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Downtime Cost Analysis in Construction Industry

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ABSTRACT: This paper performed by conducting a web-based survey within Indian firms that have at least 250 employees. The main results obtained from the investigation show that the estimated downtime cost constitutes about 23.9 % from the total manufacturing cost ratio, and 13.3 % from planned production time mechanism. Focusly, the hourly cost of downtime, whether it may plan or unplanned activities, is relatively high. However, there is a shortage of systematic models that capable to trace the individual cost imposed by downtime scenarios. This lack was shown apparently whilst 83 % of surveyed companies they do not have any complete analysis adapted for quantifying their downtime costs strategy. Generally, 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 collaborate with planned and unplanned stoppages. Still, the general pattern of downtime cost calculation mechanism allocated to direct labor and lost capacity cost in each scenario The purpose of this paper is to present a sample of how Construction companies deal with equipment downtime cost, and further how they analyze its reduction. The study was performed by conducting a web-based survey within construction firms that have at least 200 employees. The main results obtained from the investigation show that the estimated downtime cost constitutes 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. 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. In this project author use Dynamics Mechanism of DT for Downtime cost reduction

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

I. INTRODUCTION

1.1 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 address 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 [1]. In today's competitive manufacturing market, production efficiency and effectiveness are among top business priorities. Thus, production equipment becoming the central focus of interest as it is the backbone of the manufacturing process and key performance indicator of productivity. The requirements of outstanding performance force companies to substantially consider reducing their machines downtime frequency and its consequential costs. Equipment downtime occurs due to planned or unplanned stops. However, the unplanned stops caused by failures and disturbances occurrence are the most common unexpected factors that have the non-trivial influence on the overall productivity [2]. Also, this interrelation between downtime events and productivity lies in gist of economic connotation, in which cost and profit variables are inversely proportional by means of decreasing downtime cost and there by increasing production profit. To this end, in order to decrease the downtime cost, suitable and developed costing methods are needed to calculate and trace every single cost disbursed during the stoppage juncture. All activities and resources that have depleted whilst retrieving the production equipment function should be allocated based on their real costs [3].

1.2 General

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 address 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 [4].

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1.3 Aim

The overall aim of this work is to investigate on downtime costs in Indian manufacturing companies, and how they are analyzing its reduction. Specifically, this work will discuss issues related to the subject such as, cost categories and drivers that attributable to downtime events whether planned or unplanned [6]. The firms' used methods for assessing the cost of downtime, and what are their holistic vision about the cost difference between planned and unplanned stoppages. Finally, the accredited maintenance applications so as to reduce the downtime events and thus costs.

1.4 Objectives

Therefore, a set of research questions formed for achieving the work objective and those questions are:

1. To study which methods are used in industry for assessing the cost of downtime.
2. To study industry's view of the cost difference between planned and unplanned stops in production?
3. To study the maintenance strategy that applied for reducing downtime events and thereby costs?
4. To study is there any performance measurement system adopted for evaluating the improvement of production equipment?
5. To investigate the significance of analyzing and predicting construction failure.
6. To test time series model on reliability analysis and failure prediction for construction equipment.
7. To Test and validate the result in real construction case study.

1.5 Scope of the study

The purpose of this Project is to present a sample of how Construction companies deal with equipment downtime cost, and further how they analyze its reduction. The study was performed by conducting a web-based survey within construction firms that have at least 250 employees [7].



1.6 Problem statement

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. They were not considering staying cost.

So I am going to collect all data and solve this problem by using Activity based costing method and Traditional costing method[8].

II. LITERATURE REVIEW

2.1 General

In this step 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.

R. Pascual et al.(06dec 2006) In this paper Author consider the intervention costs, which include labor and materials. We include downtime costs, which consist of the cost of lost production as well as other consequential costs, such as reconfiguring alternative production lines, using less efficient methods, reduced product quality, lost raw material, The system is also subject to an aging process which depends on the frequency and quality of preventive actions. Making decisions is difficult because of discontinuities in intervention and downtime costs and the limited budget. We present a non-linear mixed integer formulation that minimizes the expected overall cost rate with respect to repair, overhaul and replacement times and the overhaul improvement factor proposed in the literature. Multi-objective optimization of the above decision variables is also an interesting issue for further research as it allows considering criteria such as failure risk, availability, etc. The model is deterministic and considers minimal repairs and imperfect overhauls. This work develops an approach to address the problem through the use of a non-linear mixed integer programming formulation.

Samuel Joss et al.(14 April 2018) This research paper the investigated the effects of additive digital fabrication (DFAB) on productivity by analyzing the cost and time required for the construction of a robotically-fabricated complex concrete wall. The CYCLONE simulation technique was used to conduct a quantitative comparison between conventional and robotic construction methods. Productivity is higher when the robotic construction method is used for complex walls, indicating that it is possible to obtain significant economic benefit from the use of additive DFAB to construct complex structures. Further research is required to assess the social impacts of using DFAB investigation was undertaken to assess the effects of digital fabrication (DFAB) on productivity by analyzing the cost and time required for the construction of a robotically-fabricated complex concrete wall onsite. After defining the different tasks for the conventional and robotically fabricated concrete wall, data was collected from different sources and used in a simulation to describe the distribution of time and cost for the different construction scenarios.

Marcus Bengtsson et al.(2016) In this paper Author elaborates on theory and difficulties in practical use of LCC for machine tools. The paper presents some theory regarding LCC as well as Life cycle profit (LCP); and suggestions on how to use LCC for machine tools. Life cycle cost models used in case studies are compared to an empirical model, used at the company, where dynamic energy, fluid, and maintenance cost are included. Linear and variable factors in the models are analyzed and discussed regarding data availability and estimation, especially with emphasis on maintenance. In purchasing machining equipment in addition to a functional design with short set-up and changeover times, aspects like operation man-time, energy use, maintenance and repair costs, downtime costs, process fluids and chemicals, some of which increase with equipment age, should be considered.

Moonseo Park et al.(2004) In this paper the Downtime (DT) caused by non-availability of equipment and equipment breakdown has non-trivial impact on the performance of construction projects. This paper is specific to the Nepalese construction industry and the project types in the study, the research results demonstrate that the DT model presented in this paper could assist managers in minimizing the impact of DT by providing insight into equipment management. We acknowledge, however, that quantifying the impact of DT is inherently subjective, and any approach does little more than assessing the monetary value of less-tangible DT costs

M.Manikandan et al.(March-2018) In this research paper the time and cost of project is most important constraint for the success of project. Data was acquired from equipment rental companies, construction companies and multiple construction projects. Hypotheses on some expected results were tested Methods of life cycle cost estimating and decision methods were researched and compared. Maintenance and it will also focusing on calculating the overall equipment effectiveness. Utilization of machine properly and match their capacities to specific project requirements.

Construction equipment planning and management problems in construction projects. The result indicated that idle time, down time, poor equipment maintenance practices, improper determination of economic life and timing of replacement, poor training of equipment operators, equipment breakdown, over maintenance of equipment, huge capital investment during acquisition, balance of interdependent equipment, misunderstanding the scope of work carried out, unit cost of production and equipment suitability for job condition were found to be the major problems that affect construction equipment planning and management.

D. B. Phadatare et al.(Aug. 2016) In this paper the main purpose of this study is to evaluate the overall traffic flow of construction equipment which influences the efficiency of construction operations. Most construction firms are tends to concentrate on maintenance efforts of unscheduled breakdowns and emergency repairs; this eventually tends to concentrate on maintenance department overtime, the production losses and in expediting parts for repairs. Thus, the equipment's are largest assets of construction companies. The purpose of this study is to find out how construction equipment affects the effectiveness of construction operations and to analysis the traffic flow.

AishwaryaPrashantPatil et al.(Nov-2017)This Study The most common effects of cost overrun identified by this research were delay, and supplementary agreement or adversarial relations among stakeholders, and budget shortfall of project owners This paper describes the state of art of the research on cost overrun factors in the construction projects. Time and cost overruns have significant impact on the national economy. He argues that, if the completion of a project exceeds the planned schedule, the people as well as the economy have to wait for the provisions of public goods and services longer than is necessary and hence delays limit the growth potential of the economy.

Mr. PrakeerthAnam et al.(2017)In this paper Author Elaborates Real estate and construction is a pivotal cog of economic growth for India, as it contributes the third highest share to the Indian economy and is also the third largest employer in India. Further, it accounts for the second highest inflows of Foreign Direct Investment (FDI) in India. Though the commercial asset classes have been witnessing healthy traction, the residential asset class has been plagued with number of issues/challenges such as demand supply mismatch across segments, project delays and liquidity issues. Additionally, the real estate sector has limited access to long-term funding, taxation and fees structures are either complicated or irrational, leading to higher project cost impacting the end user/buyer. The types of cost, factors affecting cost of projects as well as discussion on achievement of satisfactory results of time and cost by applying cost reduction techniques. In many construction projects, project managers and contractors find difficulties like poor planning of project, poor material, labor shortages, increased cost of material, delays in deliveries, wastage of material, over budgeting, unexpected weather changes, lapse in management and control, loss of material, poor communication etc. This result causes into cost and time overruns conflicts in project. So there is need to study costs included in projects and to identify cost reduction or cost control techniques for carrying construction projects effectively.

S.Kanchana et al. (Feb-2018)In this study pointed out that construction contracts in the Middle East suffer from delays and cost overruns. The reasons for the cost overrun includes modification carried out by project owners, lack of understanding of basic contractual issues, frequent changes made in legislation and regulations, etc.the factors affecting cost escalation from contractor's perspective and reported that the factors affecting the cost of construction are evaluated in subjective and imprecise terms and are difficult to quantify. Construction industry is a most complicated and dynamic industry which is constantly facing uncertainties. The various factors that cause escalation in construction industry are studied and discussed in the article. The ideas suggested by researches were also analyzed and reported cost escalation can be minimized to a greater extent by carefully adopting the remedial measure.

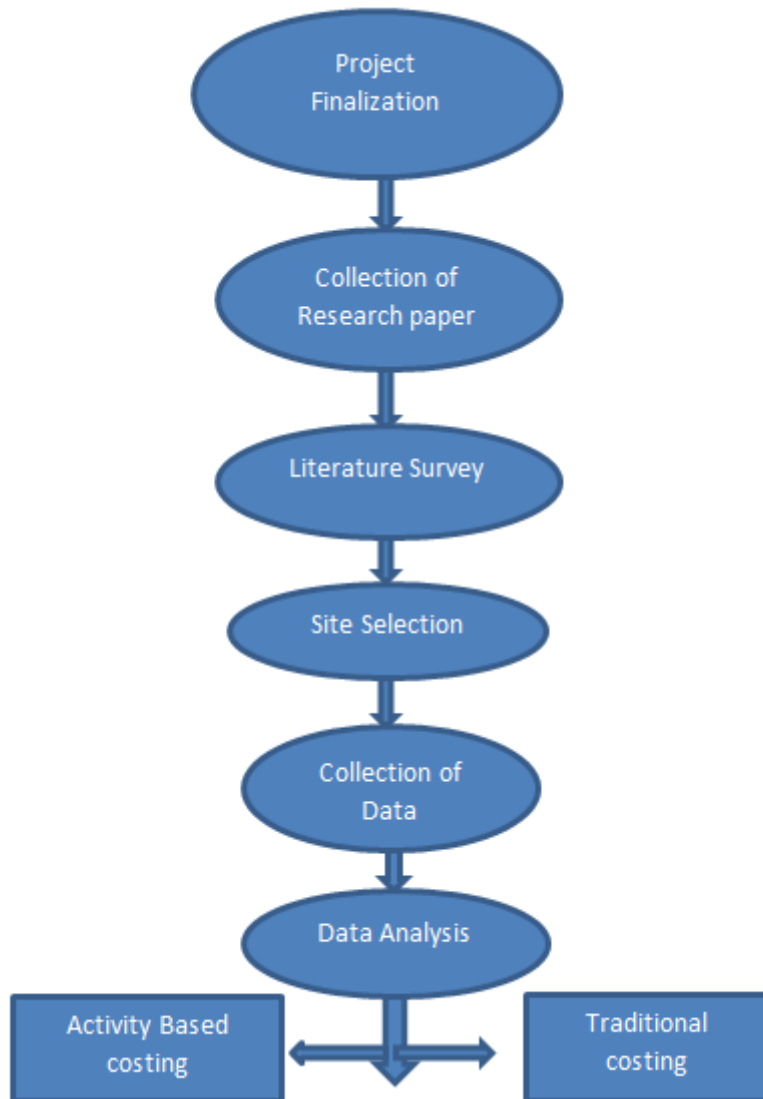
IliasNaskoudakis et al.(28-june-2016) In this paper a systematic review of the academic literature that has been published over the last decade primarily identified via online databases, main research themes such as optimization, maintenance/downtime, productivity, robotics and automation, operator's competence, innovation, environment are determined and discussed and future research directions are proffered. The outcome of this paper will facilitate future researchers to develop a body of knowledge of progress on construction equipment and its potential functions and provide future research directions on this issue. Contractors have also started to acknowledge and use telematics and other spatial technologies for timely collection of their equipment fleet data. This sub-theme has attracted a particular interest amongst researchers. Construction equipment development and applications of hybrid systems in construction machinery. Concerning equipment development, new methods and designs are implemented to enhance reliability, machine control, comfort, safety and reduce costs derived from failures and breakdowns.



D.M.Naiknaware et al.(Aug-2013) In this research paper the model is specifically designed to quantify the consequential costs associated with lack of availability and downtime in a particular operating environment model that has the capability to quantify the Consequential costs of downtime and lack of availability in four categories. The first, associated resource impact costs, deals with the costs that arise when failure in one machine impacts on the productivity and cost effectiveness of other machines working in close association with it. The second category, lack-of-readiness costs, addresses the cost that may be incurred when a capital asset is rendered idle by the downtime resulting from a prior failure. The third cost category, service level impact costs, deals with the situation that arises when one machine in a pool of resources fails to the extent that other machines in the pool must work in an uneconomical manner to maintain a given service level. The average duration of a failure, and the downtime cost per unit. This approach is suited to situations where the equipment working on a particular task is configured as a single rigid system and where failure in one component causes the whole system to go down.

III. METHODOLOGY

Here is going to compare traditional and ABC costing to the construction site equipment.



3.1 Flow Chart

Traditional Costing

Traditional costing adds an average overhead rate to the direct costs of manufacturing products. The overhead rate gets applied on the basis of a cost driver, such as number of labor hours required to make a product. Traditional costing systems apply indirect costs to products based on a predetermined overhead rate [9]. Unlike ABC, traditional costing systems treat overhead costs as a single pool of indirect costs. Traditional costing is optimal when indirect costs are low compared to direct costs. There are several steps in the traditional costing process, including the following:

1. Identify indirect costs.
2. Estimate indirect costs for the appropriate period (month, quarter, year).
3. Choose a cost-driver with a causal link to the cost (labor hours, machine hours).
4. Estimate an amount for the cost-driver for the appropriate period (labor hours per quarter, etc.).
5. Compute the predetermined overhead rate (see below).
6. Apply overhead to products using the predetermined overhead rate.

Use the following formula to calculate predetermined overhead rate:

Predetermined Overhead Rate = Estimated Overhead Costs / Estimated Cost-Driver Amount

For example:

\$30/labor hr = \$360,000 indirect costs / 12,000 hours of direct labor

• Pros and Cons of Traditional Costing

Traditional costing is best used when the overhead of a company is low compared to the direct costs of production. It gives reasonably accurate cost figures when the production volume is large, and changes in overhead costs do not create a substantial difference when calculating the costs of production. Traditional costing methods are inexpensive to implement. Companies usually use traditional costing for external reports, because it is simpler and easier for outsiders to understand. However, it does not give managers an accurate picture of product costs because the application of overhead burden rates is arbitrary and applied equally to the cost of all products. Overhead costs are not allocated to the products that actually consume the overhead activities. The traditional costing method is best used for manufacturers that only make a few different products [10].

• Activity-Based Costing

Activity-based costing identifies all of the specific overhead operations related to the manufacture of each product. Not all products require the support of all overhead costs, so it is not reasonable to apply the same overhead costs to all products. Accountants created the ABC method to solve the problems of inaccuracy that result from the traditional costing approach. Managers needed more accurate costing methods to determine which profits were actually profitable and which were not. A fundamental difference between traditional costing and ABC costing is that ABC methods expand the number of indirect cost pools that can be allocated to specific products. The traditional method takes one pool of a company's total overhead costs to allocate universally to all products.

Activity-based costing (ABC) is a costing method that identifies activities in an organization and assigns the cost of each activity to all products and services according to the actual consumption by each. This model assigns more indirect costs (overhead) into direct costs compared to conventional costing [11].

The formula for activity-based costing is the cost pool total divided by cost driver, which yields the cost driver rate. The cost driver rate is used in activity-based costing to calculate the amount of overhead and indirect costs related to a particular activity.

The ABC calculation is as follows:

1. Identify all the activities required to create the product.
2. Divide the activities into cost pools, which includes all the individual costs related to an activity—such as manufacturing. Calculate the total overhead of each cost pool.
3. Assign each cost pool activity cost drivers, such as hours or units.
4. Calculate the cost driver rate by dividing the total overhead in each cost pool by the total cost drivers.
5. Divide the total overhead of each cost pool by the total cost drivers to get the cost driver rate.
6. Multiply the cost driver rate by the number of cost drivers.

• Pros and Cons of Activity-Based Costing

Activity-based costing is the most accurate, but it is also the most difficult and costly to implement. It is more suited to businesses with high overhead costs that manufacture products, rather than companies that offer services. Companies that manufacture a large number of different products prefer an activity-based system because it gives more accurate



costs of each product. With activity-based allocation of overhead costs, it is easier to identify areas where expenses are being wasted on unprofitable products. Deciding between traditional or activity-based costing is not easy. Your choice should depend on the purpose of the reporting and who will see the information. Managers need accurate product costs and prefer to use an activity-based accounting system. Even though this system is more costly, it provides better information that will enable managers to make more profitable decisions in the long-term. For external reporting, companies still use the traditional costing system, but it is becoming obsolete as outsiders demand more accurate information about businesses [12].

3.1. Appointment of site

To complete the thesis actual work was to be done and hence I approached the site “Sai Construction” at Karvenagar Pune. There I got permission for thesis and I started working on the same.

SITE DETAILS:

Name of site: “Sai Construction”

Site Address: S.M.Tower, Karvenagar Pune.

Client: Sai Construction

Contractor: Mr. Sanjay Shelar.

Type of Building: Commercial cum Residential Building

Name of Project Manager: Mr. Ajay Jagtap.

Name of Engineer: Mr. Rakesh Sharma.

Area of building: 2500 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 cause 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 Pankaj 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.

IV. CONCLUSION

From this research it is probably concluded that by using Activity based costing method we will reduce cost due to downtime of equipment by approx. 62%. This method is useful for all the construction projects those whose overhead cost is getting more in account of company. The main results obtained from the investigation show that the estimated downtime cost constitutes about 23.9 % from the total manufacturing cost ratio, and 13.3 % from planned production time mechanism. Focusly, the hourly cost of downtime, whether it may plan or unplanned activities, is relatively high.



However, there is a shortage of systematic models that capable to trace the individual cost imposed by downtime scenarios. This lack was shown apparently whilst 83 % of surveyed companies they do not have any complete analysis adapted for quantifying their downtime costs strategy. Generally, 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 collaborate with planned and unplanned stoppages. Still, the general pattern of downtime cost calculation mechanism allocated to direct labor and lost capacity cost in each scenario The purpose of this paper is to present a sample of how Construction companies deal with equipment downtime cost, and further how they analyze its reduction.

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