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Role of project manager in improving the productibvity of construction

Ajinkya Adhav[1], Prof.M.C.Aher[2], Sandhya Karande[3]
[1,2,3]*Department of Civil Engineering, NDMVP's KBT, COE Nashik College*

Abstract— The number of construction project manager concentrates on increasing the productivity of construction. Project manager initializing the use of the last planner system of production control. Effective working of any projects depends upon the working condition along with proper planning. Many methods have been adopted for proper working condition and increasing the productivity. The better management of employee gained the relevant importance. Increasing the productivity in different formats in equipment, material and labour. This productivity affects the construction productivity in form of cost and quality and their interrelationship affects the overall project. However, manager who directly implement without planning may face with external resistance from clients and subcontractor, and feel that their organization does not offer the necessary incentive. The case studies and testimonials were available in the literature referenced in the paper, but the survey and the methods for analysis are new and have not been published elsewhere, either wholly or in part. Common effective management practices are found among successful organization.

Keywords— Equipment Productivity**,** Labour productivity**,** Material management, Rate analysis, Inventory management.

I. INTRODUCTION

Construction industry is considered as an industry that contributes significantly in economic growth of country. Building components deals with ejection of building-mass housing, hospitals and schools etc. Today's managers in construction organizations have a responsibility to review and evaluate productivity in terms of cost and employee management. Many methods have been adopted to improve the productivity, but as the productivity is interrelated the relation such all the productivities the labour, the equipment, and the material. They cannot be studied separately. By studying this productivity separately, but considering their interrelation a project manager can compare the activities and can find suitable path to increase overall productivity of construction in terms of cost and quality and proper satisfaction of the labours.

The objective of this paper is to discuss the improvement of the productivity of professional construction employee, the appraisal of employee performance, and the review of performance appraisal with employee.

II. METHOD

The measure of the rate at which work is performed is called "productivity". It is a ratio of production output to what is required to produce it. There are different impacts on construction productivity such as impact of labour on construction planning, Factors affecting motivation, Planning, Communication, Work environment, Material management, thus are the different impacts of which affects the construction productivity. The studies have shown this productivity affects slowly on any projects and thus understanding this impacts are much little difficult. Construction cost estimation is important part and there are many standards available in the construction industry for contractors as a reference value for purpose of construction cost estimation.

The Project Manager (PM) is responsible for delivering the assigned project including public-private partnership (P3) capital project in accordance with the scope, budget, timelines and guidelines established by the Assistant Deputy Ministers' Project Review Committee (ADM

Committee). Roles of project manager are viz, 1. By setting and monitoring performance 2. Providing resource support 3. Communicating feedback 4. Motivating the work.

Considering the Equipment productivity, Excavation and Dumping of Earth material is calculated by

$$V_h = \frac{540\,(hp)(e)}{Wf((RR+20(\pm S))}$$

$$V_r = \frac{540\,(hp)(e)}{We((RR+20(\pm S))}$$

$$V = \frac{60d}{Vh} + \frac{60d}{Vr}$$

$$T = (\frac{1}{Vh} + \frac{1}{Vr})d$$

Where, V_h = Velocity in Haul Direction (kmph);
V_r = Velocity in Return Direction (kmph);
V_{max} = maximum velocity based upon legal speed limit (kmph);
Hp = engine horse power;
e = engine efficiency;
W_f = weight fully loaded (ton);
S = Slope (%); RR = rolling resistance (%) and
W_e = weight empty (ton).

III. DATA COLLECTION AND ANALYSIS

At current case 6000 sq. feet of area was required to be excavated up to a depth of 10 feet and also the earth material was to be hauled and dump at the dumping site foe which two types of trucks are available to the contractor, the details of the trucks are shown in table 1, the material was to be hauled over a distance of 1.6 km to and fro, with average rolling resistance of 3%, average slope 3%, unit weight of material 1750 kg/m^3 and the speed limit of the road as 40 km/hr. For the excavation Tata Hitachi EX200 LC with a 1.125 m^3 bucket size as well as Tata TH 36 Loader cum Backhoe with a 0.30m^3 backhoe bucket capacity can be made Available o site. The Equipment ownership + maintenance + operational cost of excavator are Rs. 2200 per/hour and of backhoe are Rs.800 per/hour.

3.1. Details of available Dumpers (Trucks)

Table 1. Details of Dumpers available on site

Sr. No.	Item	Truck A	Truck B
1	Capacity (m^3)	10	14
2	Horsepower (hp)	155	183
3	Efficiency	0.80	0.80
4	Empty Weight (Ton)	15	16.3
5	Weight Full (Ton)	32.5	40.8
6	Ownership + Maintenance Cost (Rs/day)	3200	3500
7	Operational Cost (Rs./km)	7.85	11
8	Labour Cost (Rs.)	500	500

3.2. Production Rate of Backhoe:

If an excavator is considered as an independent machine, following data is required;

1) Heaped Bucket Load volume.
2) Bucket fill factor based on material being excavated from the Manufacturers Data sheet.

Table 2. Fill Factors for Excavator Buckets (courtesy of caterpillar manual)

Sr. No.	Material	Fill Factor* (%)
1	Bank Clay; Earth	100-110
2	Rock – Earth mixture	105-115
3	Rock Poorly Blasted	85-100
4	Rock well Blasted	100-110
5	Shale's, Sandstone	85-100

3) Loader Cycle Time:

Table 3. Cycle elements recorded for Backhoe

Sr. No.	Cycle Elements	Time
1	Move to stockpile to be excavate	0.10 min
2	Fill bucket	0.25 min
3	Move to truck and maneuver to load	0.20 min
4	Dump loaded bucket	0.10 min
5	Total cycle time	0.65 min

4) Bucket Capacity 0.3 m^3.
5) Swell Factor (The ratio of the weight or volume of loose excavation material to the weight or volume of the same material in place) – 0.90

$$\text{Production of Excavator} = \frac{60\,\text{min} \times Q \times F}{\text{cycle time}} \times \frac{\text{Efficiency}}{60\ \text{min/hr}} \times \frac{1}{\text{Volume Correction}}$$

$$\text{Production of Excavator} = \frac{60 \times 0.3 \times 1.0}{0.65} \times 0.8 \times \frac{1}{1 + 0.80\ (\text{swell factor})}$$

$$= 22.15\ m^3/\text{hr}$$

3.3. Calculation of Total Cycle Time for Dump Truck:

Step 1) Maximum and minimum truck velocities:

For Truck A from Table 2,S_h= 10 m^3
As, V_{max} = 40 kmph is less than V_r = 103.8 kmph assume V_r = 40 kmph

Step 2) Travelling Time:
$T = \left(\frac{1}{32.7} + \frac{1}{40}\right) 1.6$ = 0.102 hour = 6.13 min

Step 3) Dumper Loading time*(19)*:

$T_L(\text{dumper}) = \frac{\text{Dumper Capacity x loader cycle time}}{\text{Loader Capacity}} = \frac{10 \times 0.65}{0.3}$ = 27.08 min

Step 4) Delay Estimates:
But on site it was found that there was delay in time estimate as follows:

Table 4. Delay in Cycle time recorded for Dump Truck

Sr. No.	Cycle Elements	Time
1	Accelerate after load	0.5 min/cycle
2	Decelerate to dump	0.5 min/cycle
3	Maneuver and dump	1 min/cycle
4	Accelerate empty	0.5 min/cycle
5	Decelerate	0.2 min/cycle
6	Failure due traffic	2 min / cycle
7	Total	4.7 min/cycle

Total Cycle time = C = 6.13 + 27.08 + 4.7 =38.11 min

Step 5) Total time (T.T) required for completing the 1693.99 m^3 of material to be dumped,

T.T = $\frac{MxC}{60 xNxSh} = \frac{1693.99 \times 38.11}{60 \times 1 \times 10}$ = 138.77 hours of hauling.

Considering 8 hours of daily working in 1 Shifts,

Total no. Days of required for dumping work = $\frac{138.77}{8}$ = 17.34 day's

Step 6) Total cost:

Total cost of Backhoe = Hourly Cost X No. of hours of working + Labour Cost

= 800 X 138.77 + (500 x 18) = Rs. 128370 /-

Ownership+ Maintenance + operator cost of Truck = 1x 18 x 3200 + (500x17x1)

= Rs.66100/-

No. of Trips for Truck = $\frac{M}{TotalTruckHaulage} = \frac{1693.99}{10 \times 1}$ = 170 no.

Operational Cost of Truck = 170 no. of Trips x 1 no. of Trucks x 1.6 km x 7.85

= Rs. 4255 / -

Total Cost = 128370 + 66100+ 4255 = Rs. 198725 /-

Considering 10% independent cost, Total Cost = 218597 /-

Cost Index Number = $\frac{TotalCost}{M} = \frac{218597}{1693.99}$ = 129.4 Rs/ m^3

Cost index are obtained for various combinations, from which it can be observed that truck no.'s proves out to be economical having cost index

Similarly the production rate of excavator is, Cost index number= 85.64 Rs/m^3

IV. CONCLUSION

Project manager should keep a control on resource, performance labour, and equipment. If all this factors are controlled it will increase the productivity of whole project. Based on the outcome of these studies, it is recommended that immediate research concentrate on improving marketing practices, planning and scheduling, labor-management relations, site supervision, industrialized

building systems, and engineering design. It is also recommended that similar surveys be conducted every 3 to 4 years to observe and identify new trends in the industry and to steer researching the appropriate direction. Such research should be efficiently coordinated and the results speedily communicated to all the parties involved in the construction activity.

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