4 Steps to Ensure Quality & Process Control Using Digital Work Instructions

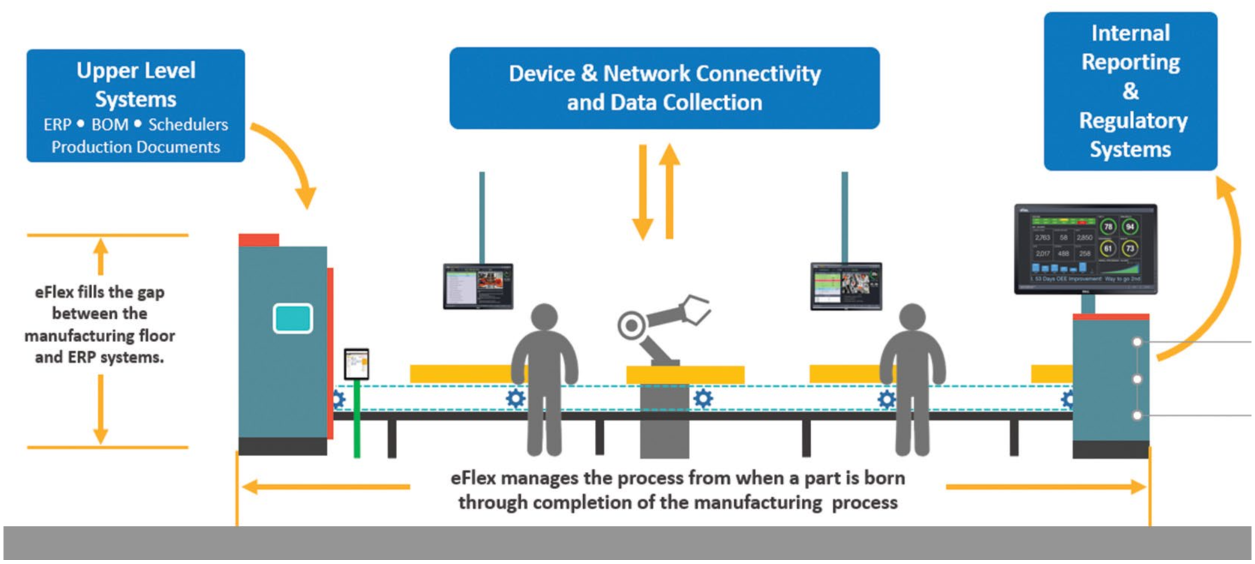
Ensuring high quality is relatively easy when all you have to do is assemble one small product at a very high volume. Such an item will likely be produced on a high-speed automated assembly system. Assuming there are no issues with the incoming parts, the system will consistently produce perfect assemblies all day long.

Maintaining quality gets much more difficult as the number of parts increases, the number of model variants grows, and the amount of manual assembly tasks expands. Program robots to do a job, they will perform that task shift after shift, day after day, week after week. Assign people to do a task, they will invariably make mistakes, no matter how skilled, well-trained or dedicated they might be. People get tired. They get distracted. They forget. To err is human, after all.

Manufacturing managers know that, of course. That's why they implement lean concepts, such as 5S, poka-yoke and standard work. And, that's why they produce detailed work instructions with text, drawings and images. The problem then becomes how to ensure that assemblers actually follow standard procedures and instructions.

Digital work instruction software—like Job Element Monitor (JEM) from eFlex Systems—solves that problem. There are many disadvantages to paper work instructions. They are hard to use. They clutter the workstation. They are often disorganized. There's no way to guarantee assemblers are using the right set of instructions, the most current set of instructions, or, indeed, if they are using the instructions at all.

JEM is scalable, web-based software that provides model- or component-based digital work instructions for a station or individual tasks. As tasks are enabled and completed in real time, the system automatically moves to the next set of instructions and images. At the same time, the software is recording cycle times, monitoring production, verifying adherence to standards, documenting quality, and collecting data for traceability. JEM does more than just provide paperless work instructions; it's a tool for enforcing an assembly process.



JEM can be deployed in any manufacturing environment, whether it's a single-station build process involving a large, complex product, such as a helicopter or a tractor, or a multistation assembly line with a 15-second takt time. It can be used with manual assembly lines or those containing a mix of manual and automated processes. For example, one automotive supplier uses robotic cells to assemble headlights for various vehicles. Some tasks, such as loading and unloading parts, are done manually. Other tasks, such as screwdriving and welding, are done automatically. JEM software ensures that the right tasks are performed on the right parts at the right time in the right way.

JEM software enables manufacturing managers to review, in real time, metrics such as how many products have been assembled, how many have been rejected, and how long a particular task is taking. Because the software is web-based, engineers and managers can view the data on dashboards at any time, from anywhere, on any device with an Internet connection, such as tablets or smartphones.

For higher quality products and a more consistent assembly process, manufacturing engineers need to remember the "four C's": configure, connect, control and collect.

Configure

JEM is configured at the task level, and each task has associated work instructions. Managers can configure tasks and instructions for individual workstations, assembly lines, or an entire factory.

Work instructions are typically displayed on a 24- or 27-inch touch screen monitor at a workstation. Through the screen, assemblers can not only access work instructions, but also quality alerts, material safety data sheets, and personal protective equipment requirements. Custom tabs enable managers to input a variety of materials into the system.

Instructions can also be customized to individual workers. For example, novice assemblers can be given more detailed instructions than more experienced ones. Thus, the best workers on a line aren't losing productive time training newbies.

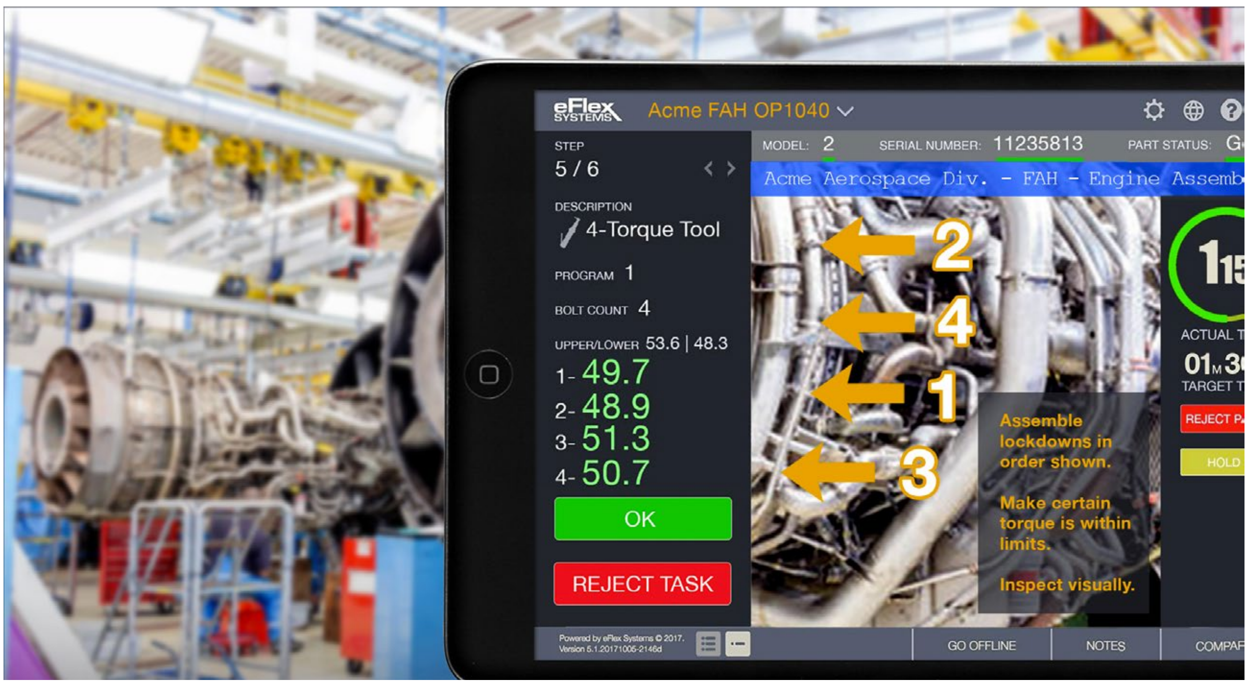
Work instructions can be based on specific products or product families, or they can be based on bills of material (BOM). In the former, instructions are tied to specific products or families of products. In the latter, instructions are tied to specific components and options. BOM-based instructions may be a better option for assembly lines that deal with a particularly large number of product variants.

Manufacturers large and small can benefit from JEM. The software is used by automotive OEMs, as well as small and midsized companies, including manufacturers of hand tools, electrical distribution equipment, faucets and gas valves. The modular, scalable software is licensed by station, rather than the user, so manufacturers only pay for what they need.

The software is intuitive and user-friendly. No coding or scripting is required.

Connect

JEM software can connect with a variety of devices, including configurable I/O, bar code scanners, vision systems, gauges and even cobots. The software can also connect to any fastening tool that supports the Open Protocol interface. The software can enable the tool controller in a configurable sequence, send PSETs, disable the tool with a specific count, store torque and angle data, and record tool faults. The software can also display and capture torque and angle data in association with a serial number. Open Protocol is supported by numerous tool suppliers, including Atlas Copco, Stanley, Cleco and Panasonic.



JEM does not directly control these devices. Rather, it tells them what program to run based on whatever model or variant is being produced. It waits for the hardware to complete the task, and receives any data—an image, a gauge measurement, a torque value, etc.—the hardware might collect.

For example, a manufacturer of medical imaging equipment uses a cobot equipped with a vision system to inspect several parts of a critical subassembly. The robot moves the camera from one inspection location to the next. At each location, the camera takes a picture to verify that the correct part has been installed in the right location in the right orientation.

JEM software coordinates the process and collects and stores all the images. First, JEM tells the robot and camera what product is being inspected, so they know where to move and what to inspect. When the robot moves to the first inspection location, it tells JEM that it's in position, and the software signals the vision system to capture an image. The robot and the vision system communicate with each other through JEM, which greatly simplifies integration.

It’s also worth noting that the quality improvements produced by JEM software enabled the manufacturer to redesign its imaging equipment to reduce costs. Prior to adopting JEM, the manufacturer’s engineers often overdesigned joints assembled with threaded fasteners. Since the fastening process was unreliable, engineers specified extra fasteners as a safety factor. Because JEM can interface with fastening tools and enforce torque and angle requirements for every fastener, engineers could have greater confidence in the integrity of each fastened joint. As a result, engineers were able to redesign one machine to eliminate a whopping two-thirds of the fasteners from the prior design.

Besides hardware, JEM can interface with various upper-level software systems. For example, JEM can link with enterprise resource planning software, such as SAP or Oracle, so orders and BOM data can be accessed. JEM can also provide data to meet the requirements of regulatory agencies, such as the Food and Drug Administration or the Federal Aviation Administration.

Control

One of the biggest benefits of digital work instructions is that assemblers always have the most up-to-date materials. Paper instructions must be routed through approvals, revised and printed. The old instructions must be removed and replaced with the new document at every workstation. With JEM, instructions are linked to tasks and stored in a library. When an instruction is updated, it’s digitally routed to all those who need to review it. Once approved, the instruction is updated automatically at every workstation associated with that task.

An ancillary benefit of converting from paper to digital work instructions is that it gives engineers the opportunity to fine-tune their assembly processes. As engineers input their processes, the software’s task-based architecture tends to reveal steps that are missing, out of order, too vague, or too granular. It’s not uncommon for managers to suddenly realize that their well-established assembly process can be better done in eight steps rather than 25.

JEM software can also be applied beyond the assembly plant. For example, healthcare facilities are using the software to ensure that reusable medical devices are properly cleaned and sterilized. A food manufacturer is using the software to ensure that the correct procedures are followed during product changeovers. And, an electrical utility is using the software to enforce preventive maintenance procedures for wind turbines.

Collect

Another benefit of digital work instruction software is that, as assemblers cycle through tasks, the software can be collecting all sorts of data, including cycle time; process variables (such as torque and angle from a nutrunner); serial numbers or lot codes of parts and subassemblies; and even images from vision systems or digital cameras.

With JEM software, every task has fields that can be configured to capture data. So, for example, as assemblers cycle through a set of instructions, the software can record how long each task took to complete. Such time-study data is invaluable for continuous improvement activities and worker training.

Similarly, if a subassembly, such as an electric motor or power cord, needs to be installed in a product, the operator can scan a serial number on the component or a lot code on a tote prior to completing the task. The software will confirm that the correct component is being installed, and it will marry the serial number or lot code to the end-product. Later, if a quality issue arises with a subassembly, the software can generate a list of every product containing that component.

A supplier of metal assemblies for a tractor manufacturer takes advantage of that capability. Workers perform welding and other tasks to produce the assemblies. When a worker completes a task, he stamps the part with a unique QR code, which is later scanned and archived by the software. Even though the assemblies are subsequently painted—obliterating the QR codes—the supplier still has a record of who did what.

JEM's data collection capability extends beyond numerical values. Images can be collected, too. That can be vital in the event of a recall. With JEM, manufacturers can specify which images they'd like to keep, how many to keep, and for how long.

That capability saved the day for a manufacturer of automotive parts. The company's assembly line was equipped with dozens of inspection cameras, producing thousands of images daily. These images would simply be dumped into a folder, which was fine—until some images were needed later.

JEM solved the problem and ultimately saved the manufacturer thousands of dollars during a recall. JEM's vision module simplifies the task of setting up a vision system. Engineers can set up a standard naming convention for image files (station, date, time, pass, fail) and establish which images to store, how many to store, and for how long. A powerful search tool lets engineers search image files by various criteria.

When engineers realized that the wrong connector had inadvertently been installed in a batch of assemblies, engineers feared they would need to recall 10,000 units. There was no way to know which assemblies had the wrong connector. Fortunately, the wrong connector was visually different from the correct one. Thanks to JEM, engineers could easily sift through archived inspection images and identify which units had the bad connector. In just a few hours, a 10,000-unit problem became only a 600-unit problem.

Other manufacturers rely on JEM's image-storing capabilities as an insurance policy against defect claims. For example, a supplier of center consoles for luxury automobiles captures images of each console prior to shipping it to the OEM. If the OEM later reports that a console arrived damaged, the supplier can retrieve the image as proof that it wasn't. Similarly, another automotive supplier captures images—using a tablet computer—of parts kits as proof that all the components were present when the kits left the building.

Regardless of industry, whether you're a large manufacturer or a small one, whether you assemble a large product in small quantities or a small product in large quantities, your operation can benefit from web-based, digital work instruction software. For more information, call eFlex at 248-651-5979 or visit www.eflexsystems.com.

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