

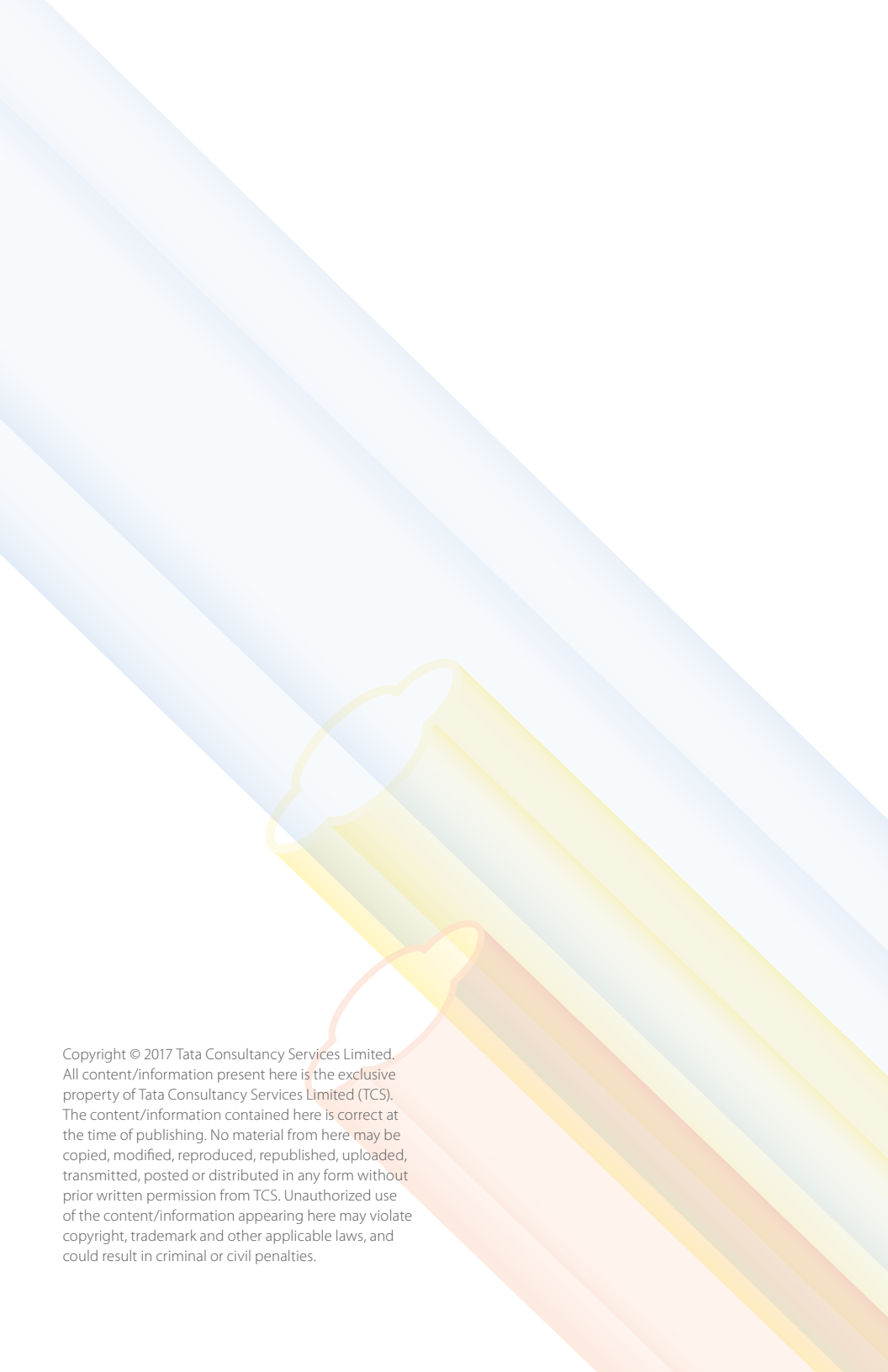


PERSPECTIVES

VOL. 10

THE BUSINESS OPPORTUNITIES
FOR GLOBAL COMPANIES THAT ARE
**INTELLIGENT, AGILE,
AUTOMATED,
AND ON THE CLOUD**

TATA
CONSULTANCY
SERVICES



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A WORD FROM KRISHNAN

How Cloud, Analytics, Automation, and IoT are Erasing Industry Boundaries

The boundaries that once clearly separated one industry from another are being erased in sector after sector. Internet retailers and video distributors are bankrolling TV series. Automakers are contemplating getting into the ride-sharing business (through AI-enabled self-driving cars). Internet companies are teaming with pharmaceutical companies to create new medicines. And they are not alone.

What's behind the rapid blurring of industry lines? The boundary erasers are pioneering companies that have made four disruptive technologies work for them: cloud computing, big data and analytics, AI and automation, and the internet of things. These technologies are gaining critical mass. Companies that are best at exploiting them are beginning to separate from the pack.

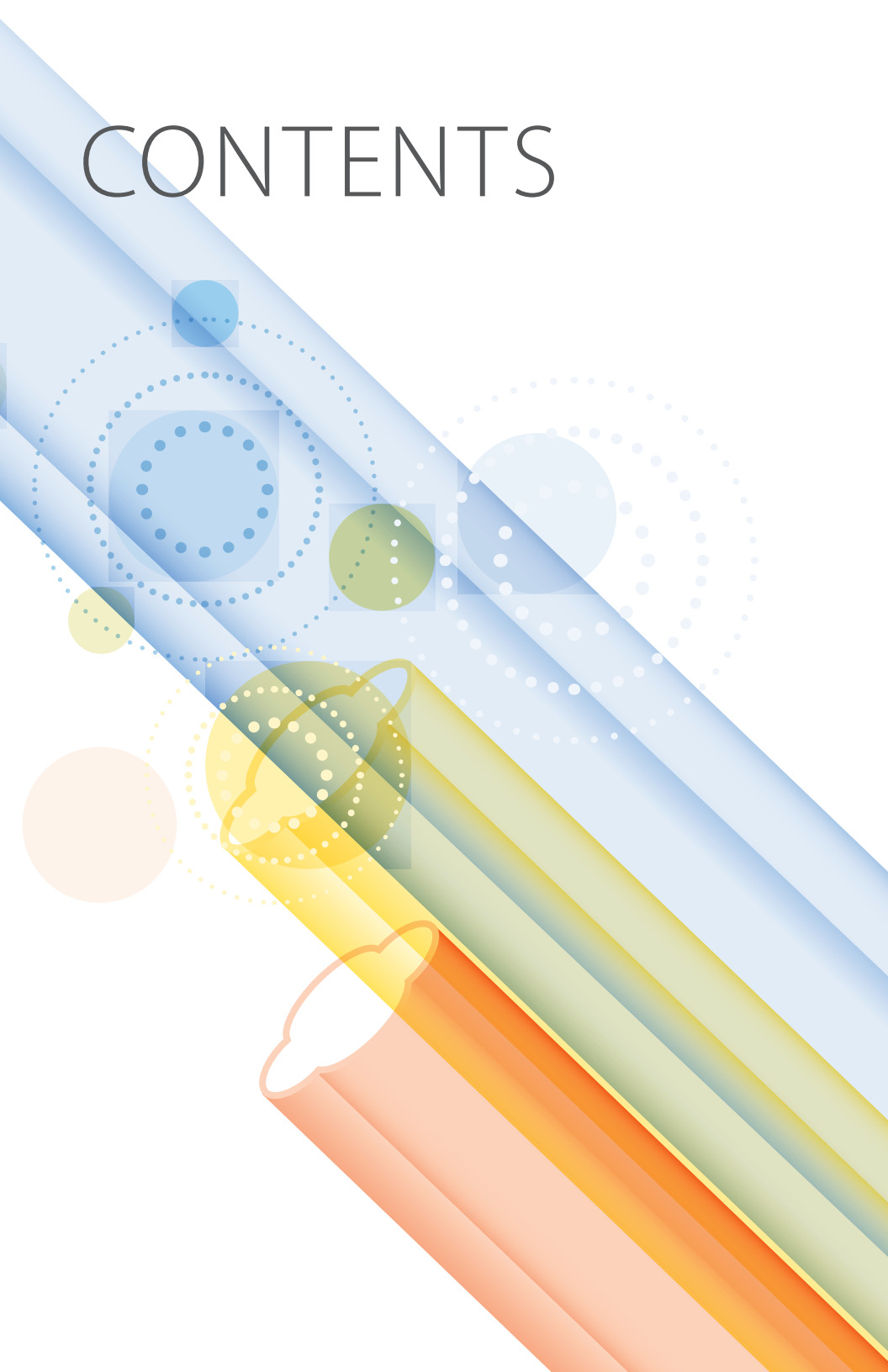
This issue of *TCS Perspectives*, our 10th since 2009, goes behind the scenes to give you strategies, tactics, and stories of companies in the lead. Those that are getting there first are tapping skills that are scarce in the marketplace. But more importantly, they are bringing whole new ways of thinking about their opportunities—opportunities that lie within and outside their industry's borders.

I hope you find the articles in our publication to be informative and inspirational.

Krishnan Ramanujam

President, Business and Technology Services
Tata Consultancy Services

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INTRODUCTION

**The View Inside:
Technologies Collide and
Industries Transform**



Author

By Krishnan Ramanujam

President, Business and Technology Services, Tata Consultancy Services

Every company we know is in a new era of information technology that has erased industry boundaries, altered competitive dynamics, and ushered in formidable new players. The technology I'm referring to is the convergence of several technologies that have rippled and ripened over the last decade, most notably cloud computing, artificial intelligence (AI), internet of things (IoT) devices, and the internet itself.

Together they are stirring the pot of industry change faster and faster. The first global sectors to be transformed are those whose entire product could be digitized and delivered digitally (media and entertainment, banking, business information, and more). But even products that must remain physical products, and services that customers must experience at a company's place of business (hotels, airplanes, etc.), are being digitally altered to become much more useful products and services.

The impact on industries can't be overstated. 'The World is Flat' author and *New York Times* columnist Tom Friedman so aptly stated this recently:

We're in the middle of a change in the 'climate' of technology. We're moving into a world where machines and software can *analyze* (see patterns that were always hidden before); *optimize* (tell a plane which altitude to fly each mile to get the best fuel efficiency); *prophesize* (tell you when your elevator will break and fix it before it does); *customize* (tailor any product or service for you alone) and *digitize and automate* just about any job. This is transforming every industry.

While such predictions could be easily dismissed in the past, they can't be today. The reason is that a growing number of companies are getting rich by using these technologies in these ways. They offer dollars-and-cents proof that the transformation is here. Consider three stunning statistics on the money some firms have already made (or their value in the stock market) by tapping into the cloud, AI, IoT, and other mobile digital devices and the internet:

- **\$2.4 trillion:** The combined market value of Facebook, Apple, Google parent company Alphabet, Amazon, and Netflix in June.² All but Netflix deliver their digital services to your digital devices through the cloud (their own data centers). Netflix delivers its video services through Amazon's cloud, AWS.
- **\$39 billion:** How much revenue investment analysts predict Facebook will produce in 2017.³ (Its 2016 revenue was \$27.6 billion.) If it hits that number, Facebook's revenue will surpass the revenue of the entire U.S. newspaper industry in 2016 (\$29.6 billion).⁴ From where does Facebook get that revenue? Since (unlike newspapers) its members can get its content for free, Facebook gets it from advertising that the company can tailor to its members' needs and tastes. And it is increasingly using AI to target those ads.

¹ The New York Times, Climate Shifts Aren't Limited to the Weather, August 02, 2017, Accessed August 02, 2017, https://www.nytimes.com/2017/08/02/opinion/climate-change-technology-globalization-china.html?ref=opinion&_r=0

² Fortune, FAANG Tech Stocks Are No Bargain. Here's Why, June 15, 2017, Accessed August 02, 2017, <http://fortune.com/2017/06/15/faang-tech-stocks/>

³ Financial Times, The estimate of Facebook 2017 revenue was the consensus of the 34 stock market analysts who cover the company, Accessed August 02, 2017, <https://markets.ft.com/data/equities/tearsheet/forecasts?s=FB:NSQ>

⁴ PR Newswire, Newspaper industry revenue number from PwC, June 05, 2017, Accessed August 02, 2017, <http://www.prnewswire.com/news-releases/pwcs-entertainment--media-outlook-forecasts-us-industry-spending-to-reach-759-billion-by-2021-300469724.html>

- **\$7 billion:** How much revenue General Electric (GE) expected to generate in 2016 from its digital business, which helped the company, customers, and its industry partners capitalize on IoT devices and software. GE predicts the number will be \$15 billion by 2020.⁵

I hope we have begun to convince you (if you weren't convinced already) that this technological revolution is having substantial here-and-now consequences. The articles we've assembled in this issue of *Perspectives* shed light on why things are playing out this way.

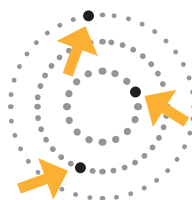
We've organized the articles into two sections: the business opportunities of the technological transformation, and how to pursue them. Here is a preview of each article.

The Business Opportunities

Where to Turn AI and Automation Loose in Your Company

Industrial-strength AI is ready for deployment. But one of the biggest challenges for large companies is determining where to use it. Although the possibilities are endless, companies' budgets, of course, are not. In their article, Ashok Pai and Krishna Mohan give executives a way to identify the best places to use AI in their organizations.

See page 13.



Why Your Products Must Be Smart and Connected

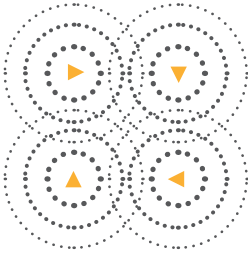
In the last few years, strategy experts like Harvard Business School Professor Michael Porter have been urging industrial companies to embed their products with digital sensors and wireless devices that report back on how they're functioning in the field. In their article, Sreenivas Chakravarti and Anurag Jain argue that making such products smart and connected is no longer an option; it's a necessity. They explain why virtually every manufacturer should now be using such technologies to turn their products into services.

See page 26.



⁵ Investors.com, GE Sees Digital Revenue More Than Doubling To \$15 Billion By 2020, June 23, 2016, Accessed August 02, 2017, <http://www.investors.com/news/ge-courts-silicon-valley-investors-for-digital-industrial-push/>

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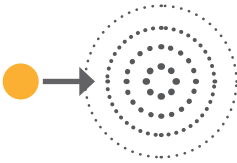


Now You Can Simulate Nearly Anything

Suppliers of public cloud computing services such as Amazon Web Services, Microsoft, and Google represent a powerful capability that many companies don't realize they now have: to simulate strategies, product and service concepts, and new business processes at affordable prices. In their article, PR Krishnan, Satishchandra Doreswamy, and Suranjan Chatterjee explain why this is so important today, and seven applications of simulations that promise big benefits. To illustrate each one, they point to examples at Kellogg, Aon Benfield, GE, and HSBC, among other companies.

How to Pursue the Opportunities

See page 49.



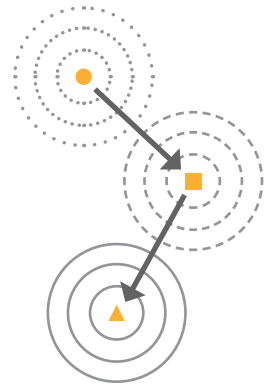
What Happens When You Turn Your Products Into Services

So you've decided to make your products 'smart and connected'. How do you then play in the 'servitization' game, the one in which you'll generate revenue by offering your product as a service? In his article, Regu Ayyaswamy explains why the service opportunities are abundant: They turn what he calls 'open-loop' systems into 'closed-loop' ones—where a manufacturer no longer loses information to third parties on how its products are performing for customers. He examines four servitization opportunities for companies with closed-loop systems, and explains how to overcome significant obstacles that will stand in the way.

Why Agile Software Development Requires Radical Changes in Budgeting and Scoping

To stay competitive in this world of intelligent cloud-based products and services, big companies need to move as quickly as new companies. That means getting new digital products and processes up in weeks or months, not years. But that can't be done if such systems are staged, funded, and scoped in the same manner of the enterprise systems of old. Companies must now rely on agile cross-functional teams that use agile software development methods. But that is harder than it sounds, and one of the biggest barriers is how agile programs are scoped and funded. In short, traditional systems budgeting and scoping methods can throw wrenches into the wheels of agile development. In their article, Nidhi Srivastava, Apala Mukherjee, and Somnath Ghosh provide an antidote to the all-too-frequent starts and stops of agile teams: a different way of scoping and budgeting these programs.

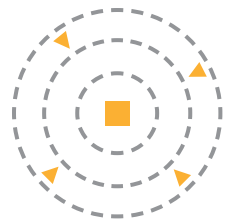
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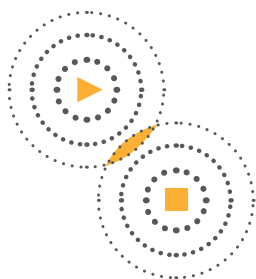
Raising Your IoT Cyber Security Game

By making their products smart and connected, manufacturers can transform themselves into service companies and generate new revenue. But they can also generate the attention of attackers to their new IoT-enabled products, as TCS IoT cyber security expert Satish Thiagarajan writes in his article. As he says, hacking incidents into IoT-enabled products in the U.S. alone soared seven times between 2010 and 2015. And most computer networks should expect IoT security breaches next year, warns IDC. Thiagarajan outlines eight steps companies should take today to reduce the chances of becoming the next victim.

See page 71.



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The Big Opportunities at the Junction of AI and Analytics: Interview with Tom Davenport

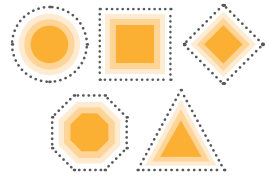
We are delighted to feature an Interview with Tom Davenport, a leading chronicler over the past 30 years on how information technology has radically transformed the work and very essence of large businesses around the world. Since the late 1980s, Davenport has been a pioneer of business process redesign/reengineering, business analytics, and other leading concepts. He has published several classic *Harvard Business Review* articles and bestselling books on the business value of enterprise systems, knowledge management, big data and analytics, and most recently AI. I think you'll find Tom's interview eye-opening, particularly his call for companies to stop focusing on using technology to get rid of people.

Executive Traits for Recognizing the Bountiful Opportunities Ahead

The opportunities we point to in this edition of *Perspectives* are substantial. But they are also difficult to recognize. In our last article, I look at five personality traits of three of the most successful CEOs of the last 10 years—Steve Jobs, Jeff Bezos, and Reed Hastings—all of whom were early to recognize the implications of cloud, mobile devices, and AI, and moved their businesses forward early to capitalize on them. I explain how the traits—abundant imagination, a voracious appetite for often-clashing ideas, relentless focus on increasing value to customers, calmness in the face of the rising competitive storm, and being sentimental about top talent but not about their jobs—are so crucial today.

I hope these articles provide you and your colleagues with inspiration and ideas that help your organization thrive in these exciting times.

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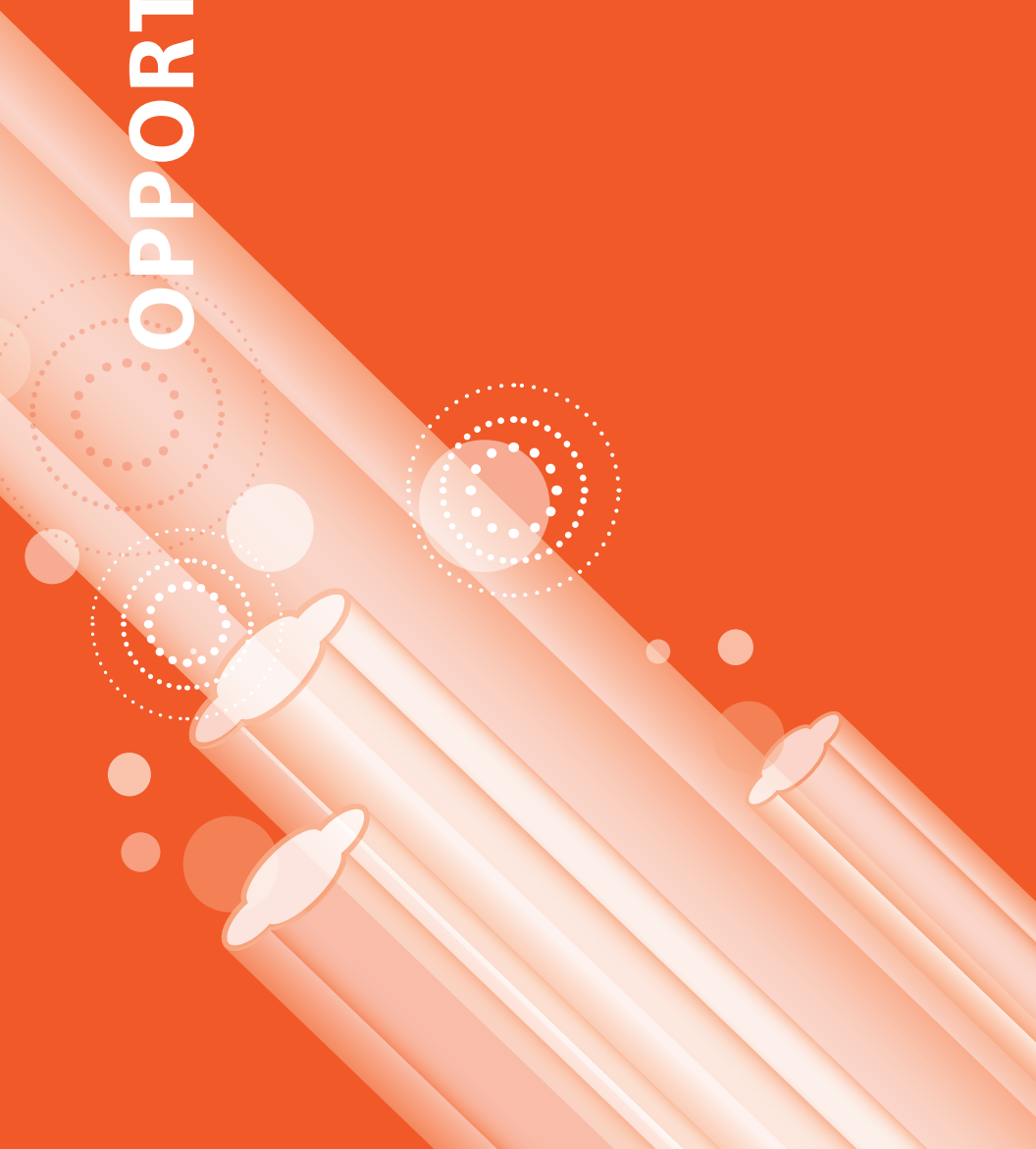


THE BUSINESS OPPORTUNITIES

Where to Turn AI and Automation Loose
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Why Your Products Must Be Smart and Connected

Now You Can Simulate Nearly Anything



Where to Turn AI and Automation Loose in Your Company

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Artificial intelligence (AI), machine learning, and related technologies were once the realm of science fiction. Fueled by affordable computing power and ample supplies of data, these technologies now have reached the point where they can evaluate options, make decisions, and even take action to execute those decisions.

The opportunities are abundant. Technological improvements in data processing and sensors, coupled with better statistical models and algorithms, have driven recent advances in AI. Sensors nowadays are approaching near-human capabilities when it comes to image processing, voice (and accent) recognition, and sentiment analysis. AI systems today can correlate events, recognize patterns, and derive meaning from the data.

The combined power of these innovations has produced breakthroughs like driverless cars. Established automakers and industry newcomers such as Google, Uber, and Tesla

are pouring billions of dollars into creating autonomous vehicles. Toyota alone will invest \$1 billion from 2015 to 2020 to introduce AI into its cars and robots in its factories.⁶

But interest in AI extends far beyond the automotive sector. By that year, the companies surveyed expect that nearly half of the AI investments would be used for transformative change rather than incremental operational improvements.

The 2017 TCS Global Trend Study⁷ of more than 800 large companies across North America, Europe, Asia-Pacific, and Latin America found that 84% companies are using AI already, and 62% see the technology as important to staying competitive in the year 2020.⁸

Companies noticing these innovations are keen to find ways to bring automation to functions ranging from customer service to risk management to HR. Consumers, who already benefit from AI through the social media sites they use, car ride services, and other smartphone apps, represent another source of big demand.

⁶ The New York Times, Toyota Invests \$1 Billion in Artificial Intelligence in U.S., November 6, 2015, accessed July 17, 2017, <https://www.nytimes.com/2015/11/06/technology/toyota-silicon-valley-artificial-intelligence-research-center.html>

⁷ Tata Consultancy Services, Getting Smarter by the Day: How AI is Elevating the Performance of Global Companies, March 15, 2017, accessed August 04, 2017, <http://sites.tcs.com/artificial-intelligence/>

⁸ The 835 companies in the TCS Global Trends study had an average revenue of \$20 billion.

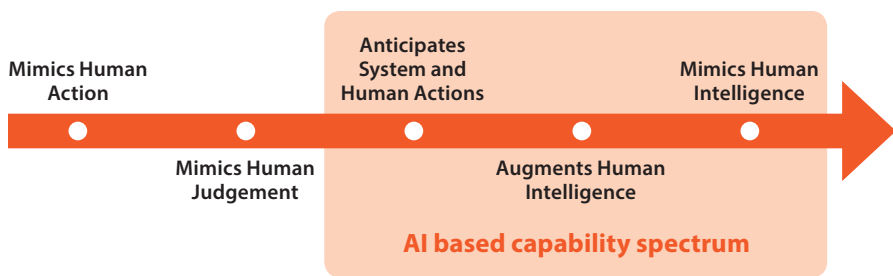


Figure 1: AI Imitates Human Action to Mimic Human Intelligence

Some companies have already generated big benefits from their AI initiatives. A global information services and publishing company used machine learning to dramatically improve its customers' ability to derive insights from thousands of legal documents they processed. A leading communication service provider has piloted an AI program to improve its network uptime by deploying a cognitive intelligent platform that combined machine learning, analytics, and robotic automation to predict and prevent network failures.

But even with such AI and automation success stories, most companies we know are not quite sure where to focus their AI investments. As a result, they proceed cautiously, while a distinct minority rushes forward. In 2016, the average annual AI investment among companies surveyed in our trend report was \$67 million, but the median spend was only \$3 million. Most companies (68%) were using AI to improve their IT operations, especially with the aim of detecting and deterring attempted intrusions into their computer networks and data centers. Significantly smaller percentages of the companies surveyed reported applying AI to their customer service (32%), sales (29%), and marketing (29%) functions. Looking to the future, 70% of the executives expect that by 2020, AI will have the greatest competitive impact outside of IT in functions such as sales, marketing, customer service, and HR.

Our experience shows these executives are not only correct, but that companies in a variety of industries see gains today along a continuum as shown in Figure 1. Market research firms are capitalizing on AI's image recognition capabilities by using it to

collect market data. Data providers use AI to analyze legal documents and identify potential problems. Telecommunications companies apply AI to diagnose network problems. CPG companies use AI to predict and prevent fraudulent invoices. And retailers use AI-powered chatbots to assist customers on internet.

A major airline provides another example. In this industry, on-time performance is a key customer experience indicator and flight delays are a huge concern. While an airline cannot control the weather, reducing the impact of delays and proactively communicating with customers can make a difference. For example, faster insights into upcoming delays can enable an airline to execute more precise schedules for airport gates, ground crews, flight crews, and other personnel.

One major airline used advanced machine learning techniques to build two predictive models—one for flight departure delays and a second for arrival delays—to anticipate whether a flight departing later in the day would take longer than scheduled. The resulting analysis led to a more precise understanding of the reasons (internal and external) for flight delays and the impact of delays on the flight network. The airline was able to improve operational efficiency by adjusting staffing and other resources for anticipated schedule changes, thereby strengthening brand perception.

Figure 1 shows that as AI increases in complexity and capability, it goes from imitating human action to mimicking human intelligence.

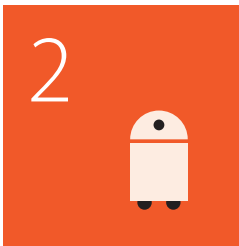
As the list of examples grows and as companies experimenting with AI gain experience, the question for both newcomers remains: Where should we begin?

Three AI Traps to Avoid

Before prioritizing their AI investments, executives should be wary about falling into three common traps:



The deep pockets trap. In most companies, the IT department spends the maximum possible on technology. IT departments can make a solid case for using AI to protect data centers and networks, but just because IT has the biggest technology budget, that doesn't mean that it necessarily deserves the lion's share of AI investments. In fact, a company might be able to get a greater ROI from targeted AI investments in finance and procurement functions to cut down on fraudulent customer transactions.



The robot trap. Beware the lure of shiny objects. Robots that can clean hotel rooms or answer questions at the front desk are alluring because they have a tangible, physical presence. An AI-powered tool that flags potentially fraudulent customer purchases may not have the same glamour as a robot, but it might have a much bigger benefit to a company's bottom line.



The pure insights trap. It's important to remember that AI is just a tool. AI applied to research and analysis can yield all sorts of insights, but executives should make sure that AI-powered research is focused on insights that are useful and applicable to the company's goals and needs. Connect AI to business value.

Pinpointing Your Company's Greatest AI Opportunities

Despite AI's potential to transform products and business processes, executives must not get caught up in the hype. Before they fund AI projects, they need to carefully consider where they can most likely get the greatest positive impact from AI in the organization. In the C-suite, each function head brings a point of view to the question. Chief operating officers typically look to trim costs. Most sales executives we know salivate over using AI to identify the best prospects and win the sale. Many corporate strategists view AI as a way to better understand the changing landscape of competitive moves and customer needs.

The key is to recognize failures quickly, cut your losses, learn from those failures, and make changes to improve the chances of success on future AI projects.

Starting out with AI means developing a sharp focus. For most companies, AI projects will not resemble the multi-year, billion-dollar 'moon shots' like the creation of a driverless car in the auto industry. Instead, C-suite executives should prioritize and fund agile, short-term (6 to 12 months) projects backed by a strong business case. Some failures are inevitable. When projects do succeed, companies can expand on those successes by pursuing additional related opportunities.

Figure 2 shows that enterprises typically start with Six Sigma/Lean and task-based automation, and then move towards more advanced stages based on AI.



Figure 2: Maturity Journey of an Intelligent Enterprise

A three-step approach to evaluating automation and AI opportunities can clarify an organization's best AI opportunities:

1

Isolate functions that require human intervention.

Any task a human currently performs, such as data entry or invoice processing, could theoretically be automated or performed by a system with AI capabilities. For example, a market research firm implemented a system that used machine learning, image recognition, and cognitive intelligence to interpret product images, and automatically capture product attributes to help its consumer packaged goods customers track the competitive marketplace. Instead of having people research and check the images and status of goods for sale, an AI-enabled system automated the process, saving considerable time and cost.

2

Remove from consideration during the pilot stage those functions that would be too costly to automate now. For example, if a telecommunications provider was exploring its first AI project, it would more likely look to an area like reducing customer churn or improving ARPU (average revenue per user), with proven results in the short term, rather than a multi-year program.

3

Automate functions with the greatest ROI potential. Companies should look to automate functions that require extensive amounts of manual labor—i.e., an AI system that analyzes insurance claims data and authorizes payments, or a credit card company's chatbot that communicates online with customers and sends out a replacement card to those who lose their cards. Companies in practically any industry could deploy HR chatbots to answer customer inquiries or collect data from job applicants (saving staff time to schedule final interviews).

The experience of a leading market research organization shows the benefits of a targeted approach. The company used advanced machine learning to automate the process of tracking consumer packaged goods to analyze their performance. The process uses a master product reference repository with a set of defined characteristics in multiple consumer product categories. Because of the volume and complexity of the data involved—there are more than 100,000 items that enter the market in a given month—it can take more than two weeks to code product entries for a few regions.

The company deployed advanced machine learning technology that automated multiple aspects of the process, including comparing existing and new products, predicting prices of goods for sale, and analyzing the text used to define the products. The system deployed an image recognition algorithm adapted to mimic the way the human brain interprets images on product labels. The system, which automates the capture of product metadata, yields faster insights

with fewer human interventions, so marketers can respond to market trends more quickly at a lower cost of operations.

How to Evaluate Potential AI and Automation Investments

This process of maximizing benefits from AI projects starts by taking a holistic overview of the company's strategic priorities and pain points. Consider the competitive landscape and determine where AI or automation can bring the company closer to attaining its strategic priorities. For instance, will AI and automation help the company accelerate time-to-market for its new products and services? Similarly, companies should determine which 'pain points', such as inefficient supply chains or poor after-sales service, stand in the way of high performance. Companies need to diagnose the root causes of those problems and should be able to identify which parts of their operations need improvement.

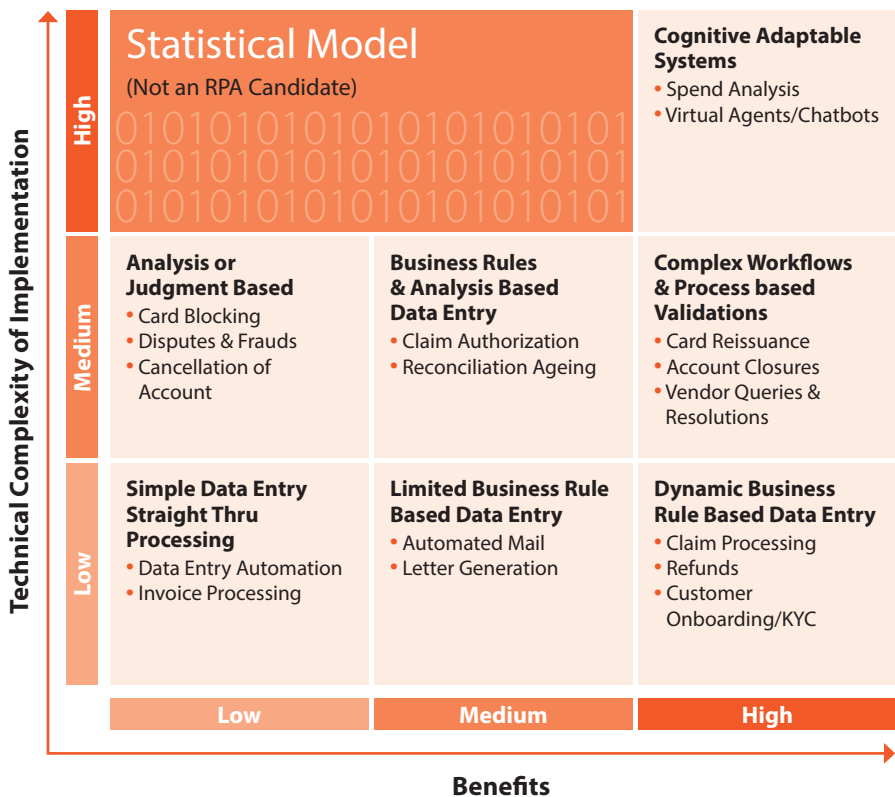


Figure 3: Technical Complexity of AI Implementation and Potential Benefits

As companies identify improvement areas, they can consider which ones lend themselves to automation and digitization. Are the processes predictable and repeatable? Is the IT environment stable or shifting? If the company is in the midst of a multi-stage IT transformation, it can be very complex to attempt to insert automation or AI technology into that precarious context.

Of course, companies should perform a cost-benefit analysis before embarking on any AI or automation project. Based on our experiences of helping companies implement such projects, we know that ROI typically requires balancing expected benefits against the technical complexities of implementation as shown in Figure 3.

To calculate the business benefits of an AI or automation program, companies should consider how many human transactions the new system will replace and the average time it takes to complete a process.

On the cost side, companies must consider the upfront investment of implementing an AI program, maintenance costs, and whether automation will deliver lower costs per transaction or such other savings.

The more judgment required, the higher-order the AI capabilities must be. For instance, a life sciences company trying to automate the process of reviewing reports from doctors, evaluating a drug going through clinical trials, would need a deep understanding of the industry.

Figure 3 shows that companies should assess automation projects based on both their technical complexity and potential business benefits.

Pulling the Right Lever at the Right Time

After identifying promising opportunities to deploy AI or automation technologies, corporate leaders still need to figure out which technology to pursue:



Artificial intelligence represents the highest level of business automation. True AI can sense, think, and act. This type of AI is necessary to power self-driving cars in complex, unpredictable environments. A medical robot might use AI to analyze human vital signs and give advice to doctors about diagnosis and possible treatments.



Cognitive computing systems also can sense and think. In a corporate context, such capabilities can enable people to do their jobs better, improve business processes, and increase profitability. Cognitive computing systems might automate actions people once performed or give people suggestions about their next action. Such systems typically have natural language processing capabilities to collect and analyze large amounts of text, documents, and other forms of unstructured data. For instance, a life sciences company could use such a system to scan records of millions of clinical cases involving its products, detect adverse events, and report them to regulators. Cognitive computing systems generally have machine learning elements that apply algorithms to find patterns in data. For instance, a marketing firm could analyze the consumption patterns of its many consumers. The predictive analytics elements of cognitive computing systems allow companies to analyze data from business processes and find recommended ways to improve results. For example, the system might review a company's existing process of delivering orders, and then provide recommendations on getting customers their products faster and with fewer errors.

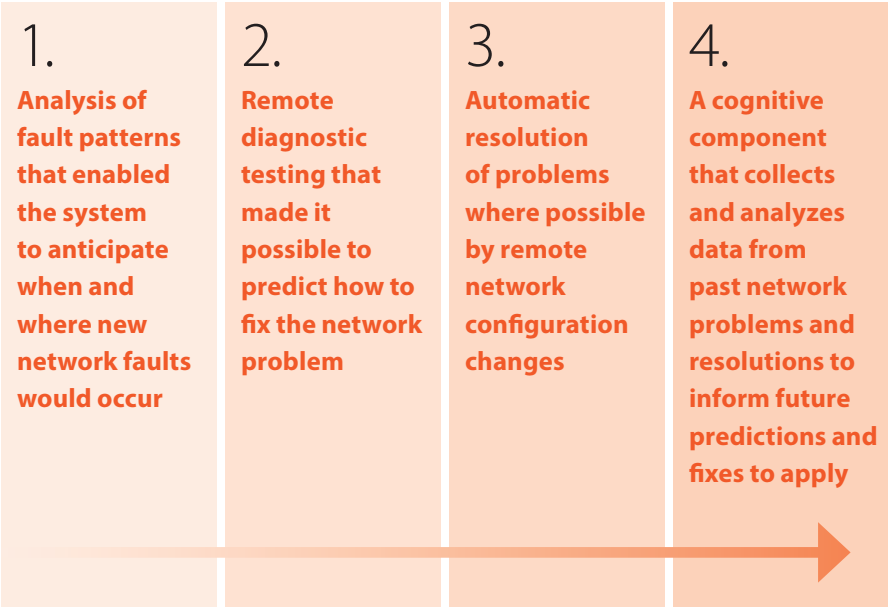


Robotic process automation gives companies a way to apply automation on smaller projects. Chatbots are still new, but they already can respond to customer queries about simple billing questions. Similarly, virtual private assistants make it easier for employees at professional services firms to make travel plans.

Assess Your Situation—Then Move

AI and automation are top-of-mind technologies. Companies around the globe are eager to take advantage of them.

Executives at a leading communication service provider were no different when they approached an opportunity to improve the uptime of their network. Providing superior connectivity depends on efficient functioning of telecom networks. The industry relies on manual identification and resolution of network incidents—caused by technical or environmental problems or human error. It is a time consuming and inefficient process. This service provider sought to improve network uptime and reduce costs while saving time and strengthening service. The project included four sequential phases:



By deploying a cognitive intelligent platform that dynamically combined machine learning, analytics, and robotic automation for network failure prediction, the company was able to automate portions of the network maintenance process.

Like the service provider's experience shows, incorporating AI into a company's operations is a tailored fit. Evaluating these opportunities requires a careful and candid assessment of a company's competitive landscape, its digital maturity, the effectiveness of existing business practices versus industry benchmarks, the potential for improvement, and the complexity of the technological context into which AI and automation would be inserted.

To get the most out of AI and automation, companies need to combine the right automation technology to the right situation at the right time. This process takes time, but there's no time to wait.

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, <http://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/>

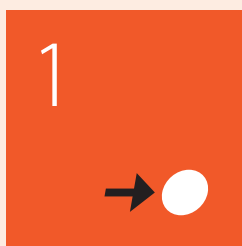
Seven Business Benefits of Smart, Connected Products

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.

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.

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>



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/>



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



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/>

6

**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.

7

**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.

Now You Can Simulate Nearly Anything

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Organizations have long performed what-if simulations and scenario planning to test strategies and tactics, try out product concepts and service approaches, and assess the potential impact of new business models. In fact, consumers and companies today are the beneficiaries of computer simulations of complex conditions ranging from weather forecasts to the performance of aircrafts that are still on the drawing boards.

Until recently, such computer simulations were largely the realm of major government entities or large companies with access to the multimillion-dollar high-performance computing systems required to run them. Now, the emergence of cloud computing opens up a world of possibilities for companies that have long wanted to experiment with simulations but lacked the resources to do so. In short, cloud computing

makes simulation opportunities abundant and economical. Just as important, the digital data that's necessary to perform these simulations is plentiful and increasing exponentially.

The same cloud computing infrastructure that gave us cheaper email systems or subscription-based salesforce automation software is now making sophisticated software tools—many of them open sourced, some available for a credit card fee—available to a vastly wider audience. These tools, such as those that manage data exchanges among different systems, make it possible to perform the calculations required for simulations. Other tools manage the security of corporate data for simulations. And because a company can share data and computing power with partners via the cloud, such platforms enable a host of new applications.

More companies are facing a pressing need for business data visibility across the entire supply and distribution chain to make informed planning and production

decisions. An automaker, for example, may decide it needs to go beyond its tier one suppliers to second- or third-tier firms to gain more control over supply timelines, and prevent unexpected downtimes for assembly lines. This calls for a connected ecosystem of IT and processes that spans several independent companies' disparate computing environments, enabling the automaker to mine the data, and simulate possibilities. Now with cloud platforms, connecting a complete chain of systems becomes easier to simulate. This scenario also opens possibilities for the automaker to monetize data assets—like data on equipment performance, transportation lead times, and consumer product buying patterns—by exposing such insights to ecosystem partners.

Further, by conducting simulations in a cloud vendor's data center, a company can reduce the cost and risk of conducting these experiments. For example, a bank or a retailer planning a digital transformation can run a simulation to model the impact on the sales and profitability of integrating multiple consumer channels.

With significant computing power now available on demand, companies have the potential to run simulations on just about anything for which they have ample, quality data. They make it possible to pose questions they have not been able to ask before and test more ideas.

But just because companies can run computer simulation models on virtually every aspect of their business, does not mean they should. Making the best use of the requisite infrastructure, analytics talent, data management, and IT skills, requires a strategy for simulations. Companies should determine what business questions simulations are best able to answer: whether it is optimizing the supply chain, pursuing an omnichannel marketing strategy, or scheduling asset maintenance. The approaches will vary depending on a company's industry, strategy, and tactics.

Simulation Sweet Spots

Companies in a spectrum of industries have been doing cloud-based simulations for a variety of uses. For example, since the beginning of the decade, Varian Medical Systems, a \$3 billion scientific-instruments company, has been running intensive 'Monte Carlo' computer simulations of design prototypes. That has accelerated product development.

A design for a mass spectrometer that would have taken six weeks to develop using internal computing resources, takes just a day in the cloud at a fraction of the cost.²⁹



²⁹ Forbes, Learning from the Cloud, October 20, 2010, Accessed August 03, 2017, <https://www.forbes.com/2010/10/20/microsoft-amazon-varian-technology-cloud.html>.

University of Arizona researchers looking to develop new drugs to fight ALS are using high-performance computing resources in the public cloud to run molecular modeling simulations in just a few hours that would otherwise take months.³⁰ Using a public cloud, Major League Baseball built a tracking system that ingests videotaped player performance data from ballparks across North America. The goal: to simulate how athletes could have made better running, fielding, and other plays.³¹ Milliman, a global provider of actuarial products and services for the life insurance industry, has lessened the cost and complexity of its compute-intensive financial modeling, which evaluates thousands of economic scenarios, by conducting it in the public cloud.³²

These early adopters have a number of characteristics in common.

They have ready access to huge amounts of data. For example, a major airline simulates the impact of flight delays on the crew management and flight scheduling. It can also examine how delays affect customer loyalty, revenue, and crew costs by using data from multiple sources. These simulation programs built using cloud-based technologies increased the airline's ability to reschedule crews based on predicted delays, and reduced costs on hotels and transportation for crews, among other benefits.

They identify situations where cloud-based simulations can make a big business impact. Companies using the cloud for simulations create use cases where the ability to predict the performance of a product, service, or process can significantly improve revenues or outcomes, or substantially reduce costs and risks. Financial services firm Aon Benfield, for example, uses a high-performance public cloud-computing platform to simulate the performance of its five million insurance retirement products, and better determine its exposure to market risks.³³

³⁰ HPCwire, Drug Developers Use Google Cloud HPC To Fight ALS, February 16, 2017, Accessed August 03, 2017, <https://www.hpcwire.com/2017/02/16/drug-developers-use-google-cloud-hpc-fight-als/>

³¹ Amazon Web Services, MLB Advanced Media Case Study, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/major-league-baseball-mlbam/>

³² Microsoft Azure: Milliman Case Study, Accessed August 03, 2017, <https://enterprise.microsoft.com/en-us/customer-story/industries/insurance/milliman/>

³³ Aon case study, Amazon Web Services, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/aon/>

They do simulations to react far faster and better to daily business conditions.

Cloud-based modeling is an ideal approach for situations in which it's critical to act rapidly or in real-time. Global food company Kellogg uses public cloud infrastructure to test the impact of potential marketing programs. Every day, it runs dozens of complex data simulations on TV ad spending, digital marketing, coupon campaigns, and other promotions, sales commissions, and display and shelving costs.³⁴ These simulations reduce waste in making these decisions, reduce time to market, and boost revenue.

They do simulations to reveal new business

models. The ability to conduct multiple experiments through simulations—to explore how to make a business operation more efficient or more profitable—can help executives identify new ways of generating revenue. Simulations help answer if such ideas are feasible. For example, a consortium of banks can experiment with selling services to other financial institutions to help the banks comply with a new regulation.

³⁴ Kellogg Co. case study, Amazon Web Services, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/kellogg-company/>



Seven Prime Use Cases for Cloud Simulations

There is a wide range of potential applications for cloud-powered simulations. We have found seven areas where many organizations are generating the greatest benefit:

1. Asset management and optimization.

Companies are using simulation modeling to predict when their assets are about to fail and may need to be repaired or replaced. General Electric's Power & Water division has developed virtual plants, using real-time simulation in the cloud. Using so-called 'digital twins' of critical pieces of equipment, the company can model the state of every asset in its gas power plants and wind farms.³⁵



2. Research and development.

High-performance cloud infrastructure can be valuable for product development—enabling organizations to evaluate designs, test performance, and prevent quality issues quickly and cost effectively. Consumer products giant Unilever, for example, is combining data generated in its labs with publicly available microbial genetic data to develop new deodorants and other products.³⁶

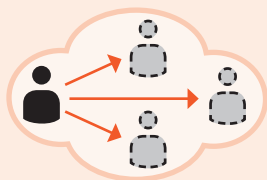


The cloud can enable similar simulation capabilities in medical research and development. Harvard Medical School's Laboratory for Personalized Medicine is using a cloud-computing platform to develop genome analysis testing models, speeding up research on the clinical

³⁵ PC World, Cloud-based 'Digital Twins' Could Make Power Plants More Efficient, September 29, 2015, Accessed August 03, 2017, <http://www.pcworld.com/article/2987525/cloud-based-digital-twins-could-make-power-plants-more-efficient.html>

³⁶ Information-age, Unilever Puts DNA in the Cloud, April 15, 2013, Accessed August 03, 2017, <http://www.information-age.com/unilever-puts-dna-in-the-cloud-123456966/>

value of new genetic tests.³⁷ Pharmaceutical company Novartis likewise accelerates its pre-clinical R&D efforts for drug development in the public cloud.³⁸



3. Human capital management.

Several companies are using cloud-based simulations to recruit employees better and assign them to the right roles. A company may discover that an MBA graduate does not necessarily correlate with longevity with the company; however, it may dig deeper to discover that MBAs in smaller markets are less likely to leave while those in metropolitan areas are more likely to switch jobs.³⁹



4. Customer experience.

Companies are using computer-modeling techniques to predict customer receptiveness to new products, services, offers or product functionality, from a new app to a new banking product. For example, one fashion retailer uses data from multiple channels—sales transactions, customer website visits, online and mobile behavior—to simulate the impact of discount offers on products at particular times (such as a holiday festival) to determine which will be most profitable. The simulations were successful in improving repeat sales and enhanced revenues on specific product lines.

³⁷ Harvard Medical School case study, Amazon Web Services, Accessed on August 03, 2017, <https://aws.amazon.com/solutions/case-studies/harvard>

³⁸ Fortune, Medical Researchers Use the Cloud To Do What They Couldn't Before, June 19, 2015, Accessed on August 03, 2017, <http://fortune.com/2015/06/19/medical-researchers-turn-cloud/>

³⁹ Talent Economy, Numbers Game: Managing Human Capital in the Age of Machine Learning, November 3, 2016, accessed August 03, 2017, <http://www.talenteconomy.io/2016/11/03/human-capital-machine-learning/>



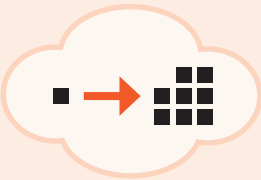
5. Fraud detection.

Many firms are using cloud resources to help identify, respond to, and potentially prevent fraud. Banking giant HSBC, for example, uses the public cloud in its anti-money laundering efforts. The bank runs analytics and machine learning on enormous data sets to identify patterns that indicate nefarious activity, which it can then escalate to the appropriate government agencies.⁴⁰



6. Customer service and field service.

In the same way that airlines and utilities use modeling for the predictive maintenance of their own assets, cloud-based simulations can help companies troubleshoot service and performance issues for customers. As companies accumulate more data from internet of things connected products and field service calls, they can model scenarios to create a more flexible, on-demand field service function.



7. Inventory management.

Using the same principle as field service simulations, organizations with very remote divisions or service areas (such as remote health centers) can use cloud-based computer models to determine how best to serve and operate their far-flung units.

⁴⁰ Computerworld UK, HSBC turns to Google Cloud for analytics and machine learning capabilities, March 9, 2017, Accessed August 03, 2017, <http://www.computerworlduk.com/cloud-computing/hsbc-turns-google-cloud-for-analytics-machine-learning-3655688/>

Where to Begin

Companies that want to pursue promising simulation opportunities need to address a number of business and technical issues before proceeding.

Tie simulations to critical business issues. First and foremost, organizations need to clearly define the problem they're trying to solve—or the questions they're attempting to answer—with computer simulation. Simulations are, by definition, experiments. But that does not mean they should be undisciplined. Rather, companies must ensure the simulations that they try have a business benefit attached.

Practice strong data management to ensure quality simulations. Companies must have the right infrastructure, tools, and processes in place to manage the volume of data required for computer simulations and validate data quality. Companies must ensure that data from disparate sources are put into formats that can be combined for purposes of simulation; otherwise they can create conflicts during the modeling process. Simulations are only as good as the data fed into them. And don't forget about the team doing this work. The investment of time, money, and talent required to prepare the data for these efforts is often underestimated and should be budgeted for from day one.

Use simulations to ‘fail fast’ and improve the next time. A computer simulation is always a work in progress. It must be refined over time with frequent changes to improve the model. That requires a much less rigid mindset and approach than a standard software project with strict governance and delivery date. Computer modeling benefits from a more agile approach. Organizations that pursue must invest in the increased time and overhead required to supervise the process and refine results.

While not every business problem is right for simulation, there are undoubtedly simulation opportunities for all businesses across industries. And now is the time to determine where the greatest opportunities are. The computing power is accessible. The data is available in greater quantities and varieties than ever before. If you don't take advantage of the opportunities to perform complex simulations using high performance cloud assets, chances are a competitor or an upstart will.

HOW TO PURSUE THE OPPORTUNITIES

The background is a solid blue color. On the left side, there is a diagonal band of lighter blue. Within this band and extending into the main blue area, there are several white dotted circles of varying sizes. At the bottom of the image, there are three light blue, three-dimensional cylinders that appear to be rising or pointing upwards. The overall design is clean and modern, with a focus on geometric shapes and a limited color palette.

**What Happens When You
Turn Your Products Into Services**

**Why Agile Software Development Requires
Radical Changes in Budgeting and Scoping**

Raising Your IoT Security Game

**The Big Opportunities at
the Junction of AI and Analytics**

What Happens When You Turn Your Products Into Services

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Manufacturers everywhere are using sensors, software, and wireless connectivity to add features to their products and differentiate them in the marketplace. In this way, digitization and the Internet of Things (IoT) are revolutionizing the sector across categories and geographies.

To be sure, the idea of connected products isn't news to manufacturers. In 1996, General Motors (GM) began offering its on-board OnStar⁴¹ concierge service in Cadillacs. What GM did then has become ubiquitous. General Electric (GE) estimates that investments in industrial IoT alone would surpass \$60 trillion in the next 15 years. Meanwhile, leading B2B and consumer companies are rushing to connect everything they make from jet engines to tractors to refrigerators to electric toothbrushes.

⁴¹ New York Times, G.M. Says OnStar Service Is Making Money After 7 Years, February 27, 2003, Accessed July 21, 2017, <http://www.nytimes.com/2003/02/27/business/company-news-gm-says-onstar-service-is-making-money-after-7-years.html>

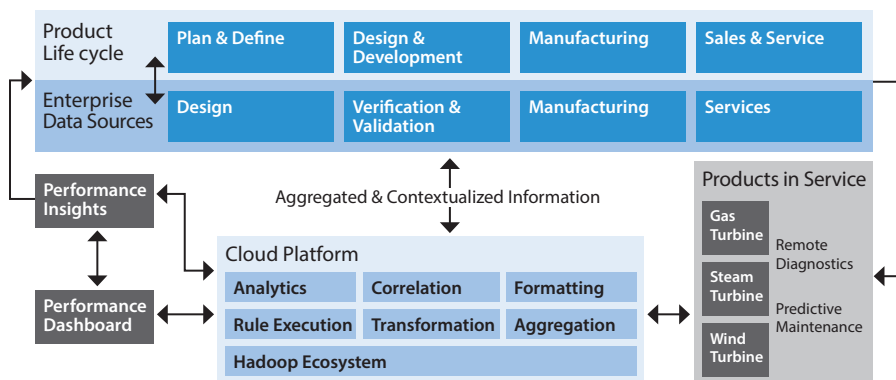


Figure 5: Illustration of a Closed-Loop System for a typical utilities company that includes the ability to gain performance insights from customers’ experience using energy systems.

It’s a trend that extends beyond major firms. A myriad of startups are seeking investors for all manners of newly imagined, IoT-enabled products. At the 2017 Consumer Electronics Show, a startup called ShadeCraft unfurled a smart patio umbrella.⁴²

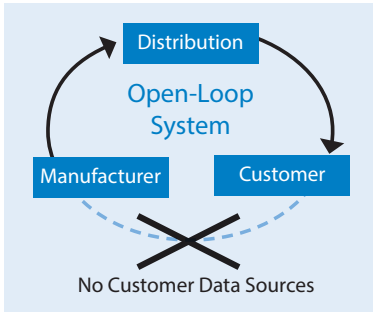
But that isn’t all manufacturers are doing with connected, smart products. In the process of connecting their products, manufacturers are unlocking a new business model. This model harbors a wealth of opportunities for manufacturers to better serve their existing customers, expand their markets, and drive profitable revenue growth.

Closing the Value-Generation Loop

The powerful new business model in manufacturing is enabled by a mashup of digitization and servitization—that is, the process of adding services to products. When manufacturers add service components to a connected product, they open up new ways to generate value to customers and to themselves. As we describe it, they gain the ability to shift from an open-loop system to a closed-loop system of value generation. Figure 5 describes the aspects of that shift.

⁴² Digital Trends, This Smart Patio Shade Can Track and Block the Sun for Your and Play Your Music, January 4, 2017, Accessed July 21, 2017, <https://www.digitaltrends.com/home/shadecraft-sunflower-patio-shade-ces-2017/>

Lost Opportunities in Open-Loop Systems



Most manufacturers operate in an open-loop system. They sell their products to OEMs or through indirect distribution channels composed of wholesalers, dealers, and/or retailers. As a result, manufacturers don't have direct, real-time sources of data that can tell them how end customers are using (or misusing) their products and how their products are performing (or not performing).

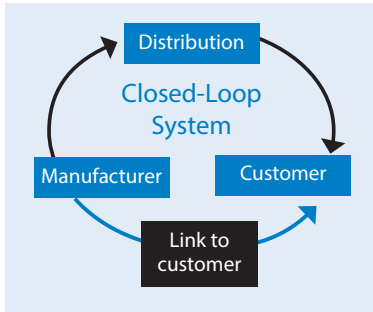
They have limited insight into what benefits or problems their customers experience. Their data on customer usage is 'open,' meaning it escapes their reach.

Most manufacturers are beginning to realize that this open-loop system is a missed opportunity, and that limited contact with end customers is a major obstacle to growth.

Overcoming this obstacle is difficult and expensive. More often than not, manufacturers lose crucial data. Savvy manufacturers try to work with their channel partners, but feedback loops break down and, in many instances, their channel partners simply do not or cannot gather the data. In any case, warranty claims arrive long after customers have been disappointed and the opportunity for a proactive response is gone.

Even more valuable opportunities are lost in an open-loop system. When manufacturers don't have a direct link to their end customers, they don't know and can't respond to how customers use their products (or hack their products to make them do things manufacturers never imagined). These are lost opportunities to build new revenue streams and enhance customer loyalty.

How Smart, Connected Products Close the Loop



In a closed-loop system, a manufacturer has a direct and ongoing digital link to end customers: access to information about the product, how the customer is using it, and any problems the customer may be having with it.

IoT technologies enable manufacturers to create a closed loop system. When they make their products smart and connected,

manufacturers that sell to OEMs and through indirect distribution channels can maintain a direct link to end customers.

Moreover, emerging technologies are making closed loop systems easier and more economical than ever before. In communications, the new 5G network standard promises much faster transmission of digital data. In computing, public clouds and ever more powerful processing promise to reduce costs associated with storing, analyzing, and gaining insights from customer product usage data.

Closed-loop systems represent a paradigm shift for most manufacturers. Product makers can now know the ultimate truth about their products: how they are performing (or not performing) for customers. They can receive continuous, real-time information about their products while those products are in the end customers' hands. They can understand how efficiently customers are using their products, when the product is nearing a breakdown, and a host of vital information.

Closed-loop systems open up a vast frontier of opportunity for manufacturers that are encompassed in the term servitization.

The Bountiful Promise of Servitization

Servitization is a fundamental rejiggering of the traditional manufacturing model. It harks back to something Harvard Business School professor Theodore Levitt wrote 40 years ago: “People don’t want to buy a quarter-inch drill, they want a quarter-inch hole.”⁴³

A manufacturer that pursues servitization as strategy taps into Levitt’s timeless truth. It shifts its primary focus from creating value by making and selling a product to creating value by delivering a service through a product. The manufacturer may or may not make money selling the product itself, but it does make money by providing the service embedded in the product.

We find that servitization opportunities come in four flavors:



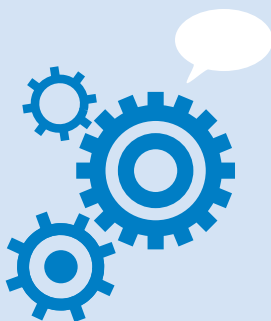
1. Enhancing reliability and uptime.

Whether it’s a truck, boiler, air compressor or any other machine, manufacturers can embed monitoring services in their products. Then, they can act (or alert their customers to act) before product failures occur. This creates customer value by raising product reliability, maximizing uptime, and reducing overall maintenance costs. All this builds value in the brand.

Maersk Drilling’s partnership with GE is an example of this at work. After a successful pilot project, Maersk is deploying a GE system to analyze the performance of 110 key pieces of equipment at nine additional offshore drilling rigs. The sensors on equipment enable GE to tell Maersk when it’s time to perform maintenance, before the equipment breaks down. That saves Maersk time and money.⁴⁴

⁴³ Harvard Business School Working Knowledge, What Customers Want From Your Products, January 16, 2006, Accessed July 21, 2017, <http://hbswk.hbs.edu/item/what-customers-want-from-your-products>

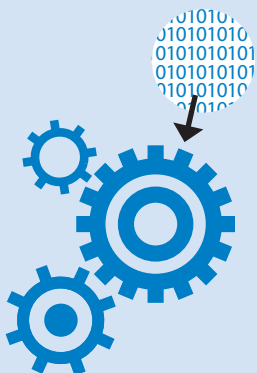
⁴⁴ JWN Energy, Maersk Drilling and GE accelerate digital partnership, target 20% efficiency boost, July 19, 2017, Accessed July 21, 2017, <http://www.jwnenergy.com/article/2017/7/maersk-drilling-and-ge-accelerate-digital-partnership-target-20-efficiency-boost/>



2. Customer operational improvement.

Manufacturers can embed services that optimize the value customers get from using a product. For instance, Rolls Royce's jet engines include smart technologies and connectivity that enable them to advise airlines on optimal flight speeds and other operating metrics that produce the lowest fuel costs.⁴⁵

Automakers could provide similar services to consumers, for instance, advising them how to accelerate and brake in ways that maximize fuel economy. So could energy utilities—by tracking in real-time precisely how much energy its customers are using and advising them how to reduce their costs.



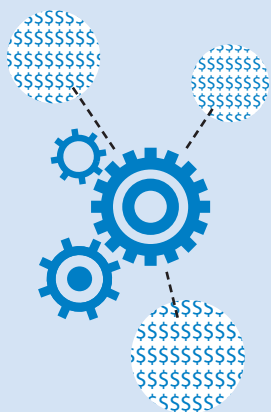
3. Selling new product capabilities.

By embedding service delivery capabilities such as software downloads in their products, manufacturers can tap into new product, subscription, and streaming revenues. Toyota is offering its car owners new mapping systems and other apps that can be downloaded as software.⁴⁶ Tesla has offered to sell the owners of its electric vehicles a software download that adjusts the car's suspension settings to provide them with more road clearance at high speeds.⁴⁷

⁴⁵ Rolls-Royce plc, Engine health management, Accessed July 21, 2017, <https://www.rolls-royce.com/about/our-technology/enabling-technologies/engine-health-management.aspx#sense>

⁴⁶ PR Newswire, 2018 Toyota Camry to Come Equipped with Xevo's Next-Generation Connected Car Technology, July 11, 2017, Accessed July 21, 2017, <http://www.prnewswire.com/news-releases/2018-toyota-camry-to-come-equipped-with-xevos-next-generation-connected-car-technology-300484269.html>

⁴⁷ Wired.com, Tesla's Over-the-Air Fix: Best Example Yet of the Internet of Things?, February 2014, Accessed July 21, 2017, <https://www.wired.com/insights/2014/02/teslas-air-fix-best-example-yet-internet-things/>



4. New revenue-generating businesses.

Perhaps the most valuable potential of servitization is when it enables manufacturers to develop entirely new businesses. They can uncover the insights that lead to such businesses by using smart, connected products to gain a deeper understanding of customer experience. Kaeser Kompressoren did this: It no longer sells air compressors; it sells air compression as a service as it monitors the usage of its machines.⁴⁸ One reason connected cars have spawned a competitive race in the auto industry is the many revenue-generating businesses they make possible including mobile advertising. Imagine driving your car and getting personalized, location-based offers in your dashboard infotainment system: a hotel just 5 miles ahead offering a 50% discount, or a steak restaurant with tables available on a busy Friday night. That world will soon arrive.

The experience of Mitsubishi Hitachi Power Systems, the maker of thermal power generation systems, shows the potential of the servitization approach. Working with TCS, the global firm is developing an artificial intelligence-based system to adjust the combustion process of coal-fired power plants to reduce costs and carbon-dioxide emissions.⁴⁹ The system, which it plans to sell to other plant operators, collects nearly 250 data inputs about the performance of a power boiler. It is designed to determine how best to tune the boiler for maximum efficiency by testing more than 10,000 combinations. The case demonstrates the value of a closed-loop system in which Mitsubishi is combining its expertise in power plants with AI capabilities to sell its engineering and product knowledge as a service.

⁴⁸ Americas' SAP Users' Group, Using the Internet of Things to Provide 'Air-as-a-Service,' June 25, 2015, Accessed July 21, 2017, <https://www.asug.com/news/using-the-internet-of-things-to-provide-air-as-a-service>

⁴⁹ Nikkei Asian Review, Tata, Japanese partners to use AI at coal-fired power plants, November 20, 2016, Accessed August 2, 2017 at <https://asia.nikkei.com/Business/Companies/Tata-Japanese-partners-to-use-AI-at-coal-fired-power-plants>

Overcoming the Resistance to Servitization

The promise of servitization is tantalizing. That's why 48% of UK manufacturers are planning to increase their investments in servitization in 2018.⁵⁰ Yet 44% admitted they are servitization beginners. They, and indeed, all leaders of manufacturing companies that are seeking to capture the opportunities of servitization, will need to be prepared to encounter internal and external resistance that appears whenever business model change is undertaken. Among the challenges:

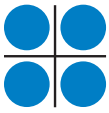


Core business dominance: Every well-established company has a dominant core business model. The managers responsible for operating this model often find it difficult to reimagine it. Change can be especially challenging when it involves new and unfamiliar technologies. (Recall that Kodak executives were aware that digital photography threatened the company's survival but failed to act.) Resistance stemming from the dominant business can remain strong even after pilots are run and proof of concept is delivered. Often, manufacturing executives continue to project their own resistance to change on their customers—either claiming customers will not pay for the service or doing little to help sell the service to customers, or both.

Approach to take: Conduct design thinking workshops, which employ both an understanding of IT systems and creative problem-solving exercises that look at issues like customer challenges from different viewpoints, to develop ideas for taking the business in new directions. Such exercises help companies to unearth new possibilities for creating value through new business ideas. The process can validate the best ideas while building support for them among different stakeholders.

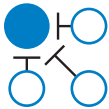
Then evaluate options for a proof of concept project that will test the theory that the company's offerings can include add-on services. Companies must assess their means to collect data on their products. They are likely to determine that they need to collect more.

⁵⁰ The Manufacturer's 2017 Annual Manufacturing Report, Accessed July 21, 2017, <https://www.themanufacturer.com/wp-content/uploads/2017/01/Annual-Manufacturing-Report-2017.pdf>



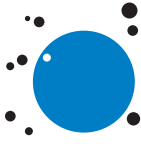
The silo trap: Manufacturers, especially large established ones like many of the automakers, are organized into silos (design, engineering, production, marketing, etc.) that all too often operate independently. That can stymie servitization initiatives.

Approach to take: Engage executives across functions in a discussion of customer value. Assign a cross-functional team to assess existing information on the customer's experience, including warranty claims and problem reports, and identify strengths, weaknesses and opportunities to expand the view. Then report on options to create a pilot test of a service offering.



Channel resistance: Manufacturers that launch servitization initiatives should also expect resistance from their sales, distribution, and service partners. Many dealers rely on a repairs and maintenance revenue that a new service model is expressly intended to reduce or eliminate. Further, servitization often carries with it the very real fear of disintermediation; you should expect dealers and other partners to protect their customer relationships.

Approach to take: To overcome channel resistance, manufacturers must reach out to their distribution partners and make accommodations. Proof of concept projects can help build evidence to show the value of new models to reluctant partners.



Customer inertia: With 20/20 hindsight, successful products and service bundles (such as Apple's iPod) look like they were no-brainers from the start. But in reality, customers often do not recognize the value of service-embedded products, and don't immediately flock to them. Companies must combat such customer reluctance with effective marketing that clearly states the value of the new offering.

Approach to take: Successful servitization requires a concerted effort at educating customers, especially consumers, on the value they would get and its price. Companies must overcome internal resistance and enlist employees in that effort. They should begin their servitization efforts with modest projects that do not require overly complex explanations. And they should be sure that customers understand both the rewards of the service model and the risks of improper use.

Servitization Is an Imperative

Leading manufacturers of all types are engaging in servitization. Sooner rather than later, those that fail to embed services in their products—and deliver the enhanced customer experiences that servitization promises—are going to be left behind.

This is especially true for any manufacturer that is in an open-loop system. Servitization offers an unprecedented opportunity to build tighter relationships with customers. They can use it to add intelligence to their products, collect valuable data on customer usage, inform design and performance improvements, and test those improvements before rolling them out at scale.

In short, servitization enables manufacturers to improve the reliability of their products, help their customers to obtain superior value, and develop new revenue generating businesses. The technologies needed to start embedding services in B2B and B2C products are available now. No manufacturer should be waiting to see what comes next.

Why Agile Software Development Requires Radical Changes in Budgeting and Scoping

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With digitally savvy disruptors seemingly making inroads in every sector, companies using so-called agile approaches to building new digital products and digital processes are becoming hard to beat. In just one example, the speed with which Amazon.com unveils new capabilities to its website—dozens of changes every day—has left many longstanding retailers in the dust or racing furiously to catch up. Even large financial services companies like ING of the Netherlands, have realized that they must organize and develop online systems in agile ways to keep pace with the explosion of online banking options.

However, in the last couple of years, companies that have mastered agile development have been leaping ahead in industries in which having excellent digital connections to customers is crucial to success. (Think financial services, high

tech, retailing, and media.) It's why 94% of companies are using agile approaches, according to a 2016 survey.⁵¹ The two biggest reasons they cited were to accelerate the delivery of software and to better manage changing priorities.

Companies that introduce new online processes or online products for customers are chasing competitors that can make changes to their online offerings weekly or even daily. If they used traditional approaches to building such systems, they would come to market way too late and (most likely) off target.

Yet not all agile projects are successful, and a key reason is how they are scoped and funded. Companies that scope and budget their agile development projects the same way they do their traditional systems projects are likely to come up far short in two ways:

1. They lock development teams into working on features of systems that may turn out to be not worth investing in (or, at least, spending as called for in the original plan) because customers don't find them valuable. In this case, traditional budgeting doesn't take advantage of the ability of agile teams to put products online and test them with customers early in the process. Getting early feedback from customers can save a company a lot of money. A firm can redirect funding away from less valuable to more valuable features.
2. They risk losing key members of their development teams, who are often assigned to other systems while the current projects are waiting for the next round of funding.

Research has found that nearly two-thirds of the features built into systems using traditional development methods are rarely or never used, and that the 20% that are used provide 80% of the value to customers.⁵²

⁵¹ VersionOne survey conducted in the second half of 2016, Accessed July 20, 2017, <https://explore.versionone.com/state-of-agile/versionone-11th-annual-state-of-agile-report-2>

⁵² Standish Group report, 2002, Accessed July 31, 2017, <http://www.featuredrivendevelopment.com/node/614>

In this article, we discuss why scoping and budgeting of software projects delivered through agile development methods must be different than those used in traditional software development approaches. We explain why agile methods should initially provide a high-level, rather than a detailed, estimate of the time and the scope of effort required to deliver a

system. Over time, as they build and test components with customers, the team will get a much more accurate and detailed estimate of time, scope, and budget. We also show why companies should fund agile programs not by their scope but rather by the value that their products bring to end customers or users (also known as “value streams”).



The Rise of Agile Techniques for a Digital Online World

Agile software development methods arrived at the turn of the 21st century, a time when companies had to build e-commerce, websites and other systems to compete for customers on the Internet. With the advent of the web in the mid-1990s, large companies had to develop systems that would be outward-facing—i.e., used by end customers outside their organizations—not just by their internal users. Suddenly, the traditional systems development process (often referred to as using the “waterfall” method to depict how the phases of requirements analysis, architecture, coding, testing and launch would follow one another across a calendar), which reliably produced internal systems, had become too slow, off-target and in other ways inadequate.⁵³

A variety of agile methods arose: Scrum, Lean, Extreme Programming, Kanban, and others. They were different answers to the very same need—to produce software much faster, try it out on real customers far earlier (building systems for the web made that easy, since customers could use the system from their own computers and digital devices), and (based on that early customer feedback) allow developers to make quick adjustments to the system so it wasn’t obsolete the moment it went live a year or two later.

⁵³ For a history of agile software development, read how its founding fathers convened in 2000, Accessed August 04, 2017, <http://agilemanifesto.org/history.html>

Agile methods differed dramatically from traditional development in at least five ways: scoping, schedule, cost estimates, deliverables and key success factors. To scope systems developed through traditional methods, teams are asked to make detailed estimates of project length and budget after doing extensive analysis of the system's requirements. The more features and functions, and the more connections to other systems there are, the greater the system complexity and therefore, more people, time, and budget to do all the work.

In other words, for traditional systems development, the schedule depends on the scope of the effort estimated, and the cost is a function of that scope, and when the company needs the system to go live (i.e., the schedule). (Building a system faster requires assigning more team members, and thus increases the cost.) Yet developers know the least about the scope (and thus the time and cost) of a software project at the beginning. Their knowledge increases once they start delivering code, and it keeps improving the more they deliver.

The key to successful software projects based on waterfall methods is doing exceptional upfront requirements analysis so that the schedule and cost turn out to be fairly accurate.

Dimensions of Comparison	Traditional Development (Waterfall)	Agile Development
Scope	Detailed estimations based on extensive upfront requirements analysis of the whole system	High-level estimation upfront; scope is flexible, and depends on how much work can be done for a fixed time and cost
Schedule	Depends on scope of effort	Fixed
Cost	Based on detailed upfront estimate of system scope and schedule	Fixed
Deliverables	Based on project stage: requirements analysis, code, testing	Working product with value for customers/users
Key Success Factors	Doing upfront requirements analysis so that systems behave as per pre-defined business needs	Keeping teams intact so key knowledge remains in place over the product lifecycle Changes are made with an “inspect and adapt” approach
Development Team Credo	“Tell us what you need, and we’ll tell you how long it will take and how much it will cost”	“Tell us when you need something and your budget, and we’ll tell you what we can deliver”

Figure 6: Comparing Agile and Traditional Software Development

Agile development is built on this premise: If developers can release pieces of a system to users early in the development process, those developers will have a much better idea early in their process about the scope of the system. Those pieces are completed in short time frames—weeks, rather than months—in “plan > do > check > act” cycles.

In agile development, scoping, scheduling and cost estimation techniques are thus very different than they are in waterfall development. (See Figure 6)

The Problems of Software Budgeting in an Agile World

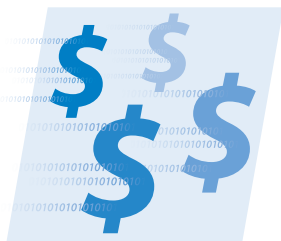


So here we are, 16 years after the Agile Manifesto emerged from the primordial software development soup. Yet most organizations (while embracing agile) are still scoping and budgeting them in the same way they structured and budgeted the big, monolithic systems projects of yesteryear. In other words, while agile development techniques are all the rage in the IT organization and the business functions they automate, the budget holder for technology in most companies (the finance organization) still doles out funding the old-fashioned way: by program, projects or stage gates (such as requirements, design, coding, testing, and so on). After requirements analysis is deemed complete, funds are released for the next phase (system architecture and development). Then once that's done, funding needs to be approved for system testing, and so on.

For software development teams that build systems using agile methods, this has become a big problem for several reasons:

- It locks teams into continuing to develop pieces of software that may not be useful to customers.
- Teams get disbanded if project funding dries up. Valuable knowledge about the business processes of the product and technologies that enable those processes is lost.

The Answer: Scoping Smaller Releases and Funding Them Faster



So how should companies that need to develop systems through agile methods rethink their scoping and budgeting? We believe they should make three key changes: funding by “value stream” rather than by the entire program; launching low-cost, high-value products/features first and high-cost, low-value ones last; and continuously funding and giving the development team work that’s been prioritized thereby ensuring that the teams aren’t on hiatus.

Let’s look at each change.

Funding by value stream. The work of agile development teams should be funded with an economic view—i.e., how useful the product or feature is to customers or other end users. Let’s say a retailer’s top management gives its new e-commerce website a full year to bring it to market. Developed through traditional methods, none of the system would see the light of day (i.e., be online for customers to use) for that year. However, using agile methods, e-commerce and IT managers would prioritize the features of the system (i.e., price lookup, product descriptions, product reviews, one-click pricing, inventory checks in store locations, and so on) and begin putting them online far earlier—perhaps within weeks after they launched the project depending on the release cadence.

Funding this project the traditional way would have called for drawing on its total budget at each step of the development process: at the start, for requirements gathering and analysis; then (after requirements were inspected) before architecture and coding; then (after the architecture and coding were checked) before testing; and finally (if the testing went well) to put it into production. Or top management would allocate budget for the full scope of the project, tying up funds for a long duration regardless of whether the project meets its intended purpose or not when it is finally completed.

Launching high-value but high-cost value streams early. One of the biggest advantages that agile has over traditional systems building methods is the ability to break a big monolithic system into smaller pieces, and then go live with some of those pieces very early in the project, even in the first few months. The pieces you want to go live with first are those that everyone believes at the outset to be low-cost, yet high-return.

How budgeting of agile projects needs to change during the software development lifecycle

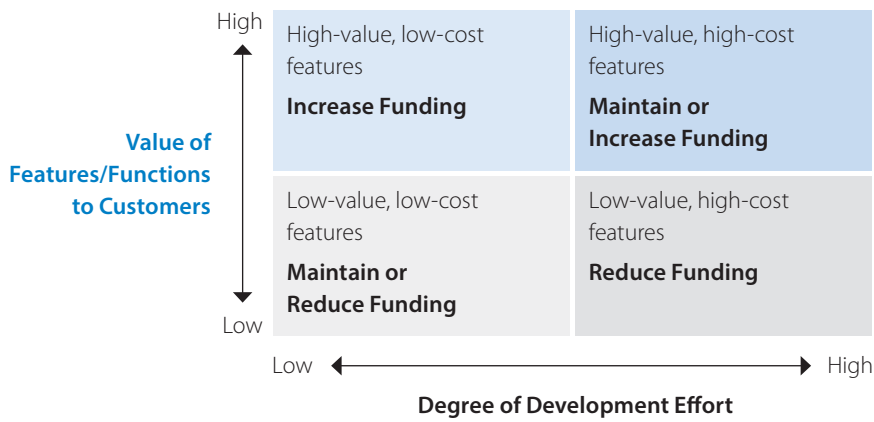


Figure 7: Adjusting the Budgets for Systems Built Through Agile Methods

The market feedback that the hypothetical retailer would get from introducing pieces of its new e-commerce website in weeks like those we’ve discussed would be highly valuable. It will reduce further funding of low-value but high-cost features. It will continue funding of high-value features. And it should increase funding for features proven to have high value but which don’t cost very much. (See Figure 7)

Delegating scoping and budgeting to the agile development teams.

The whole reason to use agile development is to come to market far faster with a new online system, and get much earlier and frequent customer feedback on which features of the system to further develop or abandon. Hence the funding decision for agile development needs to be top down, as well as dynamic.

As such, we believe that making all this work well is best done when a company delegates the decisions on what pieces of the system to work on next to the product owners in the

business (who best understand their product and its performance) and to the development teams (who best understand how long it would take to build it).

Of course, vesting that decision in the development team requires great trust by those who fund the system: the business unit, finance and IT heads. Your CFO must become comfortable with the notion that agile teams (which must include product managers/owner(s) from the business units and functions) will know best what system features are delivering value or not.

It's why the team, product owners, and managers must keep reviewing what's being delivered and monitor its performance in the marketplace to utilize available funding most judiciously.

We don't advise companies that are new to agile development to change the way they budget overnight. They need to first see the advantages of agile development and get accomplished at it. But those that are proficient with agile should consider giving their teams fixed budgets and then leave the scoping decisions to the team.

Ultimately, as leadership guru Stephen M.R. Covey once wrote about trust in business: whether the agile teams gain and keep the trust of senior executives will depend on the results they generate and their integrity, intent, and capabilities.⁵⁴

⁵⁴ The Speed of Trust, Accessed August 04, 2017, <http://www.speedoftrust.com/How-The-Speed-of-Trust-works/book>

How This is Working at a Major Retailer

The retailer, whose name will go unmentioned, is competing against Amazon, as are numerous other retailers these days. But it realized in the last few years that how often it could update its e-commerce website, the systems in its stores, merchandising, buying, and other system were critical to competing effectively in a bricks-and-clicks world.

At this retailer, portfolio level budgeting is done top-down with joint decision by business and IT. Highest priority value streams⁵⁵ get fixed funding for a fixed period without any elaborate bottom-up cost estimations based on detailed requirements upfront.

In fact, the company found that it had to change the organization structure of the IT department to make agile methods work well. So rather than being organized around IT domains such as business analysis, coding, systems analyst, testing, and so on, the new organization is structured by online “product” area: point of sales applications, HR applications, vendor negotiation applications, and so forth. Agile teams in each product area have the requisite business analysis, systems analysis, UI designers, developers, testers, and other skills necessary to build, test, and go live with an online product in their area.

The result of embracing agile, and new ways to scope and budget for agile-developed systems, has been sizable: faster system rollouts, fewer technology incidents, and a workplace that lures new systems engineering talent to the company.

The New World of Systems Scoping and Budgeting

Companies like the retailer mentioned above, ING, Netflix, Spotify, and Google are leading the way on how systems scoping and budgeting must change in a world of digital systems built through agile methods. Those companies that embrace and master agile methods, and then scope and budget for them in ways that provide highly valuable early feedback, are getting a big leg up in the race to be digital.

Raising Your IoT Security Game

Author

Satish Thiagarajan

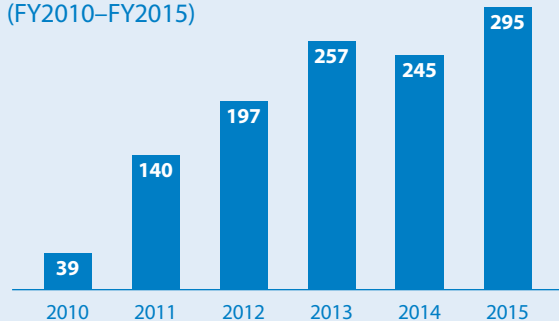
Global Head, Cyber Security Practice, Tata Consultancy Services

The Internet of Things (IoT) opens up opportunities for companies to improve visibility of their operations and the products they make by collecting data from sensors attached to a range of machines, from controllers at factories to aircraft engines. But while many companies are embedding sensors and wireless communications devices into their industrial control systems and products, each implementation has the potential to open up their systems to hackers who can steal data or disrupt operations.

In the U.S., IoT incidents logged by the U.S. Department of Homeland Security rose more than seven-fold between 2010 (39 incidents) and 2015 (295).⁵⁶ Researchers project IoT will rise on the list of risks for chief information security officers (CISOs). Two-thirds of computer networks will see an IoT security breach by 2018, IDC researchers predict, adding that

⁵⁶ Charles McLellan, "Cybersecurity predictions for 2016: how are they doing?" ZDNet, September 15, 2016, accessed at <http://www.zdnet.com/article/cybersecurity-predictions-for-2016-how-are-they-doing/>.

ICS-CERT: Number of incidents (FY2010–FY2015)



Data: ICS-CETY/Image: ZDNet

by 2020, 10% of all attacks will target IoT systems. Gartner analysts say they expect IoT security costs will rise to 20% of annual information security budgets by 2020, up from a rounding error (less than 1%) in 2015 budgets.⁵⁷

The risks of a breach in corporate networks incorporating IoT capabilities are real. Examples abound:

A regional water company saw its web-based payment system and operational technology system hacked, an event that led to unauthorized manipulations of its programmable logic controllers.⁵⁸

Researchers have identified security flaws in the communications protocols used in medical devices such as implantable cardiac defibrillators that can be adjusted remotely without surgery.⁵⁹

A demonstration by two hackers showed it was possible to gain control of a connected car with the knowledge of its IP address.⁶⁰

⁵⁷ Gil Press, "Internet of Things Predictions from Forrester, Machina Research, WEF, Gartner, IDC," Forbes.com, January 27, 2016, accessed at <https://www.forbes.com/sites/gilpress/2016/01/27/internet-of-things-iot-predictions-from-forrester-machina-research-wef-gartner-idc>.

⁵⁸ Michael Hill, "Water Treatment Plant Hit by Cyber-attack," Information Security, March 24, 2016, accessed at <https://www.infosecurity-magazine.com/news/water-treatment-plant-hit-by/>.

⁵⁹ Lily Hay Newman, "Medical Devices are the Next Security Nightmare," Wired.com, March 2, 2017, <https://www.wired.com/2017/03/medical-devices-next-security-nightmare/>.

⁶⁰ Andy Greenberg, "Hackers Remotely Kill a Jeep on the Highway—with Me in It," Wired.com, July 21, 2015, accessed at <https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/>.

The risks extend to consumer devices that interact with corporate networks. In 2016, malware called Mirai hijacked IoT devices such as closed-circuit video cameras and digital video recorders that used factory-default security settings. Those devices, in turn, attacked Dyn, an Internet infrastructure company that underpins top websites. The incident created problems for users at popular sites like Amazon, Twitter, Reddit, and Netflix.⁶¹

Such incidents demonstrate why companies must lock down their connected systems and networks, including the ones they use to design and manufacture their products and the connections they embed in their products.

The incidents show the vulnerability of interconnected systems that many parties have access to. And they point to the urgency that enterprise risk management leaders confront as they seek to maintain and improve existing defenses.

The Risks Embedded in IoT

The promise of IoT is that its technology can automate functions that are much more expensive to do manually. It's impractical to employ large operations teams to monitor all plant equipment 24x7. It's easy, and relatively cheap, to install sensors and connect them to a network that will alert managers to problems. It's now feasible to equip advanced engines with devices that provide ongoing measures of their mechanical health.

⁶¹ Brian Krebs, "Hacked Cameras, DVRs Powered Today's Massive Internet Outage," Krebs on Security, October 21, 2016, accessed at <https://krebsonsecurity.com/2016/10/hacked-cameras-dvrs-powered-todays-massive-internet-outage/>.

But as IoT deployments have spread, risks have emerged. Manufacturers designed IoT devices with functionality in mind, not security. IoT devices are out in the field—attached to company products, in locations around the world—and are often not monitored centrally for attacks (unlike the corporate data center). As a result, practitioners see that attacks such as IoT botnets can spread quickly because many IoT devices are rarely patched or updated.⁶²

In fact, the risks of IoT devices being hacked are far greater than they have been for any previous technology assets deployed by companies in at least three respects:

- 1** The large number of devices to monitor (millions, in the case of a large automaker instituting cloud-delivered infotainment systems or self-driving cars) makes the IoT a larger risk to manage than the thousands of laptops, desktops and mobile phones used by the employees of a major enterprise
- 2** The challenge is also more geographically dispersed due to IoT sensors embedded in products and machines installed or moving through corners of the world that are often far beyond where the company has offices and employees
- 3** The relatively new nature of the technology means there are heterogeneous platforms to manage. IoT devices are full of hardware and software from different vendors that make assessing vulnerabilities, patching software, and monitoring ongoing risks a multidimensional challenge

62 Verizon Security Solutions, 2017 Data Breach Digest, accessed at http://www.verizonenterprise.com/resources/reports/rp_data-breach-digest-2017-perspective-is-reality_xg_en.pdf.

Know What You're Dealing With

Addressing the IoT security challenge requires an understanding of your IoT landscape in detail. This includes analysis of what devices you have and at which point they may be vulnerable so that you can address critical security gaps. Companies must establish a group that will mitigate current problems and manage future risks. A comprehensive review requires eight steps:



1. Appoint a centralized team accountable for IoT security.

A centralized team that includes the CISO must be accountable for securing the company's IoT devices—and ensuring the firm's ongoing compliance with risk management policies.

To establish this team, companies must evaluate the maturity (in terms of in-house skills and practices) of their IT organization and the operations technology (OT) organizations. In some companies, this exercise means confronting a cultural clash. While IT professionals typically have more experience managing information security based on experience and industry-established best practices, there nevertheless may exist a distrust between IT and OT based on each group's unfamiliarity with the other.

A common organization that combines experts in control systems for operations facilities, such as integrated control systems, and IT security can bridge this gap. In addition, standards organizations for IT and OT can serve as a resource for the centralized team applying the same principles to OT devices, such as the ISO 27001 standard⁶³ for information security management systems and the ISA/IEC-62443 standard to prevent cyber attacks on industrial operations.⁶⁴

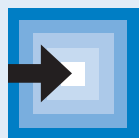
⁶³ International Standards Organization, document "ISO/IEC 27000 family—Information security management systems," accessed at <https://www.iso.org/isoiec-27001-information-security.html>

⁶⁴ Bill Lydon, "What Can We Do to Prevent Cyberattacks on Industrial Operations?" International Society of Automation Interchange blog, March 2014, accessed at <http://automation.isa.org/2014/03/cybersecurity-strategy-and-actions/>.

Once set up, the centralized team can:

- Monitor control-systems compliance with corporate policies for managing IoT devices
- Ensure that software patches are up to date for plant instrumentation, IoT devices, and infrastructure
- Run regular audits for security practices
- Conduct constant network monitoring

The team should also incorporate new best practices that emerge for IoT devices. For example, industrial service providers, including GE's Achilles program, certify devices and the organizations that implement them for compliance to the IEC-62443 standard.⁶⁵ Others provide IEC-62433 assessment services to organizations that deploy industrial systems. In addition, device manufacturers can provide maintenance and support remotely for their products. While a potential benefit to companies deploying IoT devices, such remote access must be controlled and secure.



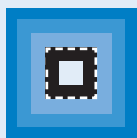
2. Locate your company's critical IoT assets.

The first priority is to identify all the connected devices and sensors your company uses, and then determine which ones represent a significant security risk. Companies often discover assets about which they were previously unaware. You must also distinguish between those assets that signify important risks and those that do not. Not every asset is critical. In some cases, the risk of a breach occurring through a particular device is less urgent than the resources required to address the remote chance of a problem.

With all that said, these assets are likely to be distributed across enterprise networks and geographical locations, and may be found in isolated networks within industrial plants. They will be present in both IT systems and OT systems, including:

- End-point devices, such as PCs, laptops, smartphones, tablets, and other mobile computers
- Devices that move with transportation containers, trucks, and ships
- Industrial control systems managed by supervisory control and data acquisition (SCADA) systems, in factories and other facilities
- Legacy infrastructure, such as the controllers that utilities use to manage flows of electricity, water and natural gas

⁶⁵ GE Digital information sheet, "Achilles Practices Certification," accessed at <https://www.ge.com/digital/sites/default/files/achilles-practices-certification-from-ge-digital-datasheet.pdf>



3. Identify the software vulnerabilities in your IoT assets.

Software vulnerabilities are the most significant risk facing IoT-connected devices. With an inventory of critical assets in hand, a company can assess which software governs the actions of each piece of hardware.

Different device manufacturers use their own conventions in software protocols, and each requires an assessment of its vulnerabilities. (For example, can a hacker exploit it remotely? How can such a weakness be fixed?) For some devices, changing the security settings in the product that was shipped can be enough to address a risk. For others, such as various generations of Windows devices, there may be known network vulnerabilities for which an immediate patch is available.

Failure to update software can leave systems susceptible to attacks, such as the one that occurred in May 2017 when a variant of the WannaCry ransomware program infected tens of thousands of computers worldwide.⁶⁶ It is imperative to maintain updated software patches on critical assets.



4. Discover devices that gain entry to your networks.

As companies assess their own devices and software, it is important to understand when new devices—whether they are company-owned or devices used by customers, business partners, or contractors—access corporate networks. Where possible, use technology that can automate the discovery of new devices.

However, you must manually detect isolated networks at industrial sites that support your IoT devices. Assess the vulnerability of these devices and execute patches on them. If they are owned by external parties, require the parties to do the same.

⁶⁶ Jeremy Ashkenas and Adam Pearce, “Animated Map of How Tens of Thousands of Computers Were Infected With Ransomware,” New York Times, May 12, 2017, accessed at <https://www.nytimes.com/interactive/2017/05/12/world/europe/wannacry-ransomware-map.html>.



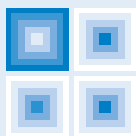
5. Watch out for emerging threats.

Monitor all connected devices for evidence of new threats such as distributed denial of service attacks. Such attacks often arise from either a software developer error or the open source software community, as hackers seek to exploit uncovered vulnerabilities in software code. Isolate the devices that are the target of threats and apply software patches to them.



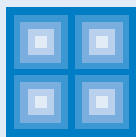
6. Inspect new devices before they connect.

Establish a process for ensuring that new devices, purchased or added, include security features in their hardware, software and network connection, and that the security features are updated.



7. Demand best practices from your business partners.

Make certain that the business partners that have access to your networks also have strong security programs—and that they demonstrate compliance with your procedures. For example, a repairs contractor, which needs to access connected systems and devices must have implemented security measures such as software updates, and comply with your company's policies before it can enter your network.



8. Have backups ready.

A cyber security program for IoT systems fits into a broader corporate risk management program. Incorporate its elements into existing plans for disaster recovery and business continuity already established to deal with a system breach. Include information about IoT security in the company's incidents communications strategy.

IoT Security in Action: Three Cases

The experiences of three companies we have worked with show how IoT cyber security can work.

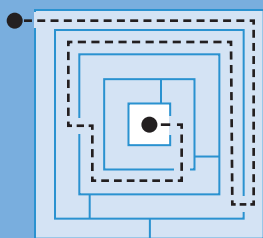


Manufacturing firm strengthens its OT security

Situation: At a manufacturing company, executives understood their plant floors had embedded software and Wi-Fi network connections in a typical mix of legacy equipment and newer devices. Such assets included programmable logic controllers (PLCs), supervisory control and data acquisition (SCADA) systems and human-machine interfaces (HMIs) to control industrial processes. The company had other connected devices including equipment for its field support crews, business continuity, and incident management programs.

Actions taken: The company deployed non-invasive software tools designed for IT systems and customized to work with OT network protocols, to scan all of its devices for vulnerabilities. The tools identified vulnerabilities, and the company then repaired them. After finishing this process at one factory, the company repeated the process at other factories.

Takeaway: By applying best information security practices developed for IT systems, this company was able to identify and remediate security risks in its operations. Building on its record, the company was able to monitor its devices and systems, and update its practices to address future vulnerabilities.



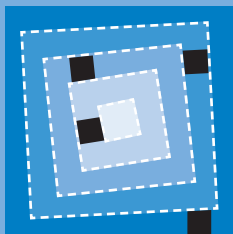
Utility establishes OT security roadmap

Situation: Concerned that its IoT devices presented a security risk, leaders at a utility company sought to identify problems and solutions.

Actions taken: The company began a 12- to 18-month assessment of its organization's security capabilities in addition to its security practices and controls, adapting the ISO 27001 IT standard developed for OT security. Assets evaluated will include controllers, HMIs, asset management systems, as well as equipment for the field service organization. The assessment also will examine how OT security should be included in its incident management plans and business continuity program.

The assessment will identify high-value assets that need immediate attention, as well as other measures the company must execute as part of a comprehensive OT security management plan.

Takeaway: By adapting best security practices for IoT devices, the company is strengthening its risk management posture.



Company establishes security governance program OT

Situation: After performing an IoT security assessment, executives at a utility company sought to develop capabilities to manage cyber security.

Actions taken: The company adapted IT best practices for its OT organization. It defined OT security policies. It established an OT security governance process with defined roles and responsibilities. It set metrics for governance procedures and security actions. It scheduled regular reports for the OT organization to update executives on the security status of its IoT assets.

Takeaway: An OT organization can establish strong information security governance to mitigate IoT security risks.

Manage Risks While Capitalizing on IoT Benefits

In the excitement to take advantage of IoT, companies today must assess the risks of a security breach or loss of control of important operational systems. Firms that demand secured technology will lay a strong foundation for ongoing risk management efforts.

Programs to prevent a security problem—such as updating and patching systems—and procedures to deal with any security disruption will enable companies to prepare for the worst as they seek to make good on the promise of this powerful technology.

Throughout these efforts, executives should ensure that IT and OT devote their experts' time to collaboration. The CISO should play a role while IT and OT leaders in a central group monitor conditions, follow best practices to mitigate risks that exist, and respond to incidents. A strong cyber security strategy includes continuous testing for, and addressing of, vulnerabilities in IoT devices.

The Big Opportunities at the Junction of AI and Analytics:

Interview with Tom Davenport

For 30 years, Tom Davenport has been one of the most influential advisors globally on the business impact and application of information technology. He made the topic of big data and analytics a boardroom issue with his groundbreaking 2006 *Harvard Business Review* article (“Competing on Analytics”⁶⁷) and a 2007 book⁶⁸ of the same name. In 2016, Davenport and Julia Kirby published a book on AI (*Only Humans Need Apply: Winners and Losers in the Age of Smart Machines*⁶⁹). Since the late 1980s, he has conducted research and published dozens of *Harvard Business Review* articles and 18 books, many of which have been bestsellers. Davenport is a professor at Babson College near Boston, a Fellow of the MIT Initiative on the Digital Economy, a co-founder of the International Institute for Analytics, and a senior advisor to Deloitte’s analytics practice.

TCS: *You, more than anyone else, made executives aware of the opportunities of big data and analytics more than 10 years ago with your Harvard Business Review article and the book that followed. Now the market’s attention seems to have shifted away from analytics to artificial intelligence. Since both depend on digital data, there must be a big connection between the two—one that may be getting lost in the marketplace. How would you describe that connection?*

⁶⁷ Harvard Business Review, Competing on Analytics, January 2006, accessed August 4, 2017 at <https://hbr.org/2006/01/competing-on-analytics>.

⁶⁸ Competing on Analytics: The New Science of Winning, at Amazon.com <https://www.amazon.com/Competing-Analytics-New-Science-Winning/dp/1422103323>

⁶⁹ Only Humans Need Apply: Winners and Losers in the Age of Smart Machines, at Amazon.com <https://www.amazon.com/Only-Humans-Need-Apply-Machines/dp/0062438611>

Davenport: The fact that we have so much digital data today—in some domains, a massive amount— means AI can succeed now in areas in which it was struggling. One example is image and facial recognition. Yes, I realize that recognizing cat photos on the internet is not one of humankind's greatest advances (laughs).

But, seriously, the distinction between big data and analytics and AI is a little bit artificial because so much of AI is based on big data and analytics. It makes big data and analytics a more autonomous and, in some cases, a more sophisticated and complex form of analytics. Some forms of AI are more semantics-based in their orientation, in trying to understand human language and so on. But the largest activity in AI, and the most sophisticated, is machine learning. Its new forms, like deep learning, are among the biggest changes in the current round of AI, and it is statistical in nature.

“The largest activity in AI, and the most sophisticated, is machine learning.”

You need a lot of data and statistical algorithms to analyze this data, no matter which of the four areas of analytics I've written about (descriptive, predictive, prescriptive, and automated). But with AI, you get industrial-scale analytics by automating the analysis.

TCS: *So does that mean you'd advise companies that haven't mastered big data and analytics not to go right to mastering AI?*

Davenport: That's right. Any company that would skip analytics and go straight to AI is not likely to be successful with AI. I was talking recently with an Asian insurance company, which is interested in automating some aspects of their underwriting. But the problem is, the business unit that proposed this doesn't use analytics to any great extent for underwriting. They continue to rely on the judgment and experience of their people who make decisions on business insurance. I think it will be very difficult to make that jump without having done the analytics and accumulating the data you need for the analytics.

"Any company that would skip analytics and go straight to AI is not likely to be successful with AI."

TCS: *In your book last year you talked about automation vs. augmentation. Talk to us briefly about each type of usage and are most companies automation over augmentation and if so, why?*

Davenport: Automation, of course, is the replacement of human workers by machines. Augmentation is when machines and people work together alongside each other. Perhaps because I am a human I am partial to augmentation. My book with Julia Kirby lays out five approaches to augmentation—three that involve

humans working closely with smart machines, and two that involve humans prospering by avoiding machines. My research since the book suggests that a great majority of companies that are implementing AI are pursuing augmentation. There has been very little job loss thus far. I am sure there will be some jobs lost to AI in the future, but I think they will be in lower numbers—and it will take longer for the jobs to go away—than most other observers.

TCS: *Do you believe every industry has big opportunities from cognitive technologies? And which ones do you believe have some of the biggest opportunities?*

Davenport: The opportunities are there for every industry. But for sure, some will move slower than others. It will be the same ones that moved more slowly with analytics. The availability of data is the key gating factor. B2B companies, for example, just don't tend to have as much data as B2C companies, at least not customer data.

In the example I mentioned earlier, business insurance will move more slowly with AI than personal lines. Any industry where you don't have much data is going to be challenged by doing really sophisticated work in this area. Also, smaller businesses are moving much more slowly than big businesses with AI, as they have with other technologies.

The nature of what a company sells also will determine whether it moves quickly or slowly. Those offering a purely digital product are going to explore AI much faster. Banking is basically all digital now, and rapid adoption of robo-advice is evidence of that. AI has also been pretty pervasive in asset management and trading for a while and getting more so.

In medicine, digital specialties like radiology and pathology are likely to be the first to embrace AI. Medical activities that involve a lot of face-to-face contact with patients or physical manipulation of patients will probably proceed more slowly.

The media industry—and especially online media such as Facebook and Google that were born digital—have huge opportunities with AI. Google and Facebook are among the world leaders in using AI, and yet they are still finding their way about just how automated they can be. Facebook has had some false starts in terms of not being able to easily identify fake news vs. real news, and so it had to back away a little bit. It also wasn't able to fully use automated approaches to identify offensive images, so it has a large number of people still doing that.

But they're trying AI all over the place. For the most part, they have been quite successful at automating key aspects of figuring out what ads to run on what sites. That's been very lucrative for both Google and Facebook.

TCS: *What jobs do you believe are at greatest risk in companies because of AI?*

Davenport: The way I think about it is this: If you're doing something that is the same as what everyone else does, you will have two problems. The first is someone can probably identify the structure of your job, and if they can identify the structure they can probably write some code to automate it. The second problem is that if you have a job that many other people are doing, there is a lot of economic incentive to go to the trouble of automating it.

If you have a niche job that few people do, why would anybody bother automating it? My favorite example of this comes from a newspaper story I read a couple of years ago. It talked about a person who connects buyers and sellers of Dunkin' Donuts franchises (a U.S. restaurant chain). He makes an incredible living and drives around in a Rolls Royce. And connecting buyers and sellers is something that machines do all the time. But I think that is such a niche that nobody would view it as economical to automate.

TCS: *Should companies that invest, or plan to invest, heavily in AI be transparent with employees about what they are doing and why they are doing it? Should they address their worry about jobs?*

Davenport: In first place, cutting jobs through automation is generally not a good strategy. It's a race to the bottom in that your costs will go down, but you should expect competitors will do the same thing. That means everybody's margins in your industry will drop, and it will be harder to innovate. Unless you already make a highly commoditized product, it will be a race to the bottom.

"We have to increase our productivity, which in the U.S. has been growing very slowly or even falling in 2016."

What's more, in the transition from humans doing the work to computers doing the work, you need a lot of help from the people doing the work. You're far more likely to get that help if you give them some assurances that they will be able to keep their jobs.

I think we have to get some economic benefit from all of this technology. We have to increase our productivity, which in the U.S. has been growing very slowly or even falling in 2016. To boost productivity, companies produce

more with less cost. But the best way to achieve that is through attrition, not through layoffs. Implementing AI is going to be a slow process anyway, so you might as well get some loyalty from your employees and say you're only going to reduce jobs through attrition.

TCS: *Do you come across companies that are thinking carefully about how these smart machines will affect employee jobs, and how employees might begin to prepare for the transition?*

Davenport: It's very early days for that. But General Electric has started to do it. They've created these personas of the types of jobs that are likely to be threatened, new types of jobs that will be created, and the jobs that will be largely augmented by machines. That was one of the topics they addressed at a big strategy meeting recently in Boston.

“The key for thought leaders will be in coming up with new ideas rather than describing numbers about old ideas.”

But I would still say it's pretty early for that kind of conversation. It should be happening more frequently, but it's not. It should be happening more for several reasons. In addition to not creating a workforce where fear of automation takes over, the fact is it will take a while to train people on the new skills they'll need to work effectively alongside the machines. This is the

“augmentation” model for AI. Now these people may hold back their knowledge and their support if they are worried that they are going to lose their jobs. So for a variety of reasons it makes sense to be upfront and start that early.

TCS: *Do you think thought leaders soon will be facing competition from AI?*

Davenport: Well, not the good ones (laughs). But I do think certain aspects of what professional services firms have referred to as thought leadership could well be at least partially automated. For example, many of them do surveys; you could easily imagine systems that automatically generated text about the results of those surveys, just like you have systems that automatically generate write-ups of baseball games and company earnings reports. Now, I don't think there is any application available for this yet for surveys.

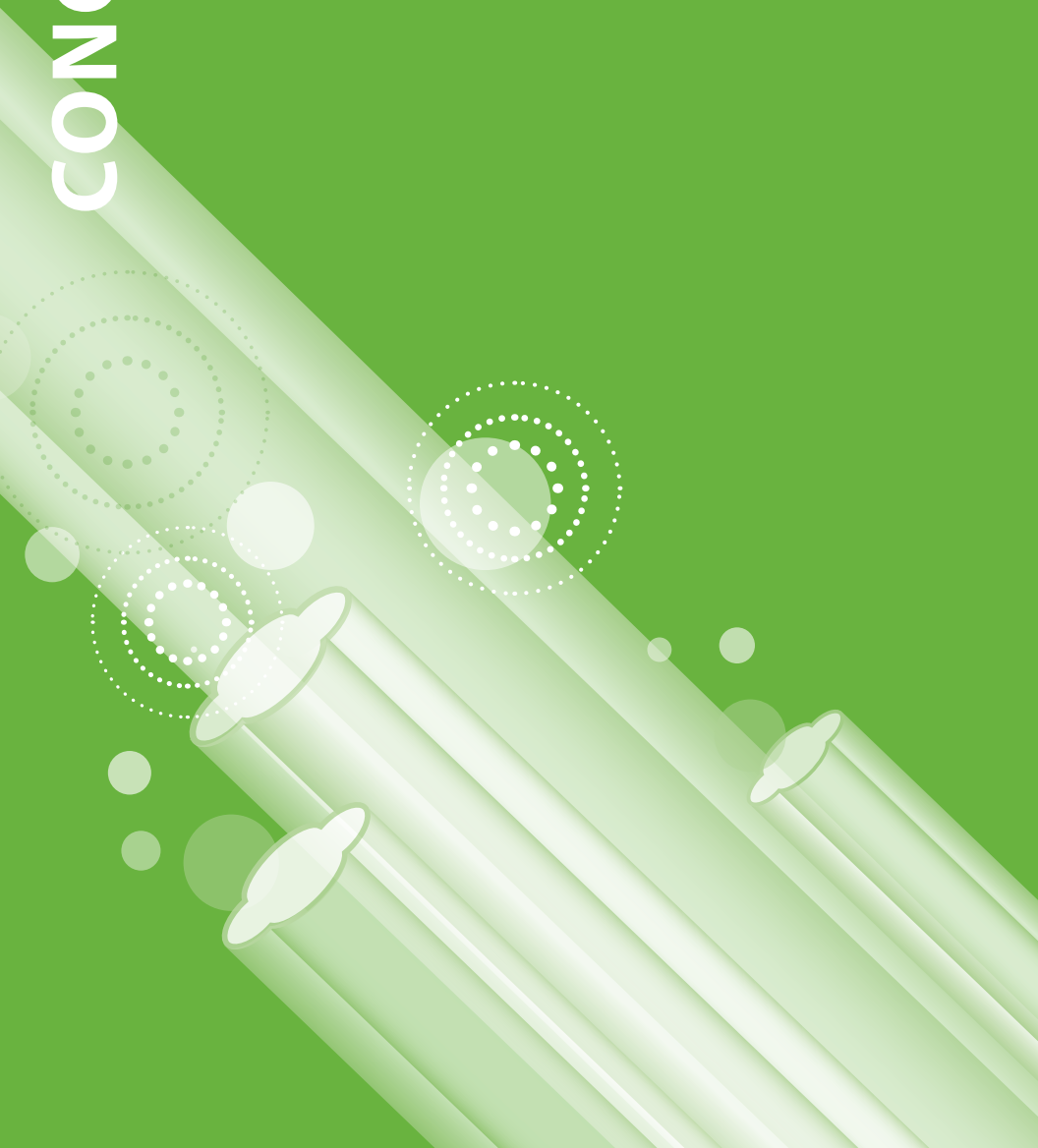
But if and when there are, I think they might be able to do a better job at writing about the numbers than a human could. For example, an AI writing application could make comparisons to other surveys, and provide analysis that a human might not notice because he or she might get bored poring over survey numbers.

This kind of writing application has worked quite well at the Associated Press and other organizations that have been automating the writing of numbers-driven reports. In fact, several companies have automated the writing of monthly investment reports, and Suspicious Activity Reports for money laundering in banking. Writing about numbers is increasingly going to be automated.

The key for thought leaders will be in coming up with new ideas rather than describing numbers about old ideas.

CONCLUSION

**Executive Traits for
Recognizing the Bountiful
Opportunities Ahead**



Author

By Krishnan Ramanujam

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Industries are being reordered today by the confluence of four technologies: cloud computing (which makes supercomputing power affordable even for startup firms), artificial intelligence (which ups the IQ of products, people and processes), big data and analytics (which turn operational chaos into coherency), and the internet of things (which lets us track products, people, customers, and premises around the clock/around the world).

But why do so many companies ignore the transformation that is happening now around them? In their new book, MIT professors Andrew McAfee and Erik Brynjolfsson argue (as Kuhn did about scientific revolutions) that it is difficult to change long-accepted beliefs. “Existing processes, customers and suppliers, pools of expertise, and more general mindsets can all blind incumbents to things that should be obvious, such as the possibilities of new technologies that depart greatly from the status quo,” they write in *Machine, Platform, Crowd: Harnessing Our Digital Future*.⁷⁰ It’s why “so many of the smartest and most experienced people and companies ... [are] the least able to see” a transformation that they won’t escape.

⁷⁰ Andrew McAfee and Erik Brynjolfsson, *Machine, Platform, Crowd: Harnessing Our Digital Future* (W.W. Norton & Company), published June 2017. <http://books.wwnorton.com/books/Machine-Platform-Crowd/> Accessed July 28, 2017.

Is such blindness avoidable? I think so. To do so, senior executives need to sharpen or develop five traits that may have sat dormant in them, but which I think reside in all of us. These traits helped the executives running three of the

most successful companies of the last 10 years—Apple, Amazon, and Netflix—rapidly recognize the potential of AI and automation, cloud computing, IoT and big data and how they would transform their businesses. Those traits are:



1. An abundance of imagination:

About new businesses to be in, and new ways of doing the business they do today.



2. A voracious appetite for new and clashing ideas:

An unquenchable thirst for new concepts they hadn't thought of, and having arguments that lead to better concepts.



3. A relentless focus on increasing value to customers:

And checking their pulse frequently to see they're getting that value.



4. Extreme calmness in the face of rising competition and market chaos:

Not taking their eyes off the prize—i.e., giving customers increasing and unprecedented levels of value—while competition breathes down their necks.



5. Being sentimental about top talent but unsentimental about what they do:

Recognizing which people are most valuable in the organization, but not letting that stop the company from automating and outsourcing their jobs and reassigning their key talent to new, more important positions.

I'll explain each trait and why the confluence of the technologies I mentioned puts them at a premium today in the C-suite. To illustrate them, I'm going to show how they played out at Apple, Amazon, and Netflix:

- Under Steve Jobs, **Apple** transformed itself from a failing maker of desktop computers to a mobile device and computer company that has redefined the music, media, photographic and telecommunications industries. Rejoining the company in 1997, 20 years ago when it was nearly bankrupt, Jobs had lifted it to more than \$100 billion in annual revenue and a net profit of \$26 billion at the time of his death in 2011.⁷¹ Since then Apple's revenue has doubled again, to \$214 billion in 2016, under CEO Tim Cook.
- Since 2006, Jeff Bezos has been expanding **Amazon's** business beyond online retailing to cloud computing services. This year, AWS' revenue is on track to exceed \$16 billion, and its operating income is larger than that of Amazon's retail business, even though its revenue is eight times greater than AWS'.⁷² Perhaps better than any other company, Amazon acted early on the convergence of cloud, big data, and automation. Said Werner Vogels, the firm's CTO: "Amazon Web Services was always considered a business by itself, with the expectation that it could even grow as big as the Amazon.com retail operation."⁷³
- Reed Hastings has presided over two transformations at **Netflix**: Its switch from distributing movies through the mail to streaming them online, and then getting into movie and TV programming business itself. In 20 years, Netflix has gone from a startup to almost \$9 billion in annual revenue, with a market cap in July of nearly \$80 billion.⁷⁴

While the stories of these companies are well-known, the five characteristics that their executives share aren't as well-understood. Here are those traits, and how they helped their leaders dissect the vast opportunities of a new technological wave.

⁷¹ Apple earnings press release. <https://www.apple.com/newsroom/2011/10/18Apple-Reports-Fourth-Quarter-Results/>

⁷² Amazon second quarter 2017 earnings press release. Accessed July 29, 2017. <http://phx.corporate-ir.net/phoenix.zhtml?c=97664&p=irol-newsArticle&ID=2289566>

⁷³ Quora.com post by Amazon CTO Werner Vogels. Accessed July 29, 2017. <https://www.quora.com/How-and-why-did-Amazon-get-into-the-cloud-computing-business>

⁷⁴ Wall Street Journal. Accessed July 29, 2017. <http://quotes.wsj.com/NFLX>

The Imagination to See What Others Didn't



Netflix founder Reed Hastings launched Netflix 20 years ago knowing that the technology of that time to distribute movies was going to change dramatically after the proliferation of high-bandwidth Internet networks. In a recent interview with venture capitalist Marc Andreessen, Hastings explained that putting DVDs in the mail was a weigh station to a streaming future.⁷⁵ "We always viewed the DVD by mail as a digital distribution network." The product—movies encoded in digital form on disks—were in fact digital. When it was technically and economically possible in the last decade for those digits to be shipped online, the Netflix business would need to change. In comparison, his earliest big competitor (Blockbuster) was run by executives who "fell in love with stores," Hastings says.

Says Hastings, "That's why we called the company Netflix rather than 'DVD By Mail' or that kind of thing. We had the slight advantage that we would not fall in love with our first business."

Netflix also had the imagination to predict that it couldn't remain only a movie and TV programming distributor. Cable and telecommunications companies were wiring up their communities with broadband, and they'd be able to distribute the same fare that Netflix could. Netflix had to also be in the "content" business—creating its own TV series. In fact, last year the company spent \$5 billion on such programming, and said it would spend another \$6 billion on it this year.⁷⁶

⁷⁵ Andreessen Horowitz website. Hastings and Andreessen interview can be seen here. <https://a16z.com/2017/02/25/reedhastings-netflix-entertainment-internet-streaming-content/>

⁷⁶ *Wired* magazine, January 20, 2017. <https://www.wired.com/2017/01/netflix-investing-original-shows-finally-pays-off/>

In other words, the top management at Netflix had the imagination to know that they had to transform their offerings beyond renting movies that are produced by other firms. They knew at some point they had to be in the movie and TV show production business too.

All in all, Hastings and his team had the imagination to see where their business was headed, and they acted first. Netflix has more than 100 subscribers now to its video streaming business worldwide, half of whom are outside its U.S. base.⁷⁷ Blockbuster, which didn't have the imagination to see and action on the future, is long gone.

Hastings realizes Netflix's success can be a damper on imagination at his firm. But he knows he can't fall into the trap. As he said to Andreessen: "The lack of imagination amongst us leaders can be very high. It's easy to look at guys like [Ken Olsen, the founding CEO of Digital Equipment Corp.] and say, 'What idiots!' But, in fact, they are us."

Jeff Bezos also recently lamented the lack of imagination across industries about the opportunities for companies. He believes big technological trends are easy to identify but "strangely hard for large organizations to embrace." Bezos pointed recently to a big trend that is "an obvious one right now"—machine learning and artificial intelligence. Amazon has been experimenting with putting machine learning to use for years—for example, in its delivery drones and Alexa cloud-based AI assistant.⁷⁸

⁷⁷ Story on Netflix in *Variety* magazine, July 17, 2017. <http://variety.com/2017/digital/news/netflix-q2-2017-earnings-1202497619/>

⁷⁸ Amazon video of Bezos internal speech, dated April 12, 2017. Accessed July 27, 2017. <https://www.amazon.com/p/feature/z6o9g6sysxur57t>

A Voracious Appetite for Compelling and Competing Ideas



The C-suite of any company is not likely to be as imaginative as it needs to be these days if only one person—the CEO—is allowed to do the imagining.

According to Steve Jobs' appointed biographer, the co-founder of Apple and the firm's lead transformer of the music, computer, cellphone, and other industries was not some lone inventor who dreamed strong ideas and told others to execute them. He sought out team members with great ideas—and the fortitude to convince him they were right. "I can tell people in a meeting that they're [wrong], but they can bark back at me and tell me I'm [wrong]," wrote Walter Isaacson in Jobs' biography.⁷⁹ "And then we have the most rip-roaring arguments, and that's why we work together well."

"We have wonderful arguments. If you want to hire great people and have them stay working for you, you have to let them make a lot of decisions and you have to be run by ideas, not by hierarchy. The best ideas have to win. Otherwise good people don't stay."⁸⁰

Jobs and his Apple executive team had many heated debates about company strategy, what products to pursue, and so on. But Jobs made sure his ideas didn't stamp out the concepts of others. Before he died, Jobs told a technology conference that great ideas—and internal debates about them—were paramount in companies, no matter where those ideas came from: "We have wonderful arguments. If you want to hire great people and have them stay working for you, you have to let them make a lot of decisions and you have to be run by ideas, not by hierarchy. The best ideas have to win. Otherwise good people don't stay."⁸⁰

⁷⁹ Fast Company interview with Walter Isaacson. <https://www.fastcompany.com/1790791/steve-jobs-biographer-apple-founder-was-driven-simplicity-mystical-thinking-and-occasional-l>

⁸⁰ Steve Jobs' conversation with Walter Mossberg. <https://www.youtube.com/watch?v=f60dhe14ARg>

Great ideas for the future—not those of the past—were what Jobs cared about. Said current CEO Tim Cook, “Another thing Steve taught us all was not to focus on the past. Be future-focused. If you’ve done something great or terrible in the past, forget it and go on and create the next thing.”⁸¹

A Relentless Customer Advocate



Jeff Bezos has had a laser focus on investments and improvements that have kept Amazon’s customers loyal and buying even more from the company. As he said in his 1997 letter to shareholders, “We will continue to focus relentlessly on our customers.”⁸² Amazon’s growth speaks volumes to the promise that Bezos has kept since then.

The way Amazon views the technology convergence that’s now upon us is through the lens of customer value: how can cloud, AI, automation, and IoT help the company generate unprecedented value for its global customers. From the start of his company, Bezos has avoided getting distracted by the technologies swirling around it. As he told a large employee group this spring, “There are many ways to center a business. You can be competitor-focused. You can be product-focused. You can be technology-focused. You can be business-model focused. And there are more. But in my view, obsessive customer focus is by far the most protective of [long-term] vitality.”⁸³

⁸¹ Macworld article, Oct. 5, 2012. Accessed July 29, 2017. <http://www.macworld.com/article/2011277/a-year-after-steve-jobs-death-as-we-should-have-expected-its-the-same-apple.html>

⁸² Visible blog post, Feb. 23, 2016. Accessed July 27, 2017. <https://visible.vc/blog/investor-letters-amazon-1997/>

⁸³ Amazon video, accessed July 28, 2017. <https://www.amazon.com/p/feature/z6o9g6sysxur57t>

Exuding Calmness in the Storm



Tumultuous market changes can distract an executive team. Bezos' "true north" amidst his company's technological and competitive storm has always been the customer. Netflix founder Hastings too has found it necessary not to worry incessantly about what competitors are doing, even those with much deeper pockets.

"People say things like 'only the paranoid survive,'" he said, repeating the title of a book by Andrew Grove, the legendary ex-CEO of Intel.⁸⁴ "It encodes a truth in a way but it oversimplifies it because paranoid [people] are delusional," explained Hastings. And when executives get delusional, they "get totally distracted on the wrong threats," Hastings said.

He should know. When Netflix's primary business was distributing movie DVDs through the mail, its competitors were much bigger companies with bigger coffers: Blockbuster, Walmart, and others. "Suddenly, we were up against much larger companies. We got through it by not getting psyched out but by focusing on improving service," Hastings said in his interview.⁸⁵ "We spend a very small amount of time thinking about the competition and most of the time about improving our service, because there is nothing we can do about the competition."

That is, Hastings has remained calm no matter how many competitors there are today and on the horizon.

⁸⁴ Andreessen Horowitz website. Hastings and Andreessen interview can be seen here. <https://a16z.com/2017/02/25/reedhastings-netflix-entertainment-internet-streaming-content/>

⁸⁵ Andreessen Horowitz website. Hastings and Andreessen interview can be seen here. <https://a16z.com/2017/02/25/reedhastings-netflix-entertainment-internet-streaming-content/>

Loyalty to Great People, But Not to Their Current Jobs



One of AI's greatest challenges for big companies is this: Making sure their most valuable people don't leave because of the fear their jobs will be automated.

One of the least recognized characteristics of the leaders at Apple, Netflix and Amazon has been their ability to retain valuable people, even if those whose jobs had to shift.

Steve Jobs stayed loyal to the executives who had helped him at Pixar and NeXT. He took many of them with him when he returned to Apple in 1997.⁸⁶ And many of them stayed as Apple evolved from a computer company to a computer, digital device, smartphone, and music distribution company.

The ability to recognize talent and redeploy it when the work and products of a company must change will be an increasingly important one in a world of AI and automation. Top executives must be unsentimental about the work of the organization that can be improved by being automated or outsourced. However, they must be sentimental to highly valuable people who occupy those jobs and are ready to put their talent into something new.

The five traits of abundant imagination, a hunger for ideas, an unrelenting focus on giving customers more and more, staying calm in the competitive storm, and staying loyal to great people but not to their old jobs are now vital in just about every large company. If you have them, they will go a long way in helping your firm to transform itself and pursue the immense opportunities ahead.

⁸⁶ New York Times, March 17, 2015. Accessed July 27, 2017. https://www.nytimes.com/2015/03/17/opinion/joe-nocera-the-hidden-talent-of-steve-jobs.html?_r=0

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