Pharmaceutical Manufacturing Modernizes with IoT

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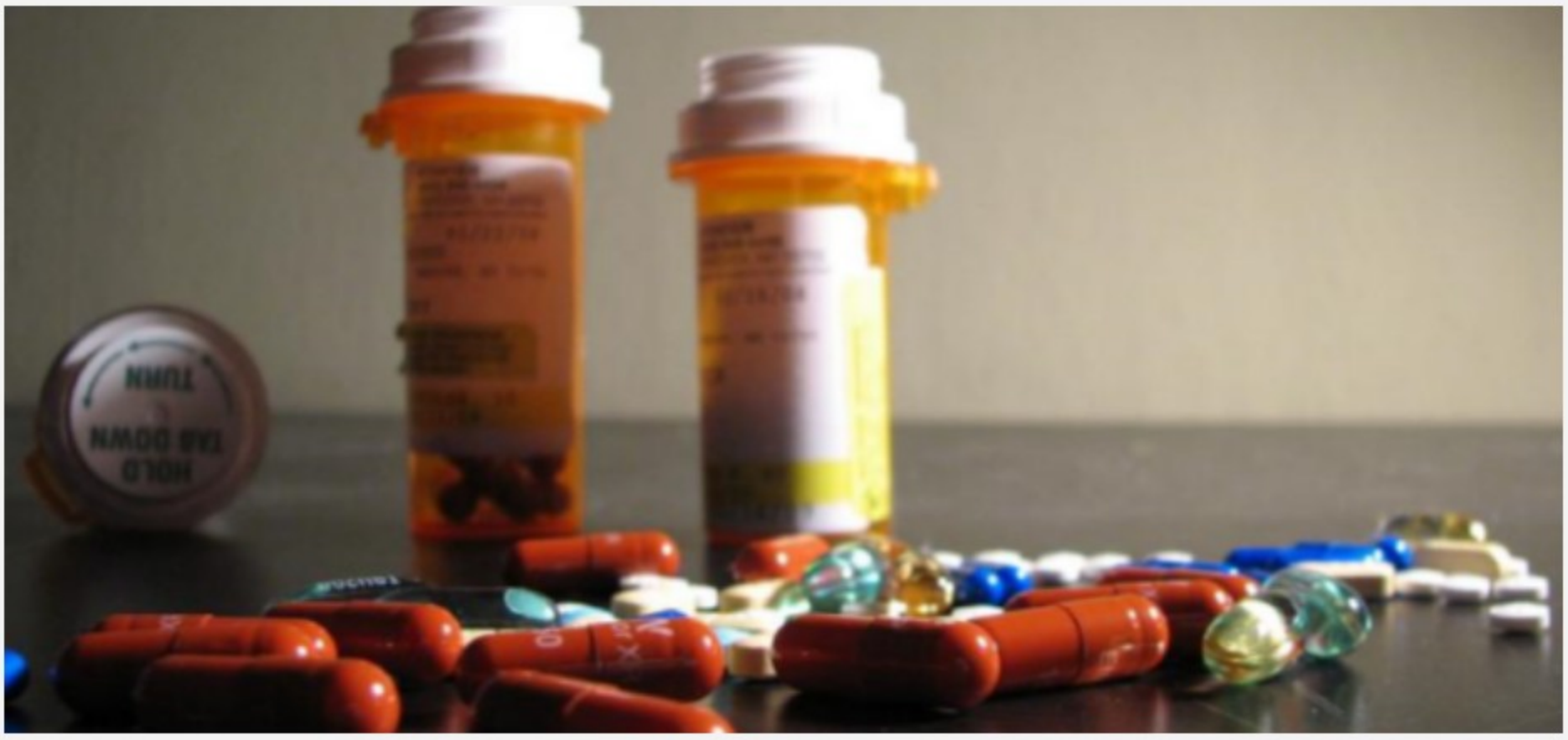

Pharma companies long coasted on the profits of their big blockbuster drugs, and made little effort to upgrade and modernize their manufacturing processes, which a recent ***Wall Street Journal*** **article** characterized as "using techniques dating to the days of the steam engine".

But the days of big profits from blockbusters are over, and pharma companies are noting that manufacturing costs for brand name drugs can be nearly 30 percent of revenues, while, by comparison, R&D costs are only 15 percent of revenues. So they are looking to emulate auto manufacturers and other advanced companies by incorporating IoT and other modern methods into their manufacturing process.

Manufacturing defects and errors have led to significant drug shortages (185 drugs were in shortage as of Q4 2015), as well as recalls.

Upgrading the processes will not be easy. Pharma manufacture is largely a batch process, involve mixing compounds in large vats, followed by long delays to measure the quality of each intermediate product, and then moving to another step, sometimes in another facility. Machinery is not used continuously. Information about conditions, status, and quality is often distributed in a wide variety of separate systems. Some critical data is still gathered and stored in paper-based logs.

Manufacturers want to move to continuous manufacture, more like the chemical industry, where compounds move through the plant without pause, measured constantly, a perfect place for an IoT implementation.

The major role of the FDA

We should no longer be surprised to discover that the main driver for implementations like IoT come, not from technical or market demands, but from regulators, and nowhere is this more true than in pharma.

Most businesses continually modify and tweak their production lines, eliminating inefficiencies, changing processes when suppliers change, and incorporating innovations. In the highly regulated business of pharma, that can't happen. The FDA approves, not only the drug itself, but every detail of the manufacturing process, down to the plant layout. This makes sense, since a process change could have enough effect to invalidate the clinical trials on which the drug's approval was based. Changes thus require explicit approval by regulators, and that requires paperwork.

Recognizing how big a problem this was becoming, since 2003 the FDA has asking pharma companies to work with its new Emerging Technology Team (ETT) to adopt innovative approaches to manufacturing. IoT will certainly be a big part of that, though the FDA is not yet specifying technologies.

Data collection expedited by the IoT will significantly aid in the data collection required by the FDA's continued process verification (CPV), which ensures that a process remains validated throughout manufacture.

How Merck analyzed a vaccine production flaw

Biopharmaceuticals, or biologics, are a class of pharmaceuticals that are manufactured using cells that have been genetically engineered. Production flows are complex, and according to McKinsey, production teams must often monitor more than 200 different variables to ensure both ingredient and product purity. The process is finicky, and small changes in temperature or other conditions can cause yields to vary by a factor of two from one batch to another. If there is even a slight variance from the FDA-approved manufacturing process, the materials and product have to be discarded.

An example of the difficulty in acquiring, analyzing, and using biologic process data is when Merck detected abnormally high discard rates on a specific vaccine. Its analysts had to incorporate data from process-historian systems on the shop floor that tag and track each batch; service dates and calibration settings from its plant equipment; air pressure and temperature data from building-management systems; and other data. These are all separate sources, with distinct formats and structures. All this would usually be analyzed via spreadsheets, a long and cumbersome process.

Merck used a cloud-based Hadoop compute to resolve the problem within three months, discovering that specific characteristics in the fermentation phase had significant effects on the yield in a final purification step. According to ***Information Week***, this required 15 billion calculations and more than 5.5 million batch-to-batch comparisons.

This is required for one process problem in one vaccine. Without detailed data about every step in the process, it can be almost impossible to figure out the source of the problem—or the potential place for yield improvement. Continuous unified data from an IoT implementation would allow for continuous process improvement, with development of models for refining which data is most significant.

Continuous improvement

In some cases switching from batch to continuous manufacturing in pharmaceutical production can reduce the time required to produce a drug from a month to a day, while also being more reliable, and safer. As pharmaceutical companies, no longer cushioned by pipelines full of blockbusters, seek to reduce margins, upgrading manufacturing processes is where they will be looking. And the continuous monitoring and control provided by the IoT will be a big part of it.

Tags: CAD, Industrial Internet of Things, Life Sciences

About the Author

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