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Resource Productivity of Highway Project

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Abstract-The aim of this research is plan resources of highway project to optimize a cost and reduce duration of project by fulfilling all the requirements. By doing a better planning of equipments, labour and materials to increase productivity factor of highway. For completion of any road project we require proper management of equipment, material and labour. For big infrastructure project, big tools and plants plays an important role in reducing or increasing productivity. To improve productivity of equipments we require to reduce the wastages in utilization and to reduce cost.

Keywords- Productivity, MSP (Microsoft project), Resource Planning, Scheduling, Resource Levelling

I. INTRODUCTION

Roads network is main factor in the overall development of country in the form of social and economic infrastructure. In an indirect way, they help in establishing better social and economic relationship between people of nearby areas and also help the country during military emergency and natural hazards. India has very large road network around 4320000km roads are constructed and cost of construction for this network are very huge. In highway projects, the total project corridor is usually divided into sections and further to sub-sections for the ease of working and resource allocation. The resources are generally allocated to the working teams / groups on the basis of their productivity level and total volume of work allotted to the respective teams. Any disparity in the expected level of output compared to actual output level could lead to untimely completion and cost overrun and actually indicate improper prediction of the productivity level leading to wrong estimation of production rate.

For the above reasons, it is quite necessary to study the productivity of the different resources in detail for highway sector. The same equipments and sometimes even the same manpower being used in different activities, a detailed study, categorization and analysis of productivity of resources for different activities are very necessary. Identification of the factors affecting the productivity of each of the resources along with formation of graphs, formulas and charts to estimate production is also essential for the easy going of the job of planning.

II. RESOURCE PRODUCTIVITY

Productivity means the ability to produce. The term 'productivity', as commonly understood, implies the ratio of output to input. The input and output can be measured in physical quantities, monetary terms or a combination of both. Many link productivity to mean of workers' output capability; they express productivity as work quantity produced per man-hours of input. Productivity is also defined as monetary value of output per man-hour of input. Some consider productivity as performance output in rupees for every rupees of input. In the narrower sense of controlling project resources, the productivity concept is used to measure the performance of resources.

$$\text{Productivity} = \text{Output} / \text{Resource used}$$

The productivity ratio can relate output to all resources used ('Multi-Factor Productivity' or 'Total Factor Productivity') or to a single factor, such as units of labour or capital or energy. The most common single factor productivity measure is labour productivity. Output can be homogenous or heterogeneous.

A. Equipment Productivity

In construction, some tasks are labour-intensive, some pre-dominantly employ equipment and some use a combination of both, i.e., labour and equipment. In big infrastructure projects like highway projects, equipment's and the plants play a crucial role in the production process. It becomes important to educate the labours and supervisors to look at equipment productivity as matter of prime importance.

B. Material Productivity

Efficient material management in project environments calls for an integrated approach covering numerous functions such as materials planning and programming, materials purchasing, inventory control, store-keeping and ware housing, materials transportation and handling at site, materials codification and standardization and the disposal of surpluses. The material planning and programming, which is the key function on materials management is closely linked with the project planning and control set-up.



Both these work together to develop a plan to procurement and stocking of construction materials so as to provide at site, materials of right quantity, at right prices from right source and at the right time. The construction material planning involves identifying the materials required, estimating quantities, defining specifications, forecasting requirements, locating resources for procurement, getting material samples approved, designing material inventory and developing procurement plan to ensure a smooth flow of materials till the connected construction work are completed at the project site

$$\text{Productivity} = \text{Output} / \text{Material used}$$

C. Labor Productivity

One of the most contentious areas in construction claims is the calculation or estimation of lost productivity. Unlike direct costs, lost productivity is often not tracked or cannot be discerned separately and contemporaneously. As a result, both causation and entitlement concerning the recovery of lost productivity are difficult to establish. Compounding this situation, there is no uniform agreement within the construction industry as to a preferred methodology of calculating lost productivity. There are, in fact, numerous ways to calculate lost productivity. Many methods of calculation are open to challenge with respect to validity and applicability to particular cases thus making settlement of the issue on a particular project problematic

D. Common Causes of Lost Productivity

On construction projects there are numerous circumstances and events which may cause productivity to decline. The circumstances set forth below may all impact labor productivity. However, for a contractor to successfully recover damages due to lost productivity from a project owner, the contractor will need to clearly demonstrate that the root cause of the event or circumstance was something for which the owner or one of the owner's agents was responsible. Additionally, the contractor must be able to show a cause and effect relationship between the event and the impact to labor productivity in order to recover damages (i.e., costs and/or time). However, the recoverable damages are not limited to direct costs. They may also include ripple damages or indirect costs, to the extent that a cause and effect relationship can be established between the downstream effects and the originating event

- 1) Changes, ripple impact, cumulative impact of multiple changes and rework
- 2) Competition for Craft Labor
- 3) Defective engineering, engineering recycle and/or rework
- 4) Dilution of supervision
- 5) Excessive overtime
- 6) Failure to coordinate trade contractors, subcontractors and/or vendors
- 7) Project management factors
- 8) Labor relations and labor management factors
- 9) Schedule Compression Impacts on Productivity
- 10) Untimely approvals or responses
- 11) Site conditions
- 12) Site or work area access restrictions
- 13) Schedule Compression Impacts on Productivity

III. RESULT AND DISCUSSION

A. Case Study

- 1) *Name of work* – Rehabilitation and up-gradation to two lanes with paved shoulder/ four lane configuration of (a) Karad - Tasgaon- Jath – Vijapura Road upto Karnataka border Road (153km) (b) Nagaj junction at NH-166 to Jath (32km) in the state of Maharashtra on Engineering procurement and construction (EPC) basic contract

Type of project	- Infrastructure
End use of Project	-Road Transportation
Client / Employer	- Government of Maharashtra Morth and NH Division (PWD) MAHARASHTRA
EPC Contractor	- MEGHA Engineers and Infrastructure LTD. S-2 Belanagar Hydrabad
Authority Engineer	- Highway Engineering consultant Malkapur Karad
Date of Start	-26/12/2017



Schedule Date of Completion -26/06/2019
 Project Cost - 356.581Cr
 Total Length -58.83km

TABLE I
 Optimised Cost

Sr. No	Task Name	Duration	Cost(Rs)
1	OGL Work	4days	22,874.15
2	Embankment Work	11days	22,353,320
3	Sub grade 1 st layer	3 days	127,200
4	BT Scarification/dismantling	2 days	84,800
5	Sub grade Top	2 days	84,800
6	GSB work	3 days	42,912
7	DLC work	5days	7,608,000
8	PQC work	3 days	12,773,618.88
10	Total	33days	43097525.03

Original cost of project – 45,001,936/-
 Optimised Cost of project- 43,097,525.03/-

B. Optimised Cost by Using MSP Software

TABLE II
 MSP WORK

ID	Task Mode	Task Name	Duration	Work	Start	Finish	Cost
1		Reconstruction of carriageway with Paved Shoulders(KM 46 TO 47)	33.38 days	296 hrs	March 14, 2019	April 14, 2019	₹43,097,525.03
2		OGL work	4 days	64 hrs	March 14, 2019	March 17, 2019	₹22,874.15
3		Levels	1 day	8 hrs	March 14, 2019	March 14, 2019	₹162.15
4		sample	1 day	8 hrs	March 14, 2019	March 14, 2019	₹160.00
5		C&G	1 day	8 hrs	March 15, 2019	March 15, 2019	₹544.00
6		Excavation	1 day	8 hrs	March 14, 2019	March 14, 2019	₹20,160.00
7		Compaction	4 days	32 hrs	March 14, 2019	March 17, 2019	₹1,848.00
8		OGL Work Complete	0 days	0 hrs	March 17, 2019	March 17, 2019	₹0.00
9							
10		Embankment Work	11 days	88 hrs	March 17, 2019	March 28, 2019	₹22,353,320.00
11		Embankment 1st	1 day	8 hrs	March 17, 2019	March 18, 2019	₹2,032,120.00
12		Embankment 2nd	1 day	8 hrs	March 18, 2019	March 19, 2019	₹2,032,120.00
13		Embankment 3rd	1 day	8 hrs	March 19, 2019	March 20, 2019	₹2,032,120.00
14		Embankment 4th	1 day	8 hrs	March 20, 2019	March 21, 2019	₹2,032,120.00
15		Embankment 5th	1 day	8 hrs	March 26, 2019	March 27, 2019	₹2,032,120.00
16		Embankment 6th	1 day	8 hrs	March 27, 2019	March 28, 2019	₹2,032,120.00
17		Embankment Top	5 days	40 hrs	March 21, 2019	March 26, 2019	₹10,160,600.00
18		1st Portion	1 day	8 hrs	March 21, 2019	March 22, 2019	₹2,032,120.00
19		2nd Portion	1 day	8 hrs	March 22, 2019	March 23, 2019	₹2,032,120.00
20		3rd Portion	1 day	8 hrs	March 23, 2019	March 24, 2019	₹2,032,120.00
21		4th Portion	1 day	8 hrs	March 24, 2019	March 25, 2019	₹2,032,120.00
22		5th Portion	1 day	8 hrs	March 25, 2019	March 26, 2019	₹2,032,120.00
23		Embankment Top Complete	0 days	0 hrs	March 25, 2019	March 25, 2019	₹0.00
24		Embankment Work	0 days	0 hrs	March 25, 2019	March 25, 2019	₹0.00
25							

Project: ff
Date: March 18, 2019

Task Summary Rollup
 Split
 Milestone
 Summary
 Project Summary
 Inactive Task
 Inactive Milestone
 Inactive Summary
 Manual Task
 Duration-only

Manual Summary
 Start-only
 Finish-only
 External Tasks
 External Milestone
 Deadline
 Progress
 Manual Progress

Page 1



IV. CONCLUSION

In India highway construction projects have lack of professionalism, leading to lack of detailed management and planning. Due to these lack of professionalism project tends to increase in cost and time of the project. To optimize cost and time proper planning and management of resources must be required. There are also some which affect productivity of resources that factors are labour, material and equipment. In our project we studied these factors affecting resource productivity and after that we merge these factors about some extent. To optimize cost and time of project we have used MSP software. All Project management plays a key role in making a project successful. This work mainly deals with improving Productivity of the Equipment's used for the Road work and Planning and Scheduling the work using MS Project software.

Following conclusions are drawn from this research-

- A. Study and use of proper equipment, material and labour for a particular job is of prime importance.
- B. A database of equipment, material and labour productivity for every site must be maintained and studied.
- C. It was observed that the Productivity of Karad-Tasegaon Road Work was low because of improper planning and scheduling.
- D. Use of Project Management software's like MS Project play a vital role in improving the Productivity of tasks by proper Planning and Scheduling of Projects.
- E. Resource factors which affects the cost of project, some of this factors are studied and merge during allowing resources
- F. It was observed that, use of MS Project software and Management techniques for these road, Cost reduces about 5% of original cost.

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