

# Beyond predictive maintenance

*The 'art of the possible' with IoT*

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*The 'art of the possible' with IoT*

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## AT A GLANCE

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IoT is fundamentally reshaping the way enterprises execute business processes and the way we interact with the physical world. As companies move past the first wave of use cases in IoT, such as predictive maintenance, they are venturing off the beaten path, harnessing the power of sensor-enabled, real-world data to reimagine why, how, and where they deploy IoT-and, ultimately, how they make money from it. Lessons from these trailblazers illustrate that success lies in focusing not just on the technology, but more holistically, on a true transformation of the business.

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**T**HE INTERNET OF THINGS (IoT) is moving past the early hype, expanding rapidly via improvements in sensor and device capabilities, increasingly reliable connectivity, new advances in data processing and machine learning (ML) techniques, technologies such as cloud & edge computing, and emerging tech such as blockchain<sup>1</sup>. In fact, the IoT market is projected to grow over 30% per annum over the next few years, with leading companies continuing to test the boundaries of what IoT can do.

More importantly, companies are beginning to lose the notion that IoT is simply a technology project to be deployed, realizing instead that connecting to the real world via sensors can create a rich source of contextual and actionable data in their business settings—one that leads to true digital transformation, with benefits as varied as reducing hospital wait times, improving the yield in aquaculture, and enhancing the quality of life for diabetes patients.

For those daring to push the envelope, however, several hurdles await—some unique to the individual IoT effort and some more commonly experienced. To overcome these hurdles, companies need to look beyond the allure of IoT as a shiny new technology and embark on their IoT journey as part of a broader change effort—one that is an essential part of their strategy and business processes.

This whitepaper attempts to lay out the best of the innovations that companies are pursuing based on the foundational data and insights provided by IoT. With examples from companies leading the deployment of IoT to transform their respective industries, we then draw out the foundational enablers for the creation of successful IoT initiatives. Our findings are based on interviews with over 50 leaders of IoT initiatives, IoT practitioners, and IoT subject-matter experts, as well as a survey of over 150 IoT executives across various industries.

## Far Beyond Predictive Maintenance

It may seem that the hype surrounding the Internet of Things (IoT) has been fading over the last couple of years, especially with companies reporting mixed perceptions of the success of IoT deployments. But recent activity suggests that adoption of IoT is continuing to grow<sup>2</sup>. One reason for the mixed perceptions may be the use of the term “IoT” itself. While some of the experts we interviewed immediately related “IoT” to specific IoT pilots, others associated their efforts at collecting and processing sensor data, not with “IoT,” but with other terms such as “digital” or “data-enabled” efforts.

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Connecting to the real world via sensors can create a rich source of contextual and actionable data in their business settings—one that leads to true digital transformation.

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Semantics aside, however, we find that digital innovation is increasingly centered on device and-sensor-enabled data from the physical world and the valuable insights that this data provides when connected with business processes. Mainstream discussions around IoT have so far tended to focus primarily on well-known industrial uses such as predictive maintenance. This is perhaps not surprising, given that predictive maintenance was one of the ten use cases that drove the first wave of growth in IoT. In fact, the global predictive maintenance market is expected to grow at a CAGR of 30% through 2020<sup>3</sup>.

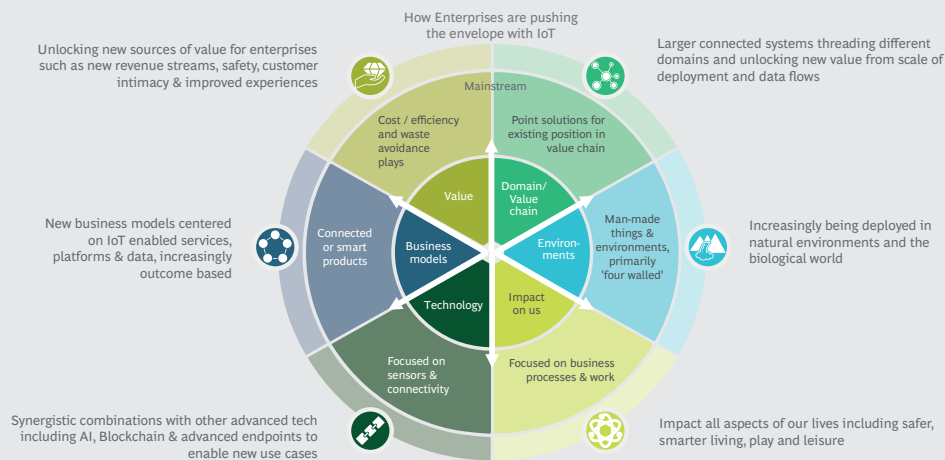
Nonetheless, we find far more exciting the ways in which a select few companies are going further and stretching the boundaries of IoT today. These companies are delivering new sources of value, disrupting existing business models, building on other advanced technologies, and linking previously unconnected domains. Many companies are also deploying IoT sensors and devices beyond manmade environments and equipment, while others are affecting not just how we work, but how we live and play. These companies are illustrating that where enterprises can broaden their thinking about IoT, they will capture both greater benefits and more value.

### DELIVERING NEW SOURCES OF VALUE

Companies are moving in several ways to generate value from IoT beyond basic cost and efficiency plays. Some are generating additional revenue streams by offering IoT-supported services to their customers. Take for example, video surveillance equipment company, Genetec. Based on data from its cameras and PoS systems, the company now sells data services that arm retailers with many of the same demographic and customer-behavior insights that have only so far been leveraged by digital, or online, storefronts.

Other companies are using IoT to discover their customer preferences. The Coca Cola Freestyle touchscreen soda fountain, for instance—already a US \$1 billion business<sup>4</sup>-has provided comprehensive data on customer preferences to Coca Cola

EXHIBIT 1 | Beyond predictive maintenance - a whole new world in IoT



Source: BCG research.

since 2014 and helped to launch new flavors such as Cherry Sprite. Companies are also using IoT to enhance the customer experience. Smart connected mirrors in Rebecca Minkoff's New York City flagship-store fitting rooms let customers view in-store products and request sizes to be brought to them. And in the travel industry, Carnival has elevated the guest experience by tracking accompanying travel parties and offering keyless room entry, personalized recommendations, and intelligent navigation aboard its Regal Princess cruise ship, all through the use of wearables given to guests and 7,000 sensors placed around the ship.

IoT products are also helping improve safety and wellness. Start-up Gaurdhat creates connected hard-hats that can detect falls and nearby moving objects, monitor locations, and provide live assistance to industrial workers. The company estimates that it can reduce overall workplace injuries by 20%.

### **DISRUPTING EXISTING BUSINESS MODELS**

Leading IoT adopters have experimented with and launched several new business models that go beyond the current focus on connecting things. One-off revenues from the sale of IoT solutions, for example, are increasingly being supplanted by recurring revenue models, giving companies an opportunity to increase their intimacy with customers. Take BigBelly, a waste management company, for instance. Equipping cities with "smart," connected trashcans has allowed the company to save those cities thousands of dollars a year in fuel, vehicle, and labor costs because they only have to empty cans when they are full. Simultaneously, this innovative solution has allowed BigBelly to offer waste departments a subscription service for monitoring and maintaining their high-tech trash solutions, moving the company away from a pure product-sales model. In another example, Medtronic, a medical device player, has combined continuous glucose-monitoring and an insulin pump to help patients monitor their diabetes in real time. Its mobile connections and the data it has collected have also allowed the company to develop a care-management service that can transmit patient blood-sugar levels directly to doctors, helping over 95,000 patients manage their diabetes. As a result, Medtronic has been able to move from a fee-for-service model to a value-based model in which portions of its contracts with payers are tied, via risk-sharing partnerships, to improved hemoglobin levels and total cost of care.

IoT-powered platforms are also disrupting business models, with some companies offering their proprietary hardware or software solutions as platforms to others in the industry. Industrial toolmaker Trumpf's digital platform for manufacturing companies, Axoom, for example, started as an in-house effort to optimize internal operations. Trumpf now offers its platform to other businesses, along with status monitoring and analytics and tools for applications such as predictive maintenance.

Several companies have been able to monetize the data generated by IoT sensors. For example, Otonomo, an automotive data-services platform, aggregates and sells the data from IoT-connected cars. The company recently partnered with Daimler to provide high-end customers with services that include pay-as-you-drive insurance and personalized car service based on fuel levels and other measures.<sup>5</sup>

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In addition, several companies are moving to outcome-based models. Proteus Digital Health, for example, offers medications with ingestible sensors that communicate when they have been ingested. Patients wear a sensor patch that receives a signal from the ingestible sensor and captures physiological responses. This information is shared via a mobile application to support patient self-care, and sends the information to a provider portal, giving insights into patient health patterns and treatment effectiveness. Digital medicines help patients see how they are doing taking their medications, making it possible for Proteus to enter into a recent agreement with Desert Oasis Healthcare to be reimbursed only when Desert Oasis' patients achieve a threshold of 80% prescription adherence. And in the rail industry, with Siemens's help, Spanish railway operator Renfe is using sensor data to optimize downtime for its trains; the company is even able to offer partial refunds if its high-speed Barcelona-Madrid line is more than 30 minutes delayed.<sup>6</sup>

### **COMBINING IOT WITH OTHER ADVANCED TECHNOLOGIES**

Companies are advancing their use of sensors and connectivity and drawing on an increasing arsenal of technology building blocks, including advanced endpoints such as drones to collect and act on data, AI and ML to draw out insights, AR and VR to overlay sensor data onto the field of vision, and blockchain for secure IoT data exchange. Farmers Insurance, for one, now uses Kespry's unmanned aerial systems to assess damage to residential rooftops after significant weather events. Deploying drones in the place of claims adjusters has improved response time as well as safety: as they move from a dangerous multi-day process to a one- or two-hour drone photo capture and automatic image-analysis process, claims adjusters are kept safely on the ground.<sup>8</sup> In another example, tire and automotive technology company Continental has created a new platform built on blockchain that shares vehicle-telematics data for driver safety and convenience, enhancing privacy and security for vehicle owners when their IoT data is shared with automotive manufacturers and service providers.

### **TYING TOGETHER PREVIOUSLY UNCONNECTED DOMAINS**

While the first wave of IoT use cases was predominantly focused on solutions deployed for single machines or locations, IoT usage today is increasingly predicated on the flow of information across different domains or systems. Shell Oil, together with car manufacturer Jaguar Land Rover, has launched the world's first in-car payment system at its gas stations. It has since partnered with other automakers and offers an API suite for connected car apps such as a station locator, loyalty tracking, and fuel usage.

In another innovative example, San Francisco insurance company Metromile has enabled a pay-per-mile offering for infrequent drivers through the collection of vehicle data via IoT. And Volkswagen's corporate fleet in Europe is now piloting the collection of weather data from its vehicles, which it shares with TenneT, an electricity transmission system operator<sup>9</sup>. With this granular weather data, TenneT can more accurately predict the solar energy that is being generated across the region and fed into the electricity grid, potentially resulting in cost savings through grid optimization.



These are all examples of data being collected by one company from connected vehicles and leveraged by other companies. It is not a stretch to imagine similar ecosystems increasingly emerging around data from connected homes, cities, and other infrastructure.

### **DEPLOYING SENSORS BEYOND MANMADE ENVIRONMENTS AND DEVICES**

IoT technology is also being extended to innovative new uses in the natural world, such as rainforest and wildlife conservation efforts, livestock management, and aquaculture. And there is already a great deal of evidence about the value generated in each of these areas. For example, poaching has been reduced by 96% in a connected conservation pilot at Kruger National Park in South Africa,<sup>9</sup> Chinese research and development company Aotoso has been able to increase its cow-estrus detection rate from 75% to 95%, and IoT startup The Yield has demonstrated a 30% reduction<sup>10</sup> in oyster farming losses due to Pacific Oyster Mortality Syndrome by measuring water temperatures, salinity, and other data.<sup>11</sup>

### **EXTENDING INTO ASPECTS OF OUR LIFE BEYOND WORK**

IoT is seeping into other aspects of our lives beyond work, from leisure activities to making our communities safer for children and other residents. Topgolf, for example, has had 13 million customers visit its high-tech driving ranges, where connected golf balls are equipped with RFID chips that measure performance and gamify the experience. In Japan, Muromachi sensors and smartphone apps cover 14,000 schoolchildren and have helped prevent 140 children from crime and accidents since its launch.<sup>12</sup>

## **Lessons from IoT Trailblazers**

The previous section gave us a glimpse into many of the use cases that enterprises are now exploring with IoT, highlighting the impressive breadth of possibilities enabled through data collection and transmission. In this section, we go deeper into the ways in which two companies are ushering IoT into industries that have had low digitization rates to date: construction and food processing.

### **(I) AN AMBITIOUS DIGITAL JOURNEY FOR PCL**

PCL, Canada's largest engineering, procurement, and construction (EPC) player, embarked on a bold digital transformation in 2014. Although it would soon be 100 years old, and anchored in some of the most traditional and analog of industries, PCL determined from the start that this digital journey would be an essential piece of the company's—and the industry's—future vision. "Some owners view EPC providers as interchangeable, with bidding primarily based on lowest cost," said Chris Palmer, senior manager for Advanced Technology Services at PCL Construction. "We are using digital innovation as a competitive differentiator and lead an industry going through massive change."

PCL's leadership thus made the transformation a business imperative, giving full support and autonomy to CIO Mark Bryant and his team as they began spearheading critical initiatives across the organization. Nonetheless, the IT function determined to keep a strictly business-first mindset in vetting and adopting use cases. Unless a proposed idea had a clear link to business value, it did not move forward.

“If we can marry the field lens and the technology lens, there are some pretty amazing things that we can do as a company,” says Bryant. IT then engaged front-line business-side employees in discussions about opportunities, and continues to seek feedback from both staff and customers. It has even adopted third-party crowdsourcing solutions, such as UserVoice and IdeaScale, to support this effort.

### First steps

The digital journey began with a full technology shift to a cloud-first, mobile-first approach. This shift laid the foundation for real-time data collection through IoT, along with advanced-analytics applications to run on top of the data. Next, the company pioneered its first flagship IoT product, a mobile-ready smart construction platform called Job Site Insights™ (JSI). Using sensors placed on equipment, in spaces, and on people, JSI helped automate what was hitherto a time-consuming and tedious manual measurement process—monitoring temperatures, humidity, barometric pressure, and other variables across a job site. Engineers can access these variables through a single-pane view, with automatic alerts and anomaly detection, often in buildings with more than 30 stories and over 400 condo suites.

Further, JSI prevents damage to sensitive components such as millwork and drywall through the continual, automatic detection of anomalies in temperature—saving rework costs that could previously reach as much as CAD 30 thousand per single room, a substantial savings orders of magnitude higher than the cost of installing JSI in the building. In addition, using sensor data to optimize heating and power usage on construction sites, PCL expects to save 10% to 20% of its annual construction energy costs.

The platform is currently installed in eight projects with over CAD 1.6 billion in construction value. More sensors and data are still to be added, with automatic flood detection to be rolled out next—lowering insurance premiums, potentially saving millions more in rework costs, and avoiding significant and costly delays in scheduled construction times.

### Overcoming Stumbling blocks

As its transformation progressed, PCL found that the ever-changing physical environment of construction sites posed difficult challenges. A location might be connected one day and not the next, for example, as sites evolved and new structures were added or removed. Site managers, in turn, often lacked the skills and knowledge to understand where the devices would work. PCL’s technology team responded by holding planning sessions together with field staff to ensure that they can easily add sensors quickly and efficiently as the building is built.

PCL also learned that technology is not always the biggest hurdle to implementing IoT. “It’s one thing to disrupt tech, but even more challenging to disrupt people. People do not like change, especially if they are not in control, and that is why it is so important to make them part of the process,” says Bryant. The company therefore adopted an iterative approach to implementation; in addition, it trained and deployed tech-savvy workers as “promoters” in the field, which had a powerful ripple effect on other employees.

Bryant now describes PCL's journey as a crawl-walk-run approach—starting small and proving value before making big changes. “The crawl is the initial proof points, the walk is expanding them across the organization, and the run is everyone understanding the value and thinking ‘how did I survive without this before?’ while asking ‘what else can be done?’” says Bryant.

### Up next

PCL is not resting on its early achievements. It is now exploring whether the JSI platform can be left behind after construction for new building owners to use—a service that several customers have requested directly once they've seen the system's capabilities. The company hopes to capitalize on this opportunity by integrating smart building technologies into its structures early on, improving their efficiency and overall utility.

## (2) SEEDING IOT TRANSFORMATION AT BÜHLER

Swiss-based Bühler, a large, 159-year-old manufacturer of food-processing equipment, has a reach that extends around the globe. In fact, one in four consumers touch something that's been processed by Bühler equipment every day. In 2016, this traditional family-owned business set a goal of becoming the market leader in digital food-processing equipment offerings; by doing so, the company aimed to cut 30% of the food waste and energy usage from its customers' value chains by 2020.

And the results have been remarkable: the company now has several IoT products on the market, along with a pipeline of more than 50 current projects. Bühler's LumoVision solution is one noteworthy example. It uses computer vision to identify and eject individual corn kernels from product flows of as much as 15 tons per hour, eliminating any kernels infected by contaminants in just milliseconds. The new solution has reduced yield loss from as much as 25% with traditional sorters to below 5%, while sharply cutting the even greater risk of full harvest contamination and death if infected kernels were left in the flow. Another new Bühler solution, MoisturePro, uses real-time sensor data to monitor and control the drying process for pet food, delivering an average of \$300K a year in direct savings from moisture removal and another \$20K-\$30K in energy savings.

Despite the company's success, the journey has not been easy. Bühler executives were cognizant from the beginning that “digital” was not in the company's DNA. To succeed, they would have to change the way the company worked. And the journey would have to start from the top, with senior executives recognizing both the opportunities and the threats in the market. Sensor costs were declining, for example, but start-ups were launching innovative new products, threatening the core business. “If there was going to be any disruption happening, we wanted to be the ones doing the disrupting,” says Stuart Bashford, Bühler's digital officer. As a result, the leadership chose not only to make the transformation a business priority, but to buy into the aspiration of becoming a digital leader—not a follower.

As a first step, Bühler created a new function, headed by CTO Ian Roberts, which included a centralized digital and IoT platform. It charged this new function with building innovative technology solutions that could be used throughout the organi-

zation. The CEO then jumpstarted the transformation by challenging each business division to develop prototypes for new digital services within the next nine months. Remarkably, all of the divisions delivered prototypes for digital, connected products on schedule.

As all of this was taking place, Bühler collaborated closely with its customers to understand and prove the worth of its new digital services. When one of its milling customers complained that it was not getting the benefits it expected, for instance, Bühler sent in teams to review the situation. They found that machine operators were skeptical of using the new technology and simply didn't turn on the service. As a result, Bühler today is mindful of working with customers both before the sale and after, to help change their processes.

Throughout the transformation, Bühler remained aware of any capabilities it lacked. As it was still building up its data science team, for example, Bühler actively worked with the Swiss Data Science Center to leverage external talent, while at the same time improving its understanding of the skills required. "When we first started, we essentially asked one interview question: are you a data scientist? We now really understand the different jobs involved. A data engineer, a data curator, and a data scientist, those are three different roles and they achieve different things," says Bashford. Bühler now has a dedicated team of close to 70 data scientists and software engineers working closely with experts from the business groups to create innovative solutions.

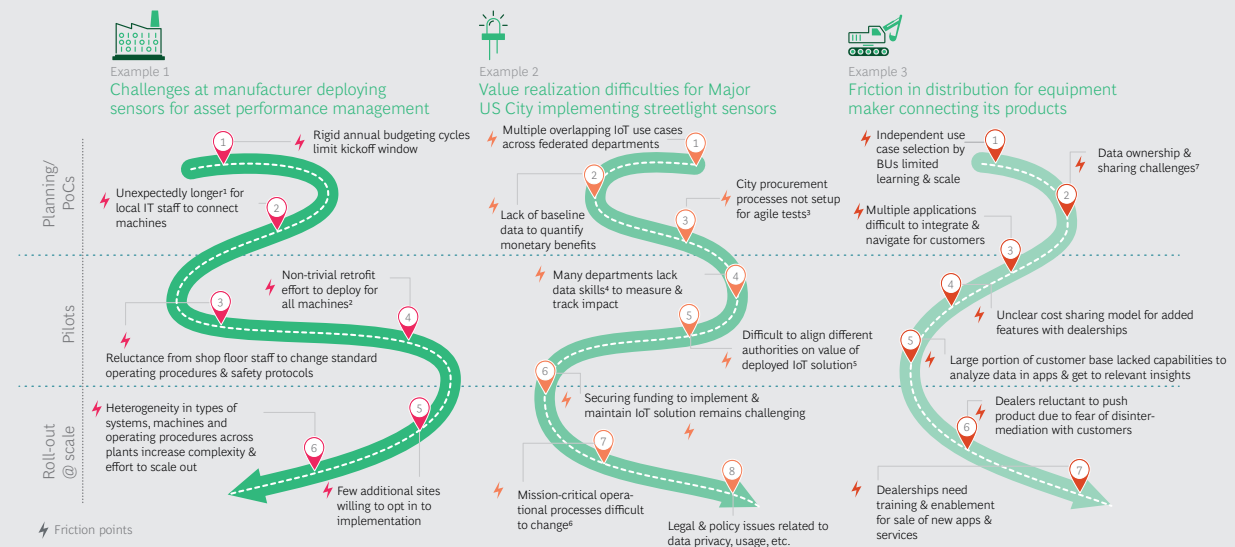
Bühler has also created headspace for creative ideas—and failures. As much as a quarter of the projects in the current pipeline don't yet have a clear business justification, but Bühler's philosophy is to give an idea time before killing it. In fact, one of the company's top-performing digital products initially failed to convince the group's owner that it could be successful, recalls Bashford. "We still feel like we're in an experimental phase, even though we have had several successes and done tens of millions of dollars' worth of revenue from digital services. Some things will work, and some things will not work. When things don't work, it's important to take the learning and move on."

"We needed to be bold enough to show the industry what it could be, if we want to be the leaders in it," says Bashford. "It is possible that in 20 years, we will be selling more data-enabled services – than we are selling machines."

## Not all Smooth Sailing

The myriad examples of enterprises pushing the boundaries of what's possible with real-world sensor data show clearly that there is considerable value at stake. Yet many companies face a host of challenges in capturing this value. No individual IoT implementation is the same as the next, and the challenges thrown up are often unique to each company's use cases and deployment. As a result, IoT implementations are often bespoke. We provide three examples below that illustrate the challenges companies face as they move from planning to full-scale deployment. (See also Exhibit 2.)

## EXHIBIT 2 | Bespoke challenges in Enterprise IoT deployment journeys



**Source:** Expert interviews, BCG research.

<sup>1</sup>E.g., It took 2-3 days to bypass local firewalls <sup>2</sup>E.g., 1 man-day to retrofit 1 machine translated into over a year to retrofit plant with ~500 machines

<sup>3</sup>Procurement process based on hard quantities & deliverables, not joint trial / solutioning for pilots <sup>4</sup>Such as data analytics and dashboarding

<sup>5</sup> E.g., business decision for connected lighting required four departments - parking, crime, public works and water/sustainability to agree on value from pilot <sup>6</sup>E.g., Additional time & effort needed by dispatch to check added screens for gunshot detection <sup>7</sup>Dealers unwilling to share data from assets with key partner focused on Machine Learning from data

**Mid-sized manufacturer deploying sensors for asset performance management.** This example illustrates the challenges of deploying IoT in a mature brownfield environment—from rigid budgeting cycles to entrenched operational procedures. In fact, the very discipline and process orientation required in a manufacturing environment present multiple hurdles when deploying IoT. Other issues include the cost and disruption to round-the-clock manufacturing and, even though the sensors themselves are cheap, the labor and uptime implications of retrofitting all of the assets in the factory.

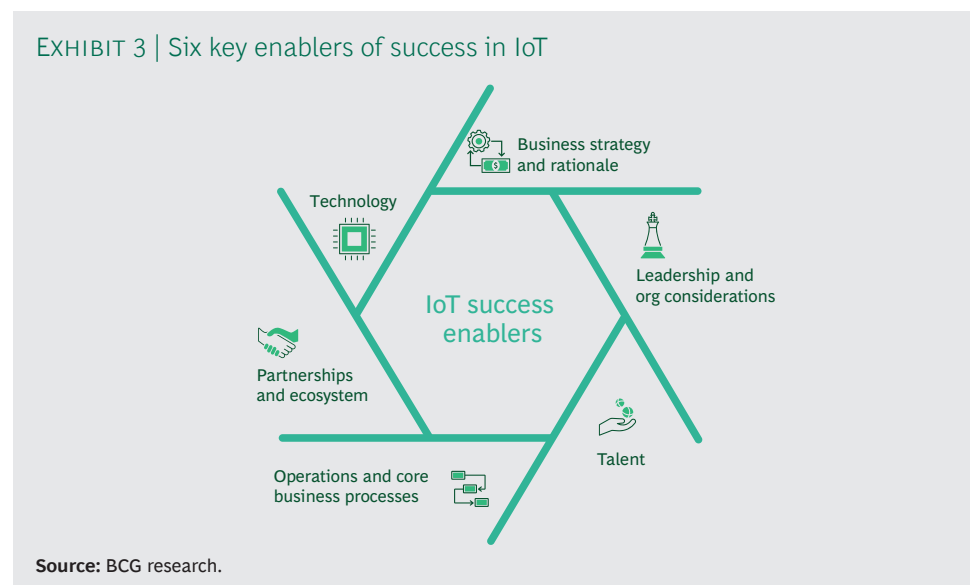
**Difficulties in proving value at a smart city initiative.** A major US city looking to implement connected street lighting with sensors struggled to develop a clear business case for the project. Difficulties included the need to span four federated city departments, align on benefits, and change entrenched ways of working. Quantifying the benefits was also challenging, as good baseline data was missing and some of the participating departments lacked the ability to act on the data that was being collected.

**Slow progress for equipment maker adding connectivity to its products.** As a maker of heavy equipment launched new sensor-enabled features in its vehicles, the company struggled to get its network of dealers onboard. Fearing disintermediation, the dealers were reluctant to share data, absorb additional costs, or push the new products in the market, affecting the products' initial traction.

While the IoT experts we interviewed often spoke of their companies' unique trials, such as those outlined above, they also noted a number of key success factors. In the next section, we walk through the leading success factors that emerged from those interviews.

## Ingredients for success (Spoiler: It's More than Just the Tech)

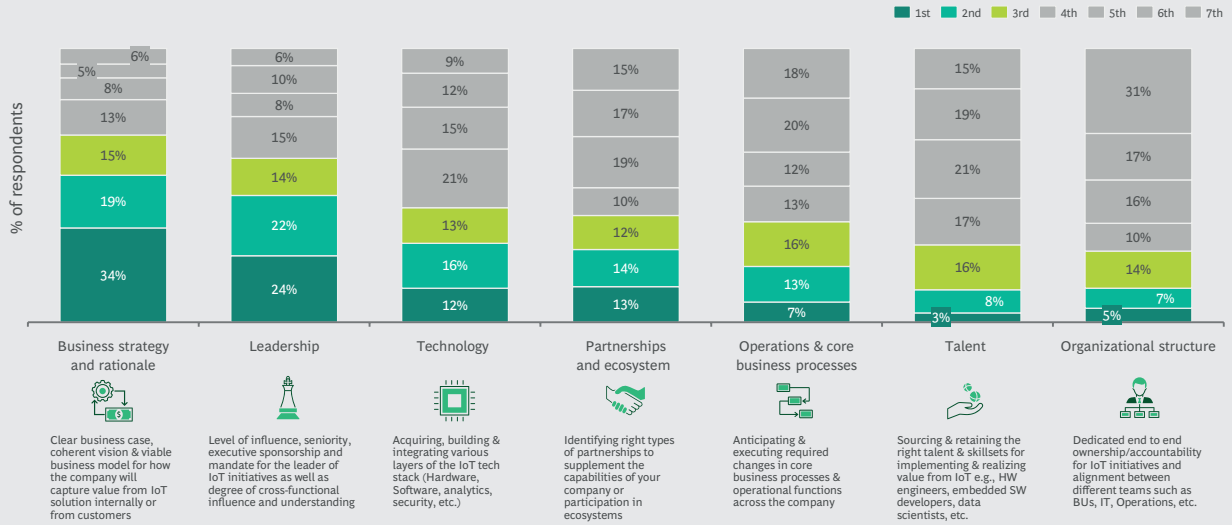
Although technological challenges in IoT often grab the headlines, our research shows that there are several essential ingredients for success that companies must get right if they are to truly harness the transformative potential of IoT. These broad enablers include the underlying technology, of course, but also leadership and organizational considerations, partnerships and alliances, talent, operations and core business processes, and business strategy and rationale. (See Exhibit 3.)



*Think about long-term technology roadmaps.* While issues such as IT/OT integration, build-versus-buy decisions across the technology stack, and IT security have been top of mind to date, many companies are slowly but surely resolving these issues as IoT becomes a familiar fixture in their tech environments. Instead, they are shifting focus to other important issues, such as creating long-term scalable architecture for their future needs, necessary for the implementation of new use cases and the broader deployment of IoT.

*Appoint leaders respected across the company.* Pushing the IoT envelope requires a renewed focus on leadership. And no wonder: IoT necessitates working across disparate areas, recalibrating business models, rewiring processes, and going toe-to-toe with technical and domain experts. This is no easy task. Rarely will one team or leader be able to bring all the necessary expertise to the table. Yet our research indicates that the biggest leadership differentiator between successful and unsuccessful companies is the presence—or lack—of a capable leader with end-to-end accountability. As a result, companies wishing to innovate around IoT will need

**EXHIBIT 4 | Business priorities and leadership indicated to be bigger challenges than technology**  
*Responses to question “Based on your experience with IoT deployments, please rank the following elements for success in implementation and scaling of solutions”*



Source: BCG IoT leaders survey, N=177.

leaders who can bridge organizational boundaries, communicate the strategic vision for IoT, and achieve broad alignment across all participating teams. And as PCL, Bühler, and several other leading firms have clearly demonstrated, IoT needs to be an enterprise-wide imperative, with full backing at the highest levels of the company.

*Partnerships are a must, companies cannot go at it alone.* Be it collaborating with other players, tapping into domain expertise, sharing data, or co-developing technical solutions, companies can’t do it alone. Successful companies utilize an entire ecosystem to support and accelerate their IoT initiatives. Yet developing such an ecosystem is hard: approximately 85% of our survey respondents indicated that business partnerships are highly challenging to build and manage. Successful companies recognize this difficulty and devote sufficient attention to fostering and managing the myriad partnerships they need.

*More than just software skills needed.* Talent is an often-overlooked, yet critical component of any IoT effort. Designing, deploying, and operating IoT requires multidisciplinary skills to be housed together. In addition, IoT development is a new muscle for a lot of IT departments and software teams. Far more complicated than just a software solution, IoT requires a gamut of skills such as hardware design, networking and connectivity as well as analytics. Experience in IoT architecture, data science, security, and AI/ML can be rare and challenging to attract for more traditional enterprises. This scarcity is accentuated by a shallow talent pool in key areas: there are only around a million embedded software developers and a scarce supply of backend developers worldwide. Companies must craft their unique talent strategy to acquire or build capabilities in their workforce based on their starting point and the gaps they need to fill.

*Core business processes will need to change to capture value.* Unlocking success from IoT therefore requires a mindset shift from thinking of IoT as a “one and done” effort to thinking of it as a fundamental change in the way the business is run. Enterprises should begin by ensuring that the core business processes affected by IoT are primed to capture value. This may require process reengineering, as well as robust change management, to ensure that the new ways of working stick. In addition, they must be sure to involve frontline staff, such as manufacturing- or store-operations managers, in IoT initiatives from the get-go. Most use cases require staff to run core business processes differently than they have in the past, either acting on data-generated insights or trusting the insights to automate actions. Buy-in from this set of stakeholders is key.

*Business strategy and rationale.* Last, but not least, the following section provides a deeper look at business strategy and rationale under the heading “Connecting IoT to Business Value.”

## Connecting IoT to Business Value

When we asked executives involved in IoT to rank the six success factors in order of importance, more than two in three respondents indicated that business strategy and rationale was the most important factor. For starters, companies building IoT offerings on top of their physical machines must often switch business models. But this is easier said than done. In fact, close to half of our respondents indicated that an unwillingness to change the existing business model was the top challenge the company encountered. As companies rush to innovate and adopt IoT, in fact, many companies have been guilty of connecting machines and devices without fully thinking through the ways this connectivity and the resulting data will help address their customers’ pain points or unmet needs.

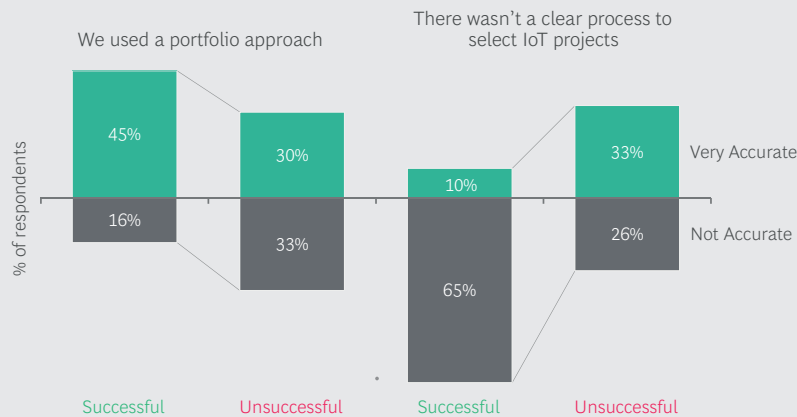
With products becoming augmented by increasingly sophisticated technology, companies must also be willing to tear down and rethink how they reach and service their customers. For example, an equipment manufacturer that faced skepticism from its dealer network not only had to develop training and enablement for its dealers, but build portals and applications that allowed its dealers to access customer data and customize solutions directly. As BigBelly, the provider of IoT-enabled waste-management solutions, transitioned its business model from selling solar trash compactors to selling smart bins that could alert cities and governments about their fill levels, it had to significantly change its after-sales support. The waste collection agencies in its customer base weren’t necessarily the most tech-savvy. So, delivering clear, prescriptive, and action-oriented alerts for everything from battery replacement to advanced diagnostics became essential to ensuring that the technology didn’t become a source of additional complexity or frustration. The company also enrolled third-party service providers to help its customers install and service the new smart bins.

To “go digital,” as noted above, companies can also fall into the trap of trying to connect non-essential devices and machines or generate data trails that are simply “nice to have.” In contrast, successful companies move relentlessly along a viable path to ROI as they invest. As we saw in the Bühler case study, businesses need to be careful not to stifle creativity, imagining all the ways in which sensor and device



## EXHIBIT 5 | successful companies more likely to use portfolio approach in their IoT initiatives

Response to question: “Which of these statements would you say best describes the planning and selection of IoT projects at your company?”



Source: BCG IoT leaders survey, N=177.

data from the physical world can enable new possibilities. When value is not clear, companies may need to challenge themselves to think even more broadly than they have so far.

Leading companies that are successful in IoT are smart about how they manage their bets. They are astutely aware of the perception of low impact and fragmented value from simpler IoT use cases and are careful not to preclude broader transformative use cases that may take more time.

Companies that are unsuccessful, in contrast, are more likely to lack a systematic process for selecting and prioritizing their IoT projects (See Exhibit 5). They may make the mistake of trying too much, too soon, or putting too much importance on getting a quick payback. A number of IoT providers and companies implementing IoT spoke to us of working on several hundred use cases; the more successful companies were prudent enough to cut these down to a few cases, many of which rapidly realized value. In fact, we find that successful companies are approximately 15% more likely than unsuccessful companies to create a balanced portfolio of bigger bets, quick wins, and exploratory options. This is a step we highly recommend.

**R**EAL-WORLD DATA IS becoming more accessible than ever before. In this increasingly digital and connected environment, the divide between enterprises that use this real-world data to their advantage and those that lag could widen considerably. In fact, the next wave in IoT will likely see leading companies break away from the pack—and in yet unforeseen ways. Businesses should therefore make a move right now to ensure that they have the foundational components in place—components that will allow them to imagine the “art of the possible” and reap the growing benefits of IoT.

## NOTES

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