Electronic Work Instructions Boost Quality, Productivity, & Return on Investment

Manufacturing organizations routinely make justifications for new equipment. A new piece of equipment might eliminate the need for a second shift, making it very easy to evaluate the financial import of the company, for example.

But, how does one determine the ROI for manufacturing software?

Manufacturing engineers often say they have two primary functions: to keep production moving on the floor, and to write and maintain work instructions. They are frustrated that production requires the first 90% of their time and work instructions require the other 90%, posing a mathematical dilemma to meet their primary job functions. Optimizing these important tasks ultimately saves time, but is that sufficient to justify the cost of a new software system?

Companies driven by purpose constantly seek ways to achieve their greatest potential. It is the recognition and realization of the potential of this saved time that ultimately determines the ROI from an electronic work instruction software system. This is the single unifying element that ties our Sequence customers together. Teaching how to make a product right each time is a basic, intrinsic need, but it cannot be the ultimate, higher goal.

This white paper consolidates and catalogs the extended ROI's that have been derived from deploying electronic work instruction packages, such as Sequence. As the path to achieving a higher performance is not the always the same within a given industry, we have generalized specific companies and industries to decouple the ROI from any single industry. Each of the following sections presents a principle behind a specific ROI with a simple summary of how a customer achieved that ROI.

Outsourcing / Supply Chain Management

Manufacturers are constantly faced with resource limitations and are forced to ask the question "What should we not be doing." The solution is often to outsource lower value activities of the manufacturing process. This brings a level of risk due to the loss of control of the manufacturing process as well as from the possible interruptions in the manufacturing supply chain.

This constant evaluation can be found in the lifecycles of many high-tech organizations developing and manufacturing cutting-edge technology for military, defense, threat detection and medical device applications.

Take, for example, the experience of one of the leading manufacturers in the threat detection industry. When introducing new screening capabilities, the core technology is likely the most valuable component of the manufacturing process. However, as the technology matures, the value proposition may change. While the value of the technology itself remains high, its relative value in manufacturing may change as the technology is used in a broader range of products.

At this point, the highest value added activities have shifted to those focused on new configurations and options for deploying the core technology. The electronic work instructions that were initially key to internal manufacturing can now be leveraged to outsource the lower value manufacturing tasks. In this manner, the prime manufacturer still maintains ownership of the manufacturing knowledge. However, now it can readily deploy it to a manufacturing partner greatly reducing the long-term risk and exposure of supply chain interruptions. The prime manufacturer also benefits from freed up manufacturing resources and the subcontractor benefits from moving up a rung in the value of the supply chain.

Reduced Production Cycle Times & New Product Introduction

In many contract manufacturing industries, order-to-delivery time is a key factor to secure a contract. It is also a key performance indicator in retaining customers. Increasing manufacturing velocity to reduce lead times requires shortening the process development cycle -- often with little time for iterative refinement. This is particularly true for companies with high-mix, low volume environments requiring significant amounts of complex manual assembly in highly regulated industries. Electronic work instruction systems streamline communication and collaboration between engineering and manufacturing and greatly reduce the time required to develop, test and build new products.

Another example is found with military electronics contract manufacturing company that must act quickly to change the configuration of any product to accommodate a mission or the physical environment. By moving from a paper-based system to fully -integrated electronic work instructions the company saved 95% in the time to capture, approve and communicate critical changes back to the manufacturing floor. This is a direct result of the ability for manufacturing personnel to communicate feedback directly to engineering regarding needed changes or improvements in the work instructions. Additionally, the ability to validate that personnel have seen and acknowledged the changes decreases the likelihood of a rework, scrap, or non-compliance issue often encountered with the paper-based system. This cycle time reduction is tremendous considering that the organization executes on hundreds of contracts per year.

A semiconductor equipment manufacturer also found that lead times significantly impact the profitability of new technologies. At this organization, it is often necessary to rapidly capture knowledge during accelerated first article builds when visiting a customer. Real-time knowledge capture during this phase all but eliminates the time it takes to author and format work instructions using conventional tools. Closed-loop communication between the shop floor and engineering allows rapid refinement during pre-production runs and shortens the manufacturing ramp-up time by days.

Engineering Capacity Gains

An often overlooked benefit of electronic work instructions is getting engineers off the shop floor and back to engineering. In organizations without an effective work instruction deployment program, engineers are often forced to spend a tremendous amount of time on the shop floor following new products through the build process to ensure product quality and conformity. This comes at a tremendous cost to the company. It shortens valuable time that should be spent engineering the next product – one of the highest value tasks inside a manufacturing company. Electronic work instructions can mitigate this cost by allowing engineers to spend less time on the manufacturing floor and more time designing new products.

Consider the case of a manufacturer of state-of-the-art materials testing systems. For years, its manufacturing was guided by tribal knowledge and direct oversight from engineering staff. This greatly limited its ability to develop new products and maintain its lead in the marketplace. After several unsuccessful attempts to capture manufacturing work instructions using conventional text editors, the organization turned to Sequence. Within months, its entire product line had been documented and the catch-phrase "Sequence-It" was ubiquitous among engineering personnel whenever an issue was encountered in manufacturing. Engineers spent far less time in manufacturing and more of their time performing R&D, allowing the organization to continue to be at the forefront of cutting-edge technology development.

Manufacturing Traceability

In many highly regulated industries, there is no room for error. Manufacturing must be rigorously controlled and tracked to maintain a complete device history record / audit trail for every order. This information is often critical to identify root cause in the event of a device failure. The problem with paper-based systems is that the task of maintaining such complete records is so daunting that it often becomes a significant bottleneck, ultimately limiting the overall manufacturing process.

An example can be found again in the threat detection industry. The rigorous documentation of its manufacturing processes and the deployment of electronic work instructions integrated with their ERP system for up-to-date BoMs have yielded significant benefits and improvements when it comes to traceability.

1. Electronic work instructions allow information to be presented to personnel on the shop floor in a controlled and validated manner. Every work order that is released from the company's ERP system represents a serial number. When a work order is released from ERP, Sequence, for example, ties a specific set of instructions to that work order. The work instructions are accessed on the plant floor by work order number and become the core of a production record book. In fact, the product will not ship without a report from Sequence.

2. Implementing bar code readers to record serial numbers associated with the build greatly reduces the chance for errors when compared the previously handwritten production record books.

3. Tightly integrating with the organization's ERP system allows more efficient change implementation and management. Notifications are automatically sent to appropriate individuals any time a change comes over from ERP.

4. The accountability and traceability from work instructions linked specifically to every serial number track defects back to root cause quicker and more efficiently.

While all of these factors are important in their own right, the net effect is to reduce the chance for errors and device failures.

Redline

While electronic work instruction systems are vital to instruct personnel how to perform a task, there are many instances where staff also need the flexibility to handle on-the-fly, shop floor changes, such as a redline.

One company that relies on electronic shop-floor redlining can be found in the aerospace industry where delivery times, traceability and error-proofing are paramount.

Before employing electronic work instructions, this organization relied on paper-based work instructions. Its redline process involved two engineers with red pens on the shop floor who were authorized to make changes. These manual redlines not only proliferated through work in progress, but also had to be captured and included in future versions of the instructions. While the manual, paper based process worked and prevented manufacturing from stopping, it was far from error-proof. Redline changes were often missed both in the current work in progress on the shop floor and in revisions in engineering.

Electronic work instructions with integrated shop-floor redline capabilities modeling the business process gave the flexibility to make approved changes on the fly without disrupting the production flow. First, the electronic redline provided a permanent record of the change and by whom it was approved. Second, the approved redline could be pushed out to all affected work in progress with appropriate notification to shop floor personnel alerting them to the change. Finally, the redline change was automatically sent back to engineering for future revisions. By closing the communications loop, not only were errors prevented on the shop floor, but new versions of the work instructions would also contain the appropriate changes for future builds.

Shop-floor Integration of Electronic Work Instructions (Mixed Automation and Manual Assembly)

In many state-of-the-art manufacturing environments, product quality and conformity depend on a mix of automation and intricate manual assembly. As expected, the software required to efficiently manage the shop floor operations also takes on a greater degree of complexity and requires components from both a Manufacturing Execution System (MES) platform with integrated electronic work instructions.

Integrating a shop-floor MES with electronic work instructions was accomplished by a computer-controlled emissions exhaust manufacturer industry. It performs a mix of highly-technical tasks in conjunction with integrated tooling, e.g., torque wrenches, micrometers, PLCs. Here, the MES system is the master. It requests the appropriate electronic work instruction for the current step, operation, routing and product while Sequence provides the backbone architecture for authoring and managing the electronic work instructions. The MES system displays the step-by-step instructions for the current assembly task while monitoring the automation input for historical data. Completion of the automation step triggers the next step in the process.

Time Savings

Time savings is the first measure of ROI that is often discussed when it comes to moving to a functionally specific electronic work instruction system. While certainly not irrelevant, it is the resulting effect of these time savings on an organization's top and bottom line that is of key importance.

For example, a military electronics contract manufacturer streamlined its work instruction management process to the extent that they eliminated a position. This resulted in an immediate $60K in savings per year in reduced headcount – also paying for the system in year one. Redeploying staff to other areas often more desirable. Consider

another Sequence customer that manufactures threat detection systems for high-value assets. Due to the critical nature of the performance, the organization maintains very accurate production record books for each system that is shipped. When this company began its search for an electronic work instruction system, it was expending 1.5 - hours during an eight hour shift to manage the paper process required for a complete production record book. This involved manually maintaining the visual instructions, auditing the bills of materials (BoMs) and laminating each document on a daily basis before starting a build. This process not only required considerable resources, but often delayed production. Electronic work instructions helped the company mitigate these issues and allowed the 1.5 person headcount previously tasked with maintaining the production record book to be redeployed to higher value-add areas of the organization contributing to increased output and top-line revenues. Leveraging Sequence and other technology, the company increased productivity to $590k per employee without adding headcount or space.

Additionally, electronic work instructions are a key contributor to the lean process that has allowed them to reduce manufacturing cycle times by nearly two weeks. These contributions have occurred in several ways.

1. Graphical authoring capabilities allowed rapid capture of the organization's core manufacturing knowledge and eliminated the need for an inefficient text editor and third party graphics.

2. It was no longer necessary to manually audit the BoMs before starting a build with the capability to maintain product BoMs up to date with changes from ERP.

3. The time spent gathering and laminating documents each day was no longer necessary.

Wrap-Up

Our goal with this white paper was to consolidate and catalog the extended ROI's that have been derived from deploying an electronic work instructions package, such as Sequence. As highlighted, the specific benefits from such a deployment are often determined by industry, manufacturing style and product complexity. While many of the organizations cited share operational similarities, their ultimate connection is a sincere desire to achieve the highest company values possible and fully realize the ROI from their investments.