CHANGING THE GAME WITH IoT

To realize the full potential of the Internet of Things, businesses need to move beyond short-sighted use cases and consider its broader impact on the world.

By Niall O'Doherty

EXECUTIVE: Most business and technology leaders today agree that the Internet of Things (IoT) represents an unprecedented opportunity in terms of ground-breaking insights and entirely new ways to understand and engage with both customers and "things." But in actuality, IoT's full promise has thus far failed to materialize, in part because of the narrow ways in which organizations define and pursue the potential capabilities.

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To realize the full economic impact that McKinsey & Company has predicted for IoT[1]—between $3.9 and $11.1 trillion per year—organizations need to look at IoT in an entirely new way. Consider, for example, that many businesses today focus their IoT efforts mainly on resolving well-understood issues, such as predicting equipment failures to enable proactive maintenance. Such IoT initiatives are primarily stovepipes, driven by individual business units. It's little wonder a leading analyst predicts that four out of five IoT implementations

will squander the transformational opportunities offered because the use cases and analytics have too narrow a focus.

Instead, businesses need to develop the organizational and technological capabilities to use IoT data at scale, as well as understand the relationships and dependencies across a complex system, such as a smart city, a factory floor or a supply chain. Only through a broader and deeper application of IoT data can companies realize new innovations, revenue streams and cost savings.

By Any Other Name
Perhaps the problem starts with the name. The "things" in IoT may be too vague and misleading. Considering that virtually anything is a *thing*, it's difficult to firmly grasp what IoT even means, let alone how to effectively use it.

A better name might be "Internet of Systems," which would refer to any number of complex entities, such as weather systems, transportation systems, financial systems, factory systems, or human immune or nervous systems. By thinking in terms of systems vs. things, we can begin to see the value of using data to better understand the inner-workings and interdependencies of complex systems, and then optimize them.

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Footnotes
1. Manyika, James and Michael Chui. "By 2025, Internet of Things Applications Could Have $11 Trillion Impact." McKinsey & Co. reprinted from Fortune, July 22, 2015. http://goo.gl/3g12Wd.

The study and exploitation of complex systems requires a deeper understanding of a data domain and the ability to capture relationships with other adjacent domains. Take, for example, proteomics, the large-scale study of protein function and interaction. Done well, this discipline takes scientific insights from across many data sources

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How IoT Changes Decision Making, Security and Public Policy

By Erik Brynjolfsson

We're in the early stages of a management revolution. The upheaval is based on our unprecedented ability to collect, measure and digitally record information about human and systems activities, particularly with the finely tuned data sets available through IoT. One of the hallmarks of this new era is the acceleration of data-driven decision making within businesses, which has tripled in just five years, according to a recent study I conducted with Kristina McElheren, a professor at University of Toronto.

Accompanying the progress anticipated in this increasingly digital age, however, will be thorny challenges and broader issues for society at large. This is particularly true as organizations begin to feed the large data sets available from IoT into systems that use machine-learning algorithms—at which point they will begin making predictions and decisions in an increasingly

(labs, databases, publications) and applies it to newly generated experimental data. The findings can literally be life-changing. By learning how proteins are coded from genes, we will develop effective drugs to treat cancer, diabetes and other diseases.

I witnessed the revolutionary difference between adopting a "things" vs. a "systems" mindset at a recent hackathon. Different groups were given the same sensor data for a factory making surfactants, a compound used as a detergent and wetting agent and for other purposes. The teams were left to their own devices to analyze the data and come back with improvement opportunities. Most focused on the relationship between temperature and pressure metrics and equipment issues—no big surprise, considering that predicting equipment failure is the poster child of IoT.

Our group, however, thought more deeply, analyzing the data in terms of its impact on the entire manufacturing system. We "interrogated" the data to understand the optimal temperature and humidity levels for the duration of

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automated way, and at large scale.

Machine-learning and artificial intelligence (AI) technologies have advanced greatly in recent years; the implications range much further than the attention they get for winning competitions with "Go" champions and chess masters. The real significance of these technologies will be found in their ability to automate and augment complex decision making.

Consider how IoT and AI-based decision making could impact retail. By instantly gathering and analyzing information from store shelves, inventory and customer purchases, large retailers could make inferences and decisions in milliseconds while benefiting from the informational economies of scale. With their detailed knowledge of customer behaviors, large retailers will operate with the customer intimacy of mom-and-pop stores, even though their headquarters are thousands of miles away.

As the premium on large, quantitative data sets grows, more companies will continue to move away from making decisions based on what they *think* and toward those based on what they *know*. Our research indicates that companies in the top third of their industry in the use of data-driven decision making are, on average, 5% more productive and 6% more profitable than competitors.

Facing Privacy Issues

The combination of IoT and AI is already starting to raise all sorts of societal issues, particularly when it comes to security and privacy. For most of human history, it was physically impossible to know very much about people's buying habits, time use or personal lives unless you hired a private detective to follow them around. Today, that same level of insight can be gleaned through connected devices like mobile phones. As we become more digital, it isn't the laws of physics but the laws of humans that determine who has access to information.

We have to consider who we want to access this kind of information: law enforcement officials, marketers, the people who generate the data themselves? At one extreme, we could keep the data inaccessible to anyone at all, but this would prevent us from reaping potential benefits such as stopping crime and fighting disease, as well as more mundane benefits like better customer service and more tailored products.

Privacy issues will need to be approached from multiple angles. Governments will implement regulations, but individual organizations will often need to go beyond the letter of the law to maintain customer goodwill. As Amazon CEO Jeff Bezos said in this year's annual letter to shareholders, there are two types of decisions—those that are reversible and those that aren't—and it's crucial to distinguish between the two. Any decision that affects your brand, reputation and customer trust falls into the latter category. Given how intimately IoT data is tied to people's lives and behaviors, misusing it can have irreversible consequences, so companies will need to minimize risk when employing it.

For organizations to succeed in a time of unprecedented access to data and automated decision making, they will need to develop not just data management, AI and analytics know-how but also a sensitivity for social concerns and how these powerful capabilities impact the greater good. •

the production process to ensure the compound was made to the correct specifications with the lowest energy consumption. In doing so, our team derived much higher value from the sensor data, because we used it to optimize a process. Using the same data with a different mindset, our group identified a huge win rather than an incremental benefit.

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Doing the Math

Developing a systems approach to IoT isn't a simple exercise. First, organizations need to recognize that *all* data has value (the systems approach), not just the data from IoT (the things approach). But analyzing IoT data in the context of other data sources from around the organization involves a complex mathematical conundrum that requires sophisticated analytics capabilities.

Even more difficult barriers to overcome are company culture and business transformation issues. The traditional way companies make decisions and set IT budgets can inherently lead them to focus on narrow use cases. Privacy issues also need to be considered (see accompanying article, previous pages).

But overcoming these challenges is worth it, as the systems viewpoint can be used to answer several important questions:
- What is happening?
- Is it significant?
- Why is it happening?
- Where has it happened before?
- What was the impact?
- Can we predict when and where it will happen again?

A Platform for Innovation

To begin shifting toward a more radical—and profitable—mindset, companies can learn from the example of industry disruptors, such as the Apple iPhone. With this device, Apple changed the way people and companies think and operate by providing a platform that invites innovation from app developers. Developers don't need to know how the platform performs, just how to create something with it.

Similarly, companies can create a platform so employees can analyze and experiment with the data from IoT and other sources, build algorithms that model and optimize complex systems, and create something new. Employees don't need to concern themselves with how the platform works, just what they can do with it to leverage insights from massive amounts of data.

Some companies have taken the lead in developing a systems mindset to IoT because they've staked their future on digitization—even at the board level. They've made a heavy investment in IoT platforms and, just as important, begun to change their decision making and investment processes to keep pace with the speed of implementation that IoT requires.

The winners in IoT, then, are those who are developing that larger, systems-wide vision. They're basing their initiatives on IoT projects that can optimize entire systems, whether that is the supply chain, a smart city, a production plant or cutting-edge medicine. They're investing in an integrated, scalable, analytical platform that opens up the possibilities for staff to make sense of the data generated by IoT. That is how they're fully ready to realize the true promise and transformational opportunity of IoT. •