

The evolution of products into intelligent, connected devices—which are increasingly embedded in broader systems—is radically reshaping companies and competition.

Smart thermostats control a growing array of home devices, transmitting data about their use back to manufacturers. Intelligent, networked industrial machines autonomously coordinate and optimize work. Cars stream data about their operation, location, and environment to their makers and receive software upgrades that enhance their performance or head off problems before they occur. Products continue to evolve long after entering service. The relationship a firm has with its products—and with its customers—is becoming continuous and open-ended.

In our previous HBR article, “How Smart, Connected Products Are Transforming Competition” (November 2014), we examined the implications external to the firm, looking in detail at how smart, connected products affect rivalry, industry structure, industry boundaries, and strategy. (See the sidebar “Implications for Strategy.”) In this article we’ll explore their internal implications: how the nature of smart, connected products substantially changes the work of virtually every function within the manufacturing firm. The core functions—product development, IT, manufacturing, logistics, marketing, sales, and after-sale service—are being redefined, and the intensity of coordination among them is increasing. Entirely new functions are emerging, including those to manage the staggering quantities of data now available. All of this has major implications for the classic organizational structure of manufacturers. What is under way is perhaps the

most substantial change in the manufacturing firm since the Second Industrial Revolution, more than a century ago.

The New Product Capabilities

To fully grasp how smart, connected products are changing how companies work, we must first understand their inherent components, technology, and capabilities—something that our previous article examined. To recap:

All smart, connected products, from home appliances to industrial equipment, share three core elements: *physical* components (such as mechanical and electrical parts); *smart* components (sensors, microprocessors, data storage, controls, software, an embedded operating system, and a digital user interface); and *connectivity* components (ports, antennae, protocols, and networks that enable communication between the product and the product cloud, which runs on remote servers and contains the product’s external operating system).

Smart, connected products require a whole new supporting technology infrastructure. This “technology stack” provides a gateway for data exchange between the product and the user and integrates data from business systems, external sources, and other related products. The technology stack also serves as the platform for data storage and analytics, runs applications, and safeguards access to products and the data flowing to and from them. (See the exhibit “The New Technology Stack.”)

Idea in Brief

A RADICAL SHIFT	NEW RELATIONSHIPS	NEW PROCESSES	NEW STRUCTURES
Smart, connected products are forcing companies to rethink their industries and nearly everything they do, beginning with their strategies. This article, the second in a two-part series, focuses on the impact of these products on companies’ operations and organizational structure.	The unprecedented data and capabilities that smart, connected products provide are changing the way firms interact with their customers. Those relationships are becoming continuous and open-ended.	The new product capabilities and infrastructure and the data they generate are reshaping the work of virtually every function in the value chain, including product development, IT, manufacturing, logistics, marketing, sales, and after-sale service. In addition, far more intense coordination among functions is now required.	New forms of cross-functional collaboration and entirely new functions are emerging. These include unified data organizations, units to continuously improve products postsale, and groups charged with optimizing customer relationships.

This infrastructure enables extraordinary new product capabilities. First, products can *monitor* and report on their own condition and environment, helping to generate previously unavailable insights into their performance and use. Second, complex product operations can be *controlled* by the users, through numerous remote-access options. That gives users the unprecedented ability to customize the function, performance, and interface of products and to operate them in hazardous or hard-to-reach environments.

Third, the combination of monitoring data and remote-control capability creates new opportunities for *optimization*. Algorithms can substantially improve product performance, utilization, and uptime, and how products work with related products in broader systems, such as smart buildings and smart farms. Fourth, the combination of monitoring data, remote control, and optimization algorithms allows *autonomy*. Products can learn, adapt to the environment and to user preferences, service themselves, and operate on their own.

Reshaping the Manufacturing Company

To create products and get them to customers, manufacturers perform a wide range of activities, which generally take place in a standard set of functional units: research and development (or engineering), IT, manufacturing, logistics, marketing, sales, after-sale service, human resources, procurement, and finance. The new capabilities of smart, connected products alter every activity in this value chain. At the core of what is reshaping the value chain is data.

THE NEW DATA RESOURCE. Before products became smart and connected, data was generated primarily by internal operations and through transactions across the value chain—order processing,

IMPLICATIONS FOR STRATEGY

In a smart, connected world, companies face 10 new strategic decisions. A firm’s choices will have a major impact on every activity in its value chain.

- 1 Which set of smart, connected product capabilities and features should the company pursue?
- 2 How much functionality should be embedded in the product and how much in the cloud?
- 3 Should the company pursue an open or closed system?
- 4 Should the company develop the full set of smart, connected product capabilities and infrastructure internally or outsource to vendors and partners?
- 5 What data must the company capture, secure, and analyze to maximize the value of its offering?
- 6 How does the company manage ownership and access rights to its product data?
- 7 Should the company fully or partially disintermediate distribution channels or service networks?
- 8 Should the company change its business model?
- 9 Should the company enter new businesses by monetizing its product data through selling it to outside parties?
- 10 Should the company expand its scope?

SOURCE: “HOW SMART CONNECTED PRODUCTS ARE TRANSFORMING COMPETITION,” HBR, NOVEMBER 2014