What would Henry Ford say?

Dell's pioneering build-to-order manufacturing model continues its transformative ways, improving a key quality metric by 34 percent with Internet of Things analytics on its global production lines

Technology | United States

Business needs

Dell factories perform random end-of-the-line quality checks on boxed finished goods, but a manufacturing team saw improvement opportunities in automating what was a mostly manual operation.

Solutions at a glance

- [Internet of Things](#)
- [Dell Edge Gateway 5100](#)

Business results

- Raises quality team productivity by 20 percent
- Refines quality-control sampling precision
- Increases sampling flexibility via real-time data
- Offers a scalable, global quality-control model

Boosts EQM platform coverage by

34%

Reduces EQM cycle time by

15%

Henry Ford, founder of the Ford Motor Company, once described the customer choices for his wildly successful Model-T automobile this way: "Any customer can have a car painted any color that he wants so long as it is black." Henry Ford never met Michael Dell.

Not long after Dell moved PC manufacturing from his University of Texas dorm room to a more conventional factory setting, he developed a revolutionary build-to-order production model. It complemented his young company's primary, direct-to-buyer sales approach, enabling customers to order their PCs configured to their liking.

In effect, Dell had introduced mass customization to the PC market. But, at the time, mass production ruled. It sought to standardize as much as possible to maximize production throughput and take advantages of economies of scale. Dell's transformative approach not only debunked that paradigm, it helped the company become one of the most capital-efficient enterprises in the world. That's because customers paid before their products were built.

Refining build-to-order many times over

Since then, the company has refined this model many times over, always seeking new ways to improve production even more. Such was the case when the operations and quality teams at the Dell factory in Brazil saw an opportunity to streamline the random quality-control sampling done on boxed finished goods at the end of the production line.

As Valter Tunin, the plant's engineering director, tells it, the just-in-time mass customization of the build-to-order model poses a big and fundamental challenge to its smooth operation: variability. "The numbers of desktops, laptops, all-in-ones, tablets and servers we build each day are always changing, from 15 to 20 different models a day," he says. "That means the proportional mix of these different product types is always changing, too."

One place where that variability was affecting an important factory function — quality control — was at the end of the production line, after products were boxed but before they were shipped. This is where the quality team diverts a specified percentage of finished goods from the conveyor to a separate room and checks the contents of each sample box.

Taming wild variability

"It had always been a manual process, but because of the variability in each day's production, the diversion numbers for each product type would change from day to day," Tunin says.

Working together with the quality team, Tunin and his group initiated a digital transformation of this process they called "Smart EQM," EQM being an abbreviation for End-of-the-line Quality Metric. After all, this point in production offers the last chance to find any defects in the boxed products, accessories and packaging before customers on the receiving end might discover them.

> "*Our Dell IoT solution has helped boost our EQM platform coverage by 34 percent, and the quality team's productivity has risen by 20 percent.*"
>
> **Valter A. Tunin**
> Operations Engineering Director,
> Manufacturing Operations, Dell

After documenting the process in detail and ensuring all the stakeholders were clear on the project's goals, the team created a solution specification that required the use of real-time analytics. "At the solution's core is the Dell Edge Gateway 5100," says Tunin. "It's an intelligent device with analytic capabilities, unlike most gateways, which simply exchange data traffic."

"With analytics right on our shop floor, real-time production data can help us better manage our EQM process. What's more, the 5100 has plenty of headroom for expansion. For example, its many I/O options let us connect, aggregate, relay and track data from virtually any sensor and network protocol, if we want. And that includes wireless mesh networks and legacy serial equipment."

Deploying edge analytics

Drawn from the Dell Edge Gateway family of devices purpose-built for Internet of Things (IoT) applications, the 5100 is fanless and powered by an extremely energy-efficient, dual-core processor with 8GB of RAM. Although Linux is an operating system option, the Smart EQM project is using Windows 10. The device has 64GB of flash storage, just a fraction of the 256GB capacity that is available with this model, but all the factory needed.

Dell Edge Gateways are designed and engineered to withstand harsh industrial conditions and operate reliably 24x7. Its compact, book-sized form factor enables deployment options inside control cabinets, on a DIN rail, or, as in this case, outside the cabinet without any mount. "Given our factory environment, we need our systems to be rugged," Tunin says. "And the Dell Edge Gateway gives us that. In fact, it is designed, engineered and built to take far harsher treatment than our plant can dish out."

Located on the factory floor near production, the 5100 is connected via an RS232 port to a programmable logic controller (PLC) that helps run the production line. In turn, the device is connected via cable to the plant network as well as wirelessly to a virtual LAN. This links it to the plant's database in its manufacturing execution system.

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"As each product moves down the production line, a smart video camera captures and sends its service tag data to the PLC, which forwards that to the 5100," Tunin explains. "The 5100 then analyzes the data against the always-incrementing unit numbers in the factory's production database.

"When a sampling diversion is required, the gateway signals the PLC, which instructs a diversion gate to be raised at the end of the line, sending a sample box off to a separate conveyor that takes it to the quality audit area for inspection."

Boosting productivity, cutting cycle times

The Smart EQM system has greatly refined the factory's quality-control sampling precision. "We're managing the variability much better," he says. "The Dell Edge Gateway gives us the flexibility to vary our sampling percentages, depending on whether we're uncovering issues or not. If we find a series of quality issues in a particular model, then we increase our sampling rate for that model."

Being able to vary sampling rates dynamically in real time helps streamline the productivity of both production and quality team members. In fact, the success of the Brazil factory has been emulated at all Dell factories worldwide.

"Globally, our Dell IoT solution has helped boost our EQM platform coverage by 34 percent, thanks to eliminating the manual steps in our previous EQM process," Tunin says. "And the quality team's productivity has risen by 20 percent, because they are no longer standing around waiting for test units to be brought to them."

The factory has reduced EQM cycle times by 15 percent. "That result comes from the combination of two things," Tunin says. "One is the more precise unit sampling via the real-time analytics of the Dell Edge Gateway 5100 making decisions of which units to divert for testing. The other comes from the time savings we've gained by automating the diversion of finished goods to the test area by means of a conveyor."

The Brazil factory now has its sights set on extending the Dell IoT solution to its burn-in testing facility, recently completing a successful proof of concept using radio frequency identification (RFID). "With help from the real-time analytics in the Dell Edge Gateway 5100 device, we aim to reduce our average burn-in testing cycle time," he says. "In phase two, we'll introduce robotics."
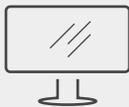
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