How Smart, Connected Products Are Transforming Companies

A HARVARD BUSINESS REVIEW WEBINAR FEATURING

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OVERVIEW
Smart, connected products are completely transforming the value chain. As a result, companies are redefining their industries and rethinking nearly everything they do. Firms are reconsidering their strategies related to product development, marketing and sales, manufacturing, and after-sales service. In addition, smart, connected products have profound implications for organizational structure, including new forms of cross-functional collaboration and entirely new functions. Although industries are in the early stages of the smart, connected product revolution, all CEOs must consider whether their companies are equipped to play in this new arena.

CONTEXT
Michael Porter and James Heppelmann discussed how smart, connected products are driving a new wave of value creation and explored the impact of these products on competition, as well as organizational structures.

KEY TAKEAWAYS
Unlike prior waves of IT-driven competition that revolutionized company processes, smart, connected products leverage embedded IT to create value.

Smart, connected products are not synonymous with the Internet of Things. The Internet simply provides ubiquitous connectivity at low cost. What is different with smart, connected products is that the products themselves are enabling the revolution. Their capabilities are unlocking new value and transforming both companies and competition.

Smart, connected products represent the third wave of IT-driven competition. In the past, value chain automation and value-chain integration changed the company processes that support competition. Smart, connected products are different. Because IT is actually embedded in the products, it changes how value is created and the nature of competition.

Figure 1
The Third Wave of IT-Driven Competition
Smart, connected products have many of the same physical components that products have always had, but also have new features that make them more intelligent. For example, sensors collect information on a product's environment and software has replaced many hardware components. Various interfaces now enable users to control products. In addition, many products are connected to the Internet and the "product cloud" which runs remote software connected to the products. A new technology stack is needed to support and enable smart, connected products.

Tesla, for example, is a leader in the smart, connected car market. In its Model S, software updates made through the cloud allow the car to be continually improved and optimized without visits to a dealer.

The competitive landscape is being reshaped by smart, connected products offering new capabilities.

The new capabilities delivered by smart, connected products build on one another:

1. **Monitoring.** Products can monitor and report on themselves and their environment in real time, creating new data and insights.

2. **Control.** Smart, connected products can be controlled through software embedded within them or that resides in the cloud. Users have an unprecedented ability to tailor product function and personalize interactions. Remote control of products increases employee safety and can reduce the number of employees needed.

3. **Optimization.** Algorithms and analytics can optimize product operation, capacity utilization, and predictive maintenance.

4. **Autonomy.** Access to monitoring data, remote control, and optimization algorithms allow for product autonomy. This enables autonomous operation, self-coordination, and self-diagnosis.

**Figure 2**

New Capabilities of Smart, Connected Products

Smart, connected products enable new categories of capabilities, with each building on the preceding layers:

- **Monitoring:**
  - Sensors and external data enables monitoring of product location, product operation, and surrounding environment.

- **Control:**
  - Software embedded in the product or cloud enables expanded and remote control of product functions.

- **Optimization:**
  - Algorithms and analytics can optimize product operation, capacity utilization, and predictive maintenance.

- **Autonomy:**
  - This combination of other capabilities enables autonomous operation and self-diagnosis.
These capabilities present an opportunity for improved profitability and growth. For example:

- **New approaches to differentiation and segmentation.** This leads to deeper relationships and greater stickiness between customers and manufacturers. It may also enable companies to shift competition away from price.

- **Greater component standardization.** Smart, connected products allow standardization of mechanical parts. This can lower costs because much of the functionality is driven by software, rather than hardware.

- **Higher barriers to market entry.** The technology stack, as well as the complex fusion of products and technologies, leads to higher barriers to entry for other competitors.

On the other hand, smart, connected products also present challenges:

- **High fixed costs.** Many of the costs associated with these products are fixed, such as software development and building the product cloud. In the face of high fixed costs, companies tend to cut price to generate volume. This is something firms must watch out for.

- **Feature “arms races.”** Sometimes companies go overboard adding new functions and features, which drive up costs and reduce profitability.

- **Reduced product demand.** If products are used infrequently, product sharing among consumers may increase.

- **New industry entrants.** In the home thermostat market, for example, Nest is now a major competitor thanks to its smart, connected product philosophy.

**As manufacturers enter the world of smart, connected products, they face new strategic choices.**

Smart, connected products make the strategy playbook for manufacturing companies more complex. Companies face new choices involving important tradeoffs. Heppelmann outlined 10 important strategic questions:

1. Which product capabilities to pursue?
2. Whether to embed functionality in the product or the cloud?
3. Whether to develop an open or proprietary system?
4. Whether to handle technology development internally or outsource to vendors?
5. Which data to capture with sensors and how often?
6. How to manage data rights, access, and security?
7. Whether to disintermediate distribution or service channels?
8. Whether to change the business model?
9. Whether to sell data to outside parties?
10. Whether to expand the product scope to systems?

“The net effect of smart, connected products will be different in every industry, but across the board the nature of competition will change.”

—MICHAEL PORTER
One of the biggest impacts of these choices is that business boundaries are expanding and shifting. For example, in the farm equipment industry, the products (like tractors) have become smart products with embedded technology, and can be connected with planters, harvesters, and tillers. Even more broadly, they can become farm management systems (“product systems”) with data related to irrigation, seeds, fertilizer, weather patterns, and more. What were once sole-purpose products are now entire systems and platforms. When this occurs, competition has expanded beyond farm equipment to a broader industry with more players.

**Figure 3**
Expanding and Shifting Industry Boundaries—Farm Equipment

With **smart, connected products, data is a critical new resource**.

Smart, connected products generate new data flows. Companies must find ways to turn that data into insights. This requires work in two areas:

- **Data aggregation and storage.** Companies must store and manage product data, external data, and enterprise data from customer relationship management systems and other platforms. All these information streams can be aggregated into a “data lake.” This requires a database that can handle unstructured data in its native format. In many cases, manufacturing companies find they need new forms of IT expertise.

- **Data analytics.** Data alone doesn’t create competitive advantage. Competitive advantage becomes a reality when companies analyze and act on the data. Companies can benefit from descriptive, diagnostic, predictive, and prescriptive analytics.

**Smart, connected products mean profound changes for the value chain.**

Every aspect of the value chain, from product development to after-sales service, is affected when companies sell smart, connected products. The impacts on organizations include:

- **Product development.** In the past, product development was generational as companies focused on periodic product releases. Looking ahead, design will become increasingly
iterative. With “evergreen design,” companies will improve products continuously. Even if the physical product remains unchanged, it can be updated via software in the cloud. As design philosophies change, the composition of the design team is also changing. In addition to mechanical engineers, companies need software engineers and data scientists.

- **Marketing and sales.** As companies gather and analyze product data, they gain new insights into customer segmentation and product customization. Smart products are a new basis for a direct and ongoing dialogue with consumers. New business models will emerge as products can be offered as a service. Sales and marketing teams will need broader knowledge to position offerings as part of larger smart, connected systems.

- **Manufacturing.** Smart, connected machines are reshaping manufacturing plants. This is evident with initiatives like Industrie 4.0 in Germany and Smart Manufacturing in the United States. Networked machines automate and optimize production, increasing efficiency and reducing malfunctions. Product components are becoming simpler as functionality shifts from mechanical parts to software.

- **After-sales service.** Smart, connected products make it feasible to deliver service remotely. In addition, sensor data can predict when parts are about to break, which makes predictive maintenance possible. More and more service technicians will use augmented reality applications that tap into the product cloud and generate a digital overlay of the product.

- **Security.** As IT is pushed into products, security concerns become amplified. Companies now are tasked with protecting thousands or millions of products in the field. Security must be embedded as a first principle in product design and across the value chain.

As manufacturing firms become hybrid hardware and software companies, they must adopt new organizational structures.

Smart, connected products are driving manufacturing firms to become both hardware and software companies. This is significant, since manufacturing companies have been organized in a similar way for decades. Now companies need new forms of collaboration and entirely new functional units.

“Before companies can determine what data is valuable, they must collect large volumes of information and then find patterns that correlate to events they care about.”

- JAMES HEPPELMANN
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Manufacturing firms must develop four new functions:

1. **Unified data organization.** A chief data officer leads this group, which captures, aggregates, and analyzes data for the entire organization.

2. **Tighter IT & R&D collaboration.** This reflects the new need for IT in product development.

3. **Dev-Ops.** Dev-Ops groups manage the product cloud. Since smart, connected products stop functioning if the product cloud fails, companies must carefully maintain, upgrade, and fix bugs in the product cloud.

4. **Customer success management.** Companies must ensure that customers derive full value from their products. As a result, marketing is evolving into customer success management.

**OTHER IMPORTANT POINT**

- **Service industries.** Smart, connected products will also be a game changer in service industries. These products are driving efficiency and productivity improvements in the airline industry, health care, and even low-tech companies like parking garages.
Biographies

Michael E. Porter  
Bishop William Lawrence University Professor, Harvard Business School  

Michael E. Porter is a leading authority on competitive strategy; the competitiveness and economic development of nations, states, and regions; and the application of competitive principles and strategic approaches to social needs, such as health care, innovation, and corporate responsibility. Porter is generally recognized as the father of the modern strategy field, and has been identified in rankings and surveys as the world’s most influential thinker on management and competitiveness. As the Bishop William Lawrence University Professor based at Harvard Business School, Porter has received the highest professional recognition that can be awarded to a Harvard faculty member.

James E. Heppelmann  
President and CEO, PTC  

James (Jim) Heppelmann is the president and chief executive officer (CEO) of PTC and is responsible for driving PTC’s global business strategy and operations. Previous to his appointment as CEO, Heppelmann served as PTC’s president and chief operating officer, responsible for managing the operating business units of the company including R&D, Marketing, Sales, Services, and Maintenance. He also serves on PTC’s Board of Directors. Heppelmann has worked in the information technology industry since 1985 and has extensive experience developing and deploying large-scale product development systems within the manufacturing marketplace.

Adi Ignatius (Moderator)  
Editor-in-Chief, Harvard Business Review  

Adi Ignatius joined HBR as Editor in Chief in January 2009. Previously, he was Deputy Managing Editor for TIME. He was the editor of two New York Times bestselling books: President Obama: The Path to the White House and Prisoner of the State: The Secret Diaries of Premier Zhao Ziyang. Prior to his 2007 appointment as Deputy Managing Editor, Ignatius served as Executive Editor of TIME starting in 2002, and from 2004 to 2007, he also held the additional title of Editor of TIME Canada. Ignatius joined TIME as Deputy Editor of TIME Asia in 1996 and was named Editor of that edition in 2000. He also wrote frequently for TIME, including cover stories on Google Inc. and the 2007 Person of the Year profile of Vladimir Putin. Prior to joining TIME, Ignatius worked for many years at the Wall Street Journal, where his work was nominated for a Pulitzer Prize.

Ignatius was awarded a Zuckerman Fellowship at Columbia University’s School of International and Public Affairs in 1990. He received his BA in History in 1981 from Haverford College. He is a member of the Council on Foreign Relations and the Asia Society.
Sponsor’s Perspective

Service organizations take note: smart, connected products will have a direct, and immediate, impact on value creation for your business and how you compete. While we’re still in the very early days of applying IoT technologies and machine data to service, we’re starting to see a shift in application from aspirational to practical:

- The opportunity to **create value through new service offerings** and use technology to deliver on their customer promises is becoming a real conversation.
- Manufacturers are further along—with 40% stating they have embedded sensors in their installed products (Tata Consulting, 2015).
- The changes in the technology landscape are also the **driving force behind our strategic partnership with PTC**.
- Smart, connected products and **outcomes-based service** have become central elements of ServiceMax’s technology solutions and vision.

Professor Porter’s insights on the impact that smart, connected products will have on the economy stood out most during the webcast. The renowned Harvard economist reasoned that, “smart, connected products may change the boundaries of what industries you’re in.” He also put forward that this might represent the biggest change to manufacturing since the Industrial Revolution. Providing the technology solutions to enable the discovery of new concepts and value that will come from these machines and their data is an exciting prospect.

- The consumer-facing services Porter mentioned, such as Nest, are a great example. However, it’s the **power IoT technology will have on the industry** that excites the field service professionals at ServiceMax.
- It’s in field service that we find one of the more compelling use cases for smart, connected products—opening up possibilities for competitive advantage and **using service to differentiate and increase market share**.

Through our partnership with PTC, ServiceMax is launching the first complete IoT solution for field service in just a few weeks. It helps make flawless, profitable service a reality by connecting smart products to our field service software.

- Our **smart, connected service system** knows immediately when something has failed or is about to fail, and automatically dispatches the necessary technician and parts to repair the machine.
- **Outages and downtime are minimized**, calls to the service desk become obsolete, and most importantly, the customer views your product and your service as exemplary.
- **Remote service and asset software management** is a key part of this solution and will prove critical as organizations become connected.

ServiceMax is proud to be a key player in fundamentally transforming the delivery of proactive, intelligent service through smart, connected products.

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**The Platform for Field Service**

![The first Internet of Things solution enabled for your service people, delivery processes, serviceable products and customer promises.](image)

**ABOUT SERVICEMAX**

Imagine flawless field service. At ServiceMax, we help customers of all sizes perfect their service delivery process, drive revenue growth, and not just satisfy customers, but also delight them. ServiceMax makes mobile, cloud-based software that makes field service smarter, more efficient and more profitable than you can imagine. ServiceMax delivers a full suite of field service management applications in the cloud, including contract entitlements, scheduling & workforce optimization, inventory & parts logistics, cutting edge mobility, social collaboration, and real-time customer and partner portal access. Our customers, on average, increase productivity by 31%, service revenue by 14% and customer satisfaction by 10%.