The impact of the digital factory on design and engineering

Engineering Specifier

by: Gelston Howell, Senior Vice President of Marketing

Published in:
www.engineeringspecifier.com/around-the-industry/the-impact-of-the-digital-factory-on-design-and-engineering-1

Data is the driving force for design decisions, product performance analysis and life cycle management. Design engineers are data driven for initial design, prototyping, new product introduction and continuous product improvement.

However, the data required is often distributed among different design, manufacturing and field organisations and can reside in isolated databases, test equipment and field performance records. Accessing all of this data is a slow and inefficient process.

The premise of the digital factory, Industry 4.0 and IIoT is to connect manufacturing machines and test equipment in cyber physical systems to consolidate data from individual equipment into a cloud-based digital factory.

The question is, with this connectivity, what value can be derived and does this connectivity benefit product designers. Sanmina has connected 25,000 pieces of manufacturing equipment in 60 factories worldwide to our cloud based Manufacturing Execution System (MES) and learned a lot in the process.

What we have learnt:

Having factory and test equipment connected in the cloud enables real time access to manufacturing data from production locations around the world, for both real time process control and ongoing process analysis. Some of this real time and aggregate data available from production is of great value to design engineers.

Design decisions, especially during the prototype and pilot phases are made with much greater confidence with complete access to comprehensive product performance, test and life time history data:

- A cabled or wireless connection to the device is essential to test and calibrate the product during manufacturing. In a digital factory, the manufacturing data and the results of parametric tests can be stored in the cloud MES for easy access by everyone involved. The cloud MES provides a large central location for this data, which can be accessed in real time not only to analyse the history of one device but also to review the aggregate performance of huge volumes of products.
- The manufacturing process is only one phase of a product's life. Products often remain in operational service for many years. During this time they are no longer connected to the digital factory. Storing product performance history, the results of tests and failure modes on the device itself provides visibility to how the device has performed during its operational life in the field as well as during manufacturing.
- Serial numbers, part numbers and date codes are a fundamental part of the product traceability record. These are used during manufacture and throughout a product's life cycle to uniquely identify the product. Integrating a 2D barcode in the design is a key enabler to efficient traceability.

Manufacturing speed and data integrity: use an ANSI MH 10.8.2 compliant 2D barcode

When manufacturing at volumes as high as 20 million devices per year, speed and accuracy of data capture are critical. Some digital factories have adopted the use of ANSI compliant 2D barcodes which save manufacturing time and guarantee data accuracy.

Traditionally, serialised sub-assemblies such as printed circuit board assemblies have at least two barcode labels. Scanning each barcode label takes time and mistake proofing is required to ensure that the data is read into the correct field in the data base. Assuming a scan time of one second and three barcodes on each product means that nearly 700 days of time will be consumed scanning product data for a product produced at the rate of 20 million devices a year.

- A 2D barcode can store multiple fields that can be read in one scan. Aligning a scanner to read a 2D barcode is much simpler than scanning a linear barcode. By adopting the ANSI MH 10.8.2 standard each field is prefixed by a data field identifier (DFI). The part number, serial number and any other data fields each have a coded prefix indicating what data type the field contains. This eliminates the possibility for errors to occur in data entry. We also learned there is an additional benefit in reduced cycle time. A 2D barcode containing multiple data fields can be read in one scan. This leads to significant time saving particularly for high-volume manufacturing.

Include test data in the system memory map to provide field and manufacturing data

Part of the architecture of any product design that includes a processor is a system memory map. This map defines the address assigned to components including the EEPROM, RAM and input output devices.

Within the EEPROM and RAM locations are assigned for use by different software. The boot code, operating system and various applications all need to know where they can access software and data stored permanently in the EEPROM and what locations in RAM they can use during operation.

What we have learnt:

- Storing the results of manufacturing and test processes in a cloud-based digital factory helps design engineers access data collected during manufacturing more quickly, however it does not provide access to data collected during the operation life of the product in the field.
- A malfunctioning system returned from the field requires a comprehensive failure analysis. An engineer analysing the failure needs information about how the device failed as well as the device's history. Accessing the history of the device during manufacturing and testing often requires the engineer to ask the supplier quality engineer to contact the manufacturer and ask for the test history for the specific product. The failure analysis process is made much simpler when the engineer has instant access anywhere in the world to the test results and parametric data recorded during manufacturing. With a digital factory and cloud connectivity, a design engineer in San Jose can access real time test and parametric data from factories in China, Mexico, the US or Europe.
- However, the engineer still requires data which will provide vital information about the operational performance of the product and its failure mode. Including a space in the system memory map is one way to provide this information in a timely manner and store it on the device itself.

The connectivity offered by the digital factory has created the ability to consolidate manufacturing and test data and make it available in real time, anywhere in the world.

This capability saves time, but also provides much more complete and comprehensive data to design engineers. By considering the technical needs of the manufacturing process and including design elements to record data on the device, design engineers can also gain visibility to lifetime product performance data.