The Technical Case for Mixing Cloud Computing and Manufacturing

MANUFACTURING, AS A VERTICAL, IS THE MARKET SECTOR WITH THE MOST POTENTIAL FOR IMPROVEMENT THROUGH CLOUD COMPUTING. Today's manufacturing processes often lack visibility into resource consumption metrics, productivity, and even logistics. The end result is huge blind spots in the building process that often mean a lack of productivity and efficiency, leading manufacturing companies down unprofitable paths.

As an industry, manufacturing in the US has been struggling for some years:

> For American manufacturers, the bad years didn't begin with the banking crisis of 2008. Indeed, the US manufacturing sector never emerged from the 2001 recession, which coincided with China's entry into the World Trade Organization. Since 2001, the country has lost 42,400 factories, including 36 percent of factories that employ more than 1,000 workers (which declined from 1,479 to 947), and 38 percent of factories that employ between 500 and 999 employees (from 3,198 to 1,972). An additional 90,000 manufacturing companies are now at risk of going out of business.[1]

The answer to manufacturing growth in the US is more about technology and intelligence than about economics. This has come to light within several manufacturing companies that leverage cloud computing, the Internet of Things (IoT), and big data analytics in pursuing a path to a competitive advantage that international low-cost competitors will find hard to replicate.

It's about Real Time

At the heart of the manufacturing issues is the lack of real-time visibility into the state of the business at any given time. Manufacturing case studies I've been involved with provide very little insight into the state of the business, such as production rates, quality issues, and distribution. These enterprises often simply respond to behavior, such as missing production runs. Instead, they need to proactively adjust to manufacturing processes while leveraging predictive analytics.

The notion of real-time data analytics dates back to the concept of the real-time enterprise. Real-time data analytics is also known as the ability to monitor what's going on in a business as it happens. Early on, the notion related more to data integration than to the cloud, data, and IoT. These days it's about how you externalize the data and what you do with it, in terms of making analytical sense of the information becomes a part of the manufacturing process.

Traditional data warehousing technology allowed manufacturing companies to slice and dice data that was used to make decisions. However, by the time the data was abstracted from operation-

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2325-6095/16/$33.00 © 2016 IEEE

al data stores, rolled up, and analyzed, weeks or months had passed. Those operating the business couldn't correct issues as they occurred. The ability to see current data and respond to analytics based on that data is the difference between a manufacturing operation making margins of 50–60 percent and one whose margins are only 10–15 percent, which means the business is dying.

Cloud and big data technologies will allow real-time data analytics in the manufacturing industry. Emerging cloud databases can be provisioned on demand to provide access to big data technology with the horsepower to provide real-time data analytics. Real-time data analytics means that the data gathered from operational data stores is almost immediately analyzed and externalized to humans, who can then act upon information that is seconds old.

For instance, a plant manager could monitor the plant equipment's maintenance needs and thus predict downtime and lost production hours with a great degree of accuracy. In the healthcare world, wearable health telemetry devices could produce real-time data analytics that could predict health events such as a heart attack. Having a large number of people wear health telemetry devices could also provide historical data that show patterns indicating the likelihood of such negative health events.[2]

This "perfect storm" of cloud, big data, analytics, and IoT has raised the bar in terms of what's possible on the path to better manufacturing. Moreover, it has the potential to be a game changer, making a once competitive US manufacturing sector relevant again. It can also make worldwide manufacturing much more efficient and less expensive, making goods cheaper and thus more obtainable by all. We could be looking at quality cars that cost less than $10,000, $100 flat screens, and $200 major appliances—all due to automation and intelligence, rather than cheaper labor or poor working conditions.

How Real-Time Metrics Work in Manufacturing

Real-time metrics aim to provide real-time visibility into data points (both raw and calculated on the fly) that provide required operational information. In manufacturing, the data points coming from IoT-enabled devices, operational systems, and other points that generate data will provide the raw data needed to determine real-time analytics. These analytics can be embedded into business processes for automated reactions, or externalized to humans who can take corrective actions.

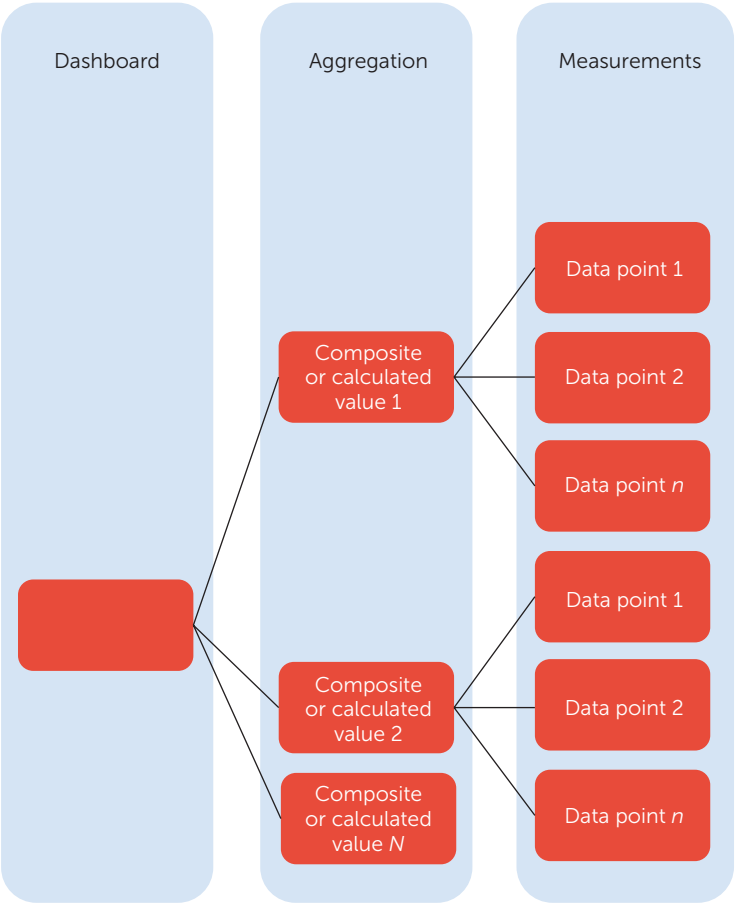

FIGURE 1. Aggregation of incoming data provides views that make more sense than raw data views.[3] (Source: Cloud Technology Partners)

Key to the inner workings of real-time metrics is service or data aggregation. These mechanisms allow users to combine many measurements into a single complex measurement (see Figure 1). IT can define what's exposed to the dashboard as well as who can view the metrics. The information can be customized so users can see and understand the metrics gathered from the measurements being made in real time.

We can do a couple of things with these aggregations.

First, we can make sure humans are alerted to specific issues so they can correct problems. For instance, an alert might inform plant management about a manufacturing machine on the plant floor that doesn't provide the output needed to supply the other parts of the manufacturing process. Because production is limited by that device's output, management should have it repaired as soon as possible.

Second, and most important, the aggregations can be embedded into real-time processes, such as production monitoring systems, and automated corrective actions can be taken. For example, the system can automatically order raw materials needed for a production run based on predictions made using data gathered from the plant floor. Thus, production will increase when the right materials are available and are aligned with the overall production rate. Missing runs due to the lack of raw materials are common problems in manufacturing.

Other examples are the ability to understand the calculated risk that a device will go into failure (such as a component in a metal press) based on incoming measurements that are run through a special risk analytics algorithm, which is the composite or calculated value. Because this calculation occurs on the fly, the data displayed on the dashboard includes the raw data coming in from the device, as well as any pattern that's processed in real time to add value to help interpret the data, such as the likelihood that a failure will occur. The real-time metrics user can even place those calculations around policies or limits to create an alert if the aggregated value goes out of a preset range.

Enter the Cloud

The cloud is the game changer here, not because cloud computing brings new technologies, but because it makes technology affordable to the manufacturing vertical that traditionally had thin margins, and thus economized on IT systems. The cloud makes access to critical systems affordable, and the elastic nature of cloud computing and pay-per-use billing means that no high up-front investment needs to be made, and the cloud bill increases only with the business's growth.

From a survey of software-as-a-service (SaaS) adoption in manufacturing, distribution, and other industries,[4] the Mint Jutras firm found that

- Forty-nine percent of respondents in the manufacturing and distribution industries don't understand the difference between single- and multitenant SaaS architectures. Overall, 66 percent of survey respondents were unaware of the difference.
- SaaS-based applications make up 22 percent of all manufacturing and distribution software installed today, and will grow to 45 percent.
- The three most important characteristics of an SaaS solution in manufacturing and distribution are giving customers a measure of control over upgrades, providing consistent support for global operations, and allowing for rapid and frequent upgrades.

The long and the short of manufacturing and the cloud is that the manufacturing vertical has the most to gain from the use of the public cloud. That said, as the survey revealed, manufacturers are likely to have little understanding of what the cloud is and what it can do. However, the use of SaaS continues to grow in line with other industries.

The movement in manufacturing needs to be around the growth of infrastructure-as-a-service (IaaS) use, including cloud-delivered servers, databases, data integration, and other core components needed to provide the types of services listed earlier. Amazon Web Services provides all of these components, as do Google and Microsoft.

But this isn't a slam dunk. Real-time data analysis, while moving to the "edges" of the network via more automated controls and sensors, might not be a good candidate for the public cloud. Other types of intense analysis on the data, maybe, but for day-to-day operations many don't see public clouds as a viable option. Thus, you need to consider your own requirements and understand that cloud might not be a fit.

That said, what keeps many manufacturing companies out of the cloud are lack of skills and knowledge. It takes a specific skill set to properly integrate existing "some-time" systems that provide no real-time visibility or automated responses with new cloud-based systems that allow companies to operationalize new and existing data points. The objective is to provide a quick return on investment as well as the ability to move

operations in more productive and less expensive directions.

The fundamentals are well understood and are becoming clearer to manufacturing organizations. What's missing is a stepwise approach that spells out the cloud conversion approach with enough detail to provide companies with a path to tactical and strategic success. Here's my recommended approach.

First, understand what data is currently available, and the frequency with which it's externalized. Many manufacturing organizations rely on canned applications that produce only a few data points. Although these aren't much help when moving to cloud-based real-time systems, they're a starting point.

Second, define the data points that can be externalized from the plant floor. These are the machines, the employees, IoT, RFID tags, and so on, that let you track items that were previously untracked. There are more out there than you might realize, since most manufacturing equipment now comes with data integration features, most of which aren't used.

Third, design the logical architecture, including data collection, data analysis, and data intelligence, within a cloud-based system. Don't choose the physical technology, but understand the logical requirements that are needed to define your target cloud-based system.

Fourth, pick your technology. This includes the cloud providers and subsystems you'll leverage, as well as use cases for each. This is the most detailed and longest part of the process, and it carries the most risk. Take your time and make sure to test the technology you've selected.

Fifth, consider security and governance. Although most manufacturing organizations consider security to be an afterthought, hackers can put you out of business. Make sure security is systemic, including your resources, APIs, and data governance.

Finally, make the improvement process ongoing. All of the analytics and processes should be under constant improvement (continuous improvement), which makes changes easy to implement. You do this by placing system volatility into a domain, so changes are made using configuration patterns versus redevelopment and deployment.

THE PROCESS OF MOVING MANUFACTURING ORGANIZATIONS TO THE CLOUD IS UNDERWAY RIGHT NOW—THAT IS, FOR COMPANIES WITH THE RIGHT VISION. Some will claim that use of the cloud is too expensive for cash-strapped manufacturing companies. I would point toward the growing evidence that the companies who make the investment actually save money, so that's not an argument in my book.

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