



Smart, Connected Products

Manufacturing's Next Transformation

A report produced in partnership with **PTC**[®]



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Introduction

The Internet of Things has quickly become part of everyday life. Early examples of the technology at work are providing convenience and business value, from electronic signs that monitor and reroute traffic in real time to commercial buildings where heating and cooling units are managed as a service and can tell the manufacturer when preventive maintenance is needed. Yet much work remains before this revolution delivers on its ultimate promise.

Smart, connected products—the “Things” in the Internet of Things—are expected to power the next wave of manufacturing. The potential is vast: the McKinsey Global Institute predicts that the Internet of Things will drive productivity growth of 2.5%–5% over the next ten years. That translates into combined revenue growth and cost savings of \$900 billion per year for the manufacturing sector alone, a figure that could go much higher depending on the extent of adoption.

To better understand how manufacturers are navigating the opportunities and challenges surrounding smart, connected products (SCPs), Oxford Economics and PTC surveyed 300 manufacturing executives around the world. Only firms with strategies to develop these products were considered. The survey, along with a series of interviews with industry leaders, shows that the SCP revolution is well under way but remains in its early stages. Manufacturers are still rethinking their products, services, and processes for the new era, and most of the gains anticipated by those huge estimates remain up for grabs.

Creating products that integrate information-processing and communications is only the first challenge that manufacturers must address. More importantly, they must figure out how to build businesses around SCPs and the data they produce. This is no small job. It requires companies to transform how they organize themselves to create value for their customers.

For example, maintaining service-oriented relationships with customers instead of just selling them products is unfamiliar ground for many companies. Now, it is part of the new normal. Protecting customer privacy has not been a traditional focus for manufacturing firms; now it is. New relationships with non-traditional partners (such as software and entertainment companies for the automotive business) further complicate matters, as does leveraging usage data across business functions, including R&D, to inform next-generation products.

Smart, connected products are at a roughly similar state of development as the Internet in the late 1990s. Their enormous potential is widely recognized, but the road map to a mature market is only now starting to take shape.

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About the research

This research program is based on a survey of 300 manufacturing executives conducted in April 2014. Survey respondents came from 13 countries across North America, Europe, and Asia. Respondents are from manufacturing firms ranging from aerospace and defense to medical devices and automotive and consumer products firms. Respondents are C-level executives or direct reports from a range of business functions, including IT, strategy, engineering, service, and operations (see Fig. 1). Only firms with strategies to develop smart, connected products were considered.

Interviews were conducted with senior executives from manufacturing firms with knowledge of their firm's development of smart, connected products. These proved valuable for both the quantitative analysis and qualitative insight into the survey findings.

Fig. 1: Respondents by function

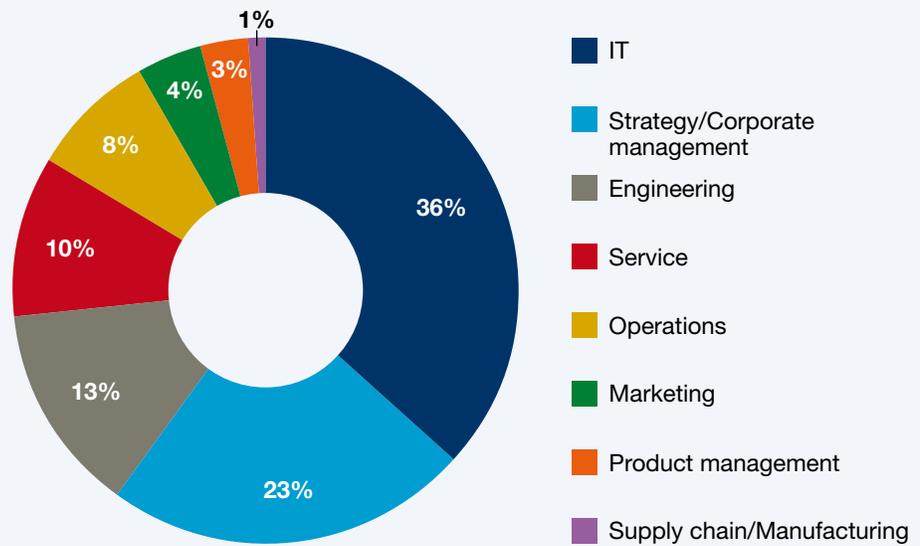
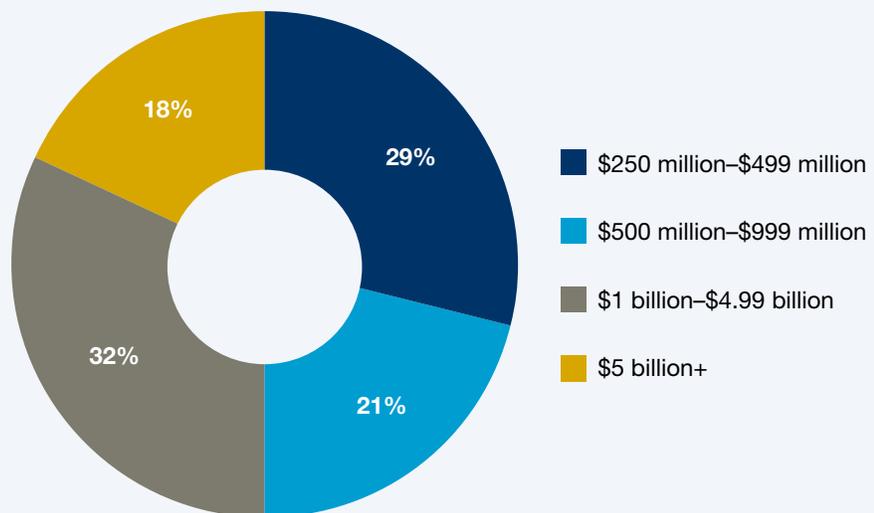


Fig. 2: Company size by revenue

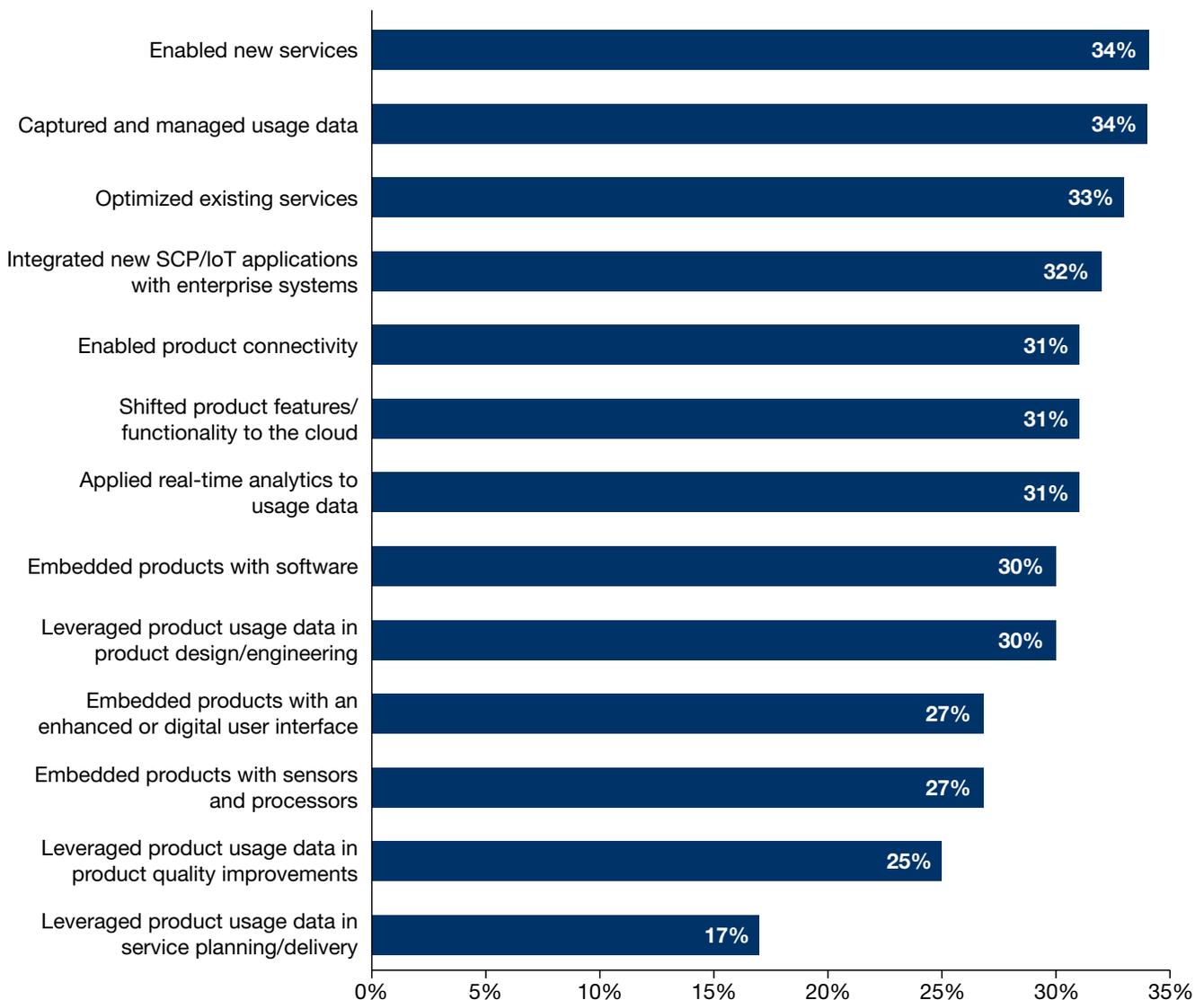


Not an overnight sensation

SCPs monitor themselves and their environments and can enable remote control, optimization, and automation. This allows manufacturers to think about their business in new ways. Freshly available features and functions can be delivered to improve revenue and margins. Operating efficiency can be increased, and new business models for capturing value are increasingly viable.

Our survey respondents are taking significant steps forward in these and other areas. But while they are in the vanguard among all manufacturers, they are in early-stage growth. The focus of early adopters involves capturing and managing product usage data, enabling product connectivity, and shifting more product features and functionality to the cloud where real-time analytics can be applied (see Fig. 3). This has enabled new services like remote monitoring or optimizing of existing services. Internally, the pioneering manufacturers have integrated new applications with enterprise systems such as Product Lifecycle Management (PLM) and Customer Relationship Management (CRM).

Fig. 3: Steps taken to transform products and services around the Internet of Things



The manufacturer's experience with maintaining and optimizing products in the field will feed back into technology and design for the next versions. But the same information can also provide manufacturers with the raw material to re-imagine their products and develop new businesses, many of them based on service propositions.

Product quality and innovation are among the main value propositions of SCPs. Nearly half of the executives surveyed believe that SCPs offer substantial or transformative value to their firms because of improved product quality, while well over half say new innovation at both the product and business level will generate substantial or transformative value. Looking ahead to future benefits, product quality will increasingly include not only the direct customer experience, which can be enhanced through continuous optimization, but better internal efficiency for maintenance and support. Innovation offers other multi-faceted benefits. On one hand, the manufacturer's experience with maintaining and optimizing products in the field will feed back into technology and design for the next versions. But the same information can also provide manufacturers with the raw material to re-imagine their products and develop new businesses, many of them based on service propositions.

The opportunity provided by SCPs is that they can add value to multiple areas simultaneously—for example, the same usage data that increases operating efficiency inside the manufacturing firm can be redirected toward solving a customer problem or improving the user experience.

Klas Bendrik, Group CIO for Volvo Cars, says the company takes various approaches to leveraging the value of SCPs. "To be sure, we are focused on the customer value side for our connected cars—at the same time it is important to have internal efficiency," he says. "However, it's not a complete separation. Take preventive maintenance, for example: You can argue that the connected capabilities are focused on internal efficiency to increase quality of ownership or the driving experience. But it also has clear customer value because you avoid unnecessary breakdowns."

However, most manufacturers are not at this point today, and it is going to take time and effort on multiple fronts to get there. Only 54% say their customers clearly understand the benefit and value of SCPs, and value creation from SCPs will grow modestly in the next three years: 42% have measureable ROI today and only 47% say they will have it in three years. Because value creation in SCPs crosses so many disciplinary boundaries, from internal operations to marketing to service to R&D, manufacturers must invest significant resources to develop multi-level strategies that cover technical, market, and organizational areas. Fully 80% of the survey respondents say their firms started developing strategies for SCPs at least two years ago, and companies with higher annual profit-margin growth tend to have been at it longer than their less dynamic peers.

Most of these strategies revolve around developing proof-of-concept projects or prioritizing selected-use cases, but the lesson should not be lost that hardening an SCP strategy and commercial offer takes time. Manufacturers that start sooner on this maturation process gain valuable clarity into how long it should take them to progress through the steps required to turn a proof-of-concept into a differentiated offering delivered at scale.

The survey data and interviews suggest that manufacturers are starting to place some bets on SCPs. But there is a world of difference between producing SCPs as pilot projects and creating a differentiated SCP-centered business. According to the survey, the typical number of employees devoted solely to SCPs ranges only between one and nine people. These include dedicated strategists, data analysts, software and application developers, and other support personnel.

There is not a direct correlation between company size and number of employees dedicated to SCPs. But it does follow that climbing the maturity curve for SCPs is not a part-time job for manufacturers. Additional investments in new skills across the enterprise will be required.

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*Klas Bendrik,
Group CIO, Volvo Cars*

Case Study: Connecting ecosystems

Connected cars are becoming standard across the automotive industry. One twist on the story: successful and leading offerings of connected services are almost as much about branding and internal organization as product performance, as Klas Bendrik, Group CIO for Volvo Cars, explains.

Volvo offers two branded services for connected cars and customers. The first is Volvo On-Call, which is included in the car and also connects to a smartphone app for activities related to the vehicle itself. For example, for emergency and breakdown calls, it can find a parked car, get access to the status of the car, start vehicles remotely for heating and cooling, and unlock the car. The second customer-facing brand is Sensus Connect, which brings in outside information and entertainment services such as music streaming, web browsing, navigation, parking solutions, and a Wi-Fi hotspot in the car.

Volvo needs these services to stay true to what differentiates its brand, which historically has revolved around the safety and reliability of the physical car. “The connected car now offers the possibility for additional convenience to our customers,” says Mr Bendrik. These connected services require additional levels of performance, some of which are not directly related to the car itself. SCPs expand the footprint of both the product and the brand ecosystem that must be put into play. “One of our core value points of the Volvo brand is safety,” says Mr. Bendrik. “But now it’s not just the safety of the physical vehicle but also the security and privacy of the customer’s information.”

Making this brand promise tangible requires significant changes in internal thinking in addition to new partners and technology infrastructure to support it. One in-house change is that manufacturers can no longer assume that their own direct assets and contributions will assure continuity of the customer experience. “For example, if you have a customer driving their connected car and the network operator doesn’t provide access, the value of the entire car suffers,” says Mr. Bendrik. “The whole ecosystem must work reliably, not just the product itself.”

Climbing the maturity curve

Over one-quarter of manufacturers are in early stages of maturing their SCP capabilities and market offers. In the main, the three initial stages for maturing an SCP business include:

- Developing an SCP strategy
- Piloting SCP capabilities in a product, service, or line of business
- Deploying SCP capabilities and hard assets at scale across business functions

How firms measure the success of their SCP strategies varies with the maturity of their efforts. Reducing product and service costs and improving quality are common goals, but companies with more advanced programs are far less likely to cite increased product revenue and improved customer satisfaction—they know from experience that these are not the primary areas of opportunity. On the other hand, more-mature firms are much more likely to cite accelerating product and service innovation than those just developing a strategy, as the explosion of opportunities driven by enhanced capabilities and data-driven innovation becomes clear to them.

Articulating strategy, changing organizational capabilities, and evolving a portfolio of metrics to gauge success are important first steps for addressing many of the opportunities surfaced by a move to SCPs. However, for the survey population and the manufacturing industry at large, SCPs present almost as many challenges. A customer's experience can no longer be isolated in a single product, but requires orchestration across numerous components of the ecosystem, and over the entire life of the product, as demonstrated in the Volvo case study.

In the short term, protecting proprietary data and intellectual property loom large as challenges that manufacturers must meet (see Fig. 4). Not all companies understand this equally well; those with flat or negative growth in their profit margins are less likely to agree that their customers are very concerned about the privacy and security of product usage data (only 40%). Another area for immediate work is the ability to create actionable insights from data analytics. However, these issues start to lessen as firms develop their SCP capabilities.

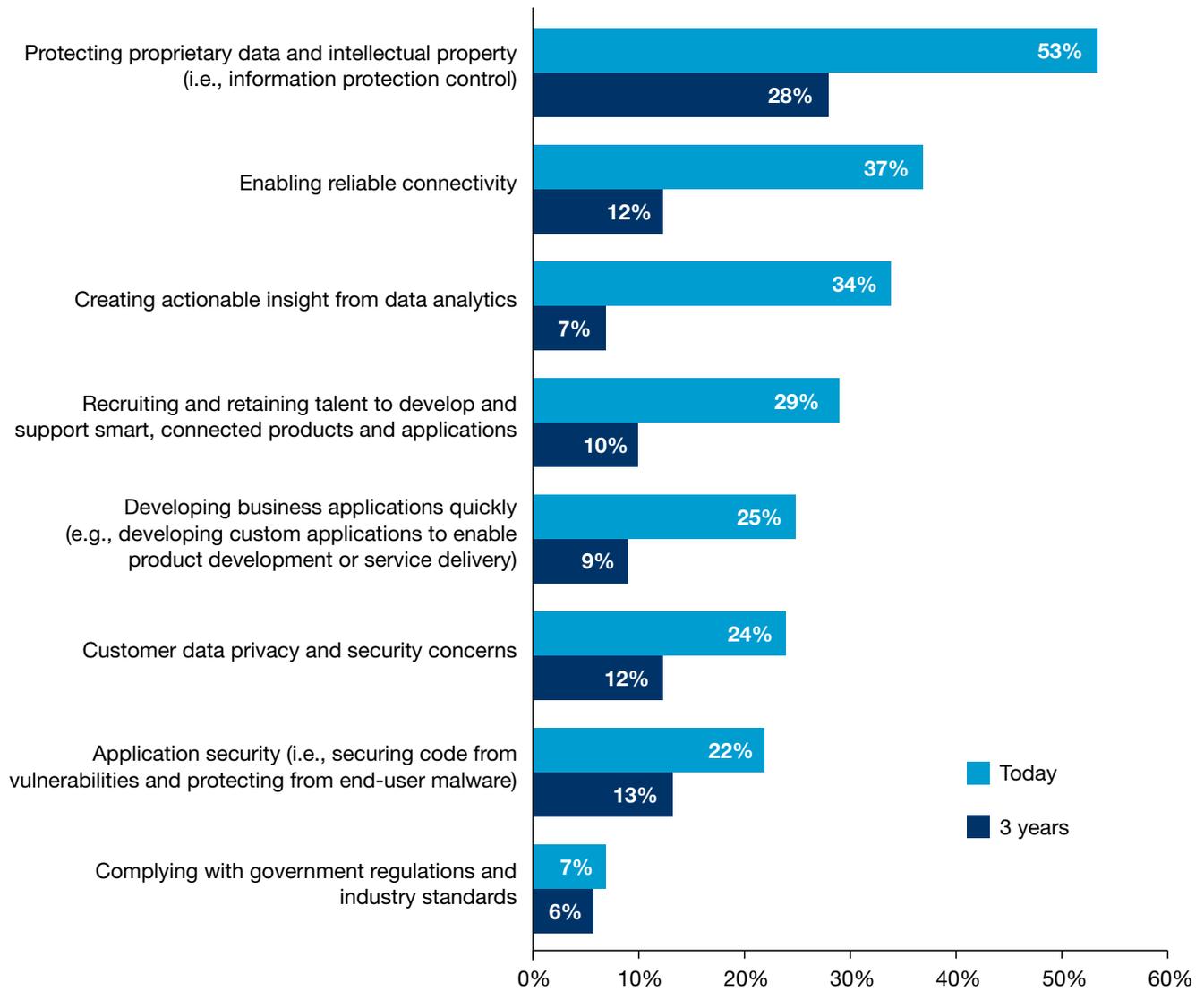
As strategies mature, the challenges shift from being product-specific to the SCP ecosystem as a whole. When asked about the major challenges they face in three years, over half of manufacturers cited integration issues with other SCPs and systems (think connected cars interfacing with connected homes) as well as integrating SCP data with internal enterprise systems such as Product Lifecycle Management (PLM) or Customer Relationship Management software (CRM).

Along with customer satisfaction, manufacturers must navigate market evolution as well. Again, views vary with the maturity of SCP strategies. While over two-thirds of manufacturers that are deploying SCPs at scale believe these products are creating a net positive effect for their industry, that optimism is tempered by the recognition that the same forces can empower new partners and suppliers at the expense of manufacturers.

More-mature firms are much more likely to cite accelerating product and service innovation than those just developing a strategy, as the explosion of opportunities driven by enhanced capabilities and data-driven innovation becomes clear to them.

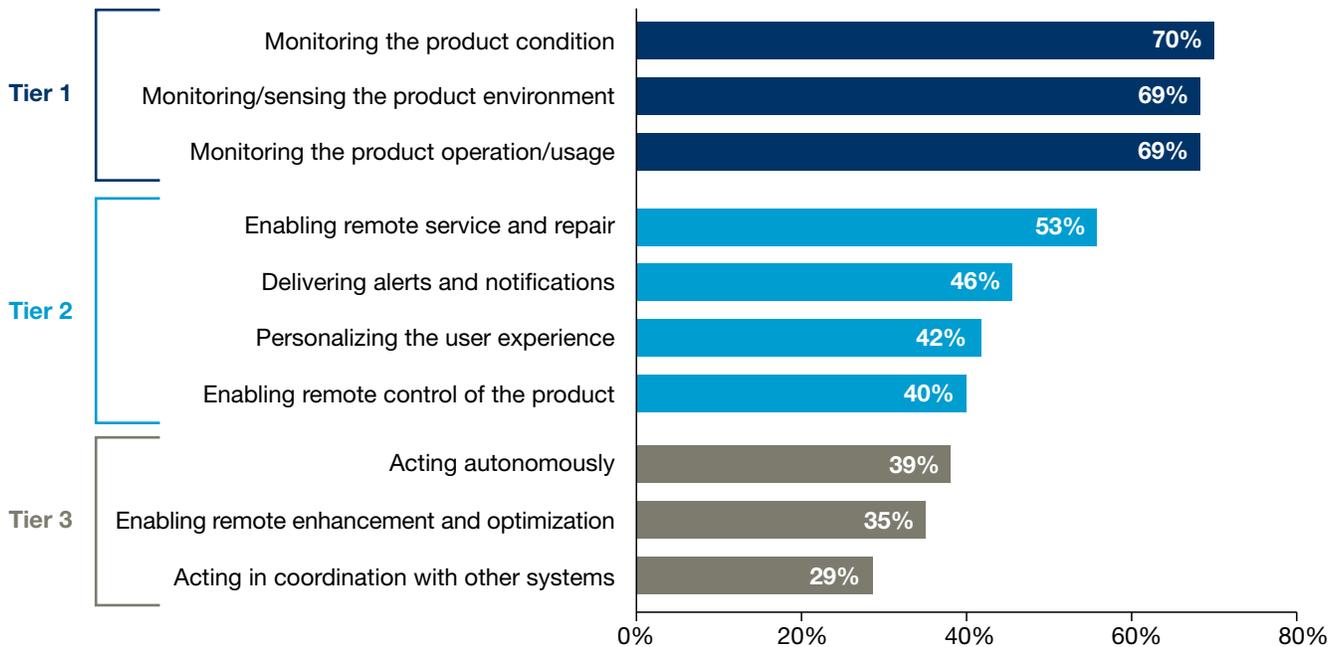
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Fig. 4: To what extent do the following issues present challenges to your firm's success with smart, connected products?



Beyond the maturity of the overall program, product capabilities show three tiers of adoption (see Fig. 5). So what have manufacturers enabled SCPs to do today? At the capability level, the continuum extends from low-level monitoring and reporting of current operating conditions, to analyzing and acting on that data, to exchanging information with other SCPs and product systems. More than two-thirds of manufacturers now make products that can monitor their current status. The numbers drop sharply when it comes to a manufacturer pushing information out to remote products. Less than half of surveyed firms can deliver alerts and notifications to their connected products, and only 40% say they enable remote control of a product. As for products speaking with other products, less than one-third of firms say their SCPs act in coordination with other product systems.

Fig. 5: Which capabilities are you building into your smart, connected products today?



So while products talking to their makers are common, products receiving actionable information is less so, and products talking to each other remains the next frontier. Like many other major business transformations, the initial spark for change was lit by technology, but lasting success depends on making the right strategic choices to harness it.

Case Study: Connecting the business to the product

Smart, connected products require substantial work on the business side of the equation. As SCP projects mature beyond proof-of-concept to become contributors to the top and bottom lines, manufacturers are rethinking how they organize core business processes such as sales and customer service.

All Traffic Solutions is the leading manufacturer of traffic safety equipment such as radar speed signs, traffic or construction information signs, and similar aids for police forces and municipalities. According to CEO Ted Graef, the primary value for customers is not the signage so much as the data it generates about traffic patterns based on volume, time-of-day, and similar factors.

Providing this customer benefit required almost as much investment of resources and talent on the sales and support side as on the R&D and production process. “We had to reorient our sales forces to make a service sale. That was a huge task to do successfully,” Mr. Graef says. “It was not just a technology change. It was a change that rippled through the organization from sales to accounting to engineering because we’re managing software performance on behalf of the client.”

Mr. Graef credits the success of this transition in part to the fact that the decision to move decisively toward a SCP-centric future came directly from the top. “If you don’t have C-level buy-in and understanding of all the changes required for success, it’s going to flounder,” he says.

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The transformation imperative

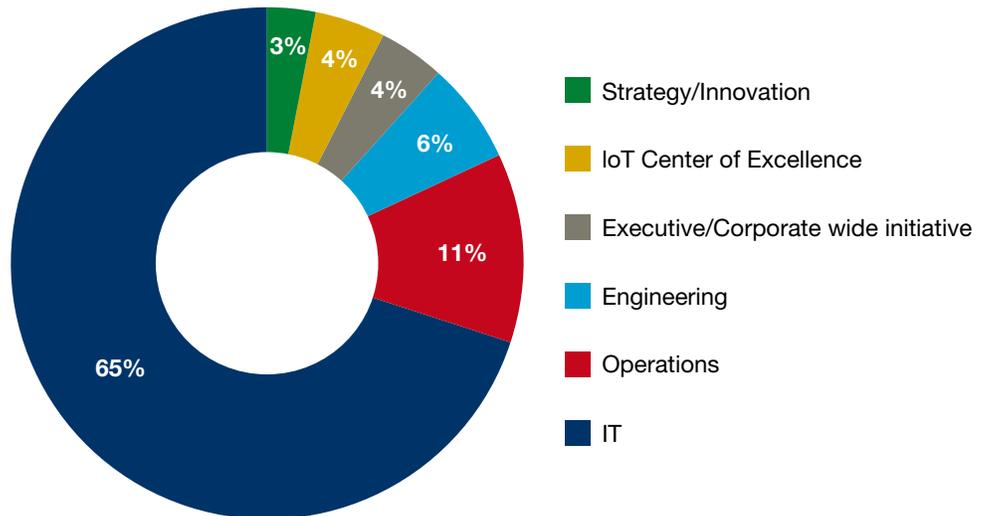
Manufacturers are reaching a point where they must commit to meaningful change around SCPs or risk being left behind. This message is getting through, as a solid majority of executives say the shift to SCPs requires significant business transformation. In three years that number climbs to 65%.

Early adopters have started to launch their 1.0 versions of transformation around SCPs. Their road map for product and organizational innovation addresses three broad shifts:

1. Transforming the organization

Manufacturers must re-think their skill sets and how they are deployed to develop and manage SCP capabilities. To date, 58% of manufacturing firms have leaned on their internal talent to develop SCP capabilities. Most executives say that their IT departments lead their firms' SCP strategy and development (see Fig. 6), with medical-device manufacturers particularly focused on IT's contribution. More-mature firms rely more heavily on non-IT departments such as IoT Centers of Excellence, Engineering, and Operations, to drive strategy.

Fig. 6: What department is leading your smart, connected product/Internet of Things strategy?



Organizational capabilities must be developed in parallel with technical capabilities. The most-mature companies are likelier than others to have changed their hiring strategies and business models. Overall, nearly 40% of executives say their firms have changed their IT strategy and upgraded IT infrastructure with SCP support in mind. A little more than one-third of the sample say their firms have changed their business models to include SCPs, while about the same number have revised their strategies for service delivery and revenue.

It makes sense that IT transformation would top the list of organizational initiatives, given the need to demonstrate SCPs from a design, production, and deployment point of view. However, for the market to grow in scale and scope, other business units and functions will need to transform in parallel. Regardless of which business unit leads the SCP strategy, change has to spread across the various organizational units. This is not just shifting around roles on an organization chart. The real payoffs will not come until all business units transform the way they create, operate, and service products.

2. Transforming the role of data

Manufacturing executives across industries, regions, and company sizes are united by their determination to leverage data. There is broad agreement that product usage data is a new source of competitive advantage, with firms in the aerospace and defense sector and in Asia showing particular enthusiasm. But there is a big difference between collecting data from SCPs and being able to analyze it for competitive differentiation. Today, a majority of manufacturers analyze less than 45% of the usage data they collect, according to the survey. Going forward three years, a majority of manufacturers still expect to analyze less than 60% of usage data captured from their products.

To improve on these numbers, companies need to define the value of the data they collect and make sure they are gathering the right information; enhance their analytics capabilities, via better technology and better people; and create more and better business applications to deliver insights. Currently, just half of respondents have data visualization and Big Data analytics tools, a number that does not move much in three years. About the same number have the application development skills to use the data they collect, and less than half will have the necessary skills in three years as more data from more products comes in. Getting better at these tasks is essential to capturing the SCP opportunity.

Product usage data creates the fundamental resource upon which new manufacturing capabilities are built. How organizations interpret such data across functions to enhance a customer's current experience or lay the groundwork for future innovation will be the decisive factor separating those firms committed to transformation from those that are not.

3. Transforming the product offering

For manufacturers, interactions with customers traditionally have meant transactional relationships and some ongoing maintenance and service agreements. SCPs change all that by allowing ongoing interactions with the product and the customer that can drive revenue over time. The product becomes a vehicle for delivering insights and services, not an end to itself, requiring new technology infrastructure and business processes and at the same time creating a new revenue model and time frame.

Already, those companies further along the maturity curve are making the transition. They are more likely to use ongoing service agreements than their less-mature peers, and are much more likely to say that servitization (defined as a business model shift in which products evolve to integrated “bundles” of products and services) is a market trend that will have great impact on their business in the next three years. Overall, half of respondents say the shift to SCPs increases the viability of new business models such as product-as-a-service and outcomes-based services.

For Trane, the climate-control unit of Ingersoll Rand, a service line built around real-time monitoring and maintenance of conditions inside customer facilities has grown into an organization with its own P&L, executive team, and contribution to the group's bottom line. Dane Taival, Trane's Vice President of Building Services, says the new service relations with customers are a major step toward a new way of doing business. “That positions us better as a strategic partner to the building owner rather than just a vendor.”

Conclusion

There is no Internet of Things without the Things. Creating the SCPs is just one part of the challenge for manufacturers; realizing the full potential of SCPs and their ability to generate value long after leaving the factory requires major revisions to every step of the product lifecycle, from design to production, sales, and service. Manufacturers must adapt to new levels of collaboration and information sharing, adopt a systems-engineering approach to product and service design, and deal with changing power relationships with different members of the value chain.

Early progress toward many of these goals has been considerable, but much remains to be done for the market to mature. In parallel with improving SCP technology, manufacturers must invest resources and push talent into non-technical areas such as customer education, partner relations, and business transformation. These areas proved critical for the rise of the Internet from a promising technology to a pillar of doing business. They are essential areas of focus again today. Those companies that grapple with SCP challenges now have a good chance of reaping the great rewards promised by this revolutionary change in the manufacturing industry.

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