The End of the (Manufacturing) World As We Know It

Smart IoT technology brings inevitable, worldwide mutation

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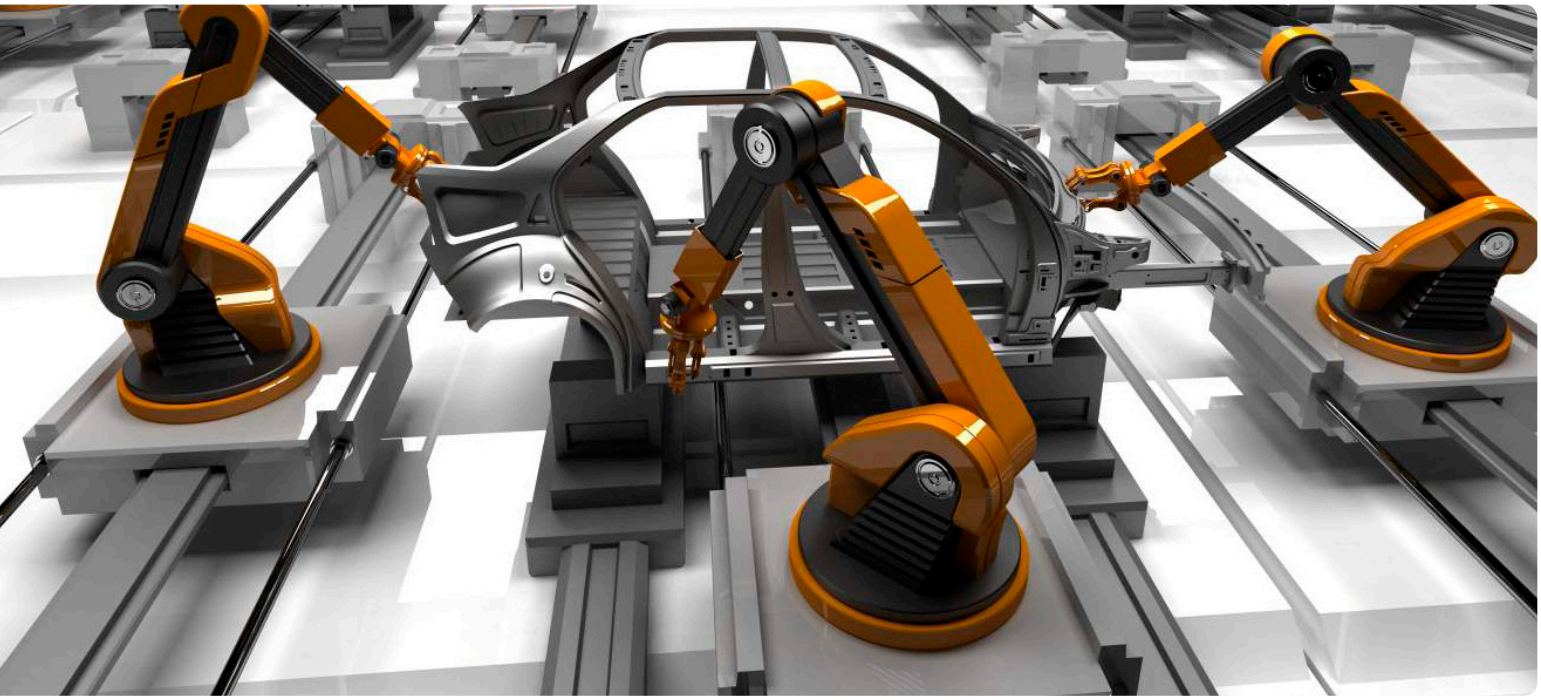

Abstract

Big data is nothing new in manufacturing environments. Ever-expanding data volumes have always been collected and analyzed in one way or another to manage complex supply chains, comply with regulations, increase quality and schedule maintenance — in other words, to streamline everything from R&D to production and quality control. Until recently, the driving goal has been to achieve cost reduction based on efficiencies and optimization without compromising safety or performance.

Now, however, technological advances related to storage capacity, high-performance computing, sensor miniaturization and advanced analytics tools have become sufficiently economical to enable manufacturers to reap new benefits from hitherto untouched data stores. In fact, as these technologies combine to create the Internet of Things (IoT) — which Gartner describes as "the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment" — they are creating a perfect storm that will forever alter the traditional manufacturing business model and value chain as we know them.

Soon, the greatest business value of advanced analytics (arguably reflected in a combination of ROI and competitive differentiators) will no longer be realized through mere optimization of processes. Instead, it will be realized only through the mutations brought about by smarter data — mutations that will take the manufacturing sector through an inevitable paradigm disruption of worldwide, decentralized automation enabled by an expansion of infrastructure investment and a broadening of user-based analytics.

The impending expansion of the IoT will radically transform not only the nature of manufacturing data sources and business relationships, but also the very analytics necessary to profit from IoT data.

Introduction

The myth of the faster horse

There is an apocryphal quote often attributed to American businessman Henry Ford regarding the innovations he introduced in the early 20th century in the manufacture of automobiles: "If I had asked people what they wanted, they would have told me faster horses."

Not that Ford was dissing his potential customers, of course. Rather, he anticipated their true desires, capitalized on existing technology and, as a result, deliberately took land travel to an entirely new level that exceeded everyone's expectations.

Continuity versus mutations

While this quote suggests an early and practical application of what we have come to call sentiment analysis, it also touches on a long-standing debate regarding human technological development: continuity versus mutations. Influential historian Lewis Mumford scorned the theory that technological progress depends solely on continuous improvements and refinements, lamenting that:

"People who sought to improve transportation [would] have devoted themselves to breeding faster horses, rather than inventing railroads, motor cars, or airplanes. Each of those inventions was a mutation, not a continuity. Indeed, at the turning point of a civilization … continuities inevitably represent inertia, the dead past; and only mutations are likely to prove durable."

It is important to understand that the imminent expansion of the IoT must necessarily produce mutations rather than continuous growth curves. These mutations are inevitable and will radically transform not only the nature of manufacturing data sources and business relationships, but also the very analytics necessary to profit from the onslaught of IoT data that will be made available.

Recent technological innovations

Why is this happening now? Several key technological innovations have converged that make smart, connected products — whether business-to-consumer (B2C) or business-to-business (B2B) — tangibly feasible and economically attainable. According to a recent Harvard Business Review article, these innovations include:

- Breakthroughs in the performance, miniaturization, and energy efficiency of sensors and batteries
- Highly compact, low-cost computer processing power and data storage, which make it feasible to put computers inside products
- Cheap connectivity ports and ubiquitous, low-cost wireless connectivity
- Tools that enable rapid software development
- Big data analytics
- A new IPv6 internet registration system that is opening up 340 trillion trillion trillion potential new internet addresses for individual devices
- Internet protocols that support greater security, simplify handoffs as devices move across networks, and enable devices to request addresses autonomously without the need for IT support

The changing competitive landscape

As these technological innovations drive down costs and complexity, data collection and predictive analytics (PA) capabilities are coming into the reach of small- and medium-sized companies, who will attempt to take advantage of this opportunity in order to maintain pace with their larger competitors.

But as more and more B2B organizations exercise big data PA and begin to tap the IoT, the cumulative efficiency achieved through operational improvements alone will become less and less of a competitive differentiator across the board. That is, as more and more companies utilize PA, the margins gained solely through operational improvements (via lower production

costs, faster go-to-market cycles, higher quality, reduced warranty expenses, fewer unplanned outages and greater efficiencies) will level out.

As the saying goes, you cannot save your way to prosperity. No longer can manufacturers claim superiority through the traditionally successful use of data merely to increase efficiency and quality through lean production. Instead, manufacturers must broaden their PA scope to new use cases with measurable and long-lasting ROI outside of the operations and supply chain. In fact, the natural benefits of operational improvements will seem minor when compared to the lucrative new realities made possible by the networked Internet of Things.

Smart manufacturing: three ways to future-proof your operations

Enter smart manufacturing. Taking advantage of smart IoT technologies is the next evolutionary leap to ensure organizational relevance — not merely because it can happen, but because manufacturers' desire to remain competitive will compel it. However, capitalizing on smart IoT technologies will require new infrastructure, new analytics solutions and a new mindset.

New infrastructure requirements

What will a smart manufacturing infrastructure look like? It will require a whole slew of supplementary physical and tech improvements: enhanced operations, networked communications, data scientists and more. This is because connected products are not necessarily of the plug-and-play variety and therefore their use requires that companies build an entirely new technology stack to integrate with their legacy systems. The same Harvard Business Review article describes the new technology stack as follows:

"[It] includes modified hardware, software applications, and an operating system embedded in the product itself; network communications to support connectivity; and a product cloud (software running on the manufacturer's or a third-party server) containing the product-data database, a platform for building software applications, a rules engine and analytics platform, and smart product applications that are not embedded in the product. Cutting across all the layers is an identity and security structure, a gateway for accessing external data, and tools that connect the data from smart, connected products to other business systems (for example, ERP and CRM systems)."

Despite the relative cost-effectiveness of new technologies and tools, the investment required will initially exceed the financial limitations of most companies, thus relegating early IoT adoption to the realm of larger players.

New analytics requirements

Organizations that build this new technology stack will enable a smarter, more agile manufacturing environment. But the greater the agility of the environment, the greater the expectations for innovation, scalability, responsiveness, robustness and ease of use.

In particular, because IoT connectivity converts and integrates more of the physical manufacturing environment into a continuous (and exponentially larger) data stream, the derivation of useful insights and operational oversight requires immediate accessibility by those with close connection to the machines involved. A certain amount of data interpretation and reaction will be handled by smart machines, yes, but any intervention required by a human being can no longer wait for the fixed office hours of the data analyst.

Instead, as the scope of data interaction expands to include executives, customer service staff, sales people and other non-analysts, ease of use will become increasingly important, driving a shift toward ever-simpler analytics and GUIs made possible through the innovations

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Manufacturers in developed markets will have to start differentiating themselves through data-driven, customer-centric services rather than through process optimization.

Figure 1. With drag-and-drop dashboards and visualizations like these from Dell Statistica, you can start exploring any set of data in just minutes. Manufacturers with such capabilities will be able to adapt readily to IoT data flows.

of technology and specialized algorithms. This development demands a new proliferation of visual dashboards and other GUI-based tools that non-analysts can use in real time, such as those shown in Figure 1.

Thankfully, innovation is already making predictive analytics less complex and therefore more accessible to a broader base of organizations — even micro- and mid-market players whose needs might be simple compared to those at the enterprise level. Market demand has produced a plethora of targeted analytic tools and comprehensive analytics platforms that offer greater ease of use, and these software solutions enable their users to derive value more quickly than before, especially in the area of advanced predictive analytics. Software and data storage compatibilities facilitate this ongoing development.

The benefit here, of course, is that more businesses can spend more time on productive efforts and less time getting caught in traditional dataflow bottlenecks. James Haight, research analyst with Blue Hill Research, puts it this way:

"A number of innovations and solutions have entered the marketplace that provide greater ease of use and a more targeted focus. … Vendors have made significant advances in the accessibility of predictive analytics solutions, and are breaking down barriers previously associated with integrating predictive capabilities. … Recent advances in modeling, drag-and-drop interfaces, access to statistical libraries, and improved workflows now allow data scientists to spend less time preparing analysis and more time conducting it."

Changes in mindset and skillset

Other factors must come up to speed simultaneously with these infrastructure and analytics advancements. Ever-growing volumes of smart machine-to-machine (M2M) data will further focus analytic efforts on competitive differentiation. For instance, manufacturers in developed markets will have to start differentiating themselves through data-driven, customer-centric services rather than through process optimization, leveraging their newfound technical advantages to offer customers greater customization and value.

More broadly, to avoid becoming lost in the torrent of potentially distractive IoT data, manufacturers will find it more practical than ever to tie analytic and reporting efforts to business questions such as: What variables are most critical to success? Which processes are most complex? Is there a defined relationship between our long-term vision and our core competencies?

Progress will be hindered if analytics and logistics players are saddled with an old mindset and therefore fail to utilize current data innovations that would help them take advantage of smart M2M data. Accordingly, it will be critical to expand user awareness by teaching experienced analysts how to use the new analytics tools and by developing the skills of algorithm specialists and software architects to adapt to the massive IoT data volumes and operational changes that are sure to come.

The end is near: decentralized, worldwide automation

So far, we have seen that bringing this smart paradigm shift to fruition requires enhancements in infrastructure, simpler advanced analytics tools, and new training and mindsets.

Now we get to see Mumford's mutation on full display.

As Mary Shacklett, president of Transworld Data, writes, "For big data, the move to smart manufacturing systems will be transformational. Big data will be called upon to 'run things,' and not just to deliver analytics."

She also quotes Peter Post, head of corporate research and program strategy at Festo: "Tasks that are currently still performed by a central master computer will be taken over by components. These will network with one another in an intelligent way, carry out their own configuration with minimal effort and independently meet the varying requirements of production orders."

Physical work flows and data flows become one

What will a world of networked M2M devices look like?

In order to anticipate and satisfy the just-in-time expectations of increasingly savvy business customers, and in order to maintain the lean policy of as-needed minimum inventories, manufacturers will find it necessary to develop worldwide supply chain networks that will, by design, be incredibly agile yet complex enough to require an entirely new layer of logistics.

Marcus Löffler, a principal at McKinsey & Company, discussed in a 2013 interview how the IoT would decentralize production control and trigger a "fourth industrial revolution" exemplified by the literal fusing of supply elements with data flow. He predicted:

"What happens is a complete consolidation of devices and process management. 'Process and device' will be inseparable; physical things become part of the process. What this means for the plant is that machines and work flows merge to become a single entity. The work flow ceases to exist as an independent logistical layer; it is integrated into the hardware."

He agrees that the world of production will become more and more networked until everything is interlinked with everything else, where products and components will actually be embedded with sensors, inextricably and dynamically linked to their own information about orders, designs, destinations, deviations and more. Just as a television journalist can switch roles from "reporter" to become "part of the story" itself, in the new IoT scenario, the physical work flow ceases to exist as an independent layer that communicates data and becomes one with the data flow instead.

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A worldwide virtual manufacturing facility

Meanwhile, with smart manufacturing's lean policies, inventory is kept to a minimum, so more vendors and suppliers are utilized worldwide at any given time to fulfill needs. As Löffler's colleague, Andreas Tschiesner, put it in the same interview:

"Manufacturers will need to coordinate with more and more suppliers—often globally, and with longer transport times, more manufacturing steps, and significantly more parties."

With the IoT, such a decentralized system is defined by the interconnection of multiple factories and regions; essentially, the world becomes smaller even as it grows into one big, virtual manufacturing facility.

Getting there

The same technology that makes these changes possible also offers resolution to their intrinsic challenges. Siegfried Dais, deputy chairman of the board of management at German engineering company Robert Bosch GmbH, notes in the interview:

"How do we find an architecture that is stable enough to keep everything networked together? I think it will primarily require algorithm specialists and software architects. We will need 'steering instruments'—new algorithms and applications that interlink millions of things, that ensure that everything runs stably, and that are synchronized across the entire value chain."

In order to handle the data volumes and granularity provided through smart technology, such new tools will inherently provide transparency into decentralized operations, helping manufacturers reduce assumptions and determine even more accurate and objective estimations of their capabilities than ever before.

Emerging questions

With this blending of data flows and machine flows, the next round of relevant questions will address asset ownership and the very business of manufacturing itself. Will customers purchase only virtual production capacity? Will owners of production technology have the best chance of controlling profits, or will it be those who own physical assets? And whom will the customer perceive as owning the final product? The designer? The manufacturer? Or maybe the person who created the contract in the first place?

These kinds of questions merit their own consideration elsewhere, but they do indicate that traditional centralized control will become a thing of the past.

Conclusion

Smart IoT technology is opening up the manufacturing industry to impressive mutations that go well beyond continuous, incremental improvements in cost-savings and quality. These rapid changes are inevitable, resulting from a perfect storm of technological innovation, economic viability and the competitive nature of the free markets.

Here are some key take-aways from this white paper:

- Manufacturers will no longer be able to save their way to prosperity. The differentiating margins achieved through process optimization will level out as more players take advantage of advanced analytics.
- Technical innovations now allow products and components to be networked into the Internet of Things, creating opportunity for manufacturers to move beyond continuous process improvements and develop new ways to conduct business and differentiate themselves.
- Worldwide decentralization of the manufacturing business model will inevitably result from this new push for differentiation using smart IoT technology.

The impact will be most obvious with regard to M2M interactions, supplier networks, algorithm and logistics development, and asset ownership.

- New levels of infrastructure investment and simpler, user-based analytics will be necessary to enable this decentralization.

Not all manufacturing businesses are positioned to take advantage of such opportunity, but some have a head start thanks to years of infrastructure investments made in pursuit of big data and related diagnostic objectives. Still others are already using predictive analytics tools that make it easy for non-analysts to integrate themselves into real-time, data-based decision making.

Those that have both the infrastructure and the user-friendly analytics tools will be ready to pursue success in the mutation of worldwide decentralization that is coming, able to convert their operations into smart profit centers and dramatically increase their revenue streams. And those that are not ready will risk losing customers to a growing list of global competitors promising they can do better.

About the author

Paul Hiller is a senior marketing analyst in the information management group at Dell Software, focused on the advanced and predictive analytics space. His current emphasis is on discussing and promoting Dell Statistica's role within that space.

Based in Tulsa, Oklahoma, Paul has broad experience in both marketing communications and graphic design, and holds a Bachelor of Arts degree in Communications/Public Relations and Business Administration from Regis University. When producing the occasional article or blog post, he prefers to eschew the hype in favor of the pragmatic and the inquisitive.

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