3110.00	1168.00
3	July	0.00	0.00	6875.00	2557.00	230.00	54.00	2796.00	1082.00

Table 1.2,1.3,1.4 shows planned and executed quantity of the major activity like Earthwork, Formwork and staging, Reinforcement, Concrete of May, June and July month. The weekly executed quantity taken from daily progress report of site. Every month is divided into four weeks and each week consists 7 days. The fourth week of month has more days compare to other weeks. The remaining days after every 21 days of month is counted in fourth week.

**Table 1.2 Planned and Executed quantity of May**

S.no	Activity	Week 1		Week 2		Week 3		Week 4	
		Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork in 'CUM'	1533	400	1533	200	1533	975	2190	300
2	Formwork in 'SQM'	2412	553	2412	726	2412	1109	3445	790
3	Reinforcement in 'MT'	109	38	109	51	109	80	156	51
4	Concrete in 'CUM'	1408	381	1408	624	1408	821	2011	811

**Table 1.3 Planned and Executed quantity of June**

S.no	Activity	Week 1		Week 2		Week 3		Week 4	
		Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork in 'CUM'	679	0	679	0	679	0	971	0
2	Formwork in 'SQM'	2031	1148	2031	1442	2031	1067	2901	1193
3	Reinforcement in 'MT'	72	43	72	46	72	27	102	29
4	Concrete in 'CUM'	702	427	702	291	702	340	1003	110

**Table 1.4 Planned and Executed quantity of July**

S.no	Activity	Week 1		Week 2		Week 3		Week 4	
		Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork in 'CUM'	0	0	0	0	0	0	0	0
2	Formwork in 'SQM'	1552	1028	1552	586	1552	269	2218	674
3	Reinforcement in 'MT'	52	6	52	11	52	3	74	34
4	Concrete in 'CUM'	631	192	631	604	631	89	902	197

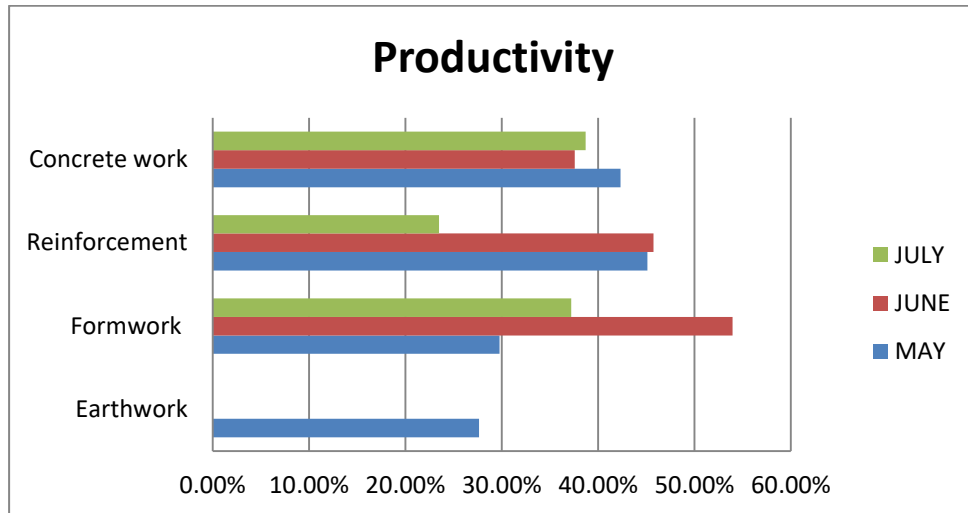
## VI. RESULT AND DISCUSSION

**Table 1.5 Productivity of Earthwork, Formwork, Reinforcement, and Concrete work**

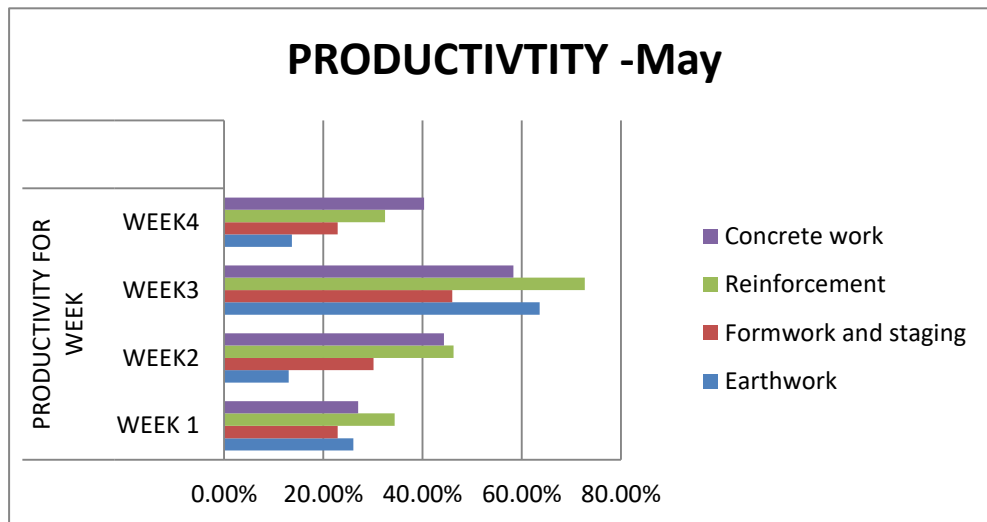
Activity	Productivity in %		
	May	June	July
Earthwork	27.62%	0.00%	0.00%
Formwork	29.76%	53.92%	37.19%
Reinforcement	45.12%	45.74%	23.48%
Concrete work	42.31%	37.56%	38.70%

**Table 1.6 Productivity shortfalls of Earthwork, Formwork, Reinforcement, and Concrete work**

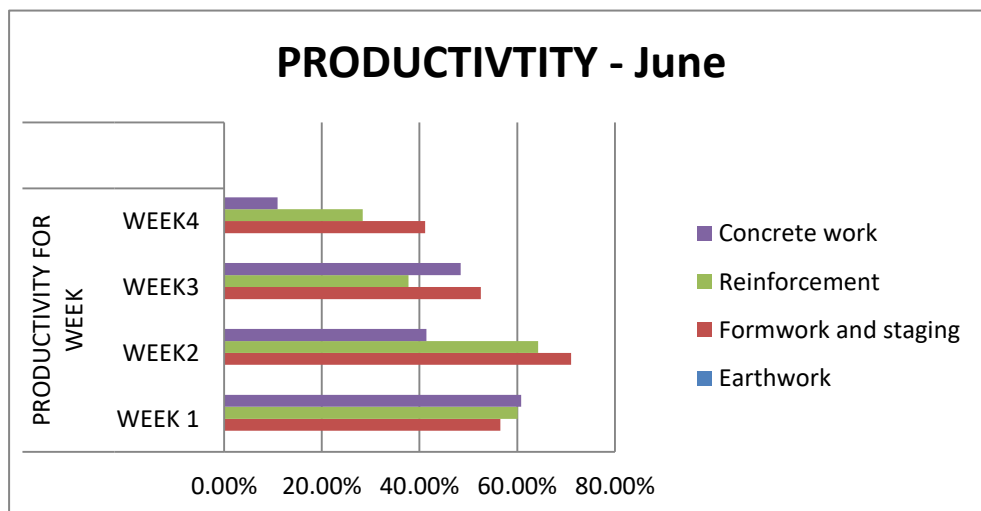
Activity	Productivity in %		
	May	June	July
Earthwork	72.38%	100.00%	100.00%
Formwork	70.24%	46.08%	62.81%
Reinforcement	54.88%	54.26%	76.52%
Concrete work	57.69%	62.44%	61.30%



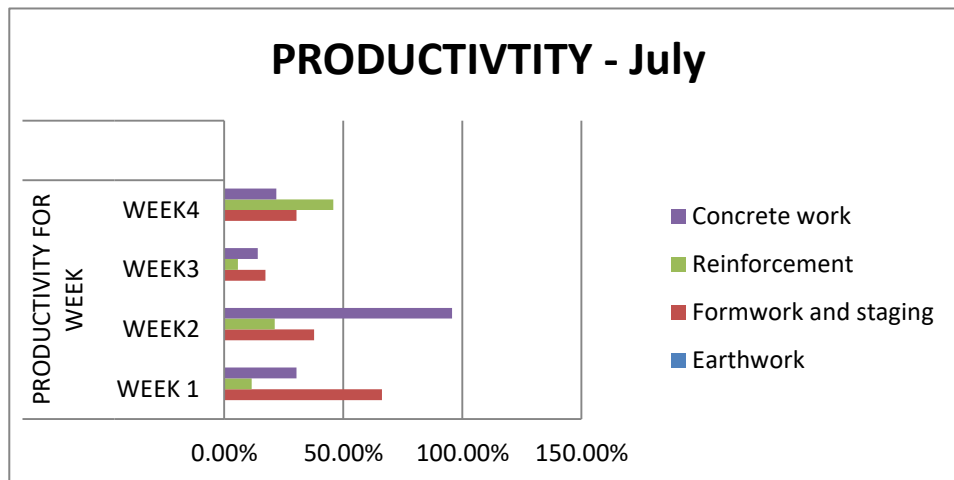
Graph 1.1 Shows Productivity of Earthwork, Formwork, Reinforcement, and Concrete work



Graph 1.2 Shows Productivity for the month may



Graph 1.3 Shows Productivity for the month June



Graph 1.4 Shows Productivity for the month July

## VII. CONCLUSION

Project is already delayed due to low productivity of 38.7%. Concrete work is the final activity of the project for the contractor as per contract document. Scope is foundation of plant up to ground level so the ultimately concrete activity is major and it can affect project. The management has to increase the percentage of productivity and manpower of site for Formwork and Reinforcement. From table 1.1 the planned quantity of activity should be sound enough to execute and it should not be meaningless. As productivity of the project is 37% as on month of July, before increasing the productivity contractor has to maintain the productivity and cover up the delay due to management has to increase the productivity by 61.3% with the substantial recommendations ( Varma santosh & Apte, 2014 ) given below:

- Appointing more subcontractors/ Agencies is recommended for splitting the work area wise.
- Increasing the shuttering material quantity.
- Storage of reinforcement so that cutting and bending of steel is done in advance.
- Make sure that all the resources and Material are available at site just in time and make funds available.
- Increasing resources/labour and sub-contractors.
- Increasing site working time to cover the delays.
- Approve an alternate concrete Batching Plant.
- Offer incentives to labour & subcontractors for meeting the targeted production per week/ per month.
- Short out difficulties if any/ disputed/ weekly meeting with clients, consultant.
- Provide more supervisory staff to control the production.

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