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HOW TO CALCULATE RETURN ON INVESTMENT FOR MAINTENANCE IMPROVEMENT PROJECTS

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In an effort to become more competitive, companies have found that maintenance represents from 15 to 40% of the total product cost and dollars saved in maintenance are a cost avoidance. In larger companies, reducing maintenance expenditures by $1 million contributes as much to profits as increasing sales by $3 million. Improving maintenance and decreasing unnecessary maintenance expenditures by $1 million is considerably easier and more likely to occur than obtaining $3 million in new sales.

In this article, guidelines are presented for calculating possible savings that may be achieved by investing in improved maintenance policies and practices, including a computerized maintenance management system.

The objective is to present a different method for examining the effect of maintenance on a company's costs. The material is divided into sections to allow various parts to be used where applicable and omitted where not.

Standard cost justification

Standard cost justification is composed of four main parts:

4 Standard Cost Justifications

1. Maintenance labor costs
2. Maintenance materials costs
3. Project cost savings
4. Downtime/availability costs

Maintenance labor costs

Maintenance productivity in most American companies averages between 25 and 35%, which is equivalent to less than 3-hr/8-hr shift of hands-on activities. Most lost productivity can be attributed to:

- Waiting on parts.
- Waiting on information, drawings, instructions, etc.
- Waiting for equipment to be shut down.
- Waiting on rental equipment to arrive.
- Waiting on other crafts to finish their part of the job.
- Running from emergency to emergency.

While 100% productivity is an unrealistic goal for any maintenance organization, a more realistic percentage of 60% is achievable.

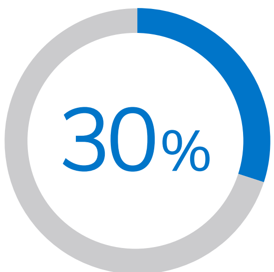
The productivity of maintenance technicians can be improved by concentrating on basic management techniques, such as:

- Planning jobs in advance.
- Scheduling jobs and coordinating schedules with operations.
- Arranging for parts to be ready.
- Coordinating availability of tools, rental equipment, etc.
- Reducing emergency work below the 50% level by preventative maintenance.

With computer assistance, planning time per job is reduced, resulting in more jobs planned and coordinated. This results in more time for preventative maintenance activities which, in turn, helps to reduce the amount of emergency and breakdown activities. This results in fewer schedule changes and increases productivity by reducing travel and waiting times. Successful users of computerized maintenance management systems have indicated an increase in productivity of 28%.

A procedure for calculating potential savings in maintenance labor costs is shown in Table I.

Since little attention is paid to maintenance materials in some companies, inventories may be higher than necessary by as much as



Inventory and stores savings

Maintenance material costs are related to the frequency and size of the repairs made to the company's equipment. The total number of parts, in addition to the stores' policies, purchasing policies and overall inventory management practices contribute to the overall maintenance materials costs. Since little attention is paid to maintenance materials in some companies, inventories may be higher than necessary by 20 to 30%.

TABLE I – Procedure for calculating savings in maintenance labor costs

1. Time wasted by personnel looking for spare equipment parts, % . . . . . . __________
   No inventory system, 15-25%
   Manual inventory system, 10-20%
   Work order system and inventory system, 5-15%
   Computerized inventory and manual work order system, 0-5%

2. Time spent looking for information about a work order, %. . . . . __________
   Manual work order system, 5-15%
   No work order system, 10-20%

3. Time wasted by starting wrong priority work order, % . . . . __________
   Manual work order system, 0-5%
   No work order system, 5-10%

4. Time wasted by equipment not being ready to work on (still in production), % __________
   Manual work order system, 0-5%
   No work order system, 10-15%

5. Total wasted time, % . . . . __________
   (add lines 1, 2, 3, and 4)

6. Total number of craftsmen . . . . __________

7. Multiply line 6 by 2080, hr . . . . __________
   (normal hours worked by an employee for a year)

8. Total number of hours for a craftsman, hr . . . . __________
   (multiply lines 5 and 7)

9. Average labor rate, including benefits for a craftsman, $/hr . . . . __________

10. Potential savings, $ . . . . __________
    (multiply lines 8 and 9)

11. Total savings, $ . . . . __________
    (multiply line 10 by percentage that describes your facility)

No work order or inventory system, 75-100%

Manual work order system and inventory system, 50-75%

Manual work order system and inventory system, 30-50%

Computerized inventory and manual work order system, 25-40%

This increases inventory holding costs and makes materials unnecessarily expensive. The inability of stores to service maintenance department's needs results in unnecessary storage depots for just in case spares. This practice also increases the cost of maintenance materials.

Good inventory control enables companies to lower the value of the inventory and continue to maintain a service level of at least 95%. This enables the maintenance department to be responsive to the operations group, while increasing the maintenance department's own personal productivity. Successful computerized maintenance management system users have averaged 19% lower material costs and an overall 18% reduction in total inventory.

A procedure for calculating potential savings in maintenance material costs is shown in Table II.

Major projects, outage and overhaul savings

In many companies, maintenance is involved in projects, outage or refurbishing activities. These activities, if not properly controlled can have a dramatic impact on a company's production capacity. The reason is, that these activities are usually performed with the equipment in a down condition. That means there is no production during this time. For this reason, any time that can be eliminated from the project, outage or refurbishing activity, can be converted to production time.

Improved planning and coordination can be achieved with a computerized maintenance management system. This will often assist in shortening the downtime, even if the company is currently using a project management system. Successful computerized maintenance management system users have indicated an average 5% reduction in outage time.

A procedure for calculating potential savings is shown in Table III.

TABLE II – Procedure for calculating savings in maintenance material costs

1. Total dollar value of maintenance spares purchased per year, $ . . . . __________
2. Percentage of time spares are already in stores
   when others are purchased, % . . . . __________
   No inventory system, 25-30%
   Manual inventory system, 10-20%
   Computerized inventory system, 5-15%
3. Savings total (cost avoidance), $ . . . . __________
4. Additional savings (inventory overhead), $ . . . . __________
   (multiply line 3 by 30%)
5. Estimated total inventory valuation, $ . . . . __________
6. Estimated inventory reduction, % . . . . __________
   No inventory system, 15-20%
   Manual system, 5-10%
   (Obsolete of unnecessary spares)
7. Estimated one-time inventory reduction, $. . . . . __________
   (multiply lines 5 and 6)
8. Estimated additional savings, $ . . . . __________
   (multiply line 7 by 30%)
   (holding cost reduction)
9. Number of stock-outs causing downtime . . . . __________
10. Amount of downtime, hr . . . . __________
11. Cost of downtime, $/hr. . . . . __________
12. Total cost of materials related downtime, $ . . . . __________
    (multiply lines 10 and 11)
13. Percentage of savings obtainable, % . . . . __________
    Current controls poor, 75%
    Current controls fair, 50%
    Current controls good, 25%
14. Savings in materials-related equipment downtime, $. . . . . __________
    (multiply lines 12 and 13)
15. Total savings, $ . . . . __________
    (add lines 3, 4, 7, 8 and 14)

TABLE III – Procedure for calculating major project outage and overhaul savings

1.	Number of major outages and overhauls per year	________
2.	Average length of outage or overhaul, days	________
3.	Cost of equipment downtime in lost sales, $ . . . . (hourly downtime rate multiplied by total hours of outages)	________
4.	Total estimated cost per year, $. . . . . (multiply lines 1, 2 and 3)	________
5.	Estimated savings percentage, %. . . . . No computerized work order system, 5-10% Project management system, 3-8% Project management system and inventory control system, 2-5%	________
6.	Total cost savings, $ . . . . (multiply lines 4 and 5)	________

Equipment downtime costs

Downtime/availability costs are major potential savings for a company that improves maintenance policies and practices. Downtime costs for equipment may very from several hundred to hundreds of thousands of dollars per hour. (One company has several production lines in its plants, with the downtime on each being $1 million/24 hr.)

In some companies, the levels of downtime can run as high as 30% or more. By dedicating the company to enforcing good maintenance policies and practices, and utilizing the computerized maintenance management system as a tracking tool, equipment downtime can be reduced dramatically. Successful users have averaged a 20% reduction in equipment downtime losses.

A procedure for calculating potential savings in equipment downtime is shown in Table IV.

Total projected savings

A summary calculation of total projected savings and return on investment is shown in Table V.

Detailed cost savings

The savings suggested in this section are more difficult to calculate for most companies because they require prior data or accurate estimates. Where available, industry averages or ranges are given as guidelines for companies not possessing complete internal data.

TABLE IV – Procedure for calculating savings in equipment downtime costs

1. Percentage of equipment downtime per year, % . . . . ________
   (if not known, use estimate-average for industry is 5 to 25%)
2. Total number of production hours for equipment for year, h . . . . ________
3. Total of all lost production hours for year, hr . . . . ________
   (multiply lines 1 and 2)
4. Multiply total lost production hours for year (line 3) by percentage that currently describes your facility, % . . . . ________
   No work order system, 25%
   Work order system, 20%
   Work order and stores inventory system, 10%
5. Total of downtime saved, hr . . . . ________
6. Cost of downtime, $/hr. . . . . ________
7. Total downtime cost savings, $ . . . . ________
   (multiply lines 5 and 6)

Optional savings considerations:

Total direct labor wages and benefits multiplied by total of all lost production hours, $________
Lost sales for year (divide total sales for year by the total number of yearly production hours and multiply figure by total downtime hours saved), $________
Increased production costs to make up production lost due to downtime. This would include the extra labor required on week-ends or off shifts to operate the equipment, extra energy costs to operate the equipment, etc.

TABLE V – Procedure for calculating total projected savings and return on investment

1. Total from Table I . . . . ________
2. Total from Table II . . . . ________
3. Total from Table III . . . . ________
4. Total from Table IV . . . . ________
5. Total savings possible from improvement program, $ . . . . ________
   (Total of lines 1 to 4)
6. Total projected price for improvement program, $ . . . . ________
7. Return on investment . . . . ________
   (divide line 6 by line 5)

Warranty costs for equipment

In many companies that have recently purchased equipment, warranty costs is an area of potential savings. In many instances, some maintenance repairs made on equipment under warranty are reimbursable under the purchase and service agreement with the equipment supplier. The amount of the reimbursement can vary but companies have found that 5 to 10% of all work performed on equipment covered by warranties can be reimbursable.

There are some considerations a company might make when investigating this area of savings. These areas may make it difficult to comply with warranty provisions:

- To be covered by the warranty, do the re pairs have to made or supervised by a representative of the supplier company?
- If the repairs are made by internal technicians, does it void the warranty?
- What level of documentation must be provided to the supplier to collect under the terms of the warranty?

If these, or similar provisions, impact the warranty, the company may want to consider whether it is worth the effort. For example, what if a critical piece of equipment would have to remain shut down waiting for the supplier's representative to arrive and make or oversee the repairs? The cost of downtime could quickly accumulate and exceed the money that could be regained from warranty claims.

There are opportunities to receive reimbursements for repairs made to equipment under warranty. However, a company would want to make a cost/benefit evaluation before these opportunities are actively pursued.

Energy cost savings

To effectively calculate any energy costs savings, it is necessary for a company to know its energy usage. If this is not known, industry averages can be used as an estimate. Studies by engineering institutes and international companies have shown that a company can reduce energy consumption at a plant by 5 to 10% depending on current maintenance effort. Companies with good maintenance programs would see savings in the 5% range. Companies with little or no preventative maintenance inspections and services would realize savings in the 10% range. Some examples of energy savings for typical systems (mechanical, electrical, steam and fluid) follow.

With mechanical systems, some of the energy savings can be defined by the type of preventative maintenance performed on some of the basic mechanical components. For example, how accurate are couplings aligned? Misalignment by as small as 0.003 in. can lead to energy loss through the coupling. This loss is typically displayed as heat energy in the flex member of the coupling and the supporting shaft bearings — even elastomer couplings will display energy loss. A second type of mechanical loss is V-belt slippage. Chain and gear misalignment will also lose energy in the transmission area and bearings. Poor maintenance practices and preventive maintenance will contribute a 5 to 10% energy loss for mechanical power transmission.

Electrical systems, as with mechanical systems, will be determined by the condition of the system and level of maintenance service performed. Typical energy losses occur in loose connections, poor mo-tor conditions, and contamination of the insulation that increases the temperature of the motor and, subsequently, its energy consumption. Improper or insufficient maintenance on mechanical drives will also increase the amount of energy required by the motor to drive the system. This, together with other losses, will contribute to excessive energy requirements by electrical systems. A 5 to 10% energy loss due to poor electrical system maintenance can be expected.

Studies show that a company can reduce energy consumption at a plant by 5 to 10% depending on current maintenance effort.

Steam generation systems have long been recognized as having the potential for substantial energy savings at most plants. Steam trap inspection pro-grams, energy efficient boilers and leak detection programs have been utilized in reducing steam system losses. Depending on the amount of maintenance performed on the steam system, energy savings from 5 to 15% have been reported by companies initiating good maintenance practices.

Fluid power systems include both hydraulic and pneumatic systems. Wasted energy in these systems in generally related to leaks. Leaks can be internal or external. External leaks are easier to find since air leaks will make a noise and oil leaks leave a pool of fluid. These leaks waste energy since the compressor or pump will have to run more frequently for the system to operate correctly. In addition, hydraulic systems will require cleaning up the leaks, another form of energy waste. Internal leaks are more difficult to detect particularly when they are small. They are usually identified by sluggish performance and, in hydraulic systems, by excessive component heat. Pumps and compressors must also run more frequently to compensate for the leaks. These, and other energy losses, will ac-count for energy losses of 5 to 15% in fluid power systems.

Quality cost savings

Since the maintenance department is responsible for the condition of equipment, quality costs are impacted by poor maintenance practices. For example, what percentage of all quality problems eventually are solved by a maintenance activity? Even if the activity is performed by the operator, the activity is one of maintaining the equipment condition. In some companies, 60% or more of the quality problems are equipment related. To calculate to possible cost savings, the value of the annual production for the plant should be calculated. Next, the current first-pass quality rate should be determined and the difference between this rate and 100% is the current reject rate.

This next step would be to determine the reasons for the rejects. Usually, a top-ten list will provide the majority of the rejects. After examining the list, determine which causes have a maintenance solution. This is the percentage amount that could be possibly reduced. An estimate of what proportion of all the maintenance related losses could be eliminated by a good maintenance program must be made. This proportion, multiplied by the dollar value of the company's annual product, will produce the possible quality related savings. This number should then be added as a line item to all of the previous savings.

Overall equipment effectiveness related savings

Overall equipment effectiveness related savings are a more recent addition to the return on investment calculation shown in Table V. This function evaluates all causes of lost production, not only maintenance. However, the exact problems causing the losses tend to be specific to the operating and organization. The following case study illustrates the potential losses that may be found at a plant.

Idling and minor stoppage losses are problems that are not closely observed. These are relatively minor problems equipment may experience and the company tolerates. The following example is taken from a disk-drive manufacturer involving the assembling of hard drives. If the robot drops a platter, it requires operator intervention. The operator's intervention requires 5 min to reset the equipment each time a disk is dropped. The operators will tolerate one intervention every 2 hr before they complain. This line operates 7 days/24-hr per day/12-hr shifts. By extrapolation, six drops per shift equals 30 min delay/shift. If the 30 min is multiplied by 14 shifts, this equals 420 min/week. The 420 min equals 7 hr of downtime. If one event of 7 hr of downtime occurs, action would be taken to determine the cause and remedy the situation. But 5-min delays are tolerated and eventually cost more than the longer delays. Examining the cost of one hour of down-time allows the appropriate amount of expenditures to be allocated to eliminate the root cause of the problem.

Conclusion

Maintenance improvement can be measured and a return on investment clearly determined.

Summary

The benefits of increased maintenance labor productivity, material cost savings, project cost savings and reduced equipment downtime have been highlighted, and procedures for calculating potential savings provided.

The role played by maintenance in obtaining energy savings is also reviewed.

For more information on calculating the ROI on your next maintenance project, contact us today!

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