Forbes insights

THE INTERNET OF THINGS: FROM THEORY TO REALITY

How Companies Are Leveraging the IoT to Move Their Businesses Forward

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TABLE OF CONTENTS

INTRODUCTION

Of all the emerging technologies, the Internet of Things (IoT) is projected to have the greatest impact on the industrial economy. Up to $11 *trillion* in annual savings and revenues are forecasted for 2025,[1] and IoT is projected to boost corporate profits by 21% by 2022[2]. Even more important, the IoT is heralded as the foundational technology for breakthroughs in artificial intelligence, robotics and other potentially broadly applicable advances.

But IoT could also be the most overhyped of new wave technologies. For the frontline decision makers—the executives who are charged with implementing IoT in their company—it can sometimes be impossible to separate the hype from reality. It can be even more difficult to discern the practical steps needed to build this reality.

To better understand the current state of IoT, Forbes Insights partnered with Hitachi Vantara to survey more than 500 senior executives around the world who are leading IoT initiatives within their companies. This report highlights the key findings from this research, and addresses the following issues:

- Is IoT still an aspiration or is it becoming an operational reality?
- How is IoT being leveraged within companies?
- In broad terms, what do IoT implementations look like at this early stage?
- Are there companies that are more advanced with using these technologies?
- What are some of the implementation lessons learned?
- What are the practical steps companies can take as they begin their own IoT journey?

1 "Unlocking the Internet of Things," McKinsey & Company, 2015.
2 "The Internet of Everything—The Next Disruption," Cisco Systems, 2014.

DEFINING THE INTERNET OF THINGS

In this research, the Internet of Things (IoT) is defined as the interconnection of machines and devices through the internet, enabling the creation of data that can yield analytical insights and support new operations. For brevity and in keeping with current usage, Forbes refers to major technology categories such as IoT, artificial intelligence or robotics as technologies. It is recognized that each of the technology categories comprises multiple technologies and capabilities. For example, IoT is dependent upon sensors, wireless communications, networks, cloud, storage, etc.

This report focuses on commercial and industrial enterprises. We have not focused on consumer applications such as wearables and smart appliances, as they operate in distinctly different markets.

KEY FINDINGS

- **THE IOT IMPACTS BUSINESS:** Almost two-thirds (64%) of companies believe the IoT is important to their current business, and over 90% believe it will be important to the future of their business.

- **IOT IS THE MOST IMPORTANT EMERGING TECHNOLOGY:** Of all emerging technologies, executives believe IoT will be the most important, ranking it above others such as artificial intelligence or robotics.

- **COMPANIES ARE EMBRACING IOT:** More than half of respondents—51%—say their company has significant IoT programs in operation or that these programs are a major contributor to their business. The other 49% remain in the early stages of IoT planning or are operating pilot programs.

- **IMPLEMENTING IOT-BASED SOLUTIONS CAN BE CHALLENGING:** When building out IoT capabilities, companies say their greatest challenges are the inability to present a compelling return on investment (32%), keeping the IoT secure (32%), cross-department cooperation (31%), integration of disparate data (30%) and availability of skilled staff (29%).

- **THERE ARE BEST PRACTICES TO IMPLEMENTING IOT-BASED SOLUTIONS:** By examining companies whose IoT initiatives are meeting or exceeding expectations, we've identified a few practices they follow to ensure success:

    - Their IoT efforts are typically championed by the CIO (53%)
    - 66% include external vendors on their IoT planning team
    - 81% use a third-party platform as the basis for their IoT operations

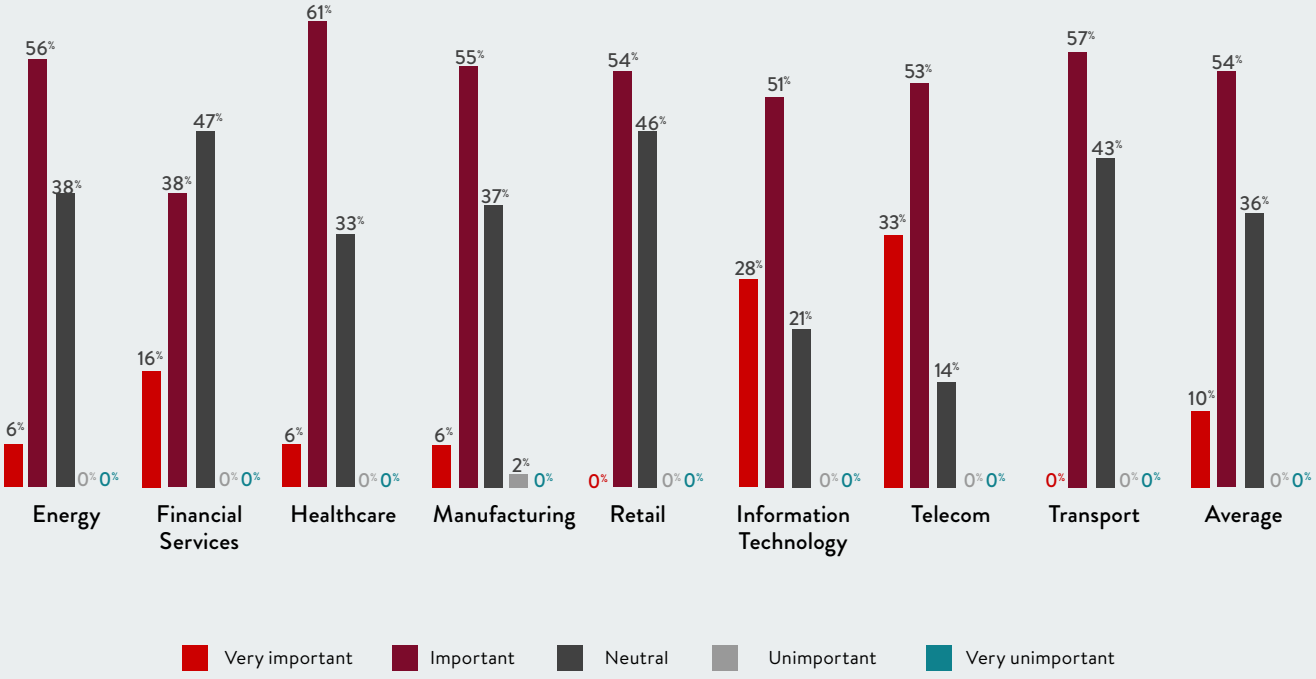
PART 1: THE STATE OF THE INTERNET OF THINGS—FROM ASPIRATIONAL TO OPERATIONAL

Across different regions, and across multiple industries, the IoT is quickly becoming a competitive differentiator in organizations. "The year 2017 is when the Internet of Things became operational," says Patrick Bass, the CEO of thyssenkrupp North America. "This is the year [the IoT] really went to work."

In fact, when more than 500 executives were asked how important the IoT is to their current business, almost two-thirds (64%) said it was important or very important (Figure 1). Not one executive said IoT was very unimportant, indicating that companies understand the IoT is here to stay and that it needs to be part of their organization's future.

While there's agreement across industries that the IoT is important, there is also a sizable segment that believes the IoT is not important to their current business. This is surprising given all the talk about IoT, but what this number could indicate is that companies either don't yet fully understand how IoT can dramatically improve their business or they're still formulating their strategy around these new technologies.

Figure 1. How important is the IoT to your company's business? *(By industry)*

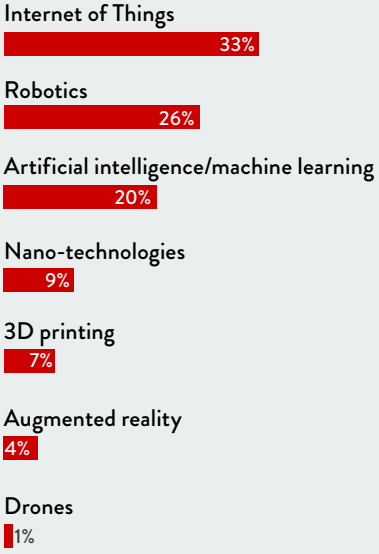


"I see customers seeing rapid shifts in the market, and that scares them," says Dave Parsons, vice president of IoT strategy and solutions at Hitachi Vantara. "Yet while they're acknowledging these shifts, and they're definitely getting into it, companies are still trying to tackle the difficult dynamics."

This rise of the IoT is indicated not only by the number of companies considering it important to their business but also by its place in company priorities. When asked to rank the importance of various technology initiatives, executives ranked IoT highest, placing it above other initiatives like robotics, artificial intelligence and augmented reality (Figure 2).

Why is IoT top of mind? This could be due to three reasons. First, unlike more specialized applications like drones, IoT is seen as part of the future of virtually every industry from healthcare to financial services to

Figure 2. Technology initiatives that are important to my company.



transportation. Second, by being integrated into legacy operational technologies, IoT costs less to implement compared to other technologies. And third, IoT generates substantial new data that feeds other advanced technologies, like artificial intelligence or automation solutions, thereby accelerating transformation even faster.

"The IoT and artificial intelligence are a match made in heaven," says Bryan Kester, the head of IoT at Autodesk. "What has been holding AI back is the shortage of good data, but as the IoT is deployed, it will create the kind of clean data that can be used in sophisticated analytics. The IoT will not only support but speed up other solutions."

THE STATE OF DEVELOPMENT

So companies acknowledge IoT is important to their business and their future success, but are they making the IoT a reality? Where do companies stand with implementation?

When asked to assess their company's state of development, 51% of executives surveyed say they have significant IoT programs in operation or that these programs are a major contributor to their business; 49% remain in the early stages of planning and pilot programs. All companies are embracing IoT, and while the extent may vary, this is clearly a global phenomenon as respondents report development across Europe, the Americas and Asia-Pacific (Figure 3).

Given that some companies have only recently launched their IoT efforts, this state of development indicates a climate of rapid adoption. "The Internet of Things is clearly moving fast," says Dominic Venturo, chief innovation officer of U.S. Bank. "Companies are seeing the value early and are making it a priority."

Yet not all companies are moving at the same pace. "There is an important sequence here," says thyssenkrupp's Bass. "Companies are moving from digitization through digitalization to digital transformation. The IoT is that transformative end game. But you now see companies in every phase of that journey."

Some predict a further acceleration of IoT implementation. Umeshwar Dayal, senior vice president and senior fellow (information research) at Hitachi America Ltd., Global Center for Social Innovation, North America, says: "The use cases and the benefits [of the IoT] are just becoming public. When the operational improvements and top-line benefits become known, and they will, you will see even more acceleration in the IoT."

This growth won't be confined to a single industry or subset of industries.

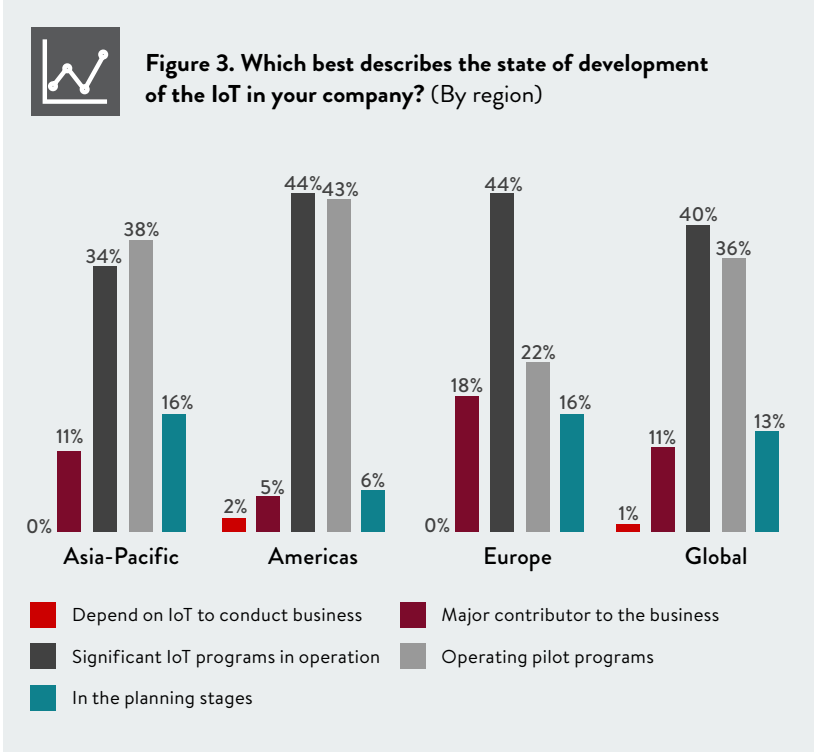
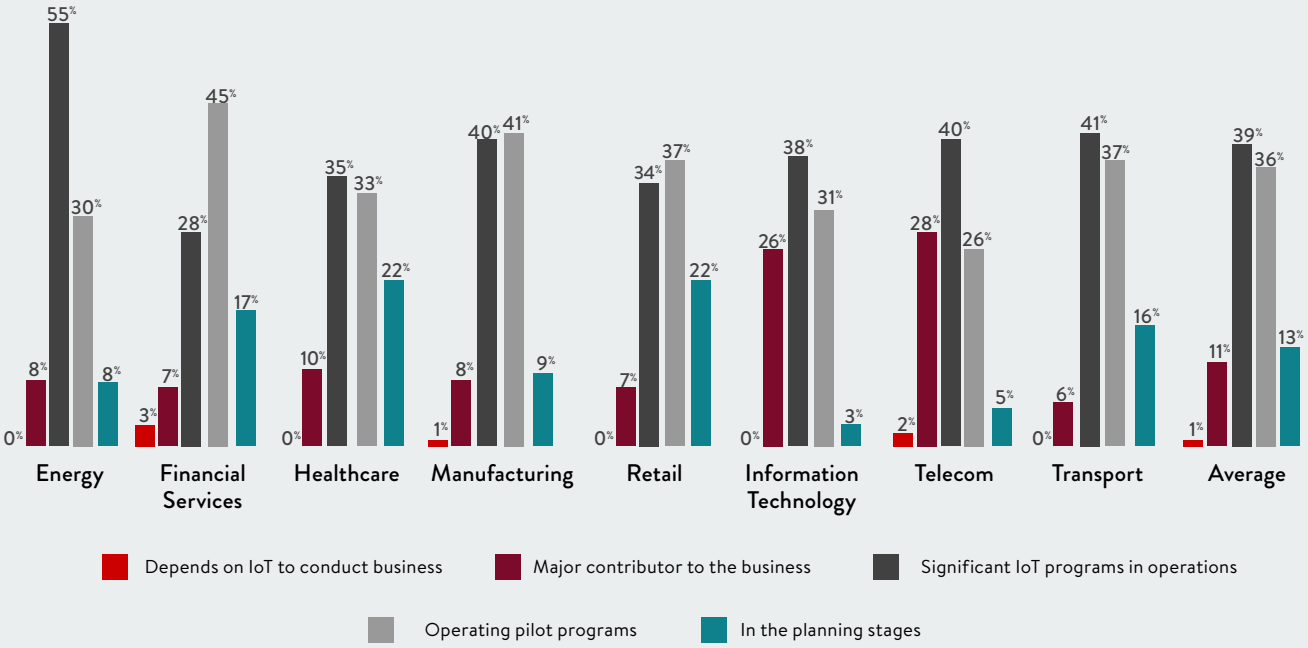


Figure 4. Which best describes the state of development of the IoT in your company? (By industry)



Right now, it's already making broad progress across a range of sectors from energy to financial services and retail (Figure 4). "We are seeing the IoT beginning to deliver across virtually all industries," continues Venturo. "Those who think it is limited to just the factory don't realize how important it has already become and what it will mean to them."

As can be expected, the highly digitized and tech-savvy technology and telecom companies are in the forefront in implementing IoT. But the data also indicates that no major industry will be exempt from the IoT, and no company will be immune from its competitive implications.

"The common denominator here is that the IoT is capable of creating data in every industry," says thyssenkrupp's Bass. "The value used to be in brick-and-mortar assets. Now the value of companies is in its data. You can go to any industry and see the valuable data that the IoT is creating. That is what is driving such widespread adoption."

The Forbes Insights and Hitachi Vantara survey also asked respondents to identify the functions they see as the highest priorities for IoT. The most striking finding is the breadth of IoT investment. The IoT is affecting many parts of organizations, most

> "We are seeing the IoT beginning to deliver across virtually all industries. Those who think it is limited to just the factory don't realize how important it has already become and what it will mean to them."
>
> **DOMINIC VENTURO**
> CHIEF INNOVATION OFFICER,
> U.S. BANK

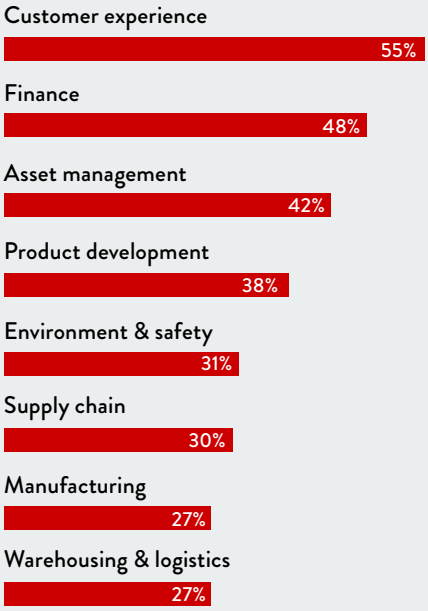
heavily customer experience (55%), finance (48%) and asset management (42%) (Figure 5). One reason for this widespread impact is that IoT often has cross-functional effects, such as when a product-based sensor tracks a unit from manufacturing through distribution and to the customer.

It's notable that customer experience ranks as the single highest priority for IoT capabilities. This may indicate the flexibility and wide applicability of the IoT. From its manufacturing roots, IoT is being used to customize products, predict demand and build a direct relationship with the customer through digitized products and services.

For U.S. Bank's Venturo, the importance of customer experience doesn't come as a surprise. "The IoT is extending the reach of the technology function to the sale and care of the customer. It is making the CIO the most important partner of sales and marketing."

This role of IoT in improving the customer experience also extends to manufacturing. "The IoT builds a direct feedback loop between the customer and production," says Hitachi America's Dayal. "The production people can understand customer usage and needs in real time, and you can ultimately provide better customer service based on data rather than sales calls."

Figure 5. To what extent is your company prioritizing the IoT across the following functions?



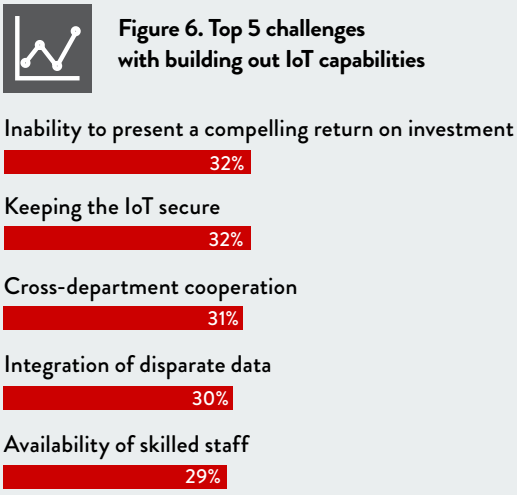
The strong focus on finance may surprise those who associate the IoT with physical processes like manufacturing. One driver may be that organizations' IoT initiatives have so many financial touchpoints—reducing costs in the supply chain, tracking valuable assets, enabling variable pricing with customers—that companies view it holistically as a finance-oriented solution.

CHALLENGES WITH IOT IMPLEMENTATION

Every wave of technology adoption has its challenges, and IoT is no exception. When building out their IoT capabilities, executives struggle with everything from integrating different data sets to having the right talent in place (Figure 6). As in most technology initiatives, cybersecurity remains top of mind as both a challenge and concern.

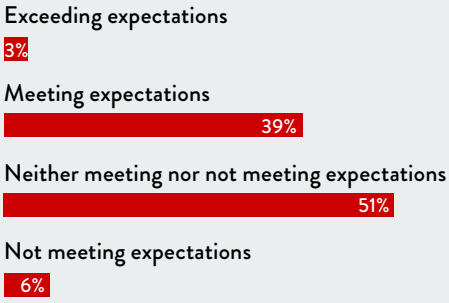
"Even though it is becoming operational, the IoT still remains in a period of experimentation, and many companies recognize there are unknown obstacles they will have to solve," says Autodesk's Kester. "To overcome these, many companies are adopting a fail-fast approach in which they learn quickly from mistakes and move on."

Figure 6. Top 5 challenges with building out IoT capabilities



Despite some initial challenges, companies are finding success with IoT. In fact, 42% of companies say their IoT programs are doing what they should be doing—saving money, making the company more efficient or earning new revenues (Figure 7). These leading companies will be analyzed more closely later on in the paper when we're discussing drivers of IoT success.

Figure 7. How well are your company's IoT programs meeting expectations?



What's worth remembering is that the growth of the IoT needs to be analyzed within context—this is a business solution that is only a few years old in its current form. Companies are still learning the ins and outs of IoT, so it's no surprise that many are still learning what works and what doesn't. What's clear is that the IoT is moving from theory to reality across the bulk of the business economy.

"The IoT has come from nowhere to being a part of our industry in just two years," says Satyam Priyadarshy, Technology Fellow and Chief Data Scientist at energy company Halliburton. "This trajectory cannot be ignored—the digital architecture will become the norm in our industry and many others in a short amount of time."

The IoT has arrived. Its rapid expansion and early traction have established it as a competitive reality in the market, and standing by is not an option. Companies need to move, and move quickly, to implement an IoT strategy. Otherwise, they risk falling behind or being disrupted.

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BRYAN KESTER
HEAD OF INTERNET OF THINGS, AUTODESK

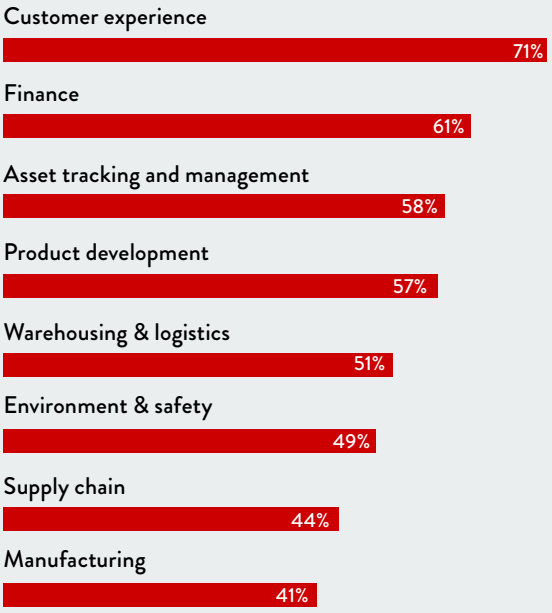
PART 2: THE IOT—DRIVERS OF SUCCESS

Every major technology wave has a cadre of early adopters that pioneer the planning, testing and implementation of the solutions. The same goes for IoT. Our survey identified a subset of companies (42%) that state their IoT programs have exceeded or met their early expectations (other companies are still in a wait-and-see mode). As part of the research, we isolated the data from these more successful organizations to determine what steps they're taking to ensure success, and what other companies can do to follow in their footsteps.

PRIORITIES—CONCENTRATING RESOURCES AND FINDING SUCCESS

A key question for these more successful organizations is, "Where are you finding success?" Accordingly, we asked these leading companies to assess their ongoing success with IoT in key parts of their organization (Figure 8).

Figure 8. How would you rate the success of your company's IoT activities in the following functions? *(Successful companies, % who rated it successful or very successful)*



The first observation is that companies are applying and finding a degree of success in many parts of their companies. "The Internet of Things is not just about connecting machinery and parts," Greg Kinsey, Vice President of industrial solutions at Hitachi Vantara. "The IoT is about digital transformation, and to be successful it must significantly improve your operating model."

When looking across functions, the greatest IoT success is being found in customer experience. Given the traditional arms-length relationship between the IT function and customers, this is an indicator of how the IoT can revolutionize companies. Organizations are using IoT capabilities to tailor products for customers, create more predictive demand forecasting and digitize their products and services.

Halliburton is an example. "We have been using sensors to connect every part of the energy business," says Halliburton's Priyadarshy. "By taking simultaneous readings on sensors in pipelines, production rigs, storage units and other physical items, we can, for example, create an even safer environment for operations of the oil and gas industry."

Hitachi America's Dayal believes the IoT will increase the linkages between customers and production. "The IoT certainly helps in assessing customer demand, but the important thing is how it links the feedback to processes. The IoT helps a manufacturer determine production runs, or design a product, or plan for higher demand."

THE INTERNET OF THINGS AND THE CUSTOMER EXPERIENCE

Over 500 IoT executives were asked where they were finding the greatest success with the Internet of Things. Their response—with customers. This can be surprising, as IT departments and production lines have traditionally had only a secondary relationship with the end-customer. One way the IoT is changing this is by using technology to create new customer offerings.

Figure 9. Do you operate IoT programs designed to create new revenues? *(Successful companies)*

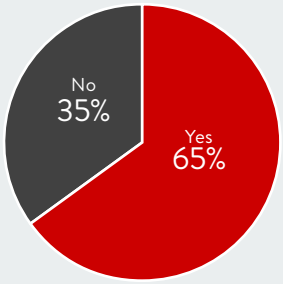


Figure 10. How does this IoT-based program generate revenue? *(Successful companies with IoT revenue programs)*

This is not an isolated phenomenon—almost two-thirds of successful companies (those whose IoT initiatives are meeting or exceeding expectations) are using the IoT to directly create new revenues (Figure 9).

One of the most interesting innovations is the ability to use the IoT to custom manufacture products rapidly and cheaply (Figure 10). Instead of mass sourcing from distant manufacturers, Adidas, for example, is able to use IoT-based additive manufacturing to customize athletic shoes near the end-customer. Transportation costs are reduced, inventory is no longer required, and the customer is happier, thanks to the IoT.

ENTRY STRATEGIES—HOW SUCCESSFUL COMPANIES ARE STRUCTURING THEIR EARLY IOT INITIATIVES

When adopting new technologies in the past, enterprises often deployed small teams that worked in isolation to determine how to best design and implement a solution. This, however, does not appear to be the path to success in IoT.

"The Internet of Things is not just another IT program," says Hitachi Vantara's Parsons. "To be successful, you need the collaboration of a broad part of the organization, reaching across silos and transforming the old businesses. You need strong support from above and to manage it across the organization."

Patrick Bass of thyssenkrupp agrees: "The IoT is not an IoT project. The IoT is not an R&D project. The IoT is a business/operations/integration project, and you have to organize for that."

Our respondents agree with this sentiment, making it clear that successful IoT programs are enterprise-led and not isolated projects. When asked where the governance of their IoT programs lay, 67% of the companies whose IoT initiatives are meeting or exceeding expectations say enterprise level (Figure 11).

At the same time, there is a strong learning curve to the IoT. "The successful companies that we are seeing are not afraid to experiment," says Hitachi Vantara's Kinsey. "The high flexibility of the IoT enables an organization to test different models and then apply what they learned to more ambitious projects."

This pattern is supported by our research. While our survey respondents follow an overall enterprise strategy, 66% of successful companies report they have purposefully pursued smaller initiatives (pilot projects, demonstrations, operational testing) to develop expertise and a technology base for larger initiatives (Figure 12).

"The IoT's flexibility allows you to build from a small base, managing risk and keeping costs down," says U.S. Bank's Venturo.

Whether large or small, projects should be conducted with a larger vision in mind. "It doesn't matter how big or small the IoT project is. It's the larger objective that it is attached to," says thyssenkrupp's Bass. "Make it work at the tactical level, of course, but also make sure you have a strategic objective in mind."

Figure 11. Our company's IoT strategy is managed at the enterprise level. *(Successful companies)*

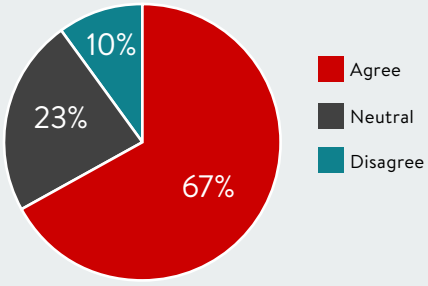
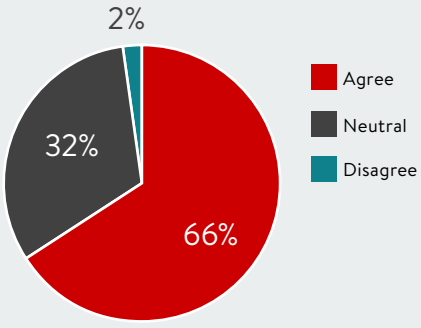


Figure 12. Our IoT strategy has been to learn from small projects and then move on to larger ones. *(Successful companies)*



> You don't create the Internet of Things as a stand-alone. Its value will come when it connects to all parts of the organization. That will lead to the transformation of the entire organization."
>
> **UMESHWAR DAYAL**
> SENIOR VICE PRESIDENT AND SENIOR FELLOW (INFORMATION RESEARCH) AT HITACHI AMERICA LTD, GLOBAL CENTER FOR SOCIAL INNOVATION, NORTH AMERICA

THE IOT TEAM—HOW SUCCESSFUL COMPANIES ORGANIZE

The IoT demands enterprise-wide governance, but it also requires a fine degree of tactical execution. Companies that are currently most successful with the IoT are managing these dual objectives with a hybrid structure.

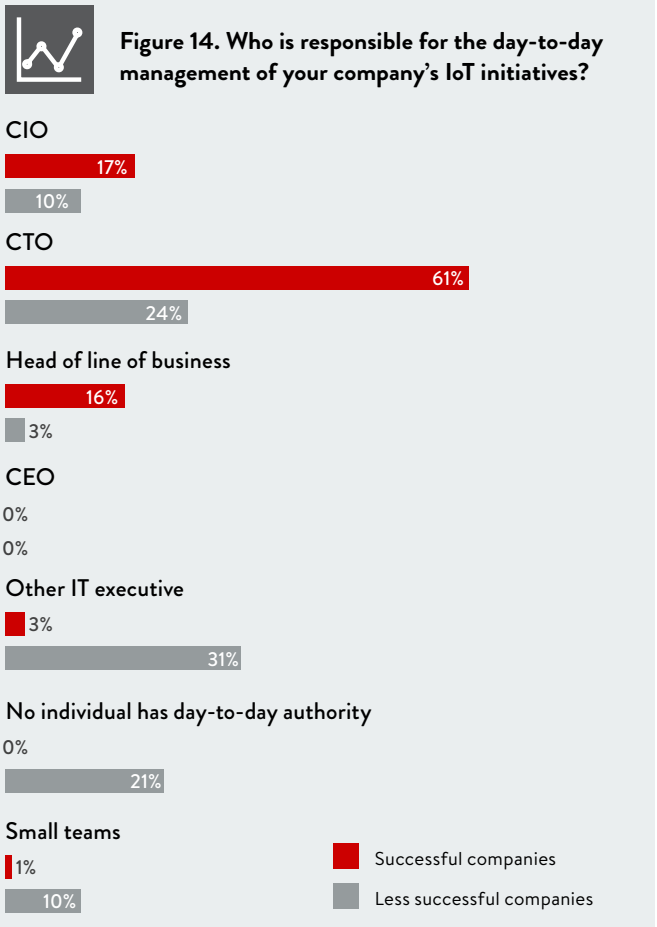
The IoT can disrupt old systems and ways of working. It can challenge old business models, call for new kinds of workers and require a healthy budget. This effort is paralleled by the technology architecture, which must bridge legacy systems, integrate data from disparate sources and be kept secure. This unity of effort demands a C-level executive to drive IoT initiatives.

Not surprisingly, successful companies are much more likely than less successful ones—53% versus 28%—to have a chief information officer who takes on the role of champion and central authority on the IoT (Figure 13).

"CIOs are the natural champions of the Internet of Things," says U.S. Bank's Venturo. "They combine the stature and the technology expertise that can drive this complex initiative forward."

Yet a time-constrained CIO cannot be expected to manage the day-to-day development of all IoT projects. A significant majority—61%—of successful companies therefore designate a chief technology officer (or equivalent) as the manager of the team. Virtually all companies house the management of their IoT programs within the broader IT group (Figure 14).

There is a disturbing countervailing trend in less successful companies: Almost a third of them, 31%, say that the management of their IoT programs are either in the hands of small teams or that no individual has day-to-day authority. Hardly any successful companies



report this management approach, indicating that strong, enterprise-level direction is a precondition for success in IoT.

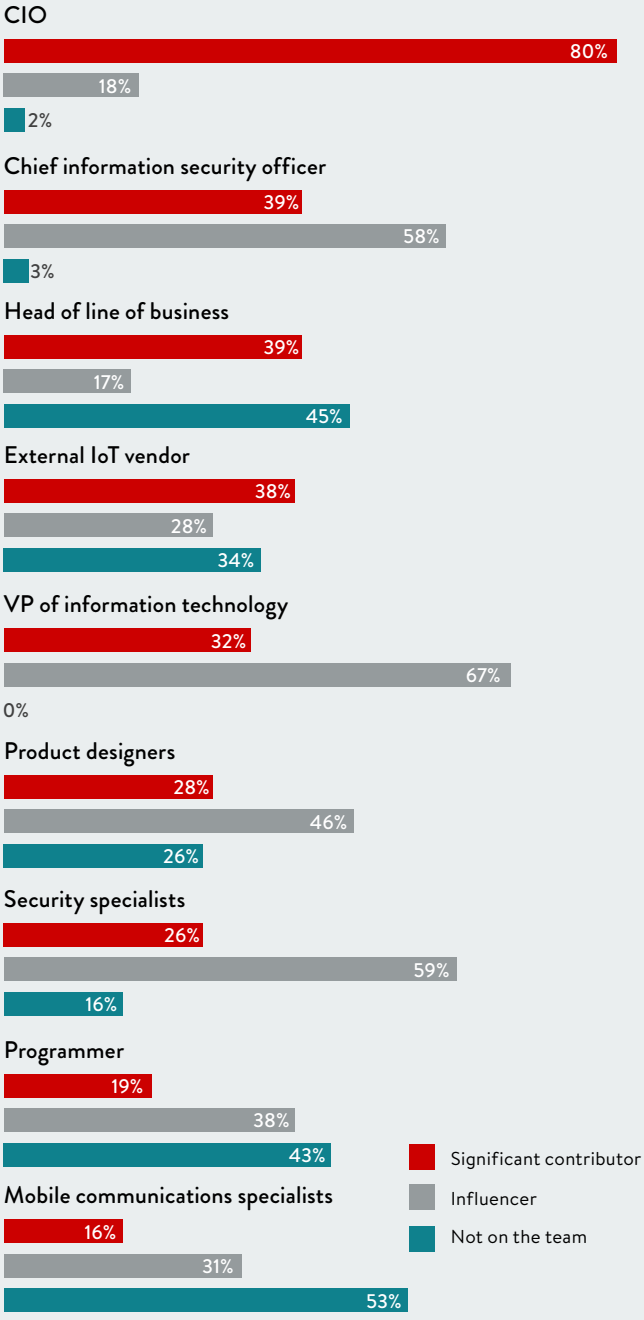
"A company's Internet of Things program is a diverse phenomenon, likely to bridge manufacturing, product development, lines of business and other non-IT functions," says Hitachi Vantara's Parsons. "Therefore, you have to make a point of having a diverse set of skills in the team charged with building out your Internet of Things capability."

Autodesk's Bryan Kester agrees: "Forward-looking companies are recognizing that the IoT is so cross-functional that you cannot let it get bogged down in silos. You need very strong support at the C-suite level to make the IoT work."

In four out of five successful companies, the CIO is a prominent member of the IoT development team (Figure 15). But these enterprises also extend responsibility to experts from the lines of business, cybersecurity and product design, ultimately making their initiatives more successful.

This doesn't come as a surprise to Halliburton's Priyadarshy, who says, "A diverse solution demands a diverse set of contributors."

Figure 15. Composition of the IoT team
(Successful companies)



IOT DEVELOPMENT—HOW SUCCESSFUL COMPANIES ENGAGE PARTNERS

Many companies express a high sense of urgency in making their IoT programs operational. It is therefore no wonder that more than four out of five companies seeing the most success with IoT report using a vendor-sourced IoT platform as part of their initiatives (Figure 16).

"There are some important reasons for using a platform," says Autodesk's Kester. "Clearly security is one of them, but there is also an immediate need for scalability. You won't get that from a homegrown solution."

The research indicates that companies are increasingly forming collaborative relationships with suppliers. Driven by the need for continued expertise and the complexity of the solutions, two out of three companies choose to include their systems vendors on their internal IoT development team (Figure 17).

"This is not IT as we have known it," says Hitachi Vantara's Kinsey. "Many IT departments have focused on buying a piece of technology and then implementing it. The Internet of Things requires many hands, and having your systems vendor there will get you where you need to go that much faster."

Who are the partners that are engaged by the most successful companies? A broad range of providers are included, but foremost are the suppliers who provide the operational technologies, like the hardware that sensors are embedded in. That said, strategy consultants, software solutions providers and IoT specialists all play important roles as members of the development team in organizations succeeding with the IoT (Figure 18).

Figure 16. Does your company use a third-party IoT platform for its IoT initiatives? *(Successful companies)*

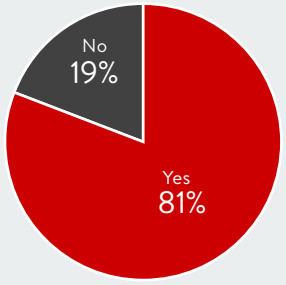


Figure 17. Presence of vendors/suppliers on the IoT development team *(Successful companies)*

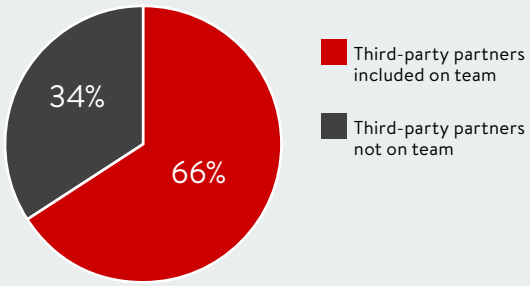


Figure 18. Which of the following external IoT vendors do you rate as important members of your IoT team? *(Successful companies)*

CYBERSECURITY—HOW SUCCESSFUL TEAMS APPROACH DATA SECURITY

As in all things technology, IoT teams must keep cybersecurity top of mind. Indeed, because the IoT creates a technological connectivity across virtually every part of the organization and presents more entry points for hacking, many believe that the cyber stakes are inherently higher in the Internet of Things.

The most successful companies are realistic about security issues, with more than a third agreeing IoT can be harder to secure than standard technology initiatives. Additionally, 39% agree that the consequences of a breach in IoT can be more serious than in other technology deployments (Figure 19).

"Every type of equipment or device is now a point of vulnerability," says Hitachi America's Dayal. "You have to build real security deep into your IoT network. It has to be part of the original design and even culture of the IoT."

Recognizing these issues, many successful companies have placed a higher security standard on their IoT deployments. For this and other reasons, successful companies report a high degree of confidence that they can keep their IoT programs secure (Figure 20).

Figure 19. Managing security in IoT initiatives *(Successful companies)*

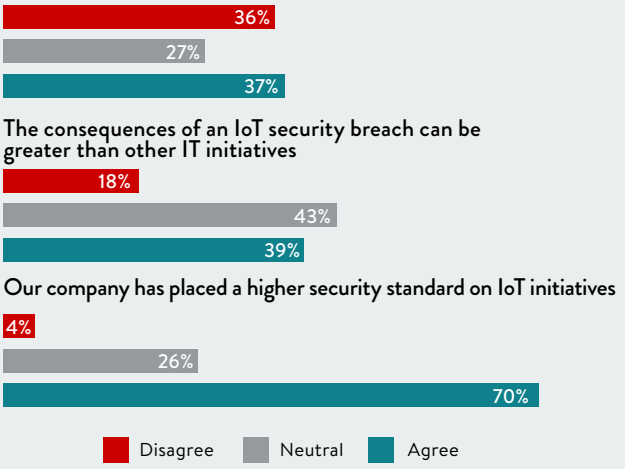
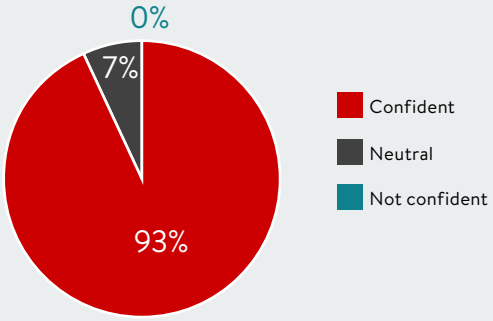


Figure 20. How confident are you in your company's ability to keep its IoT programs secure? *(Successful companies)*



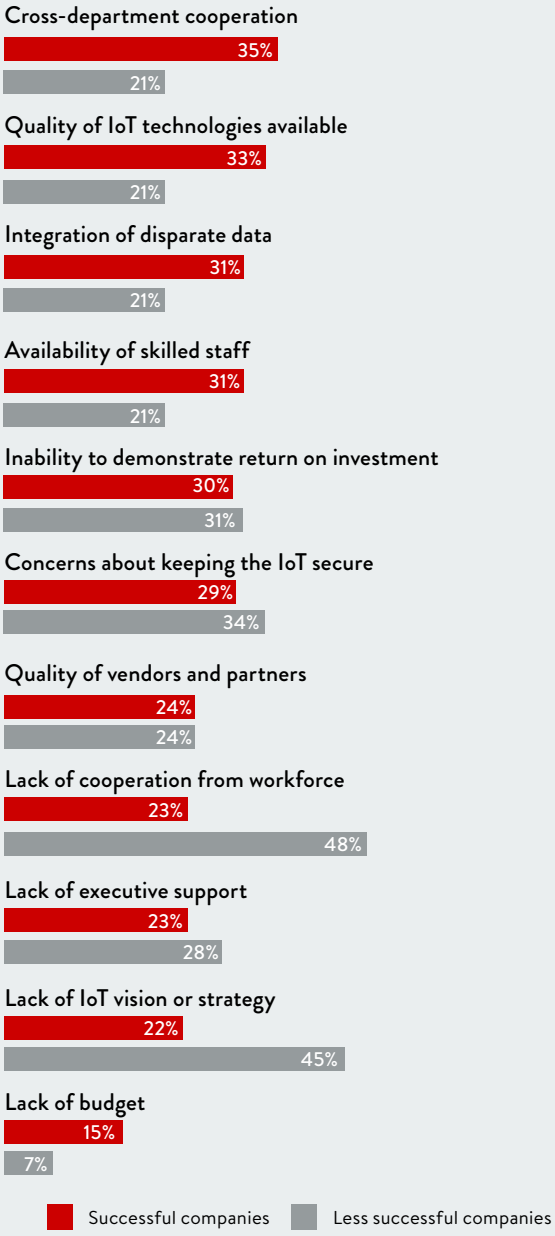
THE CHALLENGES— WHAT OBSTACLES SUCCESSFUL COMPANIES FACE WITH IOT

As in so many technology initiatives, the greatest challenges companies face when building out their IoT capabilities do not lie in the technology. For those seeing the most success with IoT, obtaining cross-department cooperation—e.g., getting sales and marketing to share their customer data with manufacturing—is seen as the most significant challenge, followed by the availability of the right talent and the integration of disparate data (Figure 21).

As noted previously, the Internet of Things is moving quickly in virtually all industries and geographic regions. The result is a particularly acute shortage of staff in this space, which may be a driver of the inclusion of external partners in IoT development teams.

"The Internet of Things is not really about machines," says Hitachi Vantara's Kinsey. "It is really about people and transformation. If you can make it work with the people, you will see success."

Figure 21. The greatest challenges to building out IoT capabilities are...



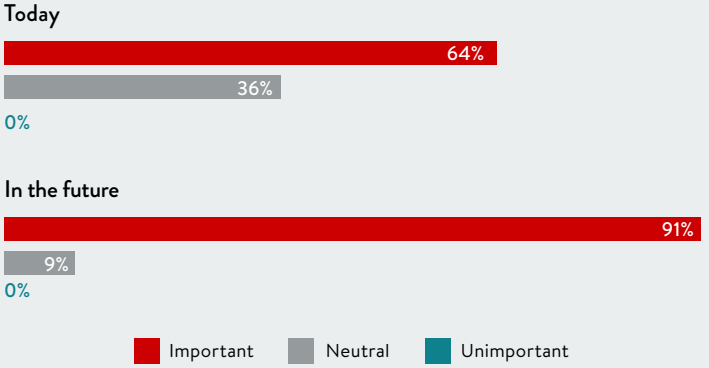
PART 3: LOOKING TO THE FUTURE

If IoT has gained ground in industries around the globe, what does its future growth look like?

Based on the data, it appears companies are "doubling down" on the Internet of Things. While about two-thirds of all companies now believe IoT is important to their business today, more than nine out of 10 believe it will be important to their business' future (Figure 22).

"I have yet to see a company that is going backward on the IoT," says U.S. Bank's Venturo. "The more they learn, the more they expand their goals and their investment."

Figure 22. How important is the IoT to your business today, and how important will it be in the future?
(All companies)



When asking these early adopters what single piece of advice they would give to a peer who was beginning to build out IoT capabilities, the biggest takeaway was creating a long-term IoT strategy driven by the needs of the business, followed by the need to have strong senior executive support (Figure 23).

"The IoT is so transformative that no company can afford to ignore it," says Autodesk's Kester. "A company that does will find itself at a major disadvantage on cost, agility and in its relationship with customers."

HOW TO FIND SUCCESS WITH THE IOT

The IoT is here to stay, and organizations that embrace these new technologies will be better prepared for the future. Here are a few recommendations to find success with the IoT.

1. BEGIN WITH THE BUSINESS CASE, NOT WITH THE TECHNOLOGY. IoT is not a standard technology deployment where you buy, integrate and implement. It is much more about the digital transformation of a business or a process. As our research indicates, building the business case and directing IoT to solve business objectives are keys to success.

2. DEVELOP A COMPREHENSIVE IOT STRATEGY. The number one piece of advice offered by successful early adopters is to have a dedicated strategy for the Internet of Things. The IoT requires the collaboration of many stakeholders and by its nature reaches across multiple silos. It will require strong leadership, particularly from the CIO and CTO. A central strategy with milestones, dedicated resources and a defined set of objectives will act as a rallying cry for the workforce, and a road map for operational development.

3. START SMALL TO GO BIG. The IoT is new ground for most companies. But it also has the flexibility to cost-

effectively support experimentation and pilots. Start with an achievable project with a defined return, using it to test your technology, organize your data and build out your team. By starting a little smaller, you will get there a lot faster.

4. IT IS ALL ABOUT CO-CREATION. IoT is not a job that will be started and finished by the IT department. It will probably not be finished by just your employees either. Successful IoT implementation is the sum of contributions from a broad base of participants. Bringing in the end-users and the lines of business, and collaborating with customers and suppliers, is key to building a holistic, co-created IoT solution.

5. VIEW THE IOT AS A SOURCE OF COMPETITIVE ADVANTAGE AND COMPETITIVE THREAT. The IoT now has a presence in every industry and in every region. If you have yet to launch a serious IoT initiative, then you are behind a dangerous curve. At least some of your competitors are prepared to reap the IoT advantages of lower costs, higher efficiency and enhanced customer offerings at your expense.

6. INSTILL A SENSE OF URGENCY IN YOURSELF, YOUR TEAM AND YOUR COMPANY. IoT has become a major force in a period of just a few years. Early adopters have the expertise, teams and operational platforms to rapidly roll it out across their enterprises. This is a phenomenon that is only going to accelerate—if you don't get onboard now, you will be disrupted.

"The IoT will not only be a source of competitive advantage, it will also be a source of competitive threats," says thyssenkrupp's Bass. "This makes the IoT non-optional in almost every industry. The IoT has arrived. It is a critical part of the future of every industry, and you have to get onboard with these technologies—and fast."

METHODOLOGY

The data in this research is derived from a 2017 Forbes Insights survey of 502 executives who identified themselves as responsible for, or familiar with, the IoT activities of their companies. Respondents were based in Europe, the Americas and Asia-Pacific, and represented a range of industries, with not one comprising more than 25% of the total. All respondents were director-level or above, and came from companies with 500 employees or more.

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- **Dominic Venturo,** Executive Vice President and Chief Innovation Officer, U.S. Bank

APPENDIX

LESSONS FROM THE INTERNET OF THINGS AND MANUFACTURING: FIVE STAGES OF ENTRY

Manufacturers are early adopters when it comes to the Internet of Things. But transforming a production line in mid-operation also presents considerable risk. Their early experience shows a pattern of risk-managed, rapidly implemented entry that can be helpful to other industries as they assess the IoT.

STAGE 1: COST REDUCTION—GO FIRST FOR THE LOW-HANGING FRUIT

Cost reduction is an attractive first option in IoT deployment—it is typically low risk, offers a defined ROI, and results can be realized quickly.

Example: Utilities have used sensors to track energy usage in households and businesses, forgoing the high costs of on-site meter reading and field service.

STAGE 2: GO FOR OPERATING EFFICIENCIES

This is the stage of "doing what you already do, but doing it better." Often an IoT network is used to displace manual processes that can be high cost and prone to error.

Example: Sensor-based analytics that signal a maintenance requirement in advance, replacing time-based maintenance schedules and forestalling a breakdown.

STAGE 3: USING THE IOT TO INCREASE FLEXIBILITY

The IoT is used to provide an unprecedented operating flexibility for the plant manager.

Example: Additive manufacturing systems (sometimes called 3D printing), when connected to suppliers, enable rapid line turnover to support efficient production of small production lots.

STAGE 4: USE THE IOT FOR DIGITAL TRANSFORMATION

In this stage, a fully connected manufacturing process—from the supplier through production to the customer—is able to adopt a completely new operational model.

Example: A railroad company operating in remote areas is able to use additive manufacturing to manufacture parts on the spot when a critical part fails.

STAGE 5: THE IOT BECOMES THE FOUNDATION FOR INNOVATION

This is the most interesting part—when an IoT solution is fully operational, unforeseen business opportunities emerge.

Example: A manufacturer of connected health monitors spotted clinical patterns that it now shares with insurers and healthcare providers.

It should be noted that these steps are not necessarily sequential—there is a sense of urgency in entering the IoT that causes these phases to overlap as success is achieved. Nonetheless, these steps demonstrate an IoT entry strategy that manages risk while keeping the momentum of IoT going.

THE INTERNET AND OIL AND GAS— MEETING THE CHALLENGES OF A TOUGH INDUSTRY

The upstream oil and gas industry, which includes the vast assets of the production fields, has always faced unique challenges. Oil and gas production is an asset-intensive business operating in a volatile market. Its far-flung assets are distributed across some of the most hostile terrain on earth, and operates under close regulatory scrutiny. Workforce safety is always a concern, and its operators are currently under severe cost pressure due to historically low oil and gas prices.

Enter the Internet of Things. Each step of the exploration and production process can be connected within an IoT network, directly addressing the industry's challenges:

1. IN EXPLORATION: Data collected from thousands of wellheads can complement seismic survey data and be used to better predict the occurrence, depth and composition of deposits, and thereby determine where and how to expand an oil field.

2. IN DRILLING: Drill bits, thousands of feet down, are equipped with sensors that predict blowouts and dangerous high-pressure conditions.

3. ON THE PLATFORM: Oil production—"roughnecking"—has historically been a dangerous profession. But incident data and its corollary factors—time of day, weather, occupations, age of the worker, time of shift—is being aggregated into analytics designed to predict, and thereby prevent, on-the-job accidents.

4. IN MIDSTREAM DISTRIBUTION: Seventy percent of crude production is transported to refineries by pipeline.* These far-flung assets have often been the source of high-profile and high-cost accidents and spills. However, IoT-connected sensors, increasingly linked to drones, can provide a real-time analysis of current and predicted faults.

For early adopters, the Internet of Things can allow companies in the oil and gas industry to meet the challenges of today. The IoT can reduce costs, make other costs more variable, support environmental compliance and create a safer work environment for employees.

* James Conca, "Pick Your Poison for Crude: Pipeline, Rail, Truck or Boat," Forbes.com, April 26, 2014.

Forbes insights

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