Closin
g the Information Gap in Maintenance & Repair Operations: The High Impact Benefits Behind Complete Work Packages
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### Introduction

The challenges facing managers of Maintenance and Repair Operations (MRO) in capital-intensive industries have never been greater. They are being asked to increase reliability and overall equipment effectiveness of aging assets, all in the face of reduced program budgets, staff reductions and an aging work force. The pressure to achieve real MRO efficiency gains continues, as they look towards new, low-cost means to drive real labor productivity and improve mean-time-to-repair.

Despite investments in Enterprise Asset Management systems, one area of the MRO process that has been identified as a significant contributor to waste and inefficiency is the time and effort required to gather the information to support work packages (i.e., operating and safety procedures, drawings, photographs, permits, regulations, etc.). This step, a bottleneck between the computer-generated work order and the actual completion of the maintenance task, dramatically impacts work productivity.

Providing planners and maintenance mechanics with complete and accurate work packages when and where they need them can improve productivity up to 25%, resulting in millions of dollars in savings and improved manpower utilization. Best of all these information access gains and process improvements can be implemented in concert with your existing MRO applications, allowing you to maximize the benefits of your current IT infrastructure.

The result? Planners and mechanics have instant access to documentation rather than spending hours searching. Mechanics arrive on the job site ready to complete the job and move on to the next task. And plant managers reap all the benefits of closing the information gap between work orders and work practice.
A familiar story

As illustrated in the above figure, most scheduled maintenance tasks are initiated by work orders generated by Enterprise Asset Management (EAM) or Computerized Maintenance Management Systems (CMMS), beginning a business process which can have significant impact on your employees’ wrench time.

Based on our experience, the following is a typical scenario which highlights the bottom line impacts as a result of how documents are incorporated in your maintenance processes.

- Typically, the planner starts by reviewing the asset history and past work orders. This can be a lengthy process if the CMMS does not include historical information. It is not uncommon for the planner to access legacy CMMS systems or hard copy documents in this first step.

- Next the planner may look for Engineering Drawings and Piping and Instrumentation Diagrams (P&ID’s), often needing to contact the Engineering Department. Version control may be an issue since the planner must ensure he is using the correct version.

- Often the planner reviews manufacturer specifications for the equipment – online and hard copy. In the latter case, binders are pulled and the hunt begins for current specs.

- After completing initial research, the planner writes up the detailed work plan, including tool list and required parts, and attaches supporting engineering drawings.

- The maintenance technician takes over and reviews the assigned work package. Before initiating work, the maintenance technician may look up ISO related SOPs and work instructions.

- Sometimes the maintenance technician reviews the Safety Procedure manual to check for personal protective equipment and other safety issues.

- After getting the tools and parts the maintenance technician finally heads to the job site.

- It has been our experience that it is not uncommon for the maintenance technician to find he needs additional information because supporting documentation has not been updated in a timely manner or version control issues result in missing information.

The scenario above is typical and many managers have yet to realize that access to the right information at the right time can significantly increase the bottom line. Think of the cost of “wait” time for technicians to resolve issues and planners to complete up-front research. The end result can quickly add up to millions of dollars in costs when the planner and technician do not notice discrepancies and take incorrect action.
**Work packages defined**

Significant investments have been made in Enterprise Asset Management (EAM), Computerized Maintenance Management Systems (CMMS) and Work Management Systems (WMS) in order to enhance MRO processes. These tools track frequency and types of problems and failure codes, predict potential problems and streamline scheduling. In essence, these systems define the required tasks and when they should be performed – producing a computer-generated work order.

But these systems and work orders don’t provide all the information that your maintenance work force needs to know about how to perform those tasks in the most efficient, effective and safe manner possible. That part of the process is defined by the way employees really work – using many documents with information to support the maintenance process.

Organizations use different terms to refer to these materials, but many call this a “work package,” and this term will be used throughout this paper. As in the scenario above, planners reference this information in estimating jobs and developing the work plan, and mechanics need it to complete the job. This “work package,” which will vary depending on the complexity of tasks, may include information such as:

- Work Order/Work Plan
- Standard Operating Procedures and Work Instructions
- Work Permits (environmental and operational)
- Material Safety Data Sheets; Safety Bulletins; and Safety Procedures (e.g., lock-out, tag-out; process safety)
- Incident Reports
- Manufacturer’s (OEM) specifications
- Parts/Equipment Data Sheets
- Engineering Drawings, Piping and Instrumentation Diagrams, etc.
- Forms or check sheets (inspection, calibration, emissions, etc.)
- Photographs, video recordings or other media

Maintenance and repair organizations may be at different levels in the extent of automation of their maintenance planning process. Some may still rely on largely manual methods, supported by legacy systems. Many have implemented EAM/CMMS, but may still be trying to understand how to analyze and manage the plethora of available data. For the most sophisticated, EAM/CMMS systems have clearly made the MRO process faster and more efficient.

Yet, no matter how much these systems streamline maintenance planning and scheduling, you’re not realizing your full ROI if you don’t address the accuracy, completeness, and accessibility of all the information required to support your maintenance process.

**The real costs in time and money**

So, is this really a problem? Why does it matter? Let’s look at how much it could be costing you.

According to *Plant Services Magazine*, only about 25% of a typical craftsperson’s day is spent on productive tasks.\(^1\)

Also known as “wrench time” or “tool time,” labor productivity impacts other significant key performance indicators, such as estimated versus actual hours, maintenance costs, mean-time-to-repair (MTTR), and equipment uptime/availability.

In addition to time spent traveling to and from the work site, personal time, tardiness, or other time wasters, almost 20% of time is spent waiting for instructions, and another 6% is spent obtaining tools, permits, materials, reference materials and other documentation required for completing an assigned task.\(^2\) Thus, your employees could be spending one-quarter of their day or more waiting for the right information they need to do their jobs.

This time waster has been validated by other sources as well – some with estimates that are even higher. Several years ago, *Engineering Magazine* quoted Jim Porter, Vice President of Engineering and Operations for Dupont:

> “‘We estimate that our maintenance personnel spend between 20 and 40 per cent of their time looking for information,’ … making information more accessible … could save the company millions of dollars per year…”\(^3\)

A recent study by Electric Power Research Institute (EPRI) found that workers spent a significant amount of their time searching for information:

- Engineering personnel – 20% to 60% of time
- Maintenance workers – 30%
If we use an extremely conservative estimate of 20% time wasted, how much could it be costing you? It could be over 300 hours annually per employee, or over $1.3 million per year for 100 workers.

When you consider the total cost of maintenance across firms in capital-intensive industries like Energy, Utilities and Manufacturing, the industry-wide cost of this productivity loss is even more significant, billions of dollars.

Getting to the root cause

What creates this problem? Let’s focus on four primary issues:

- “Control documents” and other supporting materials in different locations and formats
- Time wasted finding information
- Human factor variability – your workers’ different levels of knowledge and experience
- Loss of knowledge as your employees leave

Documents everywhere

In order to meet regulatory requirements or ISO certification for quality (ISO 9000) and environmental (ISO 14000), many firms have developed written procedures and work instructions designated as “control documents.” While these documents are now usually created and updated electronically, organizations that lack a robust document management system may still be using cumbersome manual methods for version control:

- Complex lists are used to track and monitor revision history
- Gathering input and securing approvals on suggested changes can be a time consuming process, sometimes taking weeks
- Employees may have documents “squirreled” away on their hard drives or shared drives, with no method for tracking versions

Version control of supporting documents such as engineering drawings is also a challenge. With a plant lifecycle of over thirty years, software upgrades can prevent access to engineering drawings created on prior software versions. DaratechPLANT 2004 highlighted this problem of integration of legacy information.

Hard copy may still be the primary source of reference in the plant for many of these documents, with copies stored in binders or files in multiple locations. This may also include manufacturer’s specifications, warranty notices, and other materials that are not created by the owner/operator, but instead obtained from a multitude of vendors (OEMs).

The dog-eared pages on these “mega-binders” prove the extensive use of these critical documents. But your employees often cannot easily find the right information when they need it. And how sure are you that when you changed the pump model due to an upgrade, the updated specifications actually made it into the file?

Time wasted

The sheer volume of information supporting your plant assets can be tremendous – millions of engineering drawings and other documents. As noted above, significant time is wasted searching for and updating this information, which is scattered in multiple locations and systems, in different formats.

Without an enterprise-wide view, firms may also waste time solving problems that have been previously handled in a sister plant. Industry consolidation, which has resulted in mergers and acquisitions of new plants, has compounded this challenge of information integration.

Some firms have tried copying work instructions into their EAM/CMMS systems, thinking this will save time by printing it with the work order. But if another system is used to maintain these control documents, then redundant effort is required to transfer updates to the EAM/CMMS systems. And if someone forgets to make the change in both places, a mechanic could use inaccurate information.

While many EAM/CMMS systems have the technical capability to enable attachment of supporting documents, few organizations have fully implemented and integrated these systems with robust document management capabilities. Some firms have established links or attachments from their EAM/CMMS systems to the relevant
supporting documents on shared drives. But these methods are cumbersome, as links are easily broken when documents are revised. Redundant efforts are required to re-establish EAM/CMMS links to the current version – often relying on human intervention to remember to do so.

Human factor variability
While “mean-time-to-repair” is commonly used as a key performance indicator, firms may not have recognized the impact and potential savings that can accrue by reducing the variance in the time it takes for employees to complete maintenance and repair tasks. In most organizations, performance levels vary significantly:

“Superstars do everything they feel is needed, but no two ace technicians perform identical tasks or perform them in the same way. The middle portion performs the tasks, but methods still vary. The bottom tier will do only what they are directed to do.”

The illustration below (left) shows a typical graph of the variability in the time it takes a population of mechanics to solve a non-routine maintenance task. Note that this “long right tail” distribution is typical of service businesses that involve problem resolution. By reducing the variance (right graphic), you can lower your maintenance labor costs, even without any change in mean-time-to-repair. This is a key principle of Lean Six Sigma, which focuses on reduction of variability through consistent processes. In addition to cost, variability can impact maintenance quality, and even increase safety risks.

Knowledge walking out the door
Some firms don’t utilize work packages, and don’t consider it a problem, because the majority of their employees have twenty or thirty years of experience and “know the plant inside and out.” But in addition to variability, simply relying on experienced employees’ knowledge ignores an impending problem that many firms will soon face – retirement of those long service employees:

*Upstream oil and gas companies will likely lose more than 60 percent of all employees – along with their experience and knowledge – by 2010.*

As those experienced workers leave, new employees will need complete work packages with detailed information for efficient and effective maintenance. Some work practices are so ingrained that employees take them for granted, and aren’t part of documented procedures – nor would they be recognized by pure data analysis. Firms must begin now to capture the vast knowledge of those experienced employees, so that anecdotal information and best practices can be made available to others.

Greater variability in time to repair significantly increases your maintenance costs.
Closing the information gap

You can close the gap quickly and efficiently by taking steps to understand and streamline your work process, and leverage your current IT investment to provide incremental value.

Improve the process

One of the first steps is an assessment of how your work force currently uses documents throughout your Maintenance and Repair Operations process. You may be surprised by how much your employees rely on this information every day to support how they really work. By understanding your maintenance and repair work process and how supporting documents are created, modified and used, you can uncover ways to streamline and simplify these processes. Lean Six Sigma methodologies can help you define, measure, and analyze your current state, identifying what information is most critical and establishing metrics. Based on this analysis, you can develop and implement process improvements and control the change by monitoring metrics.

Gain control

You should also examine how you maintain control of key documents that provide rigor to your MRO process, such as ISO conformance documentation. For those who have not adopted ISO standards, this may include standard operating procedures, work procedures or work instructions, and safe job procedures. Other key documents include engineering drawings, P & IDs, vendor specifications and other supporting materials.

You can improve information access by digitizing hard copy materials such as vendor specifications. Enhance your process through document management capabilities such as version control, check-in/check-out, and search and retrieval through both metadata and full text searches. Workflow capabilities can streamline your management of change process by automating review and approval of these documents. In implementing these changes, you should ensure that your document structure and taxonomy fits your work process – the way your employees really work – and the needs of your organization.

Link your data and documents to enhance information access

To leverage the value of your EAM/CMMS systems, you should enable linkages to documents based on your EAM/CMMS data structure at a component or sub-component level. Document management capabilities, such as metadata or attributes to identify asset tag or component numbers, can simplify the process of retrieving and compiling the relevant materials.

An attribute, like Asset Number, can be associated with multiple document types (e.g., Procedures, Piping & Instrumentation Diagrams, Digital Pictures, Checklists, Logs, etc.). Likewise, each of these documents (e.g., Safety Procedure, P&ID) may apply to multiple assets/components. Attributes are typically associated with the document type at the time the document is set up or indexed in the document management system, or can be added or modified to enhance search capabilities.

Managing this many-to-many relationship through a robust document management system makes these unstructured documents work smarter. When documents are updated, links are maintained and you access the current version. You can dynamically associate field equipment, spare parts and asset information with the relevant OEM documentation. By establishing attributes at a component or sub-component level, you can “roll up” the information to the asset level, to automate compiling all of the relevant documents.

Close the loop

Finally, you can develop a closed loop process, so information learned in completing the work order is captured for future planning. Mobile devices, which are rapidly gaining a foothold in many organizations, can streamline this process. Mechanics collect and enter data such as calibration readings and even visual inspection reports (through drop down selections) in the course of their work, to improve the quantity, quality and timeliness of information provided to EAM/CMMS systems.

For those who have not yet adopted handheld technologies, and for more extensive unstructured documents such as incident reports, hard copy materials can be scanned. Upload electronic documents to the document management system, with metadata added for future search and retrieval.
Engineering drawings, P&IDs, and schematics can be updated based on mechanics’ input.

You may also want to extend this closed loop process by integrating best practices and other field feedback into decision support or performance support tools. This can improve consistency and quality of mechanics’ performance and reduce the time required to solve non-routine maintenance problems.

Results you can feel and measure

The clearest and most significant benefits of streamlining and completing your work package process are through improved labor productivity (“wrench time”) and reduced maintenance and repair costs. This is enabled through fast, simple search and retrieval of documents to support MRO, and implementing document processes and tools to support how your employees really work. Access to complete, accurate information can also speed mean-time-to-repair and reduce variability of repair time.

A large Canadian utility firm estimated productivity savings of over $2 million by streamlining their process for management of change and for access and retrieval of engineering drawings.

Some may view labor productivity as “soft” dollar savings, and be looking for direct cost reductions. But as noted above, over the next five years, a significant percentage of workers are expected to retire. Labor experts have predicted that it will become more difficult to recruit skilled technical workers. As a result, firms must look for ways to streamline their processes and improve productivity -- to do more with less. These “soft savings” can actually reduce your maintenance labor costs, by downsizing through retirements and attrition, directly impacting your bottom line costs to increase profitability.

By bridging your EAM/CMMS data with supporting documents you can enhance decision support, and speed emergency response time through immediate access to up-to-date critical information and best practices. Document management capabilities that provide an audit trail for version control, document security, and workflow capabilities such as automated reporting and alerts, can also improve your safety and regulatory compliance recordkeeping and reporting.

Those who choose to implement these capabilities through hosted centralized repository services achieve the additional benefit of minimizing implementation and infrastructure investment through a “pay as you go” model. Hosted services ensure backup, recovery and security for business operations and continuity.

Realizing your opportunity

What makes Xerox Global Services uniquely qualified to help you with these challenges?

No other company has the breadth and depth of experience in document and content management as Xerox. Our industry-focused teams bring a wealth of knowledge and experience to your business. They know where to look for hidden costs, lost time, and the opportunities for improvement.

We offer proven document and business process expertise, using Lean Six Sigma methodologies. Our approach is to benchmark your current state and design a solution that leverages the value of your existing investments. Working with you, we establish metrics that can be stated in terms of cost savings, labor productivity (“wrench time”), asset/equipment availability or other measurable business improvements.

Xerox is also a leader in innovative technologies that focus on improving your document processes. Xerox Global Services implements best-in-class document technologies to enable content creation (including Microsoft Office and XML authoring tools), document capture, document workflow, and enterprise content management. Xerox provides outsourcing services for content capture and conversion, as well as hosted content management including workflow.
**Endnotes**

i “Labor utilization: Increases would put maintenance on a par with the rest of our world-class production capabilities,” R. Keith Mobley, Contributing Editor, *Plant Services Magazine*, November 05, 2003

http://www.plantservices.com/Web_First/PS.nsf/ContentsFrameSet?OpenForm&ArticleID=CBOH-5U5MBD

ii ibid

iii “Data life: The huge investment in digital data for the design and construction of facilities in the process sector has led to a need for new data models and significant information reuse.” *Engineering Magazine*, November 2000

http://www.engineeringnet.co.uk/features/eng11200013.htm

iv “Plugging the Brain Drain in Energy,” Feblowitz, Jill, et. al., AMR Research, January 27, 2004

v Calculation based on data from “Labor Utilization,” Mobley, R. Keith, *Plant Services Magazine*, Nov 5, 2003: 20% * 8 hours * 5 days/week * 46 weeks (excl vacation) * $75,000 yr/employee * 100 employees = $1.33M


vii “Best practices for maintenance work orders: It's not what technicians do, it's how they do it, that counts most,” R. Keith Mobley, Contributing Editor, February 18, 2003

http://www.plantservices.com/Web_First/PS.nsf/ContentsFrameSet?OpenForm&ArticleID=CBOH-5U5MBD

viii “Applying Knowledge Management to Oil and Gas Industry Challenges,” Paige Leavitt with contributions from Cynthia Raybourn and Cindy Hubert; American Productivity and Quality Center, October 2002.

Xerox Global Services helps companies streamline and digitize their *document-intensive business processes*™ – everyday processes like customer communications, billing, training, or record management. Our people work closely with clients to identify, quantify and realize hidden opportunities to save money, find new sources of value and simplify how work gets done.

For more information on how Xerox Global Services can apply Lean Six Sigma methodologies to improve your Maintenance and Repair process, contact Paul Backes, MRO Service Line Manager, at Paul.Backes@connect.xerox.com.

**Author: Cheryl Jones-Richter**

Cheryl has held Strategy and Marketing roles with Xerox Global Services and other Xerox divisions for eight years. She has focused on developing and bringing to market solutions and services offerings that streamline *document intensive business processes*™ to improve profitability and reduce costs. Cheryl received her Master’s in Business Administration from the Simon School of Business, and her Bachelor of Science degree from Cornell University.