

THE BUSINESS CASE FOR RELIABILITY

John Schultz - Allied Service Group, Inc.
Robert DiStefano - Management Resources Group, Inc.

ABSTRACT: “*It’s OK to get Excited about Maintenance*” is the introduction we use for every presentation we give related to maintenance, reliability, and asset management. The reason for this is the overwhelming business case associated with doing maintenance and reliability right. Asset Management initiatives have been documented to have Returns on Investment (ROI) ranging from 4:1 to 50:1. In fact, many organizations have found that a Total Equipment Asset Management (TEAM) initiative has proven to be the best investment that they have ever made in their facility. In this paper we will discuss and explore the “Business Case for Reliability” from several different angles:

1. What is ROI?
2. What are the elements of a successful TEAM initiative?
3. What are the typical costs associated with each element?
4. Where are these costs offset with savings?
5. What areas can expect to see the most significant savings?
6. What types of saving are likely in each area?
7. What is the “typical” Rate of Return (ROR)
8. What elements control ROR?
9. Where do you start?

Readers will gain a fundamental understanding of why a Reliability initiative makes financial sense for their business, what elements are essential for their success, what they can control, and how to start. If a plant already has a reliability initiative in place, but the results are not meeting expectations, calculating the business case may provide insight into why results are not being achieved.

INTRODUCTION: The definition of *insanity* has been defined as “continuing to do the same things and expecting different results”. As we travel North America viewing objectively the practices being employed at automotive plants, paper mills, steel mills, food processing plants, chemical processing plants, utility generation facilities, etc., We cannot help but wonder if *insanity* isn’t exactly what we’re seeing play it’s way through many manufacturing and maintenance organizations.

In 1988, a benchmark study showed that no less than 55% of maintenance being performed in our plants on average is reactive in nature, 30 % preventive, 10% predictive and 5% proactive. In 1992 CSI published a study that showed across all industries approximately 50% of work was reactive, 25 % preventive, 15% predictive, and 10% proactive. A 1997 benchmark study showed once again that reactive was in excess of 50%, preventive between 25-30%, and predictive and proactive represented less than 25% combined. In it’s most recent winter newsletter, an SMRP (Society of Maintenance & Reliability Professionals) survey showed 55% reactive, 31% preventive, 12% predictive and 2% as other. Along with each of these surveys, ideal percentages have been disclosed that represent best practice or top quartile plants. These ideal percentages breakdown to less than 10% reactive, 25-35% preventive, 45-55% predictive and the balance proactive.

Approximately \$5.3 billion has been invested into reliability initiatives over the past 12 years in North America alone, but plants are doing almost exactly the same type of work that they’ve always done. Not surprisingly, they’re getting the same results. You will read later in this paper that the mixture of work has a very direct impact on total cost of ownership of assets (PdM is less expensive and more effective than PM, PM is less expensive than Run To Failure (RTF), etc.). Have these plants seen a ROI for their reliability initiatives? Have they achieved spot savings that keep the program going? Has the mixture of work

changed? Are maintenance costs down? If the reliability initiative has not resulted in bottom line savings or additional product out the door, for lower cost, are we any better off than we were before we invested in reliability?

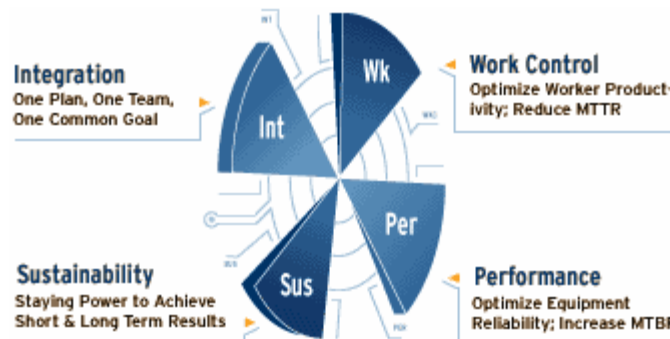
There is no question that a TEAM initiative can have a tremendous return if implemented properly, but what if it isn't implemented properly? Is it possible for a TEAM initiative to have a negative ROI, even though it has generated several finds? In order to answer these questions, we must first discuss: What is ROI?

WHAT IS ROI? ROI stands for Return on Investment. Simply put, ROI is the ratio of what savings or additional revenue streams were realized because of the initiative, divided by the investment in that initiative over the same period. If calculated correctly, a reasonable "best case" and a reasonable "worst case" ROI can be constructed to help justify the initiative. The ROI calculation will also factor in inflation and be calculated over the anticipated life of the initiative (7 years is typical based a Net Present Value (NPV) calculation from our days in Engineering Economics 101). The purpose of doing a best and a worst case is that the worst case begins to explain that the initiative is at least a viable investment and the best case shows the initiative potential if all the benefits are reaped.

Is it possible for a plant to show a negative ROI? The answer is absolutely YES. We will hold the explanation for after the discussions of the successful elements, costs and benefits.

In a 1997 benchmark survey, Top Quartile Paper Mills claimed an average ROI of 19:1, while Chemical Processing came in at 16:1, and Steel at 18:1 for their maintenance and reliability initiatives. Other industry findings were very similar. Interestingly, in poor performing plants there is a wide disparity in metrics from one industry to another, but in top performing plants the differences in performance metrics from industry to industry are very narrow! This is further validation that there is fundamentally a "right way" to do maintenance and have reliable equipment.

ELEMENTS OF TEAM: There are many required elements in a comprehensive TEAM (Total Equipment Asset Management) initiative. Every one of these elements must be deployed and functioning well at the facility to reap a significant ROI. Each of these elements can be grouped into what we call the Matrix Methodology Approach to Reliability™.



The 4 blades of the Matrix are:

1. **Work Control Tools** (efficiency) such as CMMS, Parts Lists, and Planning and Scheduling
2. **Work Performance Tools** (effectiveness) such as PM, PdM, Precision Skills and RCFA.
3. **Integration Tools** – such as integration of islands, cost optimization and standardizing on best practices.

4. **Sustainability Tools** – such as knowledge transfer, communications, and metrics.

Work Control Tools consist of all the administrative tools that are designed to control maintenance work and enhance worker productivity. Elements under Work Control Tools include:

- ERP/EAMS/CMMS
- Planning and Scheduling
- Workflow Analysis
- Information Systems
- Resources
- Data

The benefits of a well designed and deployed set of Work Control Tools are optimized worker productivity and a reduction in “lost-time” activities, which frees up craftsmen for more value-added technical activities on equipment. In other words, increased wrench-time frees up resources to work on Work Performance Initiatives.

Case in Point from Doc Palmer’s book, Maintenance Planning and Scheduling:

- Average Wrenchtime without Planning = 35%
- Average Wrenchtime with Planning = 55%
- $55\%/35\% = 1.57$ (57% Wrenchtime Improvement)
- Three Craftsmen without Planning =>
 $3 \times 35\% = \mathbf{105\%}$ Wrenchtime
- Two Craftsmen with “Planning” =>
 $1 \times 0\% + 2 \times 55\% = \mathbf{110\%}$ Wrenchtime
- Break Even for the planner is 2 Craftsmen!
- One planner can plan for 20 to 30 Craftsmen
- $30 \text{ Craftsmen} \times 1.57 = 47 \text{ Craftsmen}$
(One Planner effectively creates 17 extra Craftsmen)
- Presume \$25/hour
- $17 \text{ person} \times \$25/\text{hr} \times 2080 \text{ hr}/\text{yr} \Rightarrow \underline{\$884,000/\text{yr.}}$

Properly implemented Planning and Scheduling increases worker productivity, which frees them up to work on other, more value-added activities.

Another example of how developing and deploying Work Control Tools can lead to real bottom line savings can be seen in the area of MRO/Stores optimization.

- An average storeroom will have approximately 5,000 SKU’s valued at approximately \$1,000,000.
- It will cost approximately \$3-5 per SKU to reclassify their stores records, so that they can be easily identified and found, and so that redundancy and spoilage can be removed from the system.
- The reclassification work can be done at a cost of \$15,000 - \$25,000. This work will result in average Inventory reduction of 20-30% or a one-time savings of \$200,000-\$300,000.
- Further, since inventory has an annual carrying cost of 25-35%, if maintained, this one time reduction will result in recurring annual carrying cost reductions of \$50,000 - \$105,000.

Another area of savings in this inventory equation is that a properly described / managed inventory can result in a minimum 1 hour per day increase in craft productivity (reduce wasted time searching for materials). Clearly simply re-engineering the parts descriptions doesn't solve the whole problem. You also have to invest additional funds in developing parts lists or bills of materials (BOMs), as well as training on how to effectively search for parts in your materials management system.

- On average 5,000 SKU's in inventory can support approximately 2,650 Assets, based on an estimated duplication factor, BOMs can be developed for approximately \$85,000-\$90,000.
- Assuming that this \$1,000,000 worth of inventory is supporting 25 crafts, 1 hour a day at \$34 per hour = \$195,500 annually or could free up 2.76 people to do other work!

With improved worker productivity resulting from improved Work Control Tools, skilled people will be more available to perform value-added, technical activities that directly impact equipment reliability and health. These value-added activities are termed Work Performance Tools.

Work Performance Tools focus on the utilization of preventive and predictive technologies as well as reliability analysis tools and methodologies. Each technology and/or process has its own merit and value, including optimizing up-time, cost effectiveness, and detailed understanding of the particular asset. Performance Tools include:

- PM / PdM
- Reliability Engineering Analysis
- Precision Repair Skills
- Repair Standards

Let's focus on PM and PdM. **Vibration** – depending on the type of vibration program that you have in your facility (simple PdM route based vs. vibration control and elimination) the cost of your program should average between \$3.50 and \$7.00 per bearing. Best practice plants across a wide variety of industries have 60-80% of their bearings on vibration routes.

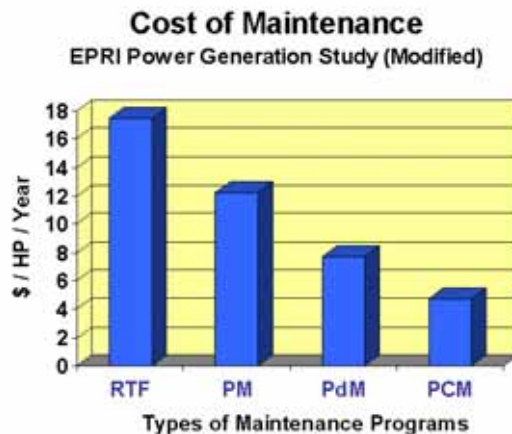
IR Thermography – the average cost of a qualified, multi-disciplined IR program is based on the cost of the thermographer's time, which ranges from \$800 - \$1,200 per day. IR should not be limited to an annual high voltage inspection. Best practice plants tend to do a twice per year high voltage survey, an annual low voltage/local disconnect survey, quarterly supplemental mechanical inspections, quarterly refractory studies, and annual building roof/building envelope inspections. These programs also emphasize the importance of "post maintenance acceptance testing and new project acceptance testing".

Tribology and Lubricant Management – a best practice Tribology / Lubricant Management program goes well beyond oil analysis and the oil analysis needs to go well beyond what standard "free" oil analysis provides. We need to use this technology to understand machine condition, not just lubricant condition. A best practice program will include:

- Lube Specification
- Receipt Verification
- Storage and disbursement
- Proper Greasing Techniques
- Sampling
- Oil Analysis – Profiling (\$29-\$75 per sample)
- Implementation & Follow-up
- Lube Disposal
- Housekeeping.Housekeeping.Housekeeping!

PM Development – the cost to develop a PM depends greatly on what methodology is used to generate it. A basic PM program that relies predominantly on the OEM’s recommendations and a cursory review of performance history costs approximately \$300 per Job Plan. A fully engineered PM that gets its roots from a form of FMEA (Failure Modes & Effects Analysis), will cost approximately \$1,500 per Job Plan. An important note is that many of the PMs developed using the “basic” methodology may later be found to be inappropriate and/or non value-added.

After all is said and done, a best practice plant can expect to spend approximately 3-5% of their total maintenance hours on PdM inspections (which will generate 40-50% of the site’s corrective work) and approximately 12-15% on PM inspections (which will generate 8-20% of the corrective work).



The 1997 Benchmark study that showed the various ROIs for Paper, Chemical Processing, and Steel, also showed in Top Quartile Plants:

- PdM and work resulting from PdM (PdMG) generated 48-60% of the total workflow.
- PM & work resulting from PM (PMG) generated approximately 30% of the total workflow.
- Maintenance cost to insured replacement asset value (Maint \$\$/RAV) ranged from 3.1% to 3.6%.

If we compare this to the plants with a much higher average of 5.5% to 7.2% Maint\$\$/RAV for those same industries at the time, where PdM & PdMG work generated less than 20% of the workflow, and PM/PMG work generated much less than the Top Quartile 30%, we can come to the conclusion that we need to significantly increase the percentage of our workflow generated by PdM and PM if we expect to perform in the top quartile and be better than the competition. Yet surprisingly, average workflow percentages for plants outside of the top quartile remain virtually unchanged since 1988! We have to ask...Are our practices insane? Why are we doing the same work and expecting better results?

Integration focuses on the balanced application of reliability initiatives. It also provides the opportunity to perform maintenance tasks based on better understanding of asset operational characteristics and performance requirements. The objective is to have reliability improvement become a comprehensive initiative, which takes into consideration the interdependencies associated with the Work Control and Performance Tools facets. Integration provides the path leading towards breakthrough improvements in reliability. Elements of this facet include:

- Consolidation of Islands
- Effectiveness Improvement
- Streamlining Processes
- Cost Optimization
- Best Practices

Over 50% of Reliability Initiatives are not reaping the anticipated ROI. This is mainly because of a lack of Integration. Organizations often view Reliability and Asset Health as strictly a “maintenance” initiative. They view the implementation of a CMMS system as a IT initiative or a purchasing initiative. The Production organization typically has a leasing mentality when it comes to the ownership of their equipment; Operations typically does not give Maintenance access to critical manufacturing information or historical process data. If this describes your plant, history would tell us to take the worst case ROI and put a negative sign in front of it, and take the best case ROI and divide it by 4!

Sustainability zero’s in on the key elements of what it takes to actually gain true long-term profitability. Sustainability provides the opportunity to reap the long-term financial gains by having the reliability improvement initiative become ingrained into the organization’s culture. Reliability needs to be as much of the culture of the plant as the safety program is. Safety programs consistently get better and stronger over time, because they are part of the culture. If the reliability improvement initiative is viewed as a project that is now complete and has allowed the organization to reach steady-state, failure is certain. In order for changes to be effective, particular attention needs to be given to the elements that increase the probability of permanence. Elements of this Sustainability facet include:

- Total Organizational Involvement
- Knowledge Transfer
- Leadership
- Metrics ID and Measurement
- Documentation & Publicizing Progress

Many companies invest in maintenance and reliability improvement initiatives only to find six months later that the same conditions which originally motivated the improvement initiative, have returned. It is imperative to deploy a set of tools that measure compliance with new business practices and procedures. The old adage “What Gets measured, Gets Done” is never more apropos than in the area of changing the habits of an organization, particularly an organization responsible for operating and maintaining millions of dollars of capital assets needed to profitably produce a company’s product.

History tells us that if we do not have a complete measurement system in place, performance will quickly degrade to previous levels.

One such measurement is the Asset Health Report. The Asset Health Report is the output of a fully populated Asset Health Matrix. The Asset Health Matrix is the visual representation of the plant’s PM and PdM maintenance strategy. The strategy is based on failure modes and affects analysis that determines what types of PM / PdM inspections need to be deployed for each asset class. The Asset Health Report depicts the health of assets by technology and is based on establishing strong and valid alarm criteria. A fully populated Asset Health Report would look as follows:

ASSET HEALTH REPORT

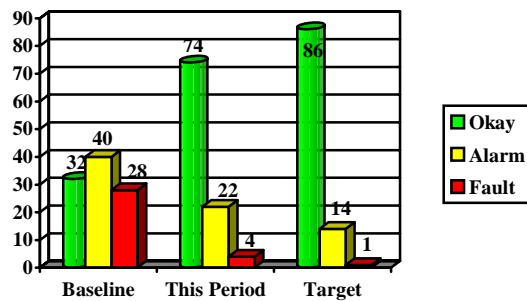
VIB IR OIL REF MCE EC PM AE

Chiller	GN	GN	GN	GN	GN	RD	GN
Comp.	GN	GN	GN		GN		GN RD
Pump	RD		RD				GN

Selecting what technologies to apply to what assets is the easy part; determining the criteria to relate to the asset conditions below requires significant research into best practices and application of statistical process control.

Red – Un-healthy
Yellow – Cautionary
Green – Healthy Condition

We have found that Best Practice Plants will have **in excess of 85%** of their equipment in a **Green Condition** and **less than 1% Red**. Note that all three of the Assets in the above Asset Health Report would role up as **Red**.



How does a plant get to - and sustain - a facility at 1.5-2.5% Maint\$/RAV? The answer can be explained with the results of this survey:

<u>Change Asset Health</u>	<u>% RAV</u>
From Red to Green	10 +/- 3.0%
From Yellow to Green	6.5 +/- 2.5%
Maintain at a Green Level	0.5 +/- 1.0%

So what happens if you spend 10% this year to improve an Asset's Health from Red to Green, but your facility does not have the standards and practices in place to sustain the Asset at a Green level? You get to spend the money again next year!

Rate of Return (ROR) - The focus up to this point has been to maximize the ROI. For many facilities the ROR or payback period is equally as important. Many managers ask the questions:

- “When will the bleeding stop?”
- “When will I break even?”

Several factors will impact the answer to these questions:

- **Current Cost** –what is the current maintenance cost/replacement asset value of your plant? How much low hanging fruit is there at your plant? It is easier to reduce this rate from 12% to 10% than it is from 4% to 2%!
- **Current Work Flow Percentage** - If you are currently doing a lot of the right things, such as already owning the inspection equipment and using it to generate corrective work, less time and money will be involved in getting Work Performance Tools in place.
- **Current Asset Health** – does your plant have a history of cheap project delivery and deferred maintenance? If so, more will have to be invested.
- **Culture** – does your plant culture embrace change or fight change?
- **Urgency/Active Participation** – positive rewards such as profit sharing or negative consequences such as threat of bankruptcy or plant closure have proven to drive some of the most aggressive implementations.

ROR is typically displayed in the form of a Funds Flow Curve.

Summary – In the last 14 years, North American industry has spent over 5.3 billion dollars trying to implement various elements of Asset Management. They have done this because of a well-founded belief in a business case and several documented success stories. It is well known that going into the 1990’s maintenance costs were believed to be the largest, most out-of-control “controllable” cost in a plant. Maintenance represents 9 to 15% of every sales dollar and 8 to 12% of every dollar that goes into the cost of making the product. Yet 12 years later, less than 10% of the organizations that have embarked on a reliability improvement initiative have reached their anticipated returns, and less than 20% of implementations are considered successful even by the employees of that facility!

Is there a logical explanation for this or was the anticipated contribution of maintenance too large? We think that it is because we continue to practice insanity. We need to aggressively change what we do and how we do it.

The numbers have showed us for years that we need to generate 45-55% of our work flow from PdM/PdMG, but yet the average is still well below 20%. The numbers and success stories have told us for years that if this is a “maintenance” initiative...it will fail. If it is an IT, purchasing, or accounting initiative, it will fail. As stated earlier, a rule of thumb that seems to hold true is that if only one segment of the organization is driving this initiative, take your worst case business case and simply put a minus sign in front of it, and take the best case and divide it by four.

Asset Management initiatives have typically been implemented in a “flavor of the month” fashion instead of as an orchestrated and engineered initiative, deployed in a way that it becomes ingrained in the plant’s culture. We find that, often, so much attention is paid to the glitzy new elements, that the *basics* of having good work-flow models, good measurements, good equipment lists, good parts lists, and good data going into the system are ignored.

Hopefully, you now have a better understanding of why the team that is responsible for designing and deploying this initiative must be fully cognizant of how each element relates to the ROI and the ROR. Otherwise it is very possible to implement an Asset Management initiative that has a negative return on investment...look around ... they are not hard to find!

“It’s OK to get Excited about Maintenance !”

For additional information please call MRG at 203-264-0500 or go to our website www.mrginc.net