

The Internet of Everything and Big Data for the Connected Enterprise

How the data generated by a more connected enterprise will change core business functions

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Abstract

The Internet of Everything (IoE) will revolutionize and reinvent how business is conducted in the 21st century by using the “big” data collected from billions of new network connections. Big data’s relevance for the enterprise isn’t defined by its size, but by the big impact it can have on enterprise efficiency, productivity, and innovation. Enterprises can use IoE data to make improvements in every business function. This article will focus on manufacturing and supply chain processes, employee recruiting and retention, and IT operations.

This article is the first in a two-part series about the impact of IoE-generated big data on the enterprise. The second article, *Powering the Internet of Everything with Big Data Analytics*, will describe how Cisco IT has implemented an analytics infrastructure to process and make that data available in relevant forms for users and applications.

Positioning the Enterprise to Benefit from the IoE

Information technology started as a way to automate and optimize business processes and improve productivity. Gains in worker productivity and the ensuing wealth creation have justified prior IT investments by enterprises.

Now, the Internet of Everything is the culmination of this IT revolution - where enterprises, consumers, and the physical world will be completely immersed in information technology. Whether you call it the end of IT or a new beginning depends on your vantage point, but the inescapable truth is that your IT strategies and your business strategies can no longer remain separate and must become two sides of the same coin.

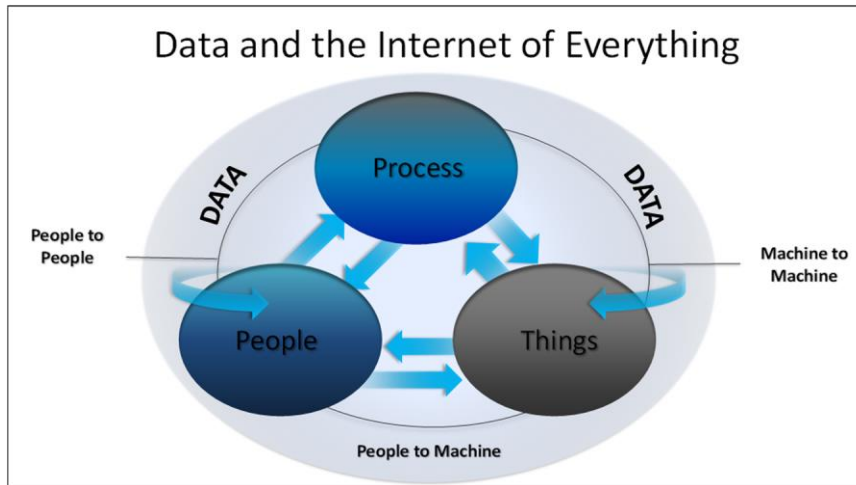
Yet it isn’t easy to change business processes, products, and organizations - even those already recognized as less than optimal. And in many cases, prior commitments to customers, partners, and employees do not allow enterprises to change operations abruptly.

Given these hurdles, enterprises need to address one key question in order to realize the promise of IoE and big data: What is the relevance of IoE to the enterprise and how will different functions change as we adopt it?

Answering this question starts with understanding the IoE and its potential to deliver both disruption and opportunity to the enterprise. The IoE is about the confluence of people, process, data, and things. (Figure 1) The Internet has disrupted many businesses over past few decades and the billions of new IoE connections will do the same for many more in the coming decade. The Cisco white paper, [Embracing the Internet of Everything to Capture Your Share of \\$14.4 Trillion](#), quantifies the value at stake in the move to IoE and provides real examples of this business transformation.

This article extends the discussion in that paper, but with a focus on the opportunity and impact of IoE on the inner workings of an enterprise. This focus is important for business leaders to understand because the IoE and big data are not concerns for the IT department alone. The enterprise's internal operations will not be immune to disruption in the business models or external changes in how the world will operate. A connected enterprise that has internally embraced the changes brought by IoE will be better positioned and prepared to face the changes that emerge externally.

Figure 1. The IoE Confluence of People, Process, Data, and Things



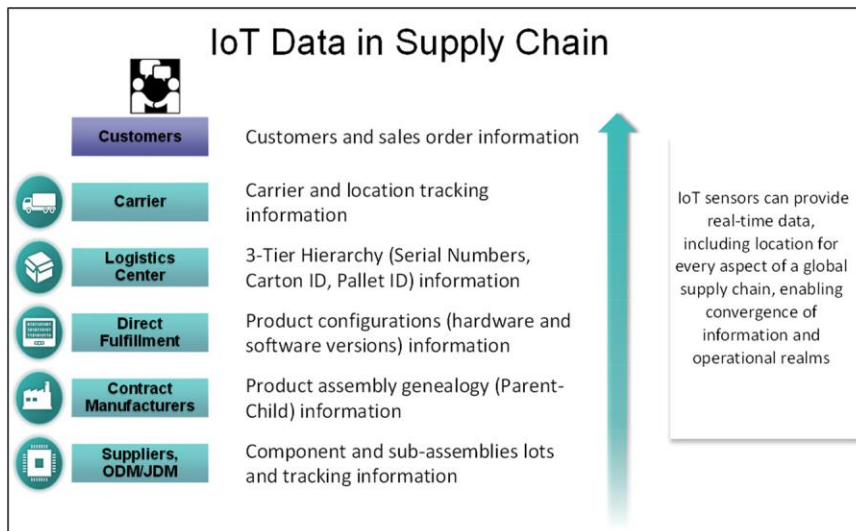
Connected Supply Chain

Today's manufacturing is about turning materials into finished products via a series of complex steps that span a global flow of goods and services. Although the manufacturing journey is tracked by information flows in IT systems, businesses struggle to keep the physical flow of goods in sync with the information flow.

The potential of IoE to transform manufacturing is being referred to as the fourth industrial revolution. The Internet of Everything integrates the physical world and the information flow so that every "thing" carries information about its state and is able to share and synchronize its data with others. As shown in Figure 2, several technologies that enable this communication are already available, including:

- RF technologies to identify and locate components, products, and cartons as they move through supply, manufacturing, and distribution processes
- Sensors that can be embedded at every stage of manufacturing and logistics processes to track process status and metrics
- Industrial robots and smart control systems with a programmable capability to change based on available information, without human intervention

Figure 2. Internet of Things (IoT) Data Sharing Among Elements in a Manufacturing Supply Chain



Consider the following benefits that will be possible as this data-enabled industrial revolution becomes a reality:

- **Improved product quality.** An IoE supports the ability to know where every material or component came from and the journey it took before being integrated into the finished product. This knowledge will allow tracing any quality issues to the root cause, e.g., a problem with the supplier, a faulty machine, or in the production environment. Cost savings will come from the ability to correct manufacturing conditions quickly and to prevent faulty components from being used in a finished product.
- **Elimination of traditional inventory management.** Knowing the location of every inventory unit at any given time will effectively eliminate the need to manage that inventory. Instead, the focus of inventory management will be on algorithms to manage complex interdependencies for an efficient and reliable flow of goods.
- **Programmable assembly lines.** When the level of product demand changes or supplies of a component become unavailable, an assembly line can be reprogrammed automatically to manufacture a different product for which demand exists and components are available. Suppliers and logistics partners will be alerted accordingly.

These manufacturing changes will not happen overnight, but the enabling technologies and market forces are already developing. IoE and big data technology will usher in this fourth industrial revolution and it is only decades, perhaps even only years, away.

Connected Employees and Human Resource Management

Employees are the most important assets of the enterprise in an information economy. With information and intelligence embedded into everything, the value of the right employee talent will grow and the challenges of attracting and retaining qualified employees will intensify. The reasons behind this trend lie in the changing nature of work and the increased understanding that productive employees are sustaining a competitive advantage for their employers.

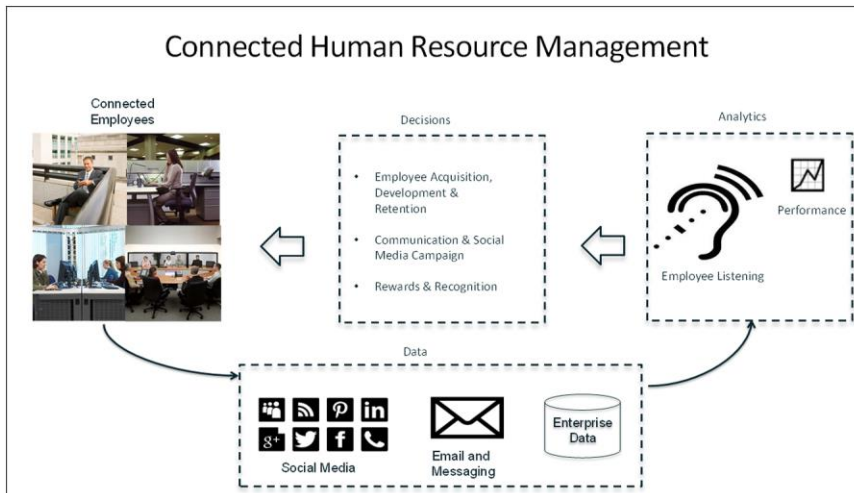
Two other IoE and big data trends are influencing workforce needs for an enterprise. First, automation, robots, and intelligence built into systems and equipment will improve enterprise efficiency. These technologies may also eliminate existing jobs and replace them with positions requiring the ability to program, build models, understand algorithms, or work with complex control systems.

The McKinsey Global Institute predicts a shortage of as many as 190,000 employees with analytical expertise in the United States by 2018 and an additional 1.5 million managers and analysts who can make decisions based on understanding big data.¹

As most managers know, top-performing employees outperform medium performers by a wide margin, so accurately identifying top performers and retaining them is a huge business advantage. Data-driven human resources management will help identify job candidates and help devise strategies to recruit and retain this talent. In the fully interconnected world, human resources (HR) departments will have unprecedented access to all aspects of employee interactions. (Figure 3) These interactions include:

- Social media profiles and participation
- Employee sentiment expressed in internal and external collaboration tools
- Employee interactions with processes, code, products, and customers
- The impact of individual employees on quality, customer satisfaction, and revenues and profits for the company
- Information on an employee's participation and progress in training and education programs
- Identification of potentially risky employee behaviors such as sharing confidential code or documents in violation of company policies
- Correlation of employee performance with experience, educational background, training, and satisfaction

Figure 3. IoE Data Availability to Support Human Resources Management



However, people do not like to be reduced to a set of numbers and mining employee data raises concerns about privacy and unethical use of the information. That said, numbers already play an important role in our careers, for example when employees are measured by factors such as sales quota and performance, customer satisfaction (CSAT) scores, and product quality metrics. Indeed, a lack of metrics often leads to opacity in measuring employee performance.

¹ McKinsey, *Deep analytical talent: Where are they now?* http://www.mckinsey.com/Features/Big_Data

When enabled with the Internet of Everything, data-driven HR will help companies effectively:

- Target hiring decisions based on detailed candidate information that is available from external sources, matching each candidate's background to desired skills and traits for the job.
- Measure employee performance and implement differentiated reward strategies that match reward and recognition with employee performance and the reward's efficacy in retaining top talent. This differentiation will allow companies to direct coveted raises to employees who possess the critical skills that are in high demand versus a single compensation approach that applies to all employees. Most companies would prefer the differentiated compensation approach but are hampered by a lack of accurate metrics as well as subjective bias from managers.
- Measure the impact of investments in employee learning, processes, and tools on productivity and take corrective actions.
- Improve HR services and policies based on analyzing and extracting insights from internal, online employee discussions. This data can give HR and management near real-time information on employee satisfaction - a key ingredient to productivity. Annual satisfaction or exit surveys are often too late for timely preventive action on employee retention issues.

Technology and data will never replace the human touch and the need to effectively engage and manage employees. Yet connected employees and the ability of the company to harvest their associated data can help make human resource management a strategic function for the company and provide managers with appropriate analytics.

Connected IT Operations

IT environments have become increasingly complex, encompassing many different technical components that are supported by different teams and often spread across data centers. Table 1 shows a simplified version of the technologies involved in delivering IT services to users.

Each layer shown in the table is served by multiple technologies from different companies, yet these layers must work in unison to deliver a business capability to users. Each of these components have become more stable over the years and today, there are redundancies built at every layer to improve IT service reliability.

Table 1. Technologies Used for Delivering IT Services

Technology and Operation Layer	Example Technologies
Information consumption by users	Mobile devices, browsers, APIs
Business process management	Business rules and workflow orchestration software
Applications	Packaged applications such as enterprise resource planning (ERP), software as a service (SaaS), Custom Java
Middleware	Application servers, enterprise application integration and enterprise messaging
Databases	Relational, NoSQL databases
Visualization	Enterprise dashboards and reporting, ad hoc analysis
Storage	Storage virtualization with multiple frames, access paths
Compute	Virtual machines, physical machines, operating systems
Network	Routers, switches, access control lists (ACLs)

In most enterprises, delivering IT services is a complex challenge. Although every recent IT trend has optimized service costs and flexibility, this optimization has been made at the expense of adding further complexity to the IT landscape. Additionally, IT improvements are sometimes negated by an increase in the total number of technology components required to deliver a business capability.

Enterprises also face challenges in supporting their IT infrastructure. If there is a failure or performance issue, it isn't easy to pinpoint a specific root cause. Additionally, IT organizations often lack employees who have expertise that spans multiple layers of the technology stack. And for components that are shared across multiple IT services, a failure or issue at any layer can have a significant impact on multiple business organizations and operations.

As more devices are connected in the enterprise, IT operations teams need to evolve their capabilities for configuring, monitoring, and managing every "thing" in the IoE. For example, every element in the application architecture stack produces terabytes of data for events, logs, processing, and real-time statistics. But during a production outage incident it will be hard to correlate all the events generated by discrete management applications to identify the problem source. Analytics capabilities that automate the filtering and presentation of IoE status and performance data will be essential for managing IT services in the future.

Conclusion

Of course, the IoE and its data will present opportunities for and make an impact on many business functions beyond those discussed here. Enterprises will need to prepare for business activities that are ever more connected and generating ever more data. IT and line-of-business leaders will need to work together to define the analytics and presentations that will help to make sense of it all. More importantly, they will need to help the business use the new connections and data for positive transformation.

For More Information

Read the Cisco white paper, [Embracing the Internet of Everything to Capture Your Share of \\$14.4 Trillion](#).

To read additional Cisco IT case studies about a variety of business solutions, visit [Cisco on Cisco: Inside Cisco IT](#).

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