

Why Your Products Must be Smart and Connected

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It's become increasingly conceivable and cost effective to embed sensors, wireless communication, and software into all kinds of products—from complex \$100,000 industrial machines to \$100 thermostats sold on the mass market. Exponential improvements in computing power, advances in sensor miniaturization, and pervasive connectivity have paved the way. It's a transformation, described by Harvard Business School professor Michael E. Porter and James Heppelmann, CEO of software company PTC, as a move from goods that are simply composed of mechanical and electrical parts to the complex systems we now know as smart, connected products.⁹

B2B manufacturers of high-cost assets have led the way in this revolution—turning their products into services, or 'servitizing' them—with significant results. Schindler no longer simply

⁹ Harvard Business Review, How Smart, Connected Products Are Transforming Competition, November 2014, Accessed August 03, 2017, <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition>

produces elevators capable of transporting passengers up and down reliably; the company's technology can analyze and predict elevator demand patterns to reduce elevator wait times by as much as 50%.¹⁰ GE has long sold jet engines, locomotives, gas-fired turbines and medical imaging equipment. Today it sells smart, connected versions of the same equipment along with new services built upon the vast amounts of data they generate. The result is a business model that not only sells jet engines, for example, but a 'full spectrum of performance enhancements across the management of a flight.'¹¹ Farm and construction equipment maker Caterpillar has more than 500,000 connected assets in service, from autonomous mining trucks to tug boats.¹²

The business value of connecting expensive assets like jet engines and mining equipment—machines that can cost companies millions in revenues if they are out of service or run inefficiently—to the Internet of Things is clear. But embedding sensors and connectivity into lower-value consumer products can deliver significant benefits as well. A number of brands have already introduced smart, connected versions of everyday goods, from home printers that can order their own ink before they run out to refrigerators that can order more milk.

The smart home space is abuzz with developments in automation and control. Even a product as seemingly simple as a toothbrush is getting the smart, connected treatment. Procter & Gamble's Oral-B Genius pairs a position detection sensor in the brush with a mobile app to help users identify spots they're missing with their oral hygiene approaches.¹³ As of February 2016, P&G said it had sold more than 1 million Oral-B SmartSeries toothbrushes worldwide. Yet it called the product merely "the tip of the iceberg."¹⁴

¹⁰ Harvard Business Review, How Smart, Connected Products Are Transforming Competition, November 2014, Accessed August 03, 2017, <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition>

¹¹ GE, Thrust for Sale: Innovation Takes Flight, Accessed August 03, 2017, <https://www.ge.com/digital/blog/thrust-sale-innovation-takes-flight>

¹² QuickBase, Smart Iron – How Caterpillar is Leveraging Data to Maximize Customer Experience, January 17, 2017, Accessed August 03, 2017, <http://www.quickbase.com/blog/smart-iron-how-caterpillar-is-leveraging-data-to-maximize-customer-experience>

¹³ Cincinnati Business Courier, P&G's latest smart toothbrush pinpoints the spots you're missing, February 23, 2016, Accessed August 03, 2017, <https://www.bizjournals.com/cincinnati/news/2016/02/23/p-g-latest-smart-toothbrush-pinpoints-the-spots.html>

¹⁴ Business Insider, Oral-B just unveiled a new smart toothbrush which shows the potential P&G has to make more of its products 'smart,'" February 22, 2016, accessed August 03, 2017, <http://www.businessinsider.com/oral-b-genius-toothbrush-hints-at-future-connected-pg-products-2016-2>

Successful manufacturers of smart, connected products adopt new technologies, including sensors, connectivity and personalization technologies, and smart materials. They must innovate not just around products, but also with their business models, to create a lean, efficient and cost-effective ecosystem that runs from the supply chain through to customers, from whom they receive real-time data and insights on product usage. Through these actions, manufacturers can translate insights from data into profitable business models for today's data economy. This is a major paradigm shift. In the past, products were sold as capital equipment churning huge revenues. In the data economy, the aim for manufacturers is to build a revenue stream by selling more services.

To match the rapid pace of change in their customers' preferences, manufacturers also have to be ready to run their business models like a social network—distributed yet connected, real-time and with a non-linear propagation. They also have technological and operational capabilities to support these ongoing changes, in products, data management, and services.

Still, many consumer and B2B companies have yet to begin making their products smart and connected. Only about a quarter (26%) of the 800 large companies we surveyed around the globe in 2015 said they had made a smart, connected product. What's more, they estimate they devoted less than a third of their Internet of Things budgets to smart product monitoring.

But companies will very soon pay a competitive price for sitting on the sidelines in the smart, connected product space. The cost of IoT sensors is rapidly declining, from \$1.30 in 2004 to a predicted \$0.38 in 2020.¹⁵ Bandwidth, processing, and storage costs have also declined several tenfolds over the last decade. The analytics systems required to make sense of the data produced by smart, connected devices are also becoming more advanced.

¹⁵ Hot for Security, The price of hardware that boosts IoT development is dropping, Goldman Sachs says, July 04, 2016, Accessed August 03, 2017, <https://hotforsecurity.bitdefender.com/blog/the-price-of-hardware-that-boosts-iot-development-is-dropping-goldman-sachs-says-14342.html>

As these trends continue, sensor technology will become ubiquitous. Gartner forecasts that 8.4 billion connected things will be in use worldwide in 2017, reaching 20.4 billion by 2020.¹⁶ The Boston Consulting Group predicts that companies will spend \$267 billion on IoT technologies, products and services in 2020.¹⁷

Nearly every manufacturer today should be exploring making their products smart and connected—not simply because the cost of doing so is dropping dramatically, but because there are increasingly clear benefits to doing so.

And the stakes for failing to ask the question could mean the difference between future success and failure.

¹⁶ Gartner, Gartner Says 8.4 Billion Connected “Things” Will Be in Use in 2017, Up 31 Percent From 2016, February 07, 2017, Accessed August 03, 2017, <http://www.gartner.com/newsroom/id/3598917>

¹⁷ BCG Perspectives, Winning in IoT: It’s All About the Business Processes, January 05, 2017, Accessed August 03, 2017, <https://www.bcgperspectives.com/content/articles/hardware-software-energy-environment-winning-in-iot-all-about-winning-processes/>

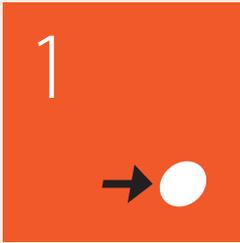
Seven Business Benefits of Smart, Connected Products

When a product—whether a \$35,000 automobile or a \$150 electric toothbrush—is ‘smart’, it has sensors, processors, and software embedded in them that can track key aspects of their performance—fuel performance or toothbrushing execution. And when that product is ‘connected’, it can wirelessly transmit the data it collected.

When companies are able to continuously analyze the data streaming from these products, it opens up a world of potential business value and competitive advantage. It creates the unprecedented ability to monitor products at the most important stage of their lifecycle—when they are in the customer’s hands. That provides an unambiguous, new source of business intelligence in a wide variety of areas—from product performance to customer experience. Smart, connected capabilities are already enabling manufacturers of both high- and low-end products to reimagine not just their products, but also their business models.

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While the business value of a smart, connected product will vary by industry, market factors, and customer needs, we have identified 7 benefits that await businesses, which embrace them.



Faster, more effective product updates and development.

Because manufacturers can continuously monitor products in use, they can update their products, patch problems, and rethink functionality—all of which improves customer satisfaction. The intelligence from smart, connected products can also inform future product features and new product development. We are all familiar with automatic app updates on our phones, giving us access to new features or fixing problems over the air. Smart, connected products can update themselves in the same way. Diebold, for example, can update and add new features to its smart, connected ATMs remotely via software.¹⁸ Fitbit has been able to increase its new product development thanks to the information it has on how customers use the fitness band—and those new offerings can come in the form of either hardware or software options.¹⁹



Cheaper, more efficient maintenance and repair.

Because smart, connected products can be monitored in the field, that data can be used to significantly streamline the process of maintenance and repair. Rolls Royce tracks the health of thousands of aircraft engines operating worldwide using onboard sensors and live satellite feeds. Its Engine Health Management system can predict when something might go wrong to address it proactively or transmit data on an engine problem so airlines can have their service technicians ready with the right part to make repairs when it lands, resulting in less downtime.²⁰

¹⁸ Harvard Business Review, How Smart, Connected Products are Transforming Competition, November 2014, Accessed August 03, 2017, <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition>

¹⁹ The Verge, Fitbit has confirmed that at least two more products will ship this year, August 02, 2016, Accessed August 03, 2017, <https://www.theverge.com/2016/8/2/12362080/fitbit-earnings-Q2-will-release-at-least-two-new-products-2016>

²⁰ Rolls-Royce, Engine Health Management, Accessed August 03, 2017, <https://www.rolls-royce.com/about/our-technology/enabling-technologies/engine-health-management.aspx#sense>

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New, better business models.

Many industrial manufacturers are remaking themselves as service providers by creating new business lines based on the analysis of smart product data. GE Digital, for example, launched its Brilliant Manufacturing software and service using real-time visibility into smart, connected machines to help customers maintain equipment based on operating conditions (rather than a breakdown), thus driving greater efficiency.²¹ In fact, some companies may see a benefit in shifting their business models from selling goods to renting products and offering services. Michelin, for example, has gone to market with a smart, connected tire that is a product-service hybrid. Fleet customers sign up for their customized tire lease programs and pay by the mile for their usage while Michelin oversees any maintenance or repair.²²

The data that manufacturers gather from their smart, connected products may also have value to other companies or organizations that would pay for it. For example, analysis of P&G's Oral-B Genius data could be sold to retailers or dentists who could use that intelligence to better run their own businesses. Or, consider the opportunity that an automaker has to send useful information to motorists through an in-car infotainment system—such as the location of a parking lot or a nearby event. The automaker becomes a medium through which other businesses communicate to prospective customers.

²¹ GE, Everything you need to know about the Industrial Internet of Things, Accessed August 03, 2017, <https://www.ge.com/digital/blog/everything-you-need-know-about-industrial-internet-things-products-2016>

²² Michelintruck, MICHELIN® FLEET SOLUTIONS™, Accessed 03, 2017, <http://www.michelintruck.com/services-and-programs/michelin-fleet-solutions/>

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Improved product usage.

A smart, connected product can provide intelligence and guidance to customers to help them make better use of it or engage more deeply with the brand. Progressive Insurance, which has a usage-based auto insurance product built upon in-car telematics sensors and monitoring, is one example. It launched a mobile app for customers that, at the end of each trip, gives drivers personalized information, including a one- to five-star rating, a data summary, a map of their drive, and tailored driving tips, to help them improve their score.²³

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Better product recall processes.

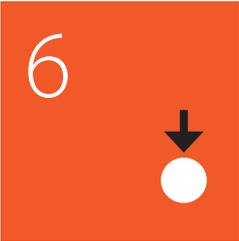
Poorly handled product defects and hazards can be enormously expensive to brands, not only in direct costs but reputational damage, as evidenced by incidents such as Takata's giant and expanding airbag recall which drove it to bankruptcy²⁴ and Samsung's Galaxy Note 7 recall, which cost the company \$5.3 billion.²⁵ With sensing, connectivity, and the ability to detect a customer's product problems, manufacturers can uncover dangerous defects more quickly and provide fixes more effectively. When the National Highway Traffic Safety Administration announced that a Tesla Motors' charger plug had been discovered to cause fires, Tesla owners didn't have to do anything; the company provided an 'over the air' software update to fix it.²⁶

²³ Progressive, Progressive® Insurance launches pilot Snapshot mobile app, September 02, 2015, Accessed August 03, 2017, <https://www.progressive.com/newsroom/article/2015/september/snapshot-mobile-app/>

²⁴ Engadget, Faulty airbags cost Takata everything, June 26, 2017, Accessed August 03, 2017, <https://www.engadget.com/2017/06/26/faulty-airbags-cost-takata-everything/>

²⁵ LA Times, Samsung Galaxy Note 7 recall to cost at least \$5.3 billion, October 14, 2016, Accessed August 03, 2017, <http://www.latimes.com/business/technology/la-fi-tn-samsung-recall-20161014-snap-story.html>

²⁶ Wired, Tesla's Over-the-Air Fix: Best Example Yet of the Internet of Things?, Accessed August 03, 2017, <https://www.wired.com/insights/2014/02/teslas-air-fix-best-example-yet-internet-things/>



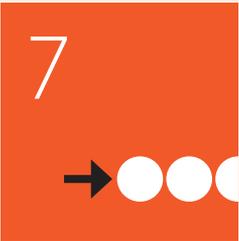
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Reduced environmental impact.

Manufacturers of smart, connected products can retain more control over what happens to a product not only during the lifecycle of its first purchase, but how it might be reused or recycled to reduce its negative environmental impact. Companies that can track individual products can better ensure its parts are recycled correctly or even reused in entirely new ways rather than being dumped in landfills.

Some visionary manufacturers are adopting a product-as-a-service approach that ensures that this is the case. For instance, if a telecom company provides handsets or smartphones as a part of its service contracts, it may collect, refurbish, and reuse them in areas where there is an economic need to provide less expensive options. With a lifetime of performance data, manufacturers can also offer reconditioned products with warranties similar to new options.



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More intelligent, adaptive supply chains.

Industrial equipment manufacturers can deploy ‘digital twins’: 3-D virtual-reality replicas of their physical products to help them model manufacturing flows and figure out how to eliminate bottlenecks or adapt to changes. As data streams in, the digital stand-in shows how the product reacts to various conditions. It then demonstrates how it can be used to “provide new insights into how products can be better designed, manufactured, operated, and serviced,” according to Porter and Heppelmann.²⁷

Ultimately, manufacturers can embrace not just connected, but cognitive supply chains to enable automated just-in-time or just-in-sequence manufacturing.

²⁷ Harvard Business Review, How Smart, Connected Products are Transforming Companies, October 2015, Accessed August 03, 2017, <https://hbr.org/2015/10/how-smart-connected-products-are-transforming-companies>

How to Evaluate Your Smart, Connected Opportunity

It's becoming clear that for most manufacturers it should no longer be a question of 'if' they make their products smart and connected, but 'when'. Those that wait too long to adapt to this new reality will get left behind.

Still, manufacturers must be prudent in their approach in this arena. Efforts to develop smart, connected products for the sake of doing so without a clear understanding of transformation requirements and business value are bound to fail. While the barrier to entry in the smart, connected product world is low—and getting lower by the day—companies must be thoughtful about what they will do with the data these intelligent products will collect. Figure 4 gives some examples of issues to consider.

Figure 4: Smart Products: Factors to Consider

Factor	Questions to ask	Example
Differentiation	Will a smart product make your offerings more attractive? Can data collection improve future product development?	Boeing aircraft performance data improves design of future models.
Customer Value	Can you quantify benefits customers will receive from your smart products? Which features provide the most benefit?	HP printers order ink refills automatically.
Product Usage Patterns	How do customers use the product now? How can data enrich the customer experience?	Smart toothbrushes provide data about user's oral hygiene habits and how they might improve.
Data Management	What is your current data management maturity level? What changes do you need to make to support a big increase in customer product usage data?	Every smart, connected product, from a toothbrush to a locomotive, requires a cloud-based infrastructure to manage growing volumes of product data.

Product and service differentiation.

Companies should begin evaluating their opportunities for connected products by figuring out whether this approach would create any significant differentiation in the product category. Will it make their product more attractive to purchase? Could it inform better product development later on? Boeing's 787, which has now been in service for six years, generates more data every day than the rest of the company's fleet does in their lifetimes. That has helped the aircraft manufacturer not only improve the performance of the Boeing 787 to the benefit of its customers; it has also informed the development of the company's latest model, the Boeing 737 Max.²⁸

Quantifying customer value.

Manufacturers should also think about what kind of value—and how much—making a product smart and connected would generate for customers. The interaction customers have with a product can help determine the right approach. High-involvement products, such as vehicles or smartphones, typically have many features and thus customers can benefit greatly from the guidance provided by a smart,

connected version. Low-involvement products, like computer printers or coffee machines, tend to have much less functionality but may still benefit from sensors and connectivity that relieve customers of burdens like reordering supplies or maintenance.

Existing product usage patterns.

Companies should also think about how companies use a product before developing a smart, connected plan for it. High-utility products, like a fitness tracker, will provide many more data points, than a smart toothbrush. Thus the data may have more or wider value in the broader business ecosystem.

Your data management

capabilities. Finally, manufacturers must ensure that they are prepared to manage the explosion of digital data that smart, connected products will produce. They will need to set up the appropriate cloud infrastructure to manage these huge and growing volumes of product data. They will also have to invest in product-specific analytic capabilities and processes to generate insight based on the data. And they will need to rethink their processes to integrate that insight and act on it.

²⁸ IndustryWeek, Boeing's Rookie Plane Boss Plots Assault on Airbus with New Jets, June 08, 2017, Accessed August 03, 2017, <http://www.industryweek.com/companies-executives/boeings-rookie-plane-boss-plots-assault-airbus-new-jets>

Next Steps

In the digital era, where customer experience is the competitive differentiator and creating sustainable competitive advantage is a top priority, making products smart and connected will make sense for most manufacturers. An intelligent approach for manufacturers that want to pursue this opportunity calls for them to:

- ✓ Invest in building their network of IoT partners and collaborators
- ✓ Map out their place in a smart, connected product services-based economy
- ✓ Forecast the business models that smart, connected products may lead them to pursue
- ✓ Adapt low-cost sensors that may be used in their product categories
- ✓ Determine whether to build an IoT platform or buy the platform as a service
- ✓ Develop a robust security strategy for connected products data
- ✓ Involve legal and compliance professionals in developing the infrastructure that will support smart, connected products.

Smart, connected products are here. Firms that get a head start can strengthen their market position. They can also demonstrate to customers that they are pursuing new ways to deliver increased value. Manufacturers that find innovative ways to turn products into successful services will win.