Downtime Cost and Reduction Analysis

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Abstract: The purpose of this paper is to present the potential impacts that equipment downtime generates on their product cost and thereby profits. The core results obtained from the investigation show the hourly cost of downtime, whether planned or unplanned, is relatively high.
However, there is absence of systematic models that proficient to trace the individual cost imposed by downtime events. Moreover, only rare companies develop their cost accounting methods to assimilate and reveal the real costs that associated with planned and unplanned stoppages.
On the other hand, the attempts of falling downtime events and thus costs were based on list maintenance tactics that maintained by overall equipment effectiveness (OEE) tool, as an indicator for affirming improvements. Nonetheless, the analysis indicates the need for optimized maintenance tactics by total productive maintenance (TPM) into companies' maintenance systems. The maintenance role of dropping downtime impacts not highly recognized.
Last but not least, the lack of totally combined models for calculating the downtime costs and frameworks for characteristic the difference between planned and unplanned stoppages are the main causes behind the continuation of cost in rising form. Due to that, the progresses will emphasize on areas with less cost saving opportunities. As a result, this will affect the production efficiency and effectiveness which in reappearance has its influence on costs and thereby profits margin.

Keywords -Downtime cost, planned stoppage, Performance measurement systems, Maintenance optimization.

1. INTRODUCTION

Downtime is any period of time when a machine is not in production. Downtime help to identify patterns in machine performance. It receives a high level of responsiveness since equipment failures and breakdowns are highly noticeable.

There is little doubt that increased efficiency of mechanized road construction methods would reduce construction costs and raise productivity. Many factors affect the efficiency of construction equipment, however. Some factors are easily detectible earlier to construction, while others are unforeseen and affect equipment productivity negatively. Downtime (DT) caused by non-availability of equipment and equipment breakdown is common unanticipated factors effect on the equipment productivity and project duration.

1.1. Objectives:

1. To study the methods used in industry for assessing the cost of downtime.
2. To study the maintenance strategy that applied for reducing downtime events and Thereby costs.
3. To investigate the significance of analyzing and predicting construction failure.
4. To Test and validate the result in real construction cases.

2. METHODOLOGY

The entire investigation and experimental work was carried out from identification of problem up to the result and discussion for the problem. The following flow chart gives the detail work carried out with the sequence of the activities from starting to the end of investigation.

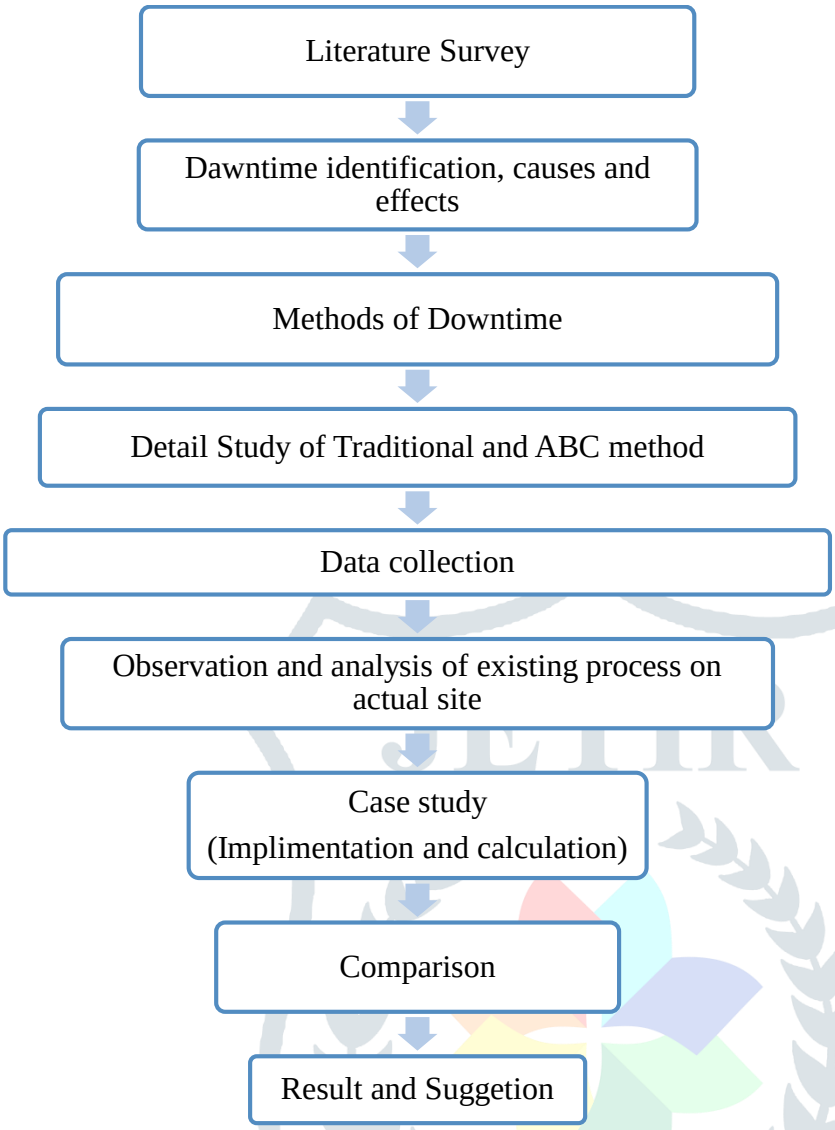

Fig.1 Flow chart of work

2.1 Downtime identification, causes and effects

The term downtime is potently denoted to period when the system is unavailable due to planned or unplanned stoppages. The unplanned stoppages mainly referred to equipment failures or process disruption. On the other hand, scheduled stops regarded to predetermine procedures of activities that undertaken as calculated duration for which the machine has to be stopped. For example, the planned maintenance, setups, adjustments, inspections, shutdowns, training, breaks, cleaning, standby state, in addition to software and hardware upgrade / update.

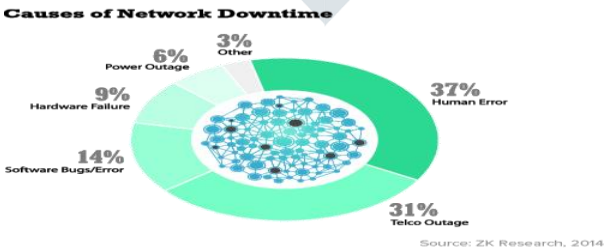

Fig.2 Causes of network downtime
Source: ZK Research

2.2 Cost accounting methods

2.2.1 Traditional cost accounting

There are many cost accounting methods exist in manufacturing industries. The evolution of those costing methods is not entirely compatible with the development that intervene production systems. The introduction of lean manufacturing strategies obliges companies to launch a new costing structure, in which can fulfill the requirements of agile production lines. Further to that, and in return to the traditional costing accounting methods, Swedish firms were stemmed its accounting method originally from a model that firstly presented by Frenckner and Samuelson.

2.2.2 Activity-based costing (ABC)

This method has been successfully conducted in manufacturing plants for improving the strategic vision of decisions-making, in addition to enhancing the business cost control and customer profitability. It helps management to notice areas of the high cost, identify the elements that stimulus these costs, and develops performance. In the ABC tactic, resources are traced to activities, and activity are then traced to the targeted object such as products or services based on their intake of the activities.

ABC model uses different structural blocks in comparison with traditional costing, see figure 3. The traditional costing approach was presented product as a cost object that consumes resources directly. On the contrary, the propose ABC model are adopted the cost objects as a consumer of activities that in turn consume resources.

Fig.3. Traditional costing and activity- based costing
Source: Lincoln.

2.3 Maintenance

Table 1. Maintenance strategies, policies and characteristics

Strategies	Policies	Characteristics
Reactive maintenance	Corrective	- Run- to-failure - Restore defective items to a specified condition - Repair and replacement of broken parts
	Prospective	- Opportunistic maintenance - Maintaining other components which not failed yet
Preventive maintenance	Pre-determined	- Schedule maintenance - Tasks are performed at a set time intervals - Entails inspection, repair, replacement, etc.
	Predictive	- Measurements that detect the onset of system degradation mechanism - Determines the current asset condition to predict the best time for maintenance applied
	Proactive	- The diversion into acting rather reacting - Ensuring machine reliability according to state-of-art - Failure root causes analysis

2.3.1 Total productive maintenance (TPM):

TPM, it is a lean manufacturing strategy that strive for enhancing the machine efficiency and effectiveness as possible, through optimizing all types of maintenance activities. The overall aims of TPM are to:

- Achieve zero losses in downtime events
- Construct integrated system capable of increase the process efficiency
- Cover all departments including production, maintenance, administration, etc.
- Involve all employees from top managers to operators and clerical staff Enable small group activity.

3. Case Study (Flyover between K.K. Wagh Engg.College To Jatra hotel,Nashik)

3.1.1 Data collection

3.1.2 Site Details:

1. Name of site: Flyover between K.K. Wagh College To Jatra hotel,Nashik
2. Site Address: K.K.K Wagh College, Nasik (Near 10th Mail, Janori road, Ozar)
3. Approximate cost : 212 crore

4. Duration : October 2016 to November 2020
5. Name of Engineer: Mr. Keshav Sharma and Mr.Saqib Faruki

3.1.3Actual Onsite Equipment

Table 2. Actual Onsite Equipment

Sr.No	Name of equipment's
1	Excavator
2	Grader
3	Tandem vibratory roller
4	backhoe loader
5	Paver
6	Dozer
7	Boom Truck (Crane pouring concrete)
8	Tipper truck
9	Box Girder Launching Gantry

3.1.4 Operators salary

Table 3. Operator's salary

Sr.No	Equipment	Salary
1	Excavator	18000
2	Grader	30000
3	RMC Batching plant	25000
4	Grader	30000
5	Roller	17000
6	T.C.M(Bitumen Spreading)	20000
7	P.V.C. Cable Paver	40000
8	Hydra crane	18000

3.1.5 Workshop (Repairing) Staff and their salary

Table 4. Workshop (Repairing) Staff and their salary

Sr. no	Name	No.	Salary per month
1	Mechanic	4	20,000-22000
2	Electrician	2	20,000-22000
3	Welder	2	20,000
4	Tire fitter	2	18000-20000
5	Helper	8	12000
6	Driver	2	16000

3.1.6 Equipment name with required operator/Person/labor and delay work

1. Excavator- 1 operator and 1 helper
If excavator fails work of site clearance excavating of present road gets delayed also exaction of drainage delay
2. Grader - 1 operator and 1 helper
Spreading of murrum and Jsb delayed
3. Roller- 1 operator and 1 helper
Compaction of murrum and aggregate delayed
4. Cutter- 1 operator and 1 helper
Road cutting work and after the work of road cutting such as spreading of murrum, and bitumen is delayed
5. Hydra crane -1 operator and 8-10 helpers
8-10 helper direct the operators and helps in keeping or placing the precast material for bridge and cross drain works such as bridge culverts drains gets delayed
6. Concrete pump- 1 operator and 1 helper, 8-10 worker
Helpers guides the operator in operating the pump
7. Gas cutter- 1 operator and 3-4 helper
The operator operates the gas cutter and the helper helps in holding the steel and adjusting the gas pressure.
If this works delayed or stop or cutter is idle then the works such that laying or spreading of concrete is delayed
8. Paver - 1 operator and 1 helper 20 labor
Compacting road surface is delayed

3.2. Calculations.

1. Excavator

Fig.4 Excavator
Source: compendium of construction equipment's

The capacity of excavator is 120 cubic meter per hour. (Bucket capacity 1.5 cubic meter and efficiency is 50%).
If the Excavator is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(120 x 15) + ((18000 / 24)/8) + (350 /8) = 1800 + 94 + 44 = 1938
If the Excavator sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
(1938 x 8) = 15504 Rupees.
Also excavator fails work of site clearance, excavating of present road gets delayed.

2. Grader

Fig.5 Grader

The capacity of grader is 1585 cubic meter per hour. (Blade length 3.17 m).
If the grader is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(1585x1.5) + ((30000 / 24)/8) + (350 /8) =2576
If the Excavator sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
2576 x 8 = 20,614 Rupees.

3. Pneumatic-tire roller

Fig.6 Pneumatic-tire roller

The capacity of Tandem vibratory rollers is 30 cubic meter per hour.
If the Tandem vibratory rollers is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(60x50) + ((17000 / 24)/8) + (350 /8) =3132
If the Tandem vibratory rollers sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
3132x 8) = 25058 Rupees

4. Backhoe loader

Fig.7 Backhoe loader
Source: compendium of construction equipment's

The capacity of backhoe loader is 114 cubic meter per hour. (3 cubic meter loader capacity)
If the backhoe loader is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(114x21) + ((24000 / 24)/8) + (350 /8) =2563
If the backhoe loader sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
2563x8=20502 Rupees

5.Tipper truck

Fig.8 Tipper truck

The capacity of Tipper truck is 252 cubic meter per hour. (25-30 km, 75-90 min for one trip)

If the Tipper truck is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(252x4) + ((19000 / 24)/8) + (350 /8) =1150
If the Tipper truck sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
1150x8 = 9205 Rupees

6. 6. Paver


Fig.9 Paver

The capacity of paver is 40 cubic meter per hour. (25-30 km, 75-90 min for one trip)
If the paver is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper + 20 labor
(80x40) + ((40000 / 24)/8) + (350 /8) + (350x20) =10452
If the paver sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
10452x8 = 83616 Rupees

7. Dozer


Fig.10Dozer
Source: compendium of construction equipment'

The capacity of bulldozer is 150 cubic meter per hour. (Efficiency 75%, speed 1.5 km/hr, width of blade is 2 meter)
If the bulldozer is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of per cubic meter + 1 operator + 1 helper
(150x8) + ((30000 / 24)/8) + (350 /8) =1400
If the bulldozer sudden breakdown for a day (8 hours), it will affect the cost of the project as follows:
1400x8 =11200 Rupees

8. Boom Truck (Crane pouring concrete)

Fig.11 Boom Truck (Crane pouring concrete)

The efficiency depends upon the structure concreting to be done. For a structure like column, the tower crane can lift about 30 cubic meters of concrete per hour.
Cost of concrete cubic meter = Rupees 5000
Cost of concrete done per hour= 25x5000 = 125000
If the Boom Truck is sudden breakdown for an hour, it will affect the cost of the project as follows:
Cost of concrete + 1 operator + 2 helper
i.e. = 125000 + (35000/24/8) + (2x350) =125882
We can also find the affected cost on project if the Boom Truck is breakdown for 1 day:
255882x8= 1007058 Rupees

9. Box Girder Launching Gantry

Fig.12 Box Girder Launching Gantry

If the Box Girder Launching Gantry is sudden breakdown for an hour, it will affect the cost of the project as follows
1 operator + 10 helper
((40000 / 24)/8) + (350x8) =16,133
We can also find the affected cost on project if the Boom Truck is breakdown for 1 day:
16,133x8= 1, 29,067Rupees.

3. RESULT AND DISCUSSION

1. By using Activity based costing method and Total productive maintenance (TPM**)** we have reduced cost due to downtime of equipment by about Rs 13, 21,824/-.

2. As the downtime is decreased the overall delay in work due to downtime is decreased which results in the Timely completion of the project.

3. Delay reduced due to downtime also helped us in fulfilling the RERA norms, budgetary completion of project.

3.1 CONCLUSION AND SUGGESTIONS

From the results of the study, it is concluded that companies must be aware of the potential impacts that equipment downtime generates on their product cost and thereby profits. The downtime effect on planned production time and downtime hourly cost.

Even though, most of the companies do not have any systematic model for assessing and tracking the individual costs that associated with planned and unexpected stoppages. They excuse that by the difficulty of such models and the time and costs required for implementation. For instance, the costs that accompanied with training and learned people. On the other hand, only few companies adopt complete models such as, activity-based costing and resource-consumption accounting for measuring downtime costs.

Consequently, the lack of optimized methods and procedures are the reasons of high downtime hourly cost.

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