MAINTENANCE COST CONTROL
IS YOUR SYSTEM ACTIVE OR PASSIVE?

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ABSTRACT

Although many mines and processing plants have sophisticated maintenance cost information systems, cost control relies ultimately on management actions based on the information such systems generate. A systematic management approach to solving problems and implementing solutions is the key to effective maintenance cost control. In this paper the selection of indices representative of maintenance effectiveness are discussed, necessary management actions with respect to problem solving are identified, and systematic approaches are described. An actual case where maintenance cost control was exercised at an underground metal mine is reviewed.

KEYWORDS

Control; Cost Points; Management System; Quantitative Performance Measure; Stratify; Variable.

INTRODUCTION

In our experience dealing with mine and plant maintenance organizations around the world we have observed many different management approaches. Although many of the procedural details are unique to each property, usually the end results are the same. They include:

- An abundance of statistical data has been captured, but is not effectively used.
- Most of the actual maintenance work is unscheduled and is related to equipment breakdowns.
- Maintenance costs are higher than they should, or could be.
- Production rates are "bottlenecked" by equipment problems.

In short, although most operations have plenty of information on which to base management decisions it is usually inappropriately structured and organized to be useful in identifying problems. This results in one of the stumbling blocks inhibiting effective maintenance control. Another stumbling block occurs because the measurement of data is a fundamentally different process than the taking of action. To effectively exercise control, the one appropriate action must be identified and taken to correct a problem causing a deviation from a plan. Therefore control does not result from the traditional company control systems, e.g. cost accounting, but from the taking of action to solve problems.

Effective control at most operations is further inhibited by the organization. Most maintenance organizations perceive their objectives to be different from the production organization's objec-

tives. For example, maintenance personnel many times view their objective is to provide a counterbalancing force to the production goal of "running equipment into the ground" to make short term production objectives.

This perceived divergence in objectives usually results in a "confrontational" relationship to some degree. Of course, the actual objectives of both organizational groups is the same, as is the rest of the operation: to produce a product to maximize profit.

To further complicate the matter, we have observed in some operations a reluctance on the part of production personnel to take an active role in improving maintenance control since poor maintenance can be a useful scapegoat to explain lost production.

In order to turn this typical situation around – to improve the effectiveness of maintenance and to dramatically reduce its cost (and thereby production cost) – we have found a systematic process is required. The first, and by far the most important, step is for local management to recognize that dramatic improvement is not only possible but attainable in a relatively short time-frame.

PERFORMANCE BASED COST CONTROL

Maintenance costs are directly related to people and equipment performance, and the keys to controlling performance are to:

- Establish and implement a plan through a maintenance management system.
- Identify and measure appropriate process and labor-related quantities and variables.
- When the measured quantity or variable indicates a deviation from plan, identify the fundamental problem causing the deviation.
- Establish the corrective action required.
- Apply the corrective action.
- Continue to measure the variables and quantities to determine whether the corrective action is working.
- Feed results into future plans.

This is a tall order; the identification of the fundamental problem in many cases is an entire management process in itself.

It is important to relate the specific concept of cost control to the general concept of performance control. A trap many managers fall into is trying to control costs directly. Although costs can be measured and compared to a plan (budget) they cannot be directly controlled since costs result from physical quantities. In reality costs can only be effectively controlled by managing their related quantities and solving problems related to them.

Performance Based Cost Control is a management approach which provides answers to the questions which naturally follow from the general list above:

- How to appropriately identify the physical quantities and variables that must be measured?
- At what frequency should they be measured?

- What resource inputs are required to exercise control, and from where must they come?
- At what organizational level should each problem be analyzed and corrective action executed?
- How to establish what the "real"problem is?
- What management methodology is required.

The variables to be controlled are those that directly affect the physical quantities comprising costs; they must be defined in small enough "packages" to allow an appropriate corrective action to be identified and applied. If the variable is too broad in scope, such as poor availability, the fundamental problem requiring corrective action is difficult to identify. However, if the variable is preventive maintenance compliance yesterday, the information is specific enough to assess the problem and to take appropriate corrective action if a deviation has occurred.

Therefore statistical data, to be effective, must be organized in a hierarchy that corresponds to the organization. Summary indices, such as mechanical availability of the truck fleet, are designed to alert higher management to problems on an exception basis. The summary information must be built from more specific information, e.g. availability of each unit; downtime hours each shift; reason for the downtime, etc.

The key to effective control is to identify specific independent variables that, if properly controlled by an individual supervisor, will minimize costs and optimize performance.

The summary data, or indices, will alert managers to zero in on these more specific variables when a deviation from plan occurs. Additionally, while it may be acceptable to review summary indices once per week or month, critical independent variables must be assessed and necessary action taken many times per shift.

We recommend identifying a quantitative performance measure for each major organizational unit's performance, and then identifying cost points or concentrations of cost impacting on each performance measure. For example, a performance measure to evaluate a concentrator maintenance department might be: maintenance cost to produce a ton of concentrate. Cost points would likely include:

- Consumption of consumables, such as slurry pump casing liners and impellers.
- Maintenance manhours.
- Hours of lost production due to failure of a specific item of equipment.
- Etc.

Basically cost points (1) are concentrations of cost which are proportional to a physical quantity or activity necessary to produce a result. They are not necessarily directly proportional to the result itself. For example: tire costs accrue from tire consumption; fuel costs from fuel consumption – they do not directly result from tons of ore handled.

Cost points transcend the typical organizational structure. For example, the consumption of mill liners is typically an operating cost. However, maintenance labor is typically used for their replacement. When cost points are examined carefully, it is apparent that the nature of the action required to control them is usually quite different for different cost points.

In order to fit the responsibility for controlling cost point quantities into the organization it is necessary to "stratify" the cost points according to their characteristics. The stratification of cost points is a concept that requires that cost points be grouped into one of four different categories, depending upon the variables that affect the cost point, resource inputs required and opportunity potential. Table 1 represents a summary structure that can be used to stratify cost points.

	CONTROL CHARACTERISTICS	FEEDBACK INFORMATION FREQUENCY	APPROPRIATE MANAGEMENT RESPONSE
A	○ Small management resource input for desired control. ○ Relatively easy tactical decisions are required to maintain control.	High frequency measurement	First line management control through a system
B	○ Moderate resource input required. ○ Some formal study required. ○ Significant tactical decisions required by "middle management".	Medium frequency measurements	Project approach by middle management
C	○ High resource inputs required. ○ Significant engineering study required. ○ Strategic decisions necessary by senior management.	Low frequency measurement	Strategic plan guided by senior management
D	○ Essentially fixed costs which are uncontrollable within a realistic time frame.	Low frequency	Top management

Table 1. Stratification of Cost Points

The intent is to manage cost points that are a function of variables that can be controlled by the front line supervisor, such as the consumption of maintenance manhours through a management system. An on-line interactive system with data base management capability is recommended.

A good maintenance management system will allow supervisors to specifically control those variables and physical quantities which are highly controllable and which impact heavily on costs and performance.

Cost points that are a function of less controllable variables, or those that may be obscured or impacted by related or non-related activities, will required a higher level of resource inputs, such as engineering studies and the solving of more complex problems than can be handled at the frontline supervisor level. For this reason a structured problem solving model and procedure for use at the middle and higher levels of management is required. Improving cost points that are a function of the least controllable variables may require major strategic decisions by senior management.

STRATIFICATION OF COST POINTS

Category A

Cost points assigned to this category represent costs that are a function of variables that can be directly controlled by frontline supervision if an appropriate management system is used. For example: the variable related to the physical quantity – maintenance manhours – is the rate at which a specific job is completed. Characteristics of this category of cost points include: relatively minor resources must be committed, and relatively easy tactical decisions are necessary for adequate control of the variables related to the cost point quantity. In other words, cost points that can be assigned to Category A are best handled by the lower levels of the organization once a good management system is installed as a control tool.

The key to effectively minimizing cost points in Category A is to identify the correct physical quantities and their related variables, structure a system for frontline supervision according to the organization, and monitor results at a high frequency. In other words, don't wait two weeks to see how things are going; check it frequently. Second level supervision must get a daily performance report out of the system every day. First line supervision must monitor variables and quantities through the system several times per shift!

Once the systems are in force, Category A cost points should not take up much time of senior level management. Sufficient time must be spent; however, to review summary reports and ask enough penetrating questions to keep everyone interested.

The real emphasis by middle and senior level managers must be to control cost points in Category B and Category C.

Category B

Category B cost points represent opportunities not taken. These are costs that many times are "institutionalized" in the process, and are assumed to be a cost of doing business that cannot be changed.

All operations are virtually teeming with Category B cost points just waiting to be attacked with logic and problem solving skills. The improvement of these costs will usually require the solving of problems, will usually require some management study, and will usually require the commitment of significant resources to achieve results. Additionally, as a result of the necessity to commit resource, significant tactical decisions are required of middle management.

To successfully attack Category B cost points, a project approach must be taken by middle management. Many times Category B cost points can be completely eliminated. Policing and support costs many times fall into this category.

For instance, your maintenance crew is changing pump shafts frequently on slurry pumps and this process is now assumed to be "a necessary evil" of operating the plant. However, if an appropriate flow and pressure of gland seal water could be realized, this process could be virtually eliminated. The Category B cost point quantity is the consumption of pump shafts. Once the problem relating to gland water is solved, the related variable to be controlled will be the flow rate and pressure of the gland seal water.

Category C

The improvement of this category of costs requires major strategic decisions by senior management. They are cost points which, if attacked incorrectly or ignored, may eventually result in the failure of the business. Examples of this type of cost point impacting on maintenance include:

- Haulage grades at an ever-deepening open pit mine continuing to increase, causing shorter wheel motor life and high wheel motor maintenance costs.
- Obsolete process equipment causing an excessive amount of downtime and lost production.

The senior levels of management cannot devote their time to Category B cost points except to review the actions and results of their subordinates. They most certainly cannot devote any significant time to handle Category A cost points. They are uniquely qualified to attack Category C cost points, and to the extent that they are not seeking them out, identifying them and isolating them into packages that can be effectively dealt with, they are not fully performing their job.

Category D

Category D cost points are those costs that are essentially "fixed". They should be assigned to technical or support staff for long-term recommendations. They are costs that absorb energy and create wasted time because they are fixed over relatively long time frames. An example of a Category D cost point is a long term lease or contract that cannot be broken in the short term.

IDENTIFYING AND CONTROLLING THE RIGHT VARIABLES

We have hinted earlier that maintenance costs transcend traditional organizational entities. For this reason a non-traditional approach is required to control the variables which directly affect physical quantities related to maintenance cost points.

The critical variables requiring control by maintenance supervisors are the quality of job performance and the rate at which it is accomplished. In other words, the most effective utilization of the physical quantity: maintenance manhours. However, there are a multitude of other variables which, if not effectively controlled, will adversely impact maintenance costs. For example, air flow rate and combustion efficiency will impact refractory maintenance costs. The level of driver training will affect haul truck maintenance costs. The examples are almost endless.

We therefore recommend that a highly coordinated maintenance-operations unit (team) in each plant or mine area defines the cost point quantities, their related variables, and sets objectives. Once the team has made the correct definitions they must actively control these variables and quantities.

This coordination between maintenance and operations must occur at a relatively low organizational level and must be an inherent part of the maintenance management system that is imple-

mented. The confrontational or adversary approach described earlier will always result in higher than necessary maintenance costs.

Figure 1 describes the general sequence for implementing a maintenance cost control program.

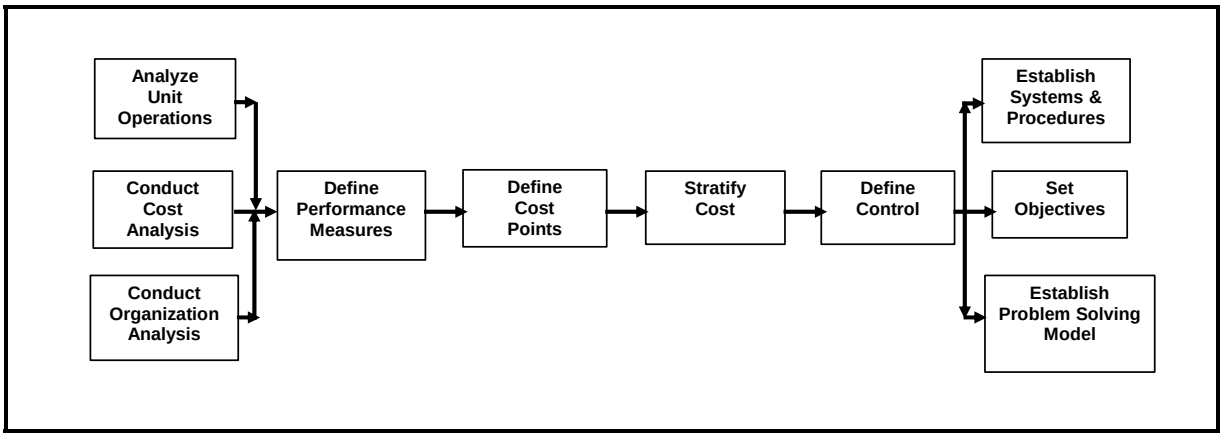

Figure 1. Performance Based Cost Control Implementation Sequence

TYPICAL CASE: UNDERGROUND METAL MINE IN AUSTRALIA

Maintenance performance was poor and costs were high, resulting in over-capitalization and poor equipment availability at a medium sized, new underground metal mine. Local management had sufficient data to isolate the problem to extremely high material costs and relatively high labor costs throughout the mobile equipment fleet, but with particular reference to the drill jumbos.

In accordance with the sequence described earlier, an initial survey was made of the property and a work plan was established to identify and stratify cost points, establish variables, and identify appropriate performance measures.

Table 2 illustrates the results of the analysis as they relate to the drill jumbos.

DRILL MAINTENANCE

PERFORMANCE MEASURES

1. Maintenance Cost per Meter Drilled
2. Hours of Drill Downtime per Shift
3. Drill-Mechanical Availability

	Category A Cost Points		Physical Quantities
1.	Parts	-	Number and type of parts used
2.	Lost drill production	-	Drill hours lost due to maintenance
3.	Unproductive maintenance manhours	-	Manhours

Variables

1. Rate of maintenance work completion
2. Quality of work
3. Parts required divided by parts used
4. Allocation of work
5. Preventive maintenance compliance

	Category B Cost Points		Physical Quantities
1.	Untrained maintenance labor	-	Manhours
		-	Drill hours lost due to maintenance
		-	Number and type of parts used
2.	Over-capitalization with respect to drills	-	Number of drills purchased

Table 2. Performance Measures, Cost Points and Variables

Underground Metal Mine – Australia

The problems to be solved quickly became obvious, and the following short-term objectives were set:

- Establish a management system to control preventive maintenance, maintenance labor, and to improve operations and maintenance coordination.
- Develop and implement a method for recording equipment history that would more specifically isolate individual problems.
- Using improved scheduling techniques, minimize the use of contractors on the surface.
- Train owner maintenance personnel in basic and advanced hydraulics which are required to effectively maintain the drill jumbos.
- Modify the organization to emphasize drill jumbo maintenance accountability.

The results were fast in coming, and they were dramatic. Figure 2 illustrates the relative maintenance cost per ton milled before and after the program's implementation during the first year. The initial 5 periods (4 weeks each) were prior to implementation, which were started during period 6.

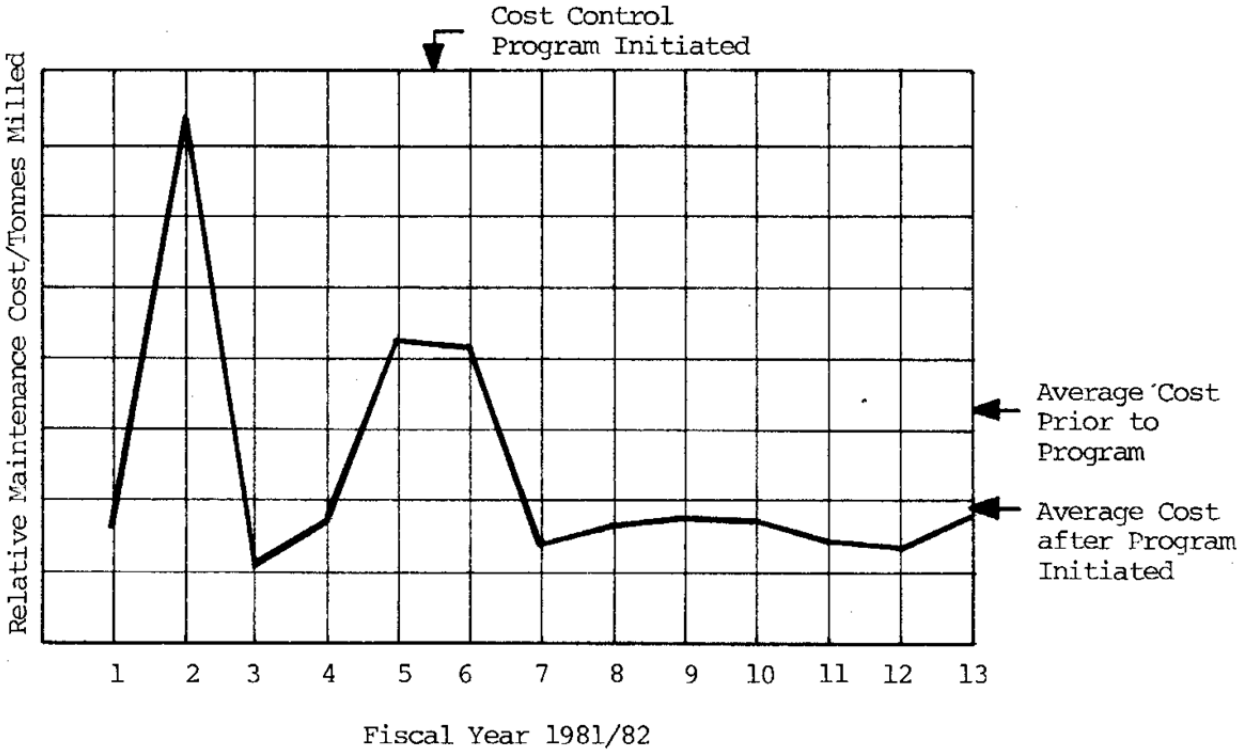

Figure 2. Relative Maintenance Cost Per Tonne Milled by Period FY 1981/82.

Underground Metal Mine – Australia

REFERENCES

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