

IS YOUR CMMS SUCCESSFUL - WHAT CAN YOU MEASURE?  
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INTRODUCTION

For your CMMS to be successful, it must assist you to make effective use of your maintenance resources while providing the required maintenance support. Let's examine that.

First, "make effective use of -your maintenance resources" means that you as a maintenance manager apply whatever resources you have so as to achieve the greatest possible maintenance effort those resources could produce. Thus, mechanics spend the greatest amount of time possible actually "turning wrenches" rather than travelling or waiting at the stockroom door. Similarly, the overhead or mobile crane waits as short a time as possible for its hookup to a lift; only the required number of parts or pieces of building materials are used on a job; and contractors or specially skilled personnel arrive at a job when the job is ready for their services. Thus, only the needed quantities and times of the resources are used; and the resources themselves and those with which they interact are used most effectively.

The second part of our definition of successful maintenance, "providing the required maintenance support," means that whatever maintenance effort is needed for successful operation is fully and successfully supplied. Thus, the bus garage is able to support the maintenance of the required number of buses each day, or the production line meets or exceeds standard outputs of acceptable quality items.

To see what is needed to achieve maintenance success, we need to examine the diagram in Figure 1. The vertical line represents the point in time when a failure occurs. Preventive and predictive maintenance, by definition, can be performed up to the point of failure. Corrective/improvement (C/I) maintenance can be performed before or after failure, but the cost of C/I work rises dramatically if done after failure and under unscheduled conditions. During failure, the failing item may damage other equipment and expand the needed repair. After failure, the time to determine the nature of the failure and the needed repair will be expanded due to confusion and the likely unavailability of mechanics, materials and supporting people and equipment.

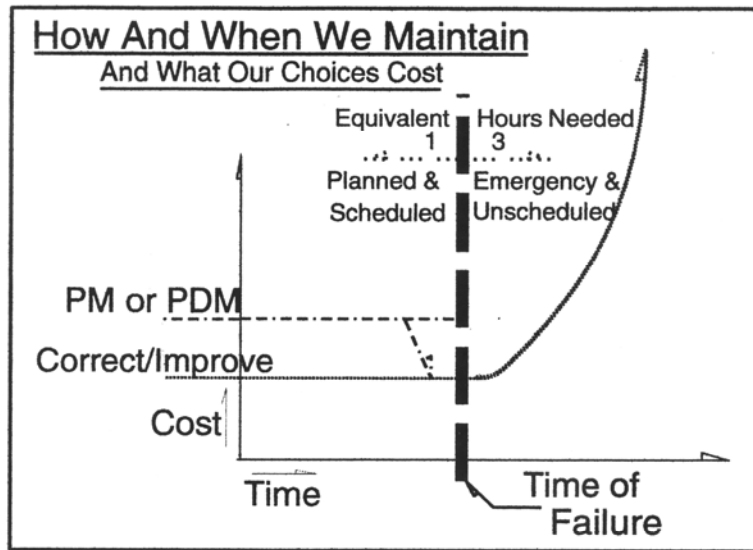


Figure 1.

If we can do our maintenance work before failure (to the left of the failure line in Figure 1), we can plan and schedule the work so as to assure both the availability of our maintenance resources and their use in the most effective way possible. The same jobs performed after failure occurs take three hours for each hour of a planned and scheduled job, and are similarly wasteful of equipment time and contractor hours. Materials are used less effectively as well. Further, jobs done unscheduled often interrupt the performance of scheduled jobs and waste time and materials resources already invested.

Each of these interruptions and overusages lessens the total amount of work that can be accomplished within our maintenance budget and the resources it can provide. Our ability to achieve required maintenance standards will be lessened as well, and perhaps to some level of maintenance below the minimum required for operating success. And last but not least, we will reduce our credibility when presenting our next maintenance budget (if our organization is still in business). We need to know if our maintenance effort is successful; and we need measurements and effective reports of those measurements to gauge that success and indicate any needed actions.

The vehicle for gathering the needed data and performing those measurements is the CMMS; and the key to the CMMS doing that is in work order planning. When jobs are planned, they are described in sufficient detail to quantify the types and amounts or working times of resources needed for performing the work. On completing the work, that description is updated to reflect actual resource usage and then becomes a part of work history. That history is our basis for measuring and evaluating maintenance causes, requirements and performance. Figure 2 indicates the integral part played by work order planning and scheduling in maintenance management; it also shows clearly that use of a CMMS enables using planning results for the effective measurement and control of maintenance.

#### INDICATORS OF SUCCESSFUL MAINTENANCE

The indicators available to us take two basic forms: directly calculable numbers, and indirect performance measures. A directly calculable number describes a specific level of a particular area of maintenance performance such as the maintenance cost per pound of product or the cost of maintenance as a per cent of the facility value.

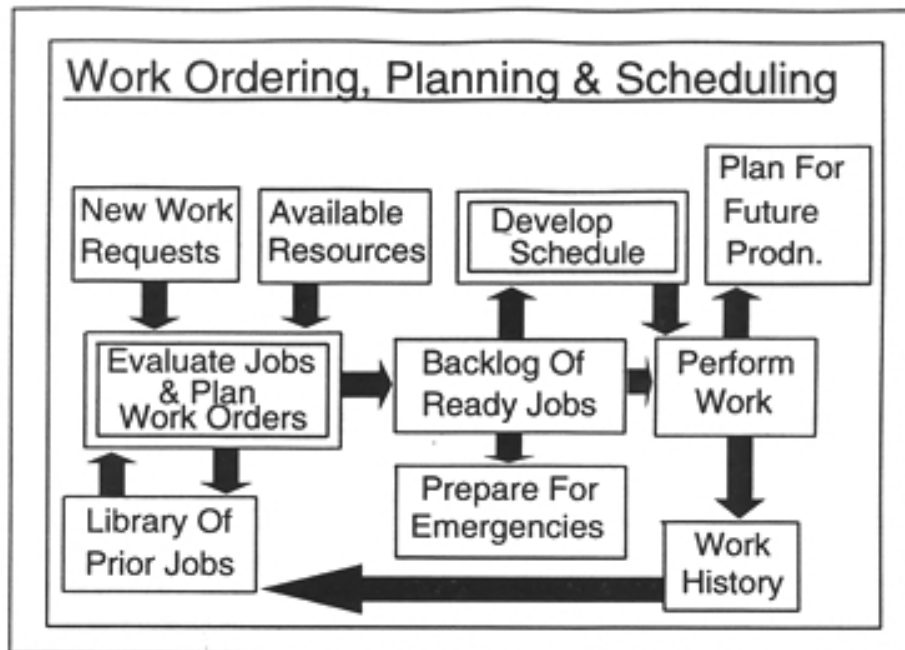


Figure 2.

An indirect indicator presents a quantity important for its implication rather than for its absolute value. It describes in more general terms how well maintenance is being performed and can project future maintenance expectations. An example could be the amount of preventive maintenance done, which is both clear indicator of maintenance resource usage effectiveness and good predictor of future failure rates. Each form of indicator has its advantages and disadvantages as indicated in Table 1. A list of recommended measurements and their target values appears in the Appendix.

**Direct Measurements**

Direct measurements included in Table 1 are: Total Maintenance Operating Cost, Maintenance Cost Per Unit Output and Maintenance Cost Per Unit Sold. There are many other direct measurements that could be made, some of which will be more applicable than others to specific facilities or industries.

The first direct measurement in Table 1 is Maintenance Operating Cost. the total cost of a period's maintenance, and a number to be compared with the maintenance budget to determine adherence to budget. This number is a better indicator of how well maintenance is being administered than of the quality or effectiveness of the maintenance effort. Yet it is important for future budget development and requesting as adherence to budget greatly eases the difficulty of justifying future budgets. This measurement is equally applicable to facilities and production maintenance.

Features Of Various Measurement Types

	Rate Budget Adherence	Rate Unit Cost	Rate Maint. Effect	Rate Profit Impact
<u>Direct Measurement</u>				
Maintenance Operating Cost	Yes	No	No	No
Maintenance Cost Per Unit Output	Yes	No	No	No
Maintenance Cost Per Unit Sold	Yes	Yes	No	Yes
<u>Indirect Measurement</u>				
% Work Planned And Scheduled	No	No	Yes	No
% Work Emergency And Unscheduled	No	No	Yes	No

Table 1.

The next item on Table 1, Maintenance Cost Per Unit Output, can indicate adherence to budget for production operations if calculated based on the maintenance budget and projected product output. For this to be an effective measure, the projected maintenance cost must have both fixed and variable components to accommodate variations in production from the forecast level and the impact of those variations on required maintenance. The major flaw in this measurement, however, is that it does not take into account production losses due to unacceptable product quality resulting from inadequately maintained equipment. In other words, it indicates the quantity but not the quality of the maintenance effort.

Maintenance Cost Per Unit Sold does not apply directly to facilities maintenance, but is a more precise measure of maintenance effectiveness in a production operation as the impact of product quality is included. If a production unit is of inadequate quality, it cannot be sold and its maintenance cost must be shared by those units that are saleable. Thus, the maintenance cost is assigned in the same way as are overhead costs so that the total cost of maintenance is carried by those units that can be sold. Because of that, Maintenance Cost Per Unit Sold is not only a direct indicator of current performance, but also serves well in comparing maintenance performance from year to year. The cost per unit sold can be used to gauge the direct impact of maintenance on unit profit; but it does not indicate the effectiveness of maintenance management. Of all of the direct measurements of maintenance performance, this is the most useful.

#### Indirect Measurements

Indirect measurements included in Table 1 are: Per Cent Maintenance Hours Planned And Scheduled, Per Cent Maintenance Hours In PM And PdM and Per Cent Maintenance Hours Unscheduled. Each of these measures the per cent of total maintenance hours in the category. Those quantities may then be compared with the goals set in each of the categories.

Per Cent Maintenance Hours Planned And Scheduled is the portion of the total maintenance hours worked that was done on planned and scheduled work orders. Work done under those circumstances makes the most effective use of the maintenance workforce and all other maintenance resources. Therefore, it is desirable to do the greatest amount of maintenance work possible under those conditions. There is a practical limit, however, as some emergencies and otherwise unplannable and unschedulable jobs will always occur. The recommended goal for planned and scheduled work (other than PM and PdM) is 40 to 45 of the total of maintenance hours. The trend of that percentage over time should be flat or rising. If those conditions are met, then we know that maintenance resources are now and in the future will be used in the most effective way even though we are not measuring the actual application of those resources.

Similarly, the Per Cent Maintenance Hours In PM And PdM is that portion of maintenance hours devoted to PM and PdM efforts and is recommended to reach 40 to 45 of the total maintenance effort. The trend of this measurement should be flat or rising. As PM and PdM are aimed at preserving and improving equipment condition, performing the needed amount of this work assures that the equipment will operate effectively and dependably into the future. Conversely, if this part of the maintenance effort is not performed as required, equipment performance is sure to deteriorate in the future. That deterioration will result in an increase in emergencies and other unscheduled work, thereby forcing a reduction in the effectiveness of maintenance resource usage. The unscheduled work takes three times the hours and scheduled jobs are interrupted.

Per Cent Emergency And Unscheduled Hours claim the remaining 10 to 20 of maintenance hours, and their trend should be flat or falling. Doing some work under these conditions is unavoidable and should therefore be expected and prepared for. In many facilities and plants, an emergency crew is always on call and is given fill-in jobs that will not suffer materially in effectiveness if interrupted by an emergency. Small non-emergency jobs not on the schedule may be received and performed

with minimal disturbance if written on a logbook for pick up and performance by mechanics when convenient. Whatever the procedure, its goal should be to assure that the needed work is performed with the most effective use possible of resources.

The three indirect measurements cited above may be combined into a single report giving a strong indication of the current effectiveness of maintenance as well as what may be expected in the future.

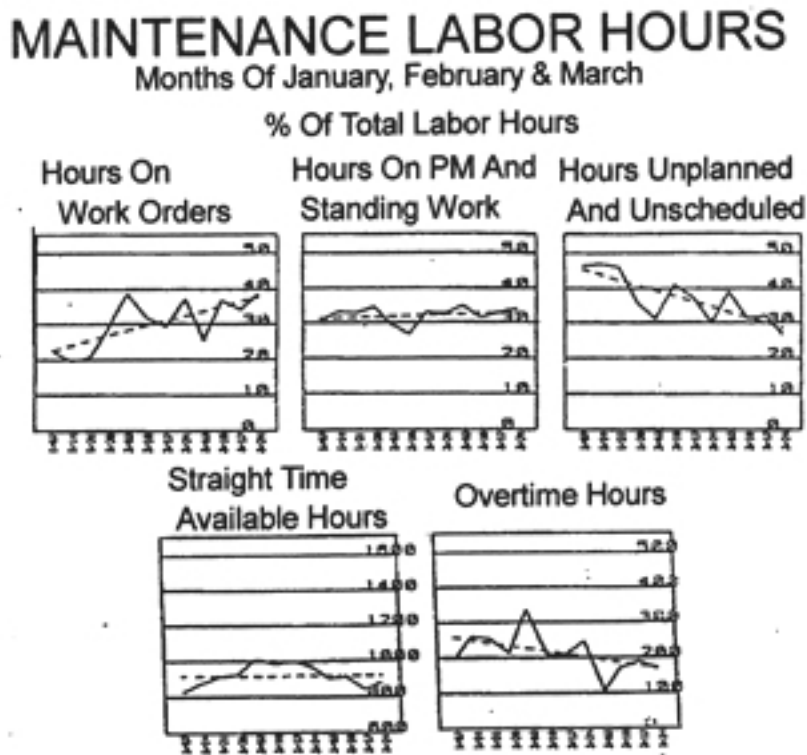


Figure 3 presents three graphs which, when taken together, constitute such a report. The first graph. Per Cent Maintenance Hours Planned And Scheduled, indicates the effectiveness of current maintenance resource usage. The level should be the recommended 40 to 45 and the trend should be flat or rising. The second graph. Per Cent Maintenance Hours In PM And PdM. indicates both current effectiveness and the expectation of future maintenance need. The level should be 40 to 45 with a flat or rising trend. The third graph. Per Cent Emergency And

Unscheduled Hours, indicates the level of ineffective use of maintenance resources and should be 10 to 20 with a flat or falling trend. When looking at this graph, it is important to remember that each per cent in this category represents only one third of the work accomplished during the same time in either of the other two categories, and is thus a constant reminder of the need to perform work under orderly conditions.

The report combining these graphs is actually an "exception report" in that if the levels and trends are as recommended, no action need be taken. Only when a level is out of the acceptable range or a trend is wrong should the work orders and log books be examined to find the cause of the problem and needed remedies be developed. When used this way, the report shown in Figure 3 is a most effective management report.

#### DEVELOPMENT OF AN EFFECTIVE MEASUREMENT SYSTEM

The following are needed steps to take in developing measuring maintenance effectiveness:

1. Select a mix of direct and indirect measurements that represent your particular situation. Begin by analyzing the nature of your operation to determine which characteristics would be the most sensitive to maintenance performance. Then select the maintenance gauge that influences that characteristic most strongly. For example, if your product has a low unit profit, comparing actual and budgeted maintenance costs per unit sold would provide a sensitive measure of maintenance effectiveness. If, however, a high production rate is critical, equipment "uptime" may be the most sensitive measure of maintenance success. Where needs are combined, such as requiring high production of a low profit item, both measurements may be needed for an adequate gauge of maintenance success.

Once the measurement(s) to be used are selected, target levels of performance must be chosen. These may, at first, be taken from "generally accepted" values such as those in the Appendix. The selected goals should be modified as needed to suit the specific application, and then refined according to experience.

The three indirect measurements described above and their graphic presentation are recommended as an accompaniment to any direct measurements selected. They will not only indicate overall current performance, but also will provide

- a valuable forecast of future maintenance performance.
2. Once the measures are selected, CMMS outputs must be evaluated to identify data outputs providing the data needed for developing the selected measurements. Where needed data are unavailable, the CMMS may have to be modified or other available data selected for the needed reports.

After assuring data availability, choose reporting formats and distribution lists that will present results effectively. Formats must be clear statements of the results, and will benefit from bearing a brief but clear statement of the meaning of the results being presented.

Finally, the distribution of the measurement reports must be developed. All in the organization who need a piece of that information for their decision-making should be on its distribution list. Of particular importance is assuring that management receives the maintenance measurement reports, and particularly the recommended three-graph indirect measurement report. This will provide management with a quickly read and evaluated statement of maintenance performance and expectation.
  3. Follow up on the reports being distributed. Make sure that they are received by those needing them and that they are understood. Check with recipients to assure that all of the information they need is being supplied, and update your reporting and distribution as needed.

## CONCLUSIONS

If your CMMS is successful, your maintenance effort meets its two most pressing needs: making effective use of your maintenance resources; and meeting the maintenance needs of your facilities and operations. Is your CMMS successful? Only by measuring and evaluating system performance can you tell.

What you measure depends heavily on the nature of your operation and must be selected carefully to yield pertinent gauges of system performance. Some gauges will measure performance factors directly, others will be valuable for their implications. Whichever types are used, the results must be reported clearly and supplied to all interested parties so that they will be both available and useful. Finally, follow up is essential so that needed improvements in the content, presentation and distribution of maintenance performance reporting are kept current and pertinent.

## Appendix

Direct Measurements	<u>Target %</u>
1. Stock Requisitions For Items Out Of Stock	2 to 5
2. Equipment Availability ("Uptime")	90
3. Maintenance Cost As % Plant Investment	3 to 6
4. Maintenance Cost As % Total Manufacturing Cost	8
5. Mechanic Direct Work As % Of Available Hours	55
Indirect Measurements	
1. Planned And Scheduled Work Orders % Of Total Work Orders Worked (Includes PM And PdM)	90
2. Emergency And All Other Unscheduled Hours	10
3. Hours On Work Orders As % Total Hours Worked	98
4. Crew Backlog Work Orders Planned (In Weeks)	3 to 5
5. Inventory Annual Turnover Rate	1 to 3 Times