Lessons Learned

Managing Digital Transformation of the Manufacturing Workplace

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Introduction:
Challenges for the "Human Interface"

Technology helps manufacturers make products faster and better, more efficiently. And while it eliminates certain kinds of jobs, it also creates new, more challenging and rewarding jobs. In addition, digital transformation of the manufacturing workplace results in:

- A cleaner, safer shop floor
- Immediate access to a wealth of pertinent information in an easy-to-understand format to make better decisions about processes and performance
- Unprecedented levels of manufacturing precision and accuracy
- Reduced operational downtime and expenses
- Optimized supply chain performance
- Increased job satisfaction
- Enhanced business value of digital transformation for employees, customers, suppliers and other stakeholders.

That said, technology is not a wonder cure. If poorly understood and poorly executed, new technology can cause more problems than the issues it was intended to fix. Atos provides leading Digital Workplace Services that help manufacturers make the best use of existing and new technologies to integrate the production line with shop floor operations at unprecedented levels of agility. Key to this, according to Mike Harm, Global Chief Technology Officer for Workplace at Atos, is a cloud-based architecture where you can customize applications to a broad set of business requirements and still maintain complete control over the manufacturing IT environment with the highest possible levels of security.

Industry Today spoke to some of the leading innovators in implementing digital transformation in the manufacturing workplace. We discuss not only the challenges of new technology adoption and lessons learned, but also effective change management strategies and the critical role of the "human interface."

The Next Industrial Revolution:
The Digital Manufacturing Workplace

Realizing the Promise of the Paperless Office

Since the introduction and widespread adoption of personal computers some forty years ago, we've been hearing about the potential of the paperless office. Thanks in large part to a workforce that's more comfortable looking at their smartphones than paper documents, we're closer than ever to that dream. Still, old habits die hard and some companies are still struggling to run completely paper-free.

According to Mike McGinnis Jr., Professional Engineer and President of Innovative Refrigeration, it's a struggle worth overcoming. "We've finally achieved becoming a paperless company in the last 18 months," he notes. Innovative Refrigeration designs, builds, installs and services customized computer controlled ammonia refrigeration, large tonnage freon and large CO_2 systems for the cold storage and food process markets. And while safety and quality are of course paramount for any manufacturer, it's of particular concern to a maker of large industrial refrigeration units.

"We use software that is sort of like a Facebook to manage safety and quality issues," McGinnis explains. For example, a technician sees a problem during an inspection, takes a picture of it and then posts it on the corresponding page for the site. The picture posting is instantaneous, so there's no delay in filing a paper report. Plus, notification is also instantaneous, again without delay of paper filing. Reporting an incident can be completed with as little as two taps. Managers are updated instantly of problems and the resolution to those problems. It not only makes compliance and recordkeeping easier, it drives continuous improvement because you've empowered employees to capture issues and take action quickly, easily and without having to fill out a lot of forms.

Key to an effective paperless office is the use of alarms to indicate steps that need to be done, or should have been done. "The problem with a paper system is that when someone doesn't do what they were supposed to do, months can go by before anyone knows there's a problem," he says. "When everything is automated, you get an immediate alarm that something that was supposed to happen, didn't, and you can correct that so it doesn't create unnecessary complications later on. We're much more efficient using a paperless system."

He adds, "With an organization as large as GE Aviation, you can imagine that we have a lot of data to collect. We're just beginning to figure out what we need to do with the data. And as we continue to collect more data, there's more work to build even further on what we already know. Actually, it's impressive that as a big company we've come as far as we have—this is a much easier task for smaller businesses."

Innovative Refrigeration employees use either iPads or smartphones to perform their day-to-day field work as well as to track their time. This not only makes it easier for the company as a whole to manage its employees, but it also provides better connections among employees. No one is left wondering what might be going on if that information is almost instantly accessible literally at your fingertips on a handheld device. Engaging employees through more efficient communications channels not only improves productivity, but job satisfaction.

In addition, the efficiencies of a digital workplace can cut weeks off the traditional and usually uninteresting onboarding process, including getting the right devices in the hands of the right people. Less "hoops" to step through not only gets people working faster, it makes employees happier spending more time doing what they were hired to do instead of tedious administrative tasks. Given the current low unemployment rate and competition to find talent with the necessary skills sets, higher job satisfaction means higher retention rates, which means not only having the people you need to serve your customers, but reduced hiring and training expenses.

Optimizing Shop Operations

While the transformation to paperless office functions benefits any business, manufacturing stands to gain much greater efficiencies by implementing a digital workplace. "Our Brilliant Factory suite of digital tools helps us determine how to better run and optimize shop operations," says Michael Meguiar, executive plant manager for GE Aviation. Adds Kellem, GE Aviation's senior manager of digital operations, "The basic idea is to push relevant data to the appropriate decision makers. In particular, you want to collect data that makes your machines smarter."

Which isn't to say that you can make the machines think for themselves (we'll get to the related idea of artificial intelligence below). Rather, Kellem explains, "You collect data for six months to determine an optimum maintenance interval. Then you look at newer 'chatter' to see if there are exceptions to what you decided. The more historical data you can collect, the more sophisticated your decisions as to how the machine should be performing, as well as what kind of data you need to look at."

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Harm notes that, "The Atos Digital Workplace offers a 'one enrollment fits all' interface, with a very tailored set of configurations and personas behind it to meet the needs of individual business units, countries, or legal entities within a given enterprise. We know that the shop floor is a different world entirely from the design studio, and the HR or procurement offices are different still. We work with our clients to create bespoke solutions for them all, without making separate or high-complexity investments to deliver that differentiation."

Not Just for Robots

Speaking of machines, it's important to point out that their importance hardly devalues the importance of human operators. Just the opposite, in fact. "People tend to think of manufacturing automation as robots, or as robots replacing people," says John Boyd, CEO and founder of Augusta Fiberglass. "But you are always going to need people to run a machine that helps automate a process, and do that process better and faster."

Also, as Robert Wu, vice president of controls and information systems for Subaru of America points out, "Automation takes up space, and you want an assembly line to be as compact as possible. So, we need to look at where it's most appropriate to introduce automation, which is usually highly repetitive functions that require high accuracy. But when it comes to final assembly, human touch is still essential."

"You can't just rely on a computer, or just push a button and expect everything to work," Boyd says. "We make some of the largest fiberglass vessels up to 119 feet in diameter and 65 feet long. The key to making these vessels is winding fiberglass yarn in layers at certain angles on a mandrel, which is then sprayed with resin. It's a very sophisticated process that is as much an art as it is a science."

Some computerization of the winding process has its role to play, particularly the ability to make product in the field instead of the shop. According to Boyd, "Technology provides the ability not only to manufacture vessels at customer locations, but also to move them thanks to the use of a computerized technique in place of cranes. The reduction in transportation costs alone is of immense benefit to our customers."

Boyd adds that deploying a digital workplace "allows us to track production from design to delivery, so we know exactly what stage a project is in and respond to any issues immediately. We're a vertically integrated company, so we already have more direct control of our supply chain, but automation is a much more effective way to manage scheduling."

AI and IoT: Helping, Not Taking Over

While the importance of human perception and experience can always perform sophisticated tasks well beyond the ken of mere machines, emerging trends in artificial intelligence (AI) and the Internet of Things (IoT) are making them, in a sense, craftier than mere robots performing repetitive tasks. Even if, as Kellem points out, "AI and IoT are buzzwords that not everyone is quite sure what they mean."

Generally speaking, though, AI is software that equips a machine with rudimentary decision-making capability. A robot can't "think"—at least not yet—in the ways people can, but it can process basic "if..then" kinds of situations and act accordingly. Consequently, the machine can perform more operations simultaneously without need of human intervention. "AI increases the ability for a human operator to run four machines at a time instead of one," Kellem explains. "So, both the human operator and the machines are running more efficiently with less downtime."

An added benefit of less downtime besides improving throughput is increased job engagement and satisfaction. "The operator spends much less time sitting around waiting for another process to complete, which is fairly typical of one operator per machine. So there's fewer boring stretches of just having to stand around doing nothing," Kellem explains.

He also disputes the popular conception of AI as somehow replacing human beings. "The goal of AI is to help people make better decisions, not replace the people making decisions," Kellem says. "Let's look at an example from another industry. In radiology, you have people who are considered experts at reading X-rays accurately 98 percent of the time, while others with some experience might only be accurate 60 percent of the time. And now you bring in AI software that is rated at 94 percent accuracy. That doesn't mean you fire the junior people with less experience. It means that when less experienced people read an X-ray, they verify their findings against the AI. If there are some discrepancies, then they elevate to the experts to review."

He adds, "Remember that the experts are more accurate readers than the software. So the role of AI is to help junior people make better decisions—i.e., identify discrepancies that could be possible errors—as they gain more experience. Meanwhile, you're making the best use of experts' time by bringing them only the cases where a misread is most likely."

For the most part, though, AI is still an emergent technology. Wu notes that, "At Subaru we're collecting business intelligence that we can use to make predictive analyses. It's not strictly AI, but it has the same goal—to make better decisions, faster."

Not Quite There Yet

According to an RT Insights study, "The most transformative technology on the digital manufacturing scene is the Internet of Things (IoT)...the use of sensors in production equipment (such as robots, stampers, actuators, 3D printers, computer numerical control (CNC) machines, etc.)...to enable a real-time flow of information about the operations status and conditions of the equipment of product."

Enrolling machines in the same device management services used by your workers ensures they, too, are always current with the latest security and software updates. And it brings their data into the same ecosystem for mobile access or collection in an industrial analytics system.

In the Atos Digital Workplace, data from machine sensors is managed by an open, secure, cloud-based IoT operating system, such as Siemens MindSphere, that reports on the overall health of your assets. The data is stored in a cloud-based database such as SAP HANA, or another scalable, pay-as-you-go service such as Amazon Web Services or Microsoft Azure. Atos provides our Codex analytics application, which uses predictive modeling to give you the truest, most complete picture of current and future operational performance. Insights into performance are communicated to management through their connected mobile apps to take appropriate actions to:

- Prevent key equipment failures
- Maximize equipment performance
- Improve yields and quality.

While that sounds promising, IoT is currently a work in progress. "We're still at the early stage of IoT," Wu says. "But we're trying to get there as fast as we can."

GE Aviation's SWOT (Standard Work Optimization Tool), an in-house custom developed software is an example of the promise of IoT. "According to Meguiar, "SWOT evaluates how an operator performs multiple tasks. We have connectivity with all the machines in the shop so the software can measure yield, throughput and overall productivity for all our shop operations. It helps us determine what is the right segue of operations to attain the highest throughput. You get a lot more insight into parts cycle time, outside supplier turnaround time, operational efficiency and quality."

As with any innovation, however, there are some problems. "One issue is that newer machines are outfitted with IoT capabilities, while older machines aren't. Then you have different adoption rates among departments with different processes," Kellem points out. "And then once we finally do get everything connected, there's the larger question of what kinds of data are we looking for and how can we act on it."

Nor is this just an issue with implementing IoT on the shop floor. To achieve a fully functional digital workplace also requires integrating larger corporate systems, which frequently involves dealing with legacy components.

"We need to develop smarter algorithms as we connect disparate ERP systems with the shop floor, update legacy systems and finally get everything working together," Kellem says. "The issue for a company as big as GE Aviation is that there is no one-size fits all solution. What works for one building may not work in another. A low-volume, high-efficiency operation has different needs than a high-volume, low-variable operation. We need to start out to build modules that address specific needs and then somehow bring all these modules together to develop an enterprise-wide system."

Wu agrees. "Subaru is a global company making cars using a common platform. Still, what works in one plant may not apply to three or four others. Sometimes we have to make compromises or adapt our processes so that we are compliant with Subaru's global platform that we wouldn't necessarily do if we were operating just on our own."

Kellem suggests that a company take a close look at what kind of automation software is best developed in-house and what can be more easily be obtained from a third-party vendor. "There's no need reinvent the wheel," Kellem says, "Focus on what you know and are doing on the factory floor, then rely on strategic partners with more generic systems where they have the established expertise.

One area where bringing disparate devices together seamlessly in the digital workplace is the BYOD trend—bring your own device. IT departments used to be very strict about what kinds of devices they would maintain. The problem was that people preferred other kinds of devices and people tend to be more productive using what they are most comfortable with. In addition, it's not just the users who had differing requirements. Many lines of business wanted form factors that more closely mapped to the type of work being performed. The traditional laptop/desktop/mobile phone issued by IT didn't always accomplish the tasks efficiently. The Atos Digital Workplace is device agnostic, while at the same time highly secure. This is accomplished by removing dependencies on things like standard images and model-specific builds. "Our UEM and MDM platforms remove this requirement, opening up the device form factor floodgates, while allowing IT to continue to deliver consistency of experience and security. Choice is the new value proposition," Harm points out.

Devices are one thing, however, big systems another. Subaru of America recently transformed from a mainframe environment to a microprocessor-based environment. "The technology allows for more scalability and flexibility," Wu points out. "Even if it weren't for the fact that it is getting harder these days to find people still conversant with mainframe operations."

Introducing such a new system does present some cultural acclimation. "What we're doing contradicts Japanese business philosophy that very much depends on hands-on management of the manufacturing floor to make evaluations, as opposed to machines telling management what to do," Wu notes.

Harm points out that, "Educating employees on the proper use of applications is key; an educated user means less reliance on support calls to try to figure things out. Which means more time is spent on actually working, as opposed to figuring out how to do the work."

Keep it Simple

As you might expect, transitioning to any new way of doing work is going to create some issues. "The problem is our skill sets don't ramp up as fast as our technologies," Wu says. "This is particularly an issue for maintenance workers, who don't necessarily have an IT background but in a digital workplace are being called upon to address IT issues. So, we need to do more training, and we need to hire more data analysts and data architects to figure out what to do with all this information we're collecting."

On the shop floor he notes, "Automation is complicated, and too much complication can be a problem. This is particularly true in an assembly line that depends on completion of sequential activities. If you make the process too complex, a breakdown in one step affects everything further down the line."

As Tesla's Elon Musk has said, "Excessive automation was a mistake."

It's also wise to introduce new digital practices gradually. "Don't try to do everything all at once. It's a process," McGinnis emphasizes. "Once you've got the process in place, it's like you have a recipe book and you just look to improve the recipe's repeatability and reliability,"

McGinnis maintains that, "Success is tied to a logical roll out of a single piece of your system every quarter. You might start with a clocking in and out procedure, then next quarter work on reporting, and then maybe implementing standard operating procedures next."

Also, he adds, "Proper set up of apps is key. You don't want anyone to have to perform more than two or three keystrokes to complete a task. The whole idea is to make things easier, not more complicated."

Seeing is Believing

According to Information Age, the amount of digital content will in 2020 will "increase to 44 trillion gigabytes, yet most companies are still incapable of dealing with the flow of information across their extended enterprise. Kellem points out that at GE Aviation, "We're three to four years away from optimizing data we're collecting now."

Key to improving effective sifting of relevant information is the visualization of data, Meguiar says. For most people, the graphical display of data is much easier to comprehend than spreadsheets or text-based reports. Plus, it's a "universal language" that anyone in any department at any skill level from any country or culture can read and grasp difficult concepts or identify patterns. An additional benefit is you can easily perform "if/what" scenarios simply by adjusting a reading and immediately seeing a probably result.

> **"Some truths can only be expressed to a certain extent in tables and plain text. Color and shapes can convey urgency and impact in ways that cannot be expressed on a spreadsheet nor a written word. With dashboards and data visualization, we can better understand the relationship between numbers, the things they represent, and our Key Performance Indicators,"** Harm says.

For the same reasons, graphical visualization can also improve training and documentation. "Systems are updated more frequently than their documentation," Kellem notes. The peril there is people wasting time trying to figure out a process or task when their documentation should be readily available to explain it using simple interactive steps. Which is why the digital workplace can potentially provide much more efficient training and documentation.

The Digital Workplace is a completely different IT/business relationship, one that enables improved user interfaces with devices fit for specific purposes," Harm says. "IT and business units are no longer butting heads in pursuing sometimes conflicting agendas. The Digital Workplace removes the limits and complications that have historically hindered the effectiveness of technology implementations by personalizing the work experience in ways that are truly relevant to getting the job done, resulting in improved and more efficient products, services and work experiences."

The Future is Here

The current trend of manufacturing automation connecting machines and workers is often referred to as Industry 4.0, meaning the fourth industrial revolution (following mechanization and water/steam power, mass production and electricity, and initial computerization). By the end of this decade, human-machine collaborative environments in manufacturing are likely to be commonplace. Unquestionably, the digital workplace in manufacturing has arrived. As we've seen in talking to just a few executives in the front line of this transformation, while there are challenges to surmount, the results are truly transformational. With an Atos Digital Workplace implementation, manufacturers have an affordable solution to modernize and integrate disparate operations to connect, communicate and collaborate in productive ways that meet both their individual needs and preferences, as well as the overall needs of the enterprise. The Digital Workplace helps manufacturers build the factory of the future.

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For More Information

Try it for yourself. A proof of concept will show you how connecting your enterprise would really work. For more information about connecting the manufacturing enterprise through Digital Workplace, visit

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