MANUFACTURING TECHNOLOGY INSIGHTS

Published in: https://machine-vision.manufacturingtechnologyinsights.com/cioviewpoint/my-path-to-world-class-manufacturing-nwid-217.html

My Path to World Class Manufacturing

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When I started my career in information technology 30 years ago, I was lucky to win a position with a global manufacturing giant—one of the largest automotive OEMs in the world. That experience opened my eyes to the advantages that world-class manufacturing can bring to a business and showed me great examples of ***advanced automation and robotics***—the first generation of computer-controlled manufacturing.

I brought my experience to Silicon Valley in the 1990s, where I applied those lessons to a series of early-stage companies in the semiconductor and advanced electronics market.

One of the primary drivers of our adoption of advanced automation was the increasing complexity of the products we were designing and the accompanying complexities in the manufacturing operations and processes required to build these products. That basic rule continued after I joined Sanmina Corporation in 1997; the more complex products we designed and manufactured, the more sophisticated our manufacturing processes had to be.

At Sanmina, a company that focuses on complex electronic assemblies, the off-the-shelf manufacturing software worked for us for a while. As Sanmina grew along with the ***Electronics Manufacturing Services (EMS) market***, our requirements began to outstrip the ***Manufacturing Execution Systems*** (MES) that were available. That growth worked in another way as well: Sanmina acquired several companies and manufacturing facilities in a relatively short span of time, bringing exposure to (and headaches from) scores of incompatible MES platforms. My team and I learnt lessons from each of those systems. What architecture worked for our needs? What provided the best flexibility? The most robust platform? And what operations could be automated and tracked?

At first, companies created systems that were "islands" of automation focused on specific functions within a factory. With time, these islands needed connections to each other, to equipment and corporate systems; the complexity, costs, and the risk grew very rapidly with systems becoming very difficult to manage and even more difficult to change.

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In 2001, Sanmina acquired SCI Corporation, another EMS leader. SCI had charted a different course with manufacturing software; they had developed their own advanced MES platform to support their manufacturing operations. That was an eye-opener. The power and flexibility of that platform was far beyond anything we had seen in the commercial market at that time.

Fast forward to a few years ago: in the early 2010s, we saw a new wave of automation coming, the first inklings of Industry 4.0. At the same time, our customers were designing incredibly sophisticated products that required increasing levels of quality and productivity, and demanded a level of advanced automation beyond any production environments we had seen at that time. There were the constant financial pressures to lower the total cost of ownership of our systems and increase margins from our manufacturing operations.

We knew that the requirements we developed at that time were going to be very difficult to achieve.

- Support for IoT and advanced automation, including easy integration with robotic systems, manufacturing and test equipment.

- Ability to make changes easily and quickly. E.g., making changes to a multi-step process routing had to be achieved in minutes rather than the hours or days that were typical.

- Easy integration with PLM and ERP systems, so that shop orders, Engineering Change Requests (ECRs) and work instructions were instantly communicated to the plant floor to ensure that no operator would ever be working from old information.

- Advanced labeling: I can't stress enough the importance of strong labeling features for us given the incredible complexity in our Bills of Material, which might contain hundreds or thousands of components, sub-assemblies, and allowable substitutions. We had to support labeling for multi-level BOMS, for configure-to-order systems, and multi-part assemblies, as well as stringent placement accuracy for finished products.

- Recipe management: More and more customers require personalization and product lot sizes of 1 for highly complex equipment that is sometimes combined with high-velocity manufacturing. Production based on recipes and automation is essential success factors to deliver this today and moving forward.
- Portability: If Sanmina is building the same product in the three different factories around the world, we wanted everything to be immediately portable— the process routings, the labeling, everything.

- Controls: The ability to apply different levels of controls to automated line stops is essential for many of our customers in regulated industries.

- Scale up and scale down due to business volatility.

- Increasing volume of data from test automation.

- End to end genealogy and traceability management: Customer requirements are evolving to connect field install performance back to the factory to enable full traceability and genealogy at all times.

Note, too, that the complexity of products and processes I mentioned above is especially true for EMS companies, who are tightly integrated into customers' production and operations.

We realized quickly that a cloud-based, advanced manufacturing platform was our only way forward. Moving to the cloud would give us a common, shared operating environment that would cover the majority of the requirements, plus give us flexibility internally and externally.

Happily, we found a cloud-based MES platform that actually met our needs. That system, ***42Q***, has become our corporate standard for plants around the world.

One important note here: decisions about technology are often made based on technical requirements and the people in the manufacturing environment are left out. Our decision to embrace a cloud MES platform was made with the realization that it must work well with our manufacturing operations and processes as well as the people who utilize the W software and who design and run those processes. That should be an absolute requirement for every manufacturing software decision made.

Again, this requirement is especially true for ***EMS providers,*** who have sophisticated integration and collaboration requirements that often presage what other manufacturers will experience in the next few years.

What results have we seen from this adoption of the cloud-based MES platform? Many of them are at the production level: less rework or waste, for example. And at the highest level, we how have industry-leading productivity efficiencies. We've seen improvements that average almost 20 percent. Now our employees manage their work with our ***MES solution***, rather than wrestling with systems that weren't designed for their current requirements.

We've also seen quality improvements across the board. Virtually everything gets measured now, and as we all know, what gets measured gets managed (and improved). There's less paper, no waiting for engineers to download data and "message" it to get the reports we need. Everything is right at our fingertips. Our people have the right data in the right format at the right time, so they can make better and timely decisions.

For our customers, the new system means they have visibility into data that they need to run their business and that data is up to the minute. Test data, product data, process and production activity are all readily available and up to date. That makes for happy customers.

And that's the mark of true success.