SANMINA

The ROI of Digital Factories

What you get when you connect 25,000 pieces of manufacturing equipment to the cloud

By Gelston Howell, Senior Vice President, Sanmina Corporation.

Published in http://online.fliphtml5.com/kwnhb/jrrw/#p=4, November 2017

Sanmina recently reached a major Industry 4.0 milestone when they surpassed 25,000 pieces of manufacturing equipment connected to its cloud manufacturing execution system (MES).

Their cloud based MES system provides real-time manufacturing visibility, process and quality control across their operations and a backbone for "instant IOT" (Internet of Things) and manufacturing automation initiatives. Sanmina's equipment is connected to their cloud based MES in more than 50 factories in 15 countries worldwide, including full integration with highly complex surface mount production (SMT) and fully automated production lines.

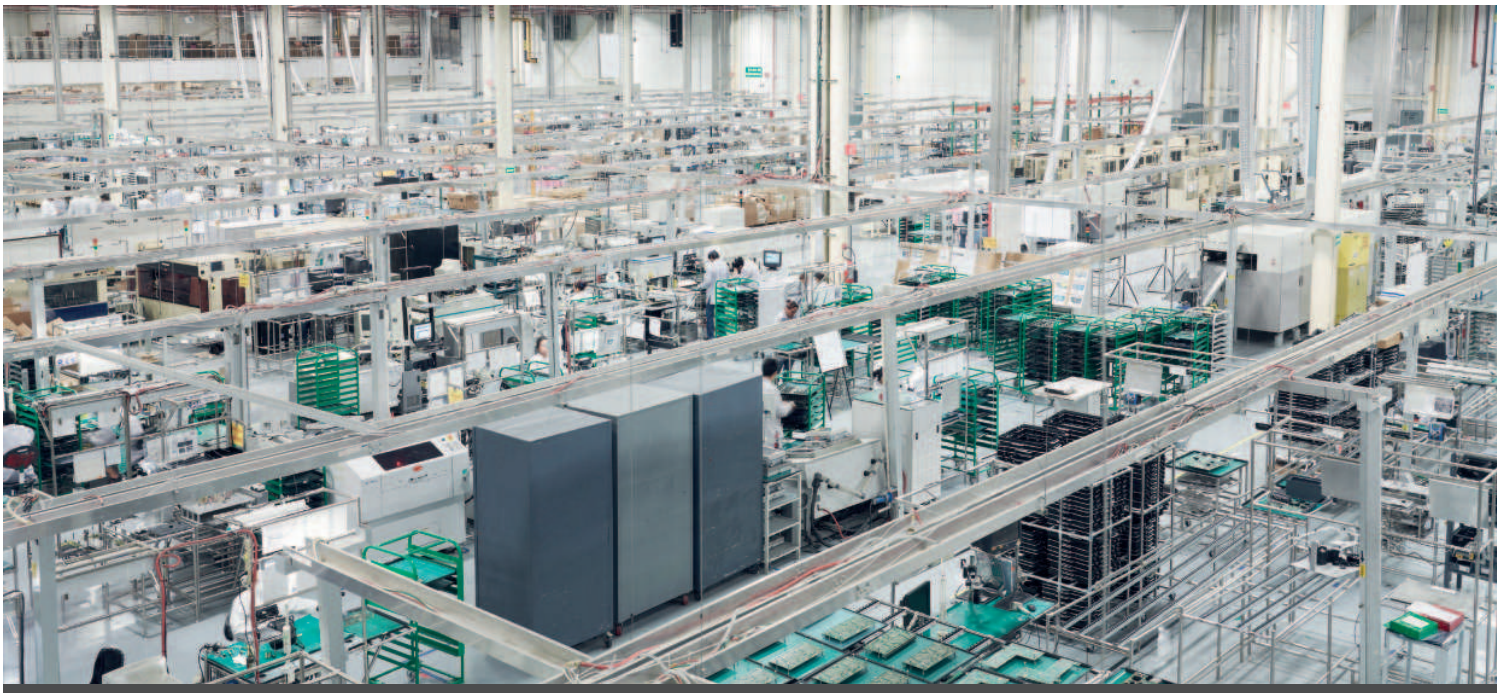
Industry 4.0 and the Industrial Internet of Things (IIoT) initiatives are central to digital factory transformation and provide a framework for linking production, automation and analytics. The convergence of low-cost storage and sensors, powerful artificial intelligence and analytics, widespread adoption of cloud computing, promises an intelligent interaction of the real and virtual worlds – with huge impact for global supply chains and manufacturing. However, many are asking if these initiatives are real, gaining traction, or just hype. Furthermore, people often ask what the value or ROI (return on investment) is of these initiatives, and if they are being embraced and advanced by leading companies. The results achieved with more than 25,000 pieces of equipment connected to the cloud are proof that the combination of the cloud and IIoT significantly improve global supply chain visibility, real time production control and operating efficiency.

For example, in hundreds of production lines around the world, WIP (work in process), production rates and yields are monitored by Sanmina's MES in real-time. Real-time text alerts are sent to production staff automatically when key business indicators fall below a programmed threshold. For some production lines, raw material levels are continuously monitored, and guided vehicles deliver components from automated warehouses to replenish workstations. Alerts are automatically sent to production staff to be at that workstation when the guided vehicle arrives.

Connecting its equipment to the cloud has enabled real time, M2M (machine to machine) communication for a significant portion of Sanmina's manufacturing equipment. This M2M communication, along with relatively simple real time analytics delivers on the promises of Industry 4.0; tangible ROI, higher product quality and manufacturing efficiency. The two examples below describe how machine to cloud connectivity and interoperability were used to increase SMT machine uptime and implement real-time inventory management.

Guided Vehicles Connected with MES Provides Real Factory ROI

Virtually every key performance indicator (KPI) used to measure manufacturing effectiveness is adversely



affected by downtime. Equipment utilization and cost metrics are particularly vulnerable.

A factory running dozens of high-speed surface mount technology (SMT) lines can produce tens of thousands of PCBAs per hour. One of the most common obstacles to running machines continuously is stock out — one or more reels of surface mount components being depleted without a replacement reel being immediately available. A stock out on the SMT line triggers immediate downtime, resulting in lower line utilization. A typical SMT line costs five million dollars. In a factory with dozens of these lines, downtime results in significant financial impact — and an opportunity for cost avoidance.

A closed loop system was implemented to ensure components are available as required by SMT machines. A cloud-based MES solution, machine-to-machine and machine-to-human communication enabled the innovative approach.

SMT machines provide a supply and usage status of all components loaded on the machine. When a component needs to be replenished, the machine automatically sends a signal to the manufacturing execution system (MES). The MES forwards a replenishment order to the warehouse picking system. The warehouse system prioritizes the pick, an operator locates the component in the warehouse (or in some factories, an automated warehouse system provides the proper reel) and triggers the replenishment procedure in the inventory management system. The component is then placed at a collection station and an autonomous robotic vehicle collects and transports it to the SMT line where it is needed.

In the past, special tracks would have been laid in the factory floor allowing the autonomous guided vehicle to navigate its route through the factory. Today this is accomplished using cloud-based navigation, making the system much more flexible and allowing re-configuration of the facility as business needs change. When the robotic vehicle leaves the stockroom, a text alert is sent to a technician, so he or she is ready at the SMT line to load the material when the guided vehicle delivers the reel of components to the line.

Optimizing Production Line Uptime with Cloud Enabled Automatic Backflush

The impact of inaccurate or delayed inventory transactions in a large factory can be enormous. Picture a factory with 25 SMT lines, 1,000 employees and 5,000 components located on the manufacturing floor at any point in time. Components are transacted from the warehouse to the production floor and are visible in the MRP (Materials Requirements Planning) system. Physically the components are built into printed board assemblies at a rate of hundreds of thousands per hour on each SMT line. However, a transaction needs to be completed in the MRP to reflect the reduction in component quantities and the increase in finished printed circuit board assemblies. Delays or errors in completing the transactions will result in production planners believing that hundreds of thousands of components are available on the production floor when they have actually been consumed. This can result in dozens of production operators idled for the day and production lines stopped because production planners don't have real-time inventory numbers. Connected production lines can avoid this situation.

In a traditional SMT manufacturing enterprise, production floor supervisors physically manage components, work-in-process and finished sub-assemblies. The material requirements planning system (MRP) provides the data about quantity and location of components, WIP and finished sub-assemblies needed by production planners, component buyers and customer service personnel.

Production personnel monitor and complete transactions as the MRP system "consumes" or reduces inventory at discreet points in a manufacturing process. In a batch manufacturing environment, components are issued to production and are consumed as products are manufactured. The warehouse operators provide individual components to the production team for specific work orders. As the work order progresses through the sub-assembly build, the production planners consume the components and integrate their value into the built subassemblies and finished products. The entire process is dependent upon the input of a significant number of people, resulting in potential data entry delays and errors.

As the production process consumes components, an operator, supervisor, or scheduler has to "consume" them in the online MRP system. This consumption is part of a process called "back flushing." It is a critical step in the management of inventory and in the conversion of component value and labor value into the price of the finished product. Production and materials teams depend on this information to manage the production and material supply process. The roadblock caused by these "back flush" transactions has to do with timing – frequently delayed, because of the number of people involved in the transactions. A factory with 25 production lines and a thousand employees makes communications complex. A common and significant problem is that production schedulers and planners may think they have enough components to meet production schedules that day, but they are looking at "pre-backflush" data.

By incorporating Industry 4.0 concepts and technologies, Sanmina's factories have automated most of these back flushing operations, moving to a real-time data consumption and reporting model. Under the new system, when the product (e.g. a printed circuit board assembly or PCBA) completes automatic optical inspection (AOI), the AOI machine sends its serial number to the MRP for immediate back flushing. Manual communication from the shop floor to the planner is eliminated along with the associated delay and inevitable human errors. The new system has turned a manual, reactive system dependent on effective human communication to an automated, predictive system with real-time accuracy.

These are just two examples of how a connected factory delivers quantifiable results in terms of equipment utilization, efficiency and real-time control. Real-time text alerts sent to technicians when manufacturing equipment requires intervention is another example. In medical, automotive and aerospace industries regulatory requirements are automated by the connectivity of over 25,000 devices to the cloud creating a virtual factory. Managing traceability, bill of material compliance and process compliance are further examples. The key factor in achieving these results was the intelligent application of Industry 4.0 and IIoT technologies to connect thousands of pieces of manufacturing equipment in the cloud, enabling machine-to-machine, machine-to-cloud and machine-to-human communication.

This cloud enabled, machine to machine communication "unlocks" manufacturing and materials data, and makes this data accessible to other machines and systems, such as the MRP or warehouse management systems, in real time. In the past, a planner, manufacturing engineer or warehouse personnel would have to look at the data from one machine then take action with another machine or system. With the machines connected in the cloud in real time, relatively simple analytics can make decisions in real time, avoiding delays and unnecessary costs. The guided vehicle implementation discussed above is a good example of machine to machine communication with simple analytics that resulted in substantial cost avoidance. This and many other implementations provide proof that some forward thinking companies embracing Industry4.0, IIoT and the digital factory have achieved substantial ROI.

www.sanmina.com

> "By incorporating Industry 4.0 concepts and technologies, Sanmina's factories have automated most of these back flushing operations, moving to a real-time data consumption and reporting model"

SANMINA

Sanmina is a Global Electronic Manufacturing Services Provider with 75 Locations Worldwide

TIME TO MARKET.

SUPPLY CHAIN SIMPLIFICATION.

Sanmina's advanced supply chain management systems, global footprint and complete services enable the worlds most innovative companies to launch, manufacture and get their high technology products to market faster.

Learn more at: www.sanmina.com