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Analyzing the Effect of Downtime Cost of Equipment Used In a Construction Industry

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ABSTRACT: The purpose of this paper is to present a sample of how Swedish manufacturing companies deal with equipment downtime cost, and further how they analyze its reduction. The study was performed by conducting a web-based survey within Swedish firms that have at least 200 employees. The main results obtained from the investigation show that the estimated downtime costs constitute about 23.9 % from the total manufacturing cost ratio, and 13.3 % from planned production time. Additionally, the hourly cost of downtime, whether planned or unplanned, is relatively high. However, there is a shortage of systematic models that capable to trace the individual cost imposed by downtime events. This lack was shown apparently whilst 83 % of surveyed companies they do not have any complete model adapted for quantifying their downtime costs. Moreover, only few companies develop their cost accounting methods such as, activity-based costing (ABC) and resource consumption accounting (RCA) to assimilate and reveal the real costs that associated with planned and unplanned stoppages. Still, the general pattern of downtime cost calculation allocated to direct labor and lost capacity cost. On the other hand, the attempts of decreasing downtime events and thus costs were based on schedule maintenance tactics that supported by overall equipment effectiveness (OEE) tool, as an indicator for affirming improvements. Nonetheless, the analysis indicates the need for optimized maintenance tactics by incorporating reliability-centered maintenance (RCM) and total productive maintenance (TPM) into companies' maintenance systems. The maintenance role of reducing downtime impacts not highly recognized. Furthermore, the same analysis shows the requirement for better results of performance measurement systems is by implementing total equipment effectiveness performance tool (TEEP). The advantage of such tool is to provide the impact index of planned stoppages in equipment utilization factor. Finally, the lack of fully integrated models for assessing the downtime costs and frameworks for distinguishing the difference between planned and unplanned stoppages are the main reasons behind the continuation of cost in ascending form. Due to that, the improvements will emphasize on areas with less cost saving opportunities. As a result, this will affect the production efficiency and effectiveness which in return has its influence on costs and thereby profits margin.

KEYWORDS: Downtime cost, planned stoppage, Maintenance optimization, Performance measurement systems, Indian manufacturing companies

I. INTRODUCTION

The opening chapter mainly displays the motivation factors behind the thesis topic and the intention of approaching such a subject. Further, the introduction context enclosed by different constituent elements namely background, problem discussion, objective, research questions, delimitations, limitations, and finally a chapter summary. The report structure consists of eight chapters, and at the end of the first three chapters brief summary will be provided. The purpose is to facilitate the process of idea flow and content coherence; especially the first three chapters addresses the theoretical background of this study. Consequently, the overall goal of this chapter is to furnish the reader with a general understanding about the proposed topic.

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1.1 Background

In today's aggressive assembling market, creation productivity and viability are among top business needs. Along these lines, generation hardware turning into the focal concentration of enthusiasm as it is the foundation of the assembling procedure and key execution pointer of efficiency. The necessities of exceptional execution drive organizations to significantly consider lessening their machines downtime recurrence and its noteworthy expenses [1]. Gear downtime happens because of arranged or impromptu stops. In any case, the impromptu stops created by disappointments and unsettling influences event are the most widely recognized surprising elements that have the non-unimportant impact on the general efficiency. Additionally, this interrelation between downtime occasions and efficiency lies in essence of financial undertone, in which cost and benefit factors are conversely corresponding by methods for diminishing downtime cost and along these lines expanding creation benefit [1]. To this end, keeping in mind the end goal to diminish the downtime cost, reasonable and created costing strategies are expected to figure and follow each and every cost dispensed amid the stoppage point. All exercises and assets that have exhausted while recovering the generation hardware capacity ought to be allotted in view of their genuine expenses.

1.2 Motivations

The essential part of costing strategy is to highlight ranges with high-cost investment funds, and of which supervisors continue to actualize upgrades. For example, one express exchange off is between costing techniques and upkeep applications. Profitable support takes a stab at limiting downtime occasions and subsequently cost. Then again, appropriate costing technique can be of much useful to support administrators through surveying the effectiveness of the received upkeep strategy. In addition, it permits the utilization of arrangement scientific demonstrating and reenactment as a contribution to upgrading upkeep technique, specifically, the preventive support procedure [2]. Immediately, a genuine contextual analysis is exceptionally dire in moving toward this point in a coherent way. As indicated by that, Indian assembling industry was decided for this issue as it has seen unfathomable mechanical advance inside generation offices. Also, the framework of such improvement depended on the establishment of mechanical frameworks. In any case, these modern and complex frameworks presented to regular stoppages wherein some of these stoppages are significantly affects creation blackout thus lost benefit [3]. The instance of breaking down hardware and its reclamation is exorbitant and requires numerous assets and spending costs. For those said reasons, Indian assembling industry is viewed as a decent alternative to examine particularly the issues that identified with downtime cost and lessening examination.

1.3 Problem statement

The downtime costing methods that have been used by construction companies they are often static in nature and inappropriate of measuring the dynamic nature of production lines. These methods lack the ability of identifying the hidden cost categories and instead emphasized on the direct cost that levied itself According to Traditional cost accounting method the downtime cost of equipment's was so high as they were using the Traditional costing method. In Traditional cost accounting method the action were taken after the breakdown of equipment's.

II. LITERATURE SURVEY

The contractual worker's gear arrangement and hardware administration framework greatly affect the benefit of a firm, particularly for temporary workers with substantial interest in gear. The cost of gear in structural building development activities can run from 25-40% of the aggregate venture cost. In this paper data given about how the arranged and legitimate support is vital for development gear for better generation. The information given is month to month gear usage on location and different purposes behind misfortunes in development hardware creation. Appropriate arranging, choice, acquisition, establishment, operation and support of development hardware assume vital part underway in development ventures. [1]

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Development gear assumes awesome critical part in development industry, costs as high as 36% of the aggregate development extend cost, be that as it may, the hardware support has not been given proper consideration and this add to around 40% of aggregate development extend cost overwhelm. The goal of this examination is to guarantee that development specialists acknowledge and hold fast to appropriate gear upkeep methodology as successful part of development venture productivity. For assessment of elements a few polls has been readied utilizing this data and circulated between development experts. Point of this paper is to decrease downtime, accomplish ideal gear usage and increment generation at least cost. [2]

A deliberate way to deal with sit still time diminishment can essentially support the effectiveness of development prepare ment amid their lifetime, result in higher general efficiency, and eventually secure general wellbeing and the earth. Towards this objective, this paper depicts examine gone for outlining a system for es-timating substantial hardware sit still circumstances amid a development extend. A disseminated sensor system is de-ployed to impart and introduce measurements about sit without moving circumstances and generation rates and educate extend chiefs and field administrators when sit out of gear time edges are surpassed. The outlined UI in-cludesa graphical portrayal of the site design to imagine the status of hardware progressively in sup-port of venture administration and basic leadership errands. Gathered information will be additionally used to decide en-ergy utilization and CO2 outflow levels as the venture gains ground. Utilizing reproduction demonstrating, different operational methodologies are assessed from the perspective of gear discharge and sit times. [3]

The objective of this review was to build up a crane and overwhelming hardware upkeep get ready for enhancing wellbeing and productivity. XYZ Construction does not have a methodical strategy for keeping up its cranes and substantial hardware. Their way to deal with hardware upkeep could make dangers to specialists and property. This organization understands the potential for misfortune and thinks enhancing their upkeep plan will help relieve this issue. So as to finish this, the paper utilized three stages to build up a support plan.[4]

An extensive collection of writing has been devoted to research contemplates on development hardware. Numerous themes were talked about and dissected, and different conclusions have been accounted for. Nonetheless, inquire about papers distributed with respect to con-struction hardware, are profoundly differentiated, and there is an absence of precise examination and arrangement. Subsequently, an entire comprehension of the subject is unrealistic, nor is the assess-ment of any future research bearing. A meta-investigation of the most recent diary papers committed to development apparatus would not just portray the fields the scholastic research was focused on however would furthermore uncover potential crevices for future research. In the ebb and flow examine, through a precise survey of the scholastic writing distributed in the course of the most recent decade, primar-ily distinguished by means of online databases, principle look into topics, for example, enhancement, support/downtime, efficiency, mechanical autonomy and computerization, administrator ability, development, and envi-ronment are resolved and talked about, with future research headings recommended. The result of this paper will encourage future scientists to build up an assortment of learning of advance on development hardware and its potential capacities and pro-vide future research headings on this issue. [5]

Taking after a nitty gritty writing audit, eighteen common issues confronting the UK development industry are recognized. The seriousness of these issues as opined by experienced UK development organization executives, gotten through a poll review, is consequently displayed. Discoveries uncover that the two severest issues are thought to be the poor picture and notoriety of the business, aligned with a dominance of 'cattle rustler manufacturers'. Configuration changes are positioned third, trailed by late installments, time restrictions and dependence on focused offering methodology. In light of these perspectives it is prescribed that the business' need ought to be towards nullifying corrupt firms in the residential repair, upkeep and change area, in this manner driving towards the advancement of a more expert picture. This ought to be consolidated with an endeavor by all development members to annihilate the current antagonistic nature of the business. A long haul vital arrangement is required if such non specific extensive issues are to be tended to adequately in the new millennium.[6]

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The development venture can fluctuate from to a great degree gainful to scarcely justified, despite all the trouble and here and there wind up costing the contractual worker more than what he or she is getting paid to finish it. In development industry the point of venture control is to guarantee the undertakings complete on time, inside spending plan and accomplishing other venture exercises. Time and cost are two fundamental concerns which increment significance of cost diminishment strategies. Diminishment of cost of development is a consistent objective for development industry. One method for decreasing development cost is to create imaginative innovations and also philosophies to expand profitability. This paper takes care of sorts of expense, elements influencing expense of ventures and additionally exchange on accomplishment of acceptable consequences of time and cost by applying cost decrease techniques.[7]

Development hardware assumes extraordinary noteworthy part in development industry, costs as high as 36% of the aggregate development extend cost, notwithstanding, the gear support has not been given suitable consideration and this add to around 40% of aggregate development extend cost overwhelm. The goal of this examination is to guarantee that development professionals acknowledge and stick to legitimate hardware support methodology as powerful part of development venture benefit. The review evaluated this target using Investigatory Survey Research Approach (ISRA) strategy. Five (5) distinctive basic, however firmly related indispensable methodologies of compelling development gear administration were distinguished. An aggregate number of sixty-five (65) very much organized polls were managed to eight diverse development organizations with character of A, B, C, D, E, F, G and H to gather quantitative and subjective information on how gear support has been taken care of in some haphazardly chose development organizations situated in Abuja, Minna and their environs. The contextual investigation regions were chosen as a result of their center overwhelming development ventures exercises. Fifty-seven (57) which speaks to 87.7% of the aggregate polls were recovered and broke down. The information gathered was subjected to recurrence investigation technique. The review uncovered that 51.5% of the development organizations surveyed don't append high need to gear upkeep and this contributed significantly to development extend cost invade coming about because of hardware breakdown. Dependability of development gear incredibly relies on upon the support. It is suggested that development experts bear the cost of the chance of gear upkeep technique as a major aspect of development venture administration. This will help lessen costs, likelihood of unforeseen disappointment, upgrade use and limit hardware downtime, which will consequently build the general development ventures profitability.[8]

III. EXPERIMENTAL SET UP

In this step we get detailed idea about the previous thesis done, after the detailed study it was noted that there are some laggings which are still affecting the cost of construction project. This encouraged me to get into the subject and do the detailed thesis, so that downtime cost of equipment's used in a construction industry to be minimized.

3.1 SITE DETAILS:

Name of site: Sheetal Distributors

Site Address: WadkiHadapsar Pune..

Client: SSP Technology

Contractor: SaiCostruction

Type of Building: Commercial

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Name of Project Manager: Mr. Shailesh Jagtap

Name of Engineer: Mr. Sanjay Shelar

Area of building: 3500 sq.m.

3.2. Observation, Study & Analysis of the existing process

In this step I observed the whole ongoing system which is used in daily construction practice. The record such as activity log book, work hindrance register, etc. were studied in detail. After the study of the ongoing system it was noted that there were some lags in system which causes downtime of construction equipment's.

3.3. Discussion

A brief discussion meeting was held at site with site team as well as some of the staff from head office. In this meeting results of observation and its study were presented in front of them. After seeing the results, they were agreed to do some changes in the system, and for the same I suggested them to follow the system which were designed by me and Babu Sir. Some suggestion was agreed by them so as to reduce downtime cost of equipment's.

3.4. Implementation

Implementation of a new system was started after the approval of management immediately. In this system some changes were done which are as follows:

1. Social Changes
2. Reduction of Communication Gap
3. Changes in Maintenance Strategy
4. Daily Inspection Process

3.5. Analysis

After the Implementation of new system, the work measurements were recorded on monthly basis. This data recorded were analyzed for the final results and the results of analysis were submitted to the Project Manager.

3.6. Study of Analysis

After the analysis of the record which is gathered and recorded after making changes in the system, the detailed study of analysis were done and presented in front of the authority.

3.7. Result

The result of work measurement were found so useful to minimize downtime cost as it reduces 25-30% more downtime cost with compare to previous method.

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IV. RESULT & DISCUSSION

Table no.1.Actual Onsite Equipment

No	Name of equipment's
1	Mega Crain
2	Bar Bending Machine
3	Pressing Machine
4	Mini Transit Mixer
5	Pock lain
6	Rod Cutting Machine
7	Needle
8	Diesel Generator
9	Concrete Pump

4.1. Mega Crain Activity:



Figure.No.1Mega Crain

Concreting by Mega Crain of the most efficient task, the efficiency depends upon the structure concreting to be done. For a structure like column, the tower crane can lift about 10 cu.m of concrete per hour.

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1. Cost of concrete/cu.m = Rupees 5000

2. Cost of concrete done per hour= $8 \times 5000 = 40000$

If the tower crane is sudden breakdown for an hour, it will affect the cost of the project as follows:

Cost of concrete + Labor Cost (1mason, 2helper); i.e. = $40000 + 1500 + 2 \times 350 = 42,200$.

We can also find the affected cost on project if the tower crane is breakdown for 1 day: In 1 day if you are planning to do a concrete quantity 24 cu.m of a column & beam and your tower crane suddenly breakdown after the 2 concrete vehicles reach at site, in this case the total affected cost on your project is $12 \times 5000 + 1500 \times 2 + 350 \times 3 = 64,050$.

Sometime tower crane is idle as the operator of tower crane is on a shore break or lunch break. A short break takes 30 min to resume his work where Lunch break takes 1.5 hours to resume the work. If an operator is on a short break tower crane remains idle for half hour which will affect the cost of the project.

4.1.2. Considering above points I have made some changes in our system:

a. Social Changes:

In this we have arranged the alternate operator for megacrane, also the shift wise working system was implemented. In this system before any one operator goes for a break, he gives charge to another one so as to not keep tower crane idle. By implementing this system we achieved our desired goal with full efficiency and utilization of machine. Due to this implementation our cost of idleness reduced by 20 to 25%.

4.2 Name of Equipment: Bar Bending Machine



Figure. No 2 Bar Bending Machine

4.2.1. Activity: Reinforcement work

The capacity of bar bending machine is to bend 4-5 tonne of steel per 8 hours, this means the capacity of bending machine per hour is equal to $5/8 = 0.625$ tonne per hour. In this case there is only one operator and two helpers to execute the work, if the operator goes for a break the helper

and the machine is idle for that time period. If your machine is idle for an hour your project cost affects as follows:

1operator + 2helpers + 2fitter + 2 helper = $600 + 350 \times 2 + 2 \times 500 + 2 \times 350 = 3,000$ Rs. (Labour Charges)

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As the reinforcement work is delayed the shuttering can't be done due to which carpenter and there helper also have to sit idle, i.e. $2*500 + 2*350 = 1700Rs$. As these activity gets delayed all further activity gets delayed and finally your project gets delayed which leads you the increase the construction cost.

4.2.2. Considering above situation I have done some changes in our existing working system:

a. Preventive Maintenance:

Here we use preventive maintenance so that sudden breakdown of the machine does not occurs and the work goes on fluently. AMC is given to third party for monthly basis maintenance as well as daily inspection of machine is done by our MEP incharge so as to prevent any sudden breakdown. This helps us to reduce downtime of machine till 20- 30%.

b. Social Changes:

The operator was given one helper who was trained with the job (Bar Bending Operation) he have to do in absence of operator. In this case when the operator goes on a short break or Lunch break, the helper continues the job so as to not keep the machine idle at that time. Due to this the capacity of machine was fully achieved and the production was increased to 4.5 tonne per day.

4.3 Name of Equipment: Pressing Machine



Figure.No..3 Bar Pressing Machine

4.3.1. Activity: Reinforcement

The capacity of bar pressing machine is to press 8 tonne of steel per 8 hours , this mean the capacity of pressing machine per hour is equals to $8/8=1.0$ tonne per hour . In this case there is only one operator and two helpers to execute the work, if the operator goes for a break the helper and the machine is idle for that time period. If your machine is idle for an hour your project cost affect as follows:

1operator + 2helpers + 2fitter + 2helper = $600 + 350*2 + 2*500 + 2*350 = 3,000$ Rs. (Labour Charges)

As the reinforcement work is delayed the shuttering can't be done due to which carpenter and there helper also have to sit idle, i.e. $2*500 + 2*350 = 1700Rs$.

As these activity gets delayed all further activity getsdelayed and finally your project gets delayed which leads you the increase the construction cost.

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Here we use preventive maintenance so that sudden breakdown of the machine does not occur and the work goes on fluently. AMC is given to third party for monthly basis maintenance as well as daily inspection of machine is done by our MEP incharge so as to prevent any sudden breakdown. This helps us to reduce downtime of machine till 20-30%.

b. Social Changes:

The operator was given one helper who was trained with the job (Pressing Operation) he has to do in absence of operator. In this case when the operator goes on a short break or Lunch break, the helper continues the job so as to not keep the machine idle at that time. Due to this the capacity of machine was fully achieved and the production was increased to 7 tonne per day from 4-5 tonne per day.

4.4. After analyzing why there is difference between actual & theoretical cost it was observed that there was a communication gap between the site team and plant team for ordering the concrete.

By eliminating this communication gap the ordering sequence of concrete is stream lined. After eliminating this communication gap it was observed that the pouring capacity of concrete pump was increased to 12-13cu.m per hour where as prior it was 8cu.m per hour. The lag is now 1cu.m which cost 300 Rs. In this case we have achieved 90% of efficiency of a concrete pump.

4.5. Considering above points we have done some changes which are as follows:

As the cost of vibrator needle machine is not so expensive, we purchased two spare needle machines which are useful when the other needle is breakdown. The electric supply of needle is checked on day to day basis so as to prevent breakdown of vibrator needle. Training was given to the labor those who are operating the needle at the time of concreting so as to prevent sudden breakdown due to short circuit due to high pressure on it.

Sr. No	Name of equipment	Cost without failure	Cost with failure	Difference in cost
1	Bar bending machine	3000	4700	1700
2	Pressing machine	3000	4700	1700
3	Mega crane	25,200	49,200	24000
4	Transit mixer	2,000	26,500	24,500
5	Diesel generator	1,500	20,800	19,300
6	Total station	5000	10700	5700
7	Ply cutting machine	1800	10200	8400
8	Vibrator needle	25,050	50100	25050
9	Concrete Pump	4400	4300	1900
	TOTAL	70,950	1,81,200	1,12,250

Table No 02 Comparative Calculations

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4.6 Summary

Table 4: Represents difference in cost before breakdown of equipment and after breakdown of equipment

4.7 Result:

By using Activity based costing method we have reduced cost due to downtime of equipment by about 62%. Before using ABC method we were using Traditional method in which we used to cost 1,80,200 as downtime cost whereas after using ABC method the downtime cost were reduced to 68,950. As the downtime is decreased the overall delay in work due to downtime is decreased which results in the Timely completion of the project.

V. CONCLUSION

1. By using Activity based costing method we have reduced cost due to downtime of equipment by about 72%. This method is useful for all the construction projects those whose overhead cost is getting more in account of company.
2. Before using ABC method we were using Traditional method in which we used to cost 1,81,200 as downtime cost whereas after using ABC method the downtime cost were reduced to 70,950. This help us in reducing the total amount up to 1,12,250.
3. As the downtime is decreased the overall delay in work due to downtime is decreased which results in the Timely completion of the project.
4. Delay reduced due to downtime also helped us in fulfilling the RERA norms, budgetary completion of project.

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