Downtime Cost of Construction Equipment

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Abstract

Construction industry is backbone of economy for any country. For India, it is second largest industry to contribute maximum percentage for GDP development. now a days the growth of construction activity is depend upon equipment of it's availability, method of use ,greater recovery of breakdowns ,planning and management. Machine downtime is invariably perceived as one of the most critical problems faced by highway contractors and plant managers. Attempts to reduce downtime often result in failure due to the dynamic behaviors between equipment management practices and downtime. This project is thus intended to highlight the heavy equipment management practices and downtime in large stone crusher plant them as a framework in constructing a downtime and corresponding cost approach.. The finding reveals that, to be successful in downtime identification, plant manager must view heir practices on equipment management as an integration of multiple feedback processes, which are inter related and interdependent with downtime. Based on various validation observation, cox and nunally model is deemed appropriate in representing the equipment management system as related to downtime of large highway contractors. The research is of value in facilitating better understanding on the dynamics of equipment management practices and downtime as well as their interdependency.

Keywords: Maintenance, Breakdowns of Equipments, Downtime and Cost

I. INTRODUCTION

Major civil engineering projects are frequently executed throughout the world. Project conditions such as technical complexity, timely completion, the impact offered by project, resources limitations and the enormous costs involved in such projects, necessitate the most efficient use of planning, designing and construction controls so as to achieve the desired target date and cost of completion of the project. Herein lies the success of construction management to use available resources viz. materials, manpower, machinery, money and time, efficiently and effectively in the realization of the project in an optimal manner.

In India, Construction industry is growing rapidly and becoming increasingly competitive. In construction industry, the construction equipment itself is one of the areas in construction operation where significant gains can be made. The success of construction project largely depends on use of available resource in optimal manner such as human resource, machinery, materials, money etc. The industry must manage the construction equipment in a systematic and professional way.

If less attention has been given to the maintenance of construction equipment then it leads the construction equipment to a breakdown. The breakdown of construction equipment causes delay in the construction activities and it directly affects the project completion, so downtime tracking information is essential to correct ongoing machinery problems and deficiencies, and to fine-tune the maintenance and operations management systems. It's important to remember that an overall system of maintenance should be required to speed up the construction projects.

Consequential costs that arise from the failure of any machine and its impact on the chain of the work associated with it present an entirely different problem in that they cannot be assessed with any degree of certainty except under very rigid , well defined circumstances.

A. Problem Statement

- What are the main cost categories involved in downtime cost of equipment?
- What are various reasons of failure of construction equipment?
- How can be downtime cost of equipment determined by various models?

B. Objectives of the Study

- To identifies various reasons of failure of construction equipments
- To determine downtime cost of crusher plant by cox and nunally models
- To minimize downtime cost of crusher plant and hence to increase production.

C. Scope of the Work

This study is only applicable for construction equipment as stone crusher plant and it's associated equipment (Trucks/ hywa, Jcb, loaders). The downtime cost and it's remedial measures have done through this equipment.

D. Methodology of the Work

In this study analytical work is done with respect to downtime and its downtime cost of construction plant. For this, stone crusher plant site selected as a case study. In this construction equipment information like cycle process, maintenance, breakdowns are observed and recorded. Data related to equipment downtime in terms of cost and time consumed were identified with help of downtime cost model.

II. DATA COLLECTION

A. Case Study

1) Stone Crusher Plant

NAME OF THE PROJECT: Improvements and extension of NH-150 highway construction from sinnor (Karnataka) to akkalkot (Maharashtra).

A data collection sheet is prepared for the purpose of data collection.

Data collection sheet-

- Total purchase cost of m/c-
- Life of equipment in years.-
- Life of equipment in hours-
- Expected daily production-
- Operation hours per day-
- Frequency of downtime per year/month-
- Average duration of downtime-
- Operating days per month-
- Operating hours per day-
- Operating hours per month-
- Monthly downtime for minor repair-
- Monthly downtime for major repair-
- Yearly planned hours of operation-
- Yearly estimated % of downtime hours-
- No of associated equipments-
- Actual capacity of equipment-
- Theoretical capacity of equipment -
- Operating cost of equipment per hour-
- Fuel/power consumption per hour-
- Equipment operator salary per month-
- Equipment helper salary per month-

B. Analysis of Data Collected

The data collected from construction sites is analysed in following manner,

- HOURLY COST of construction equipment is calculated by,

1) Owning Cost

a) Investment Cost

According to recommendations by the plant & machinery committee;1974, the average investment cost and depreciation will be worked out on the basis of modified straight line method, starting from the acquisition cost till 50% of cost, in 40% of the life & after the 50% of the cost till the residual value of 10% of cost in the remaining 60% of life.

- Average investment in Rs./ year= Total/Equipment life
- Hourly investment rate / hour= Average investment in Rs. per year / Total operating hours in equipment life.

b) Depreciation Cost

- Yearly depreciation (Rs./year) =(Total cost - Scrap value)/ Equipment life in years
- Hourly depreciation (Rs./year) =(Total cost- Scrap value)/ Total operating hours in equipment life

c) Major repair Cost

- Assuming 60% of depreciation cost/ hour.
- TOTAL OWNING COST= (Investment cost) + (Depreciation cost) + (Major repair cost)

2) Operating Cost

1) Operation cost- Operating cost of equipment per hour is calculated.
2) Field repair cost- These are considered as 50% of major repairs cost & which are 60% of depreciation cost. Therefore field repair cost is 30% of depreciation cost.

3) Spare parts & inventory cost- It is assumed as 10% of major repair cost.
4) Labour charges- Labour charges are worked out based on data collected from site.

TOTAL OPERATING COST= (Operation cost) + (Field repair cost) + (Spare parts & inventory cost) + (Labour charges)
TOTAL COST/HOUR = OWNNIG COST + OPERATING COST

The data collected from sites are analysed further and downtime cost of construction equipments are calculated with help of following models.

Model used for calculating Downtime cost-

a) COX Model

Downtime Cost = (Annual frequency of component failure) x (Average duration of failure) x (Cost/ hour of equipment)

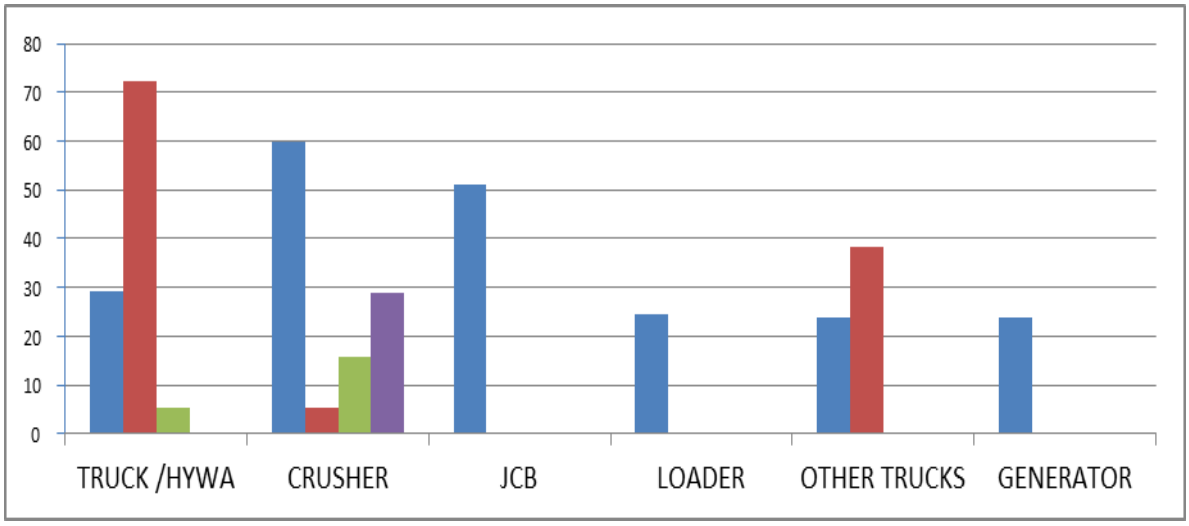
b) Nunally Model

Downtime cost = (Estimated % of downtime) x (Yearly planned hours of operation) x (Hourly cost of equipment.

Equipment	*Equipment functions*	*Downtime cost (Rs)/Hour (cox model)*	*Downtime cost (Rs)/Hour (Nunally model)*	*DT Cost Percentage by COX Model*	*DT Cost Percentage by Nunally model*
Trucks/hywa	*Cory to crusher*	*303.67*	*21.69*	*29.16*	*2.08*
	Crusher to site	*91481.32*	*2825.04*	*72.18*	*18.7*
	Crusher to stock	*167.69*	*11.27*	*5.3*	*1.2*
Crusher	*Jaw crusher*	*1100.93*	*48.33*	*60*	*12.6*
	Cone crusher	*63.79*	*10.52*	*5.3*	*0.8*
	Vertical shaft impact	*199.08*	*12.22*	*15.83*	*6.9*
	Screen	*514.46*	*152.05*	*29*	*14.53*
Jcb	*Excavating and other*	*4710.30*	*145.23*	*51*	*13.43*
Loaders	*Loading to RMC plant*	*4116.19*	*120.40*	*24.48*	*11.24*
Other trucks	*Diesel tanker*	*52.15*	*15.36*	*23.97*	*7.8*
	Water tanker	*80.44*	*36.98*	*38.30*	*11.60*
Generator	*To supply electricity*	*577.23*	*76.85*	*23.99*	*3.19*

III. RESULTS & DISCUSSION

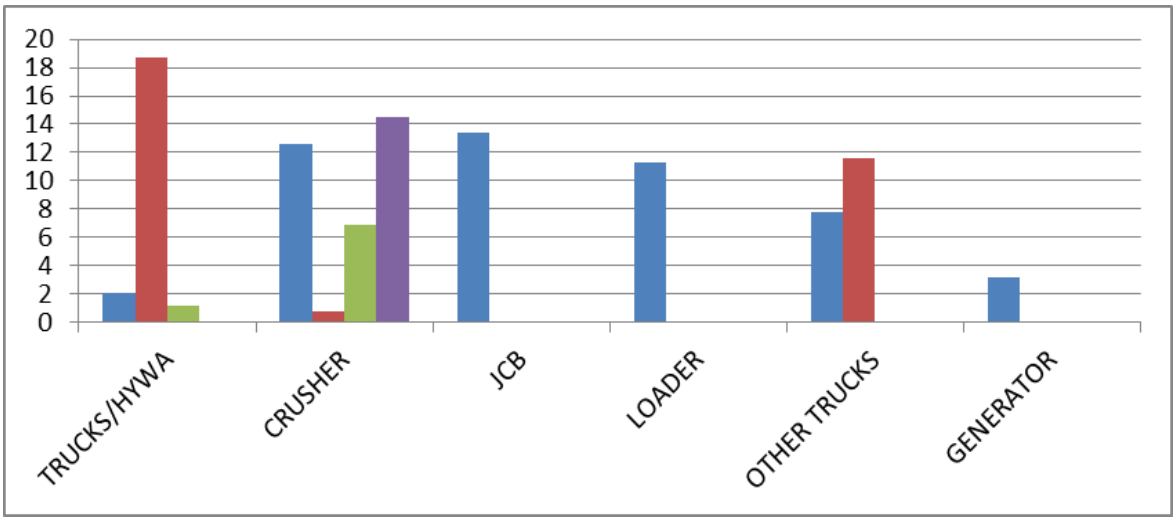
A. *Percentage of DT cost by Cox Model*



Here Graph shows that: percentage of downtime cost of a particular equipment through given downtime .the highest percentage of equipment function crusher to site has 72.18% and minimum percentage generator having 5.3%.

Because the Cox model generally gives downtime cost on a higher side since the total cost of the team affected by failure does not consider the action and replan considered by the management.

B. Percentage of DT cost by NUNALLY Model



Here Graph 6.2 shows that percentage of downtime cost of a particular equipment through given downtime .the highest percentage of equipment function crusher and minimum percentage generator Nunally's approach focuses on failed machine itself and it does not recognize the impact that the failure may have on other members of the working team. It thus tends to underestimate the cost.

IV. CONCLUSION

The DT model introduced in this report contributes mainly in terms of the following features:

1) The model identifies factors that cause DT.
2) The model emphasizes the importance of focusing on crew-level factors.
3) The model shows how the ramifications of DT can occur by generating a structure of equipment costs through managerial action, decisions, time frame.
4) The model shows the equipment breakdowns role in influencing the DT. Finally, the model provides a framework for tracing the causes of DT and its impact on project performance.
5) Downtime costs of different construction equipment calculated by Cox model and Nunally model is compared with help of chart and it shows that downtime cost calculated by Cox model gives higher cost than downtime cost calculated by Nunally model.
6) Generally during planning, cost of equipment is calculated as Total cost= operating cost + owning cost but in actual field, downtime cost occurs due to breakdown of equipment, so thorough study of downtime and its cost calculation is necessary.

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