Utilizing Activity-Based Costing To Manage The Maintenance Function In A Manufacturing Company

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INTRODUCTION

Maintenance is the term used by many industries and businesses to describe the broad functions associated with preserving assets. Of course, preserving assets requires the expenditure of funds. In many industries, the amount of monetary funds dedicated to maintenance functions can exceed 40% of a typical operating budget. However, even at this level of spending, management decision-making in the maintenance area is generally accomplished without the necessary information or strategy other business areas demand.

Historically, maintenance has been looked at as the necessary evil of doing business and that maintenance departments cost rather than contribute to the organization. It must be recognized, however, that maintenance is an expense of having assets. The concern lies in the ability to manage the overall maintenance function so that it provides value and follows an appropriate strategy, which is consistent with an organization's objective. Cost minimization along with an efficient and effective maintenance function is the organization's goal. In order to achieve a complete understanding of the cost makeup of this function is required. The application of ABC principles will help toward a better understanding of costs.

Activity-based costing (ABC) focuses on activities, or processes, highlighting what drives costs therefore, usually, better management of costs. The application of ABC principles into management process has very the past ten years proved to be successful (see for example: Cokins, 1999, Pieper, 1993, Slagmulder, 1999) currently, in this production facility costs are accumulated along departmental lines. Therefore maintenance is considered a department in an organization with a fixed operating budget consisting of line items such as salaries, benefits, parts, and supplies. This paper will explore the concepts and practices of applying ABC to a production plants' maintenance department. Previous studies of maintenance costs shows work on development of new tracking methods using ABC principles Several (Morris, 1993, another (Mohamed Ali Mirghani. 2001) focused on allocating support services costs to planned maintenance jobs using the concepts and techniques of activity-based-costing. The purpose of utilizing ABC is to focus the attention of management on a department that has long been neglected due to the misunderstanding of the true costs of the maintenance function. It is anticipated that once understood management will be able to see how the maintenance function can be managed to add to the long-term profitability and survival of the organization.

This paper presents a first step in analyzing the activities involved in the maintenance function and attaching costs to those activities. Also presents a more accurate view of the expenses associated with maintenance. The results then provide a basis for a further analysis.

DEFINING MAINTENANCE

What is maintenance? This is a difficult question with many answers. For the purposes of this examination, maintenance is defined, as all the activities required preserving the operation of an asset to perform its defined function. Three broad categories of terms used in the practice of maintenance include *preventative, predictive and corrective maintenance.*

Preventative maintenance is performing activities on assets to prevent them from failing without warning. This type of maintenance is similar to changing the oil in an automobile to extend its life and minimize damage due to operation. *Predictive* maintenance activities are those that attempt to monitor assets to assess their operability and integrity. This is performed to reduce the possibility of premature failures and to provide information allowing the ability to plan for repairs or replacements of assets. This is similar to diagnostic testing procedures completed at car dealership service departments. *Corrective* refers to the restoration of an asset to a like-new state in order for its operation to continue. This type of maintenance is normally performed on assets allowed to fail or on assets that have prematurely failed without warning. Each of these broad categories of maintenance requires activities to be performed and assessed as part of the maintenance function.

The process whereby the maintenance function is employed can be described by defining a work management process typical of many production plants. The maintenance function is similar to any work management process. This process has outputs that include work orders, actual executed work, reports, and costs. Figure 1 provides a depiction of the process

As the figure shows, the work management process that is the process followed in all maintenance operations, starts by work being requested. An evaluation follows of the request to decide if the work will be performed, which if approved, moves into the planning stage to further define the work and order any necessary parts. Once parts are received, a work order can be issued to the maintenance group for execution of the actual work. Completing the process requires feedback, which is the information from the maintenance team about the actual work performed and cost data, which is used in reports and statistical analysis. This process is repeated for each specific work request that enters the system.

Current Accounting

Production plants are generally divided into those with dedicated maintenance personnel and those that are served by a central maintenance group. For the purposes of this paper, the production plant analyzed has a dedicated maintenance group specifically identified to perform the work management process for the assets of the production plant. Additionally, the production plant has personnel in operations, management, engineering, and clerical support. The importance of identifying the additional personnel will become evident in the ABC analysis of the maintenance function.

The monthly budget associated with the production plant with the dedicated maintenance is as shown in the following table (costs associated with raw materials are excluded):

Line Item	Budget (000's)	Description
C&B	$457.2	Salaries and benefits
Utilities	$916	Steam, Electricity, etc.
Maintenance Cullinet	$284	Maintenance expenditures on purchase orders for contractors and materials other than stores
Maintenance Stores	$17	Materials for maintenance activities from stores warehouse.
Supplies	$44	Miscellaneous supplies for office, unit operations, etc.
Other	$4	Other expenses of the production plant-discretion of management.
Lease/Rent	$36	Leases and rental expenses.

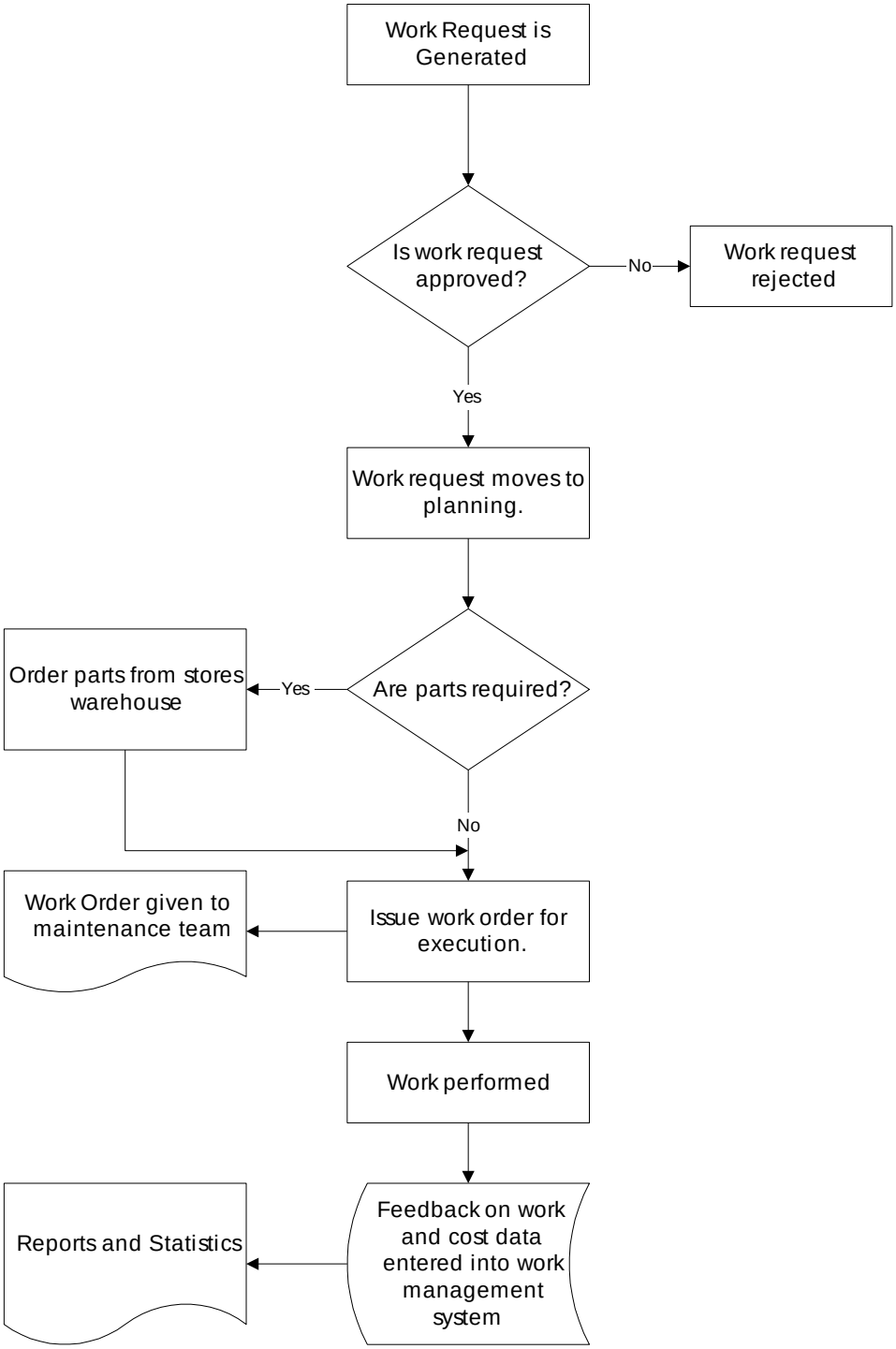

Figure 1-Work Management Process Used By The Maintenance Function

The budget shown has been developed by the organization for typical financial reporting and control. The two maintenance items represent purchase orders and materials. Therefore there is not a full accounting for the maintenance function. Expenses on labor and supplies for used in the maintenance process need to be determined. This lack of full accounting can be identified as one of the main contributing factors to the problem of effectively managing the maintenance function.

C & B – Salaries And Benefits

In order to separate the costs associated of operations of the production plant from those involved in maintenance, the line items from the operating budget must be further defined and evaluated. Figure 2 provides an overview of the production plant organization, which will provide a basis for understanding the costs of labor outlined in the budget.

The salary and benefits budget includes all personnel depicted in the diagram below as Operations or Maintenance, Admin Assistant, and some support staff (generally referred to as non-exempt with the remaining referred to as exempt, with reference to the designation of direct labor. These positions are exempt personnel, and the costs are handled through base cost of the organization as overhead.

Maintenance Cullinet. The budget of Maintenance Cullinet is created to cover outside contractors used for maintenance activities, and materials or parts that are not inventoried in Stores. This portion of the budget is expended through a purchase order system, with the requests for expenditures originating in the production plant. The control over expenditures is handled through requestor/approver relationships in the system for personnel requesting funds. This allows different levels of management to approve expenditures based on the cost level of the transaction. *Maintenance Stores* is the line item budgeted to cover those parts and materials inventoried in the operations Stores warehouse system. Items are ordered from the Stores warehouse through the work management process. There is no control process over the ability to order parts through this system other than access to the system itself. Management receives a monthly report of all items ordered through Stores for their review and analysis.

Supplies The Supplies line item of the budget covers miscellaneous supplies of the production plant such as typical office supplies. However, this account is also used for items that would be considered maintenance expense. This lack of control over this account displays another avenue where managements' ability to control maintenance expense is compromised utilizing the existing operational budget. All other budget line items: Utilities, Lease/Rent and Other, do not contain expenses that need to be split between operations and maintenance.

ABC Approach

The Activity-Based Costing approach will be utilized to separate and define the costs of maintenance. In response to initial enquiries it appeared that volume was a critical factor in determining level of activity. Therefore as a first step the majority of activities were deemed to be driven by the number of work orders. Both preventive and predictive maintenance follow reasonable standard processes and therefore one would not expect a large variety of activity types or cost drivers.

The table on the next page provides a breakdown of each category and the activities required to perform the function.

As the table shows, many activities are the same regardless of the category of maintenance being performed. This is consistent with the way work is performed in a production plant. Work orders, work permits, and closing work orders are all activities that are performed whenever work is performed in one of these three categories. The additional activities shown in each category provides the increased level of work that must be done in order to complete that type of maintenance function. The allocation mechanism is also shown to distinguish whether cost is allocated based on actual labor hours for that activity or the number of work orders generated in that category. Also, when costs should be allocated from the exempt labor not originally shown in the budget, the cost driver is provided when applicable.

Activities	Cost Driver
Predictive	
Issue Work Order	# of Work Orders
Issue Work Permit	# of Work Orders
Perform Work	Direct Labor Hours
Assess Results	# of Work Orders (using exempt labor costs)
Close Work Order	# of Work Orders
Preventative	
Issue Work Order	# of Work Orders
Issue Work Permit	# of Work Orders
Prepare Equipment	Direct Labor Hours
Perform LOTO's	Direct Labor Hours
Order Parts	# of Work Orders
Perform Work	Direct Labor Hours
Close Work Order	# of Work Orders
Corrective	
Issue Work Order	# of Work Orders
Issue Work Permit	# of Work Orders
Prepare Equipment	Direct Labor Hours
Perform LOTO's	Direct Labor Hours
Order Parts	# of Work Orders
Engineering	# of Work Orders (using exempt labor costs)
Perform Work	Direct Labor Hours
Return Equipment to Operation	Direct Labor Hours
Close Work Order	# of Work Orders

With the cost drivers established, the cost allocation can be performed once the number of work orders for each category and the associated direct labor hours are defined. Unlike many other processes, being that a production plant is a dynamic entity, the number of work orders and hours required to perform work can vary from a month-to-month and year-to-year basis. However, for the purposes of examining the cost allocation strategy, this paper will utilize the average number of work orders and labor hours used over the past year on a monthly basis to use for allocation. Shown in the following table are the monthly averages for work orders and hours in each category for the production plant:

Having the average number of work orders and the direct hours for each category of maintenance provides the basis for cost allocation. In order to allocate costs, the values associated with each cost driver must be known. Utilizing the same logic, the average costs to perform the defined activities have been found over the past year. These values will provide the charge out rates used in allocating costs according to the cost drivers in each category of maintenance.

With the categories of maintenance functions defined along with the accompanying activities in each category and their costs, the unit cost per work order can be defined. This unit cost can then be utilized to generate the cost allocation for each work order type and provide a more accurate depiction of the maintenance cost associated with operating a production plant as illustrated below.

	Values	Basis
Predictive		
# of Work Orders	320	
Direct Labor (per Work Order)	0.5 hrs	1 man for ½ hour to Perform Work
Preventative		
# of Work Orders	200	
Direct Labor (per Work Order)	6.5 hrs	1 man for 2 hours to Prepare Equipment 1 man for ½ hour to Perform LOTO 2 men for 2 hours to Perform Work
Parts (per Work Order)	$284.00	
Supplies (per Work Order)	$22.00	
Corrective		
# of Work Orders	160	
Direct Labor (per Work Order)	27.5 hrs	1 man for 2 hrs to Prepare Equipment 1 man for ½ hr to Perform LOTO 2 men for 12 hrs to Perform Work 1 man for 1 hr to Return Equipment
Parts (per Work Order)	$1420.00	
Supplies (per Work Order)	$55.00	

Activities	Cost	Basis
Issuing Work Orders	$39.75	Planner is responsible for issuing work orders. Each work order requires time for planning and delivering to maintenance team. Average cost is based on 1 planner for 1 hour.
Issuing Work Permits	$19.88	Operators have responsibility of issuing permits for all work functions in plant. Average cost is based on 1 operator for ½ hour.
Assessing Results	$57.38	Once predictive work is performed, the results require evaluation and assessment. Maintenance and engineering both support this activity. Average cost is based on 1maintenance technician for ½ hour, and 1 engineer for ½ hour.
Engineering	$300.00	Corrective maintenance normally requires engineering involvement for recommendations and specifications of repairs. Average cost is based on 1 engineer for 4 hours.
Closing Work Orders	$39.75	Final information must be provided at the end of each work order to establish history and cost. Average cost is based on 1maintenance technician for ½ hour, and 1 planner for ½ hour.
Direct Labor	$39.75	The direct labor cost is the charge-out rate used to cover salary and benefits for non-exempt employees currently covered by the production budget.

The above table provides a breakdown of all the costs associated with performing the maintenance function at the production plant. As shown, the costs associated with maintenance are far different than potentially observed utilizing the original production budget. One obvious inclusion not currently reported in the production budget is engineering. However, even without the costs not normally included in the production budget, management decision making should change based on this new cost structure.

ANALYSIS

There are two significant findings: the relative cost of maintenance and operation and the cost for each type of maintenance is quite varied.

Categories	# of Work Orders	Hours	Unit Cost	Total Costs
Predictive	320			
Issue Work Order			$39.75	$12,720
Issue Work Permit			$19.88	$6,362
Perform Work		0.5	$39.75	$6,360
Assess Results			$57.38	$18,362
Close Work Order			$39.75	$12,720
Total Monthly Predictive Cost				**$56,524**
Preventative	200			
Issue Work Order			$39.75	$7,950
Issue Work Permit			$19.88	$3,976
Prepare Equipment		2	$39.75	$15,900
Perform LOTO's		0.5	$39.75	$3,975
Order Parts			$284	$56,800
Supplies			$22	$4,400
Perform Work		4	$39.75	$31,800
Close Work Order			$39.75	$7,950
Total Monthly Preventative Cost				**$132,751**
Corrective	160			
Issue Work Order			$39.75	$6,360
Issue Work Permit			$19.88	$3,181
Prepare Equipment		2	$39.75	$12,720
Perform LOTO's		0.5	$39.75	$3,180
Order Parts			$1,420	$227,200
Supplies			$55	$8,800
Engineering			$300	$48,000
Perform Work		24	$39.75	$152,640
Return Equipment to Operation		1	$39.75	$6,360
Close Work Order			$39.75	$6,360
Total Monthly Corrective Cost				**$474,801**
Total Monthly Maintenance Cost				**$664,076**

The relative cost of maintenance and operations is an unexpected finding for the company. The company, by keeping accounts to satisfy reporting needs, had been unaware how much was being spent on maintenance relative to operations. However, Morris (1993) results were similar, after applying ABM techniques "plant officials found that maintenance accounted for 30% of total plant operating costs, more than twice what it took to for actual production". The current analysis shows salaries and benefits associated with maintenance is larger than those associated with operations. Wile line items with the title maintenance previous summed to approximately $300,000 the dollar amounts now associated is $664,000, a significant change. With this knowledge, the company's approach to managing the maintenance function should go through a significant change. Most likely processes around this function will be subject to review and subsequent change.

Each type of maintenance has now been allocated separate costs. Corrective is significantly higher than preventive and predictive. This is an interesting finding as it suggests a strategy for the organization. Previous to this analysis the deployment of the maintenance department had no specific strategy. An obvious strategy is to reduce corrective maintenance, while increasing preventative and predictive. Further analysis of the corrective maintenance cost needs to be conducted. This may diversify the cost driver pool to allow a more comprehensive understanding of the sources of cost.

CONCLUSION

This paper is a first attempt at understanding maintenance costs within a production unit. Findings show that the cost of maintenance as determined by an activity approach was far larger than originally expected. The distribution

of maintenance costs was also revealing. Although, management must have some intuition that this was the case because they requested an anlysis, the facts have shown it to be true.

Maintenance of assets will always be a cost of doing business. Management has the option of looking at the maintenance function as an uncontrollable, non-value adding cost associated with their business, or they can attempt to understand its true costs and its ability to add productivity and efficiency to their objectives. In order to properly manage any activity, managers must understand the purposes and functions of the activities and the total costs associated with performing those activities. Many times management will simply cut costs from a budget in their zeal to control costs. However, if the budget does not have the correct level of detail, how can the decision to cut costs in a particular area be understood?

The maintenance function has long been an area of expense associated with production plants where the total costs and activities are generally not well managed. Production managers simply accept that expenses must be incurred without allowing the proper analysis to be performed that would allow better decision-making regarding maintenance. This paper explored one production plant and its current budget and showed where the actual costs are incurred within the plant. Utilizing ABC, the maintenance activities could be separated from the other activities associated with running a production facility. After analyzing the true costs of the maintenance expenses it was found to be a useful exercise that has only just begun.

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