Harvard Business Review
ANALYTIC SERVICES

Pulse Survey

ACCELERATING THE INTERNET OF THINGS TIMELINE

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Taking the Pulse of IoT Adoption

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The advance of digitalization is catalyzing business across sectors and in multiple ways. With the internet of things (IoT), we see a similar trajectory—the proliferation of network-enabled objects is transforming entire industries. Industrial IoT, the biggest lever of digital transformation, can make operations more efficient, streamline processes, and change businesses into digital organizations. Even more, we believe industrial IoT will have a major positive impact on our society.

The challenge of adapting to the new paradigm, however, can be daunting for individual companies. While IoT is often associated with the required hardware and software, the technical adaptations needed for leveraging IoT are just one part of the picture. A complete digital transformation entails a fundamental rethinking and repositioning of the way business is done.

At Siemens, we are engaged in our own digital transformation, designing our unique digital journey and constantly reinventing ourselves. It's not just us, every day, as the CEO of the newly formed IoT Services Unit, I encounter clients who are eager to take advantage of IoT for their own business but also describe the challenges involved. For instance, they must assess the likely return on investment in a new IoT infrastructure. The question of cybersecurity looms large, and in some cases, transforming into a fully digital company may necessitate new partnerships. This changeover cannot take place without a fundamental cultural and organizational change throughout the entire value chain, including suppliers and clients. The journey ahead is a challenging one.

In order to gain a holistic overview of our clients' current status with regard to IoT, we partnered with HBR Analytic Services to conduct a pulse survey of executives from various industries. Remarkably, 741 executives from around the globe participated, confirming the buzz surrounding IoT as well as indicating a desire for information exchange, universal standards, and better answers to open questions.

The survey provided additional evidence that IoT is a core topic in industrial digitalization; nearly three-quarters of respondents (74%) indicated that IoT was a competitive differentiator within their industries. The majority (56%) were still in the process of identifying potential use cases, not having moved into deploying IoT projects yet. These respondents indicated that they feel pressed to meet the challenge to quantify and leverage the potential benefits of IoT applications before their competitors.

Looking forward, we believe IoT will be THE key lever of the ongoing Fourth Industrial Revolution, which is marked by opportunities and paradigm-changing innovations that facilitate entirely new business models. Seizing these opportunities requires a comprehensive business strategy to guide IoT efforts. We advise our clients to start small and scale fast, advancing to prototyping based on the first minimum viable product as quickly as possible. Executives must also help their employees embark on this journey, because any IoT project changes the way the company does business which impacts people's mindset and work. Sustainable impact is created only when people believe in the opportunities ahead and don't reject them.

I invite you to dive into the survey results and see how executives evaluate the current and future status of IoT. We can't wait to tackle the challenges ahead and make IoT the success story everybody is expecting it to be.

ACCELERATING THE INTERNET OF THINGS TIMELINE

Digital transformation is spurring innovation and new business models across virtually all industrial and commercial sectors. In fact, 69% of senior executives responding to a global survey by Harvard Business Review Analytic Services report that changes to their business model expanded their markets to additional business segments over the past two years. Few emerging technologies offer more transformative potential for forward-thinking companies than the internet of things (IoT). The reason: it combines sensors and sophisticated software analytics to process large volumes of operational data.

But global leaders aren't being drawn to IoT because of its technical underpinnings—savvy executives clearly see it as fuel for business success. For example, almost three-quarters (74%) of the 741 executives in the industrial, commercial, health care, and public sectors in the global survey say IoT will become a competitive differentiator in their markets over the next two years. Underscoring the drive to capitalize on IoT, a similar number—70%—"strongly agree" that the need to adopt IoT technology will grow over the next two years.

Attitudes about IoT as a competitive differentiator show that C-suites and boards don't need convincing about its importance. However, they do need a game plan for transitioning their business models and current IT and operations environments into a comprehensive and effective strategy for reaping IoT's potential business benefits.

One major hurdle for leaders that the survey unearthed is that 90% of respondents can't accurately measure ROIs for some or any of their IoT projects. Without hard numbers, senior leaders may invest in the technology for now and hope returns will eventually materialize. "Many companies are making initial IoT investments because they see their competitors exploring this area," says Shiyu Zhou, director of the IoT Systems Research Center at the University of Wisconsin-Madison. "They also see IoT technology developing rapidly, and they fear that a delay of even a year or two will put them too far behind to catch up."

HIGHLIGHTS

74%
OF GLOBAL EXECUTIVES SAY IOT WILL BECOME A COMPETITIVE DIFFERENTIATOR WITHIN TWO YEARS

48%
OF SURVEY RESPONDENTS RANK ENHANCEMENTS TO CUSTOMER SERVICE AND SATISFACTION AS TOP IOT BUSINESS BENEFITS

45%
SAY THEY SEE THE POTENTIAL OF IOT BUT DON'T KNOW WHERE TO BEGIN TO ADOPT THE TECHNOLOGY

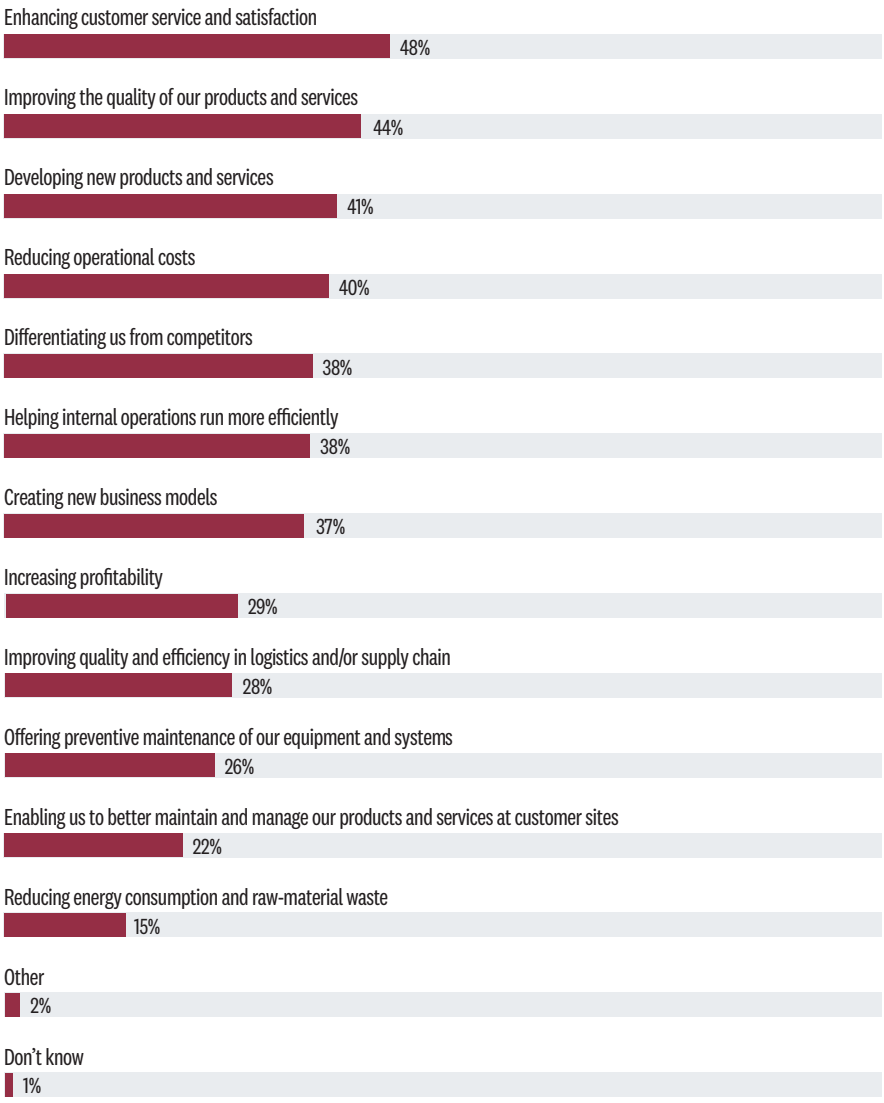
Global spending on IoT is on pace to reach **$745 billion this year**, a rise of more than 15% over 2018, according to International Data Corp.

FIGURE 1

BUSINESS BENEFITS FUEL IOT INTEREST

Executives rank the most significant business benefits they see or expect to see from IoT.

[MULTIPLE REPLIES PERMITTED]



SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

But over time, senior managers will need clear indicators of return of investment to justify the investment in IoT, Zhou says.

There are other issues, too, which, once addressed, will help companies reap greater rewards from IoT investments. For example, executives aren't sure how to move forward. Legacy infrastructure clouds development. Meanwhile, leaders in different industries and regions of the world face IoT challenges particular to those specific markets.

This report will detail IoT business opportunities, the demands that can derail project success, and the emerging best practices executives can choose when it comes to obtaining the right technology and expert partnerships for their enterprises.

Fueling the Move to IoT

The push to adopt IoT is accelerating in industries worldwide. Global spending is on pace to reach $745 billion this year, a rise of more than 15% over 2018, according to International Data Corp. (IDC). The market researcher forecasts worldwide IoT spending will continue to grow by double digits through 2022, when it will surpass $1 trillion.

"Many companies have been dabbling in IoT projects over the last few years, but now they're planning to expand their investments in the next 12 to 24 months," says Carrie MacGillivray, vice president, internet of things and mobility, at IDC.

The biggest spenders on IoT solutions in 2019 will be organizations in the discrete manufacturing ($119 billion), process manufacturing ($78 billion), transportation ($71 billion), and utilities ($61 billion) sectors,

she adds. Looking farther out, MacGillivray forecasts that health care will be among the industries seeing the fastest compound annual growth by 2022.

Underpinning the growing investments across industry sectors is a host of business goals that executives expect to achieve with IoT. Continuous data streams and real-time analytics, two hallmarks of modern IoT implementations, can give companies the steady flow of information needed to address customer-service and quality-control issues before they grow into larger problems. This prospect of gaining more information helps explain why the most respondents (48%) in the survey chose enhancements to customer service and satisfaction as a top business benefit. FIGURE 1
In addition, 44% of the executives ranked improvements in the quality of products and services as important benefits.

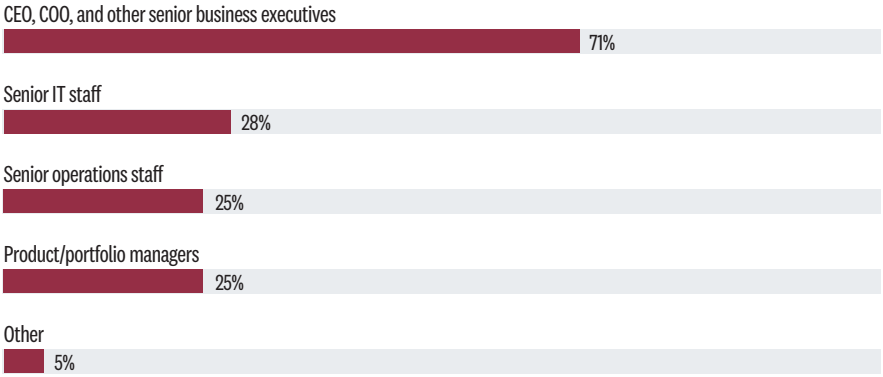
Executives are also using IoT to reduce downtime in business operations. The software company VMware installed sensors and building-systems monitors on each floor of its far-flung facilities. The technology gathers information to quickly identify problems in IT networks or in heating and cooling systems. "We were able to isolate floors where downtime problems occurred most often and then retrofit those areas accordingly," says Bask Iyer, chief information officer for VMware and general manager of IoT and edge computing for its parent, Dell Technologies. "We also made these IoT systems standard components in all new buildings. I haven't received downtime complaints in a very long time."

IoT also creates comfortable and productive high-tech working environments that VMware uses to attract and retain top Silicon Valley talent. Sensor-backed amenities include security systems that authenticate employees via their smartphones so they don't need to flash badges to enter buildings. In addition, IoT applications save time and reduce frustration by locating available parking spaces and conference rooms.

FIGURE 2

SENIOR BUSINESS EXECUTIVES DRIVE IOT INITIATIVES

The people responsible for making IoT decisions [MULTIPLE REPLIES PERMITTED]



SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

The business focus of IoT initiatives is also reflected in who drives these projects within enterprises. Seventy-one percent of respondents say CEOs, COOs, and other senior business executives are responsible for making IoT decisions. FIGURE 2

Ongoing Challenges Threaten IoT Initiatives

While executives see a clear link between IoT deployments and business benefits, they're less clear about the best ways to move forward. When asked to name the biggest challenges these projects face, executives are most concerned about a mix of technological and cultural issues. Ranking highest are concerns about how to modernize their existing operations to accommodate new hardware and software for IoT. FIGURE 3

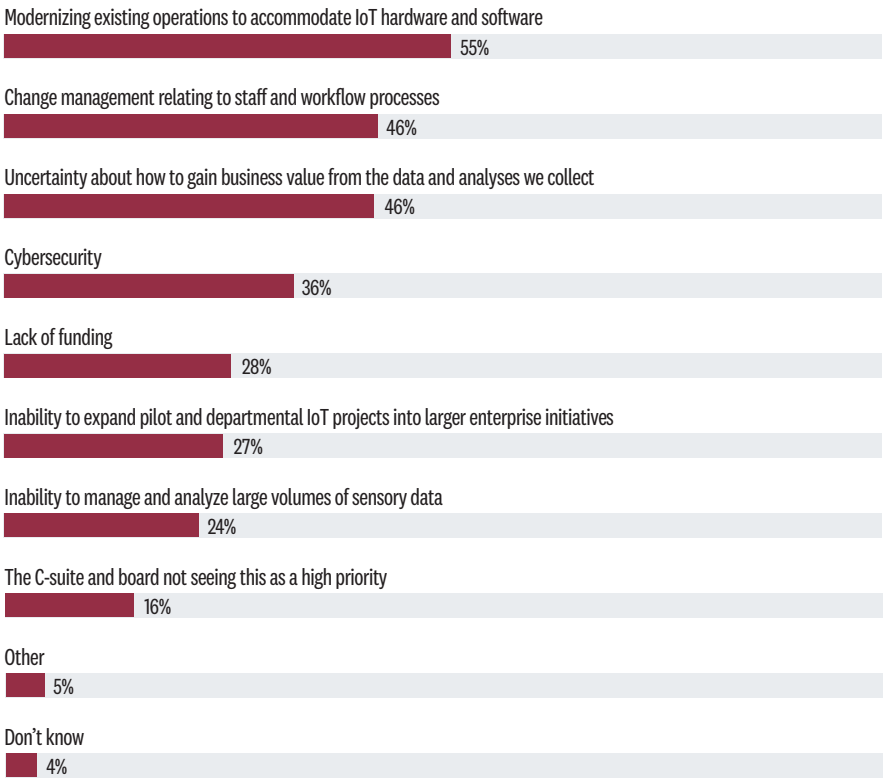
Technology problems aren't the only concerns keeping executives up at night. Nearly half (46%) worry about navigating change-management challenges related to staffing and workflow processes. The same percentage is uncertain how to gain business value from the data and analyses they collect.

FIGURE 3

LEGACY INFRASTRUCTURE AND OTHER FACTORS STYMIE IOT PROJECTS

The biggest challenges organizations face when launching or expanding IoT

[MULTIPLE REPLIES PERMITTED]

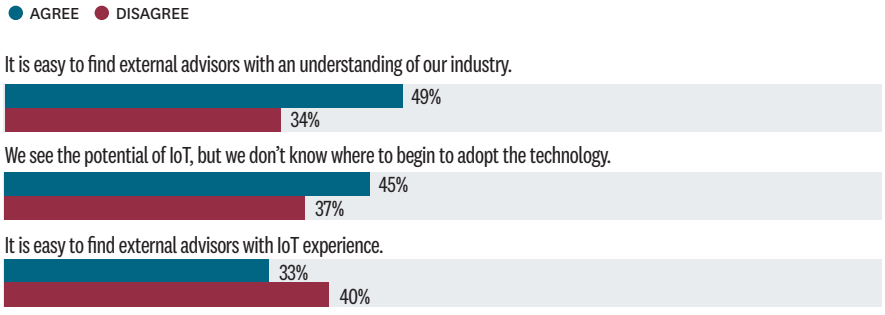


SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

FIGURE 4

EXECUTIVES AREN'T SURE HOW TO MOVE FORWARD

Percentage of respondents agreeing or disagreeing with the following statements



SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

Nearly half of the respondents (45%) say they see the potential of IoT, but they don't know where to begin to adopt the technology. Looking across the entire sample, 40% of the executives pinpoint the adoption problem as difficulties in finding external advisors with IoT experience. A third (34%) of the executives say they struggle to find external advisors with an understanding of their industry. FIGURE 4

It's significant that one challenge often seen with large-scale enterprise initiatives—lack of buy-in by the C-suite and board—ranks low among IoT problems. In fact, only 16% of the respondents say the C-suite and board don't consider IoT a high priority. That level of commitment appears to mitigate funding problems that often arise with new initiatives. Only 28% of companies say they lack adequate financial resources for IoT projects, indicating that more than two-thirds of the rest have the money they need if they can present a viable IoT business case. Clearly, senior leaders don't need to be convinced of IoT's business potential.

Five Building Blocks Create a Solid IoT Foundation

The survey identified important differences in IoT maturity among the participating enterprises. More than half (57%) of the organizations are still planning or piloting IoT projects. They have an opportunity to learn from the experiences of a smaller, elite group (30%) of enterprises that are already using the technology in core operations. The remaining executives say they currently don't see a need for IoT in their companies.

Insights gained from the responses of these leaders, along with input from industry analysts, offer guidance for launching and expanding IoT initiatives that can help executives gain an edge against business competitors. Five factors contribute to the success of these projects.

1. Develop a cross-disciplinary team with expertise from throughout the enterprise. While the survey data

show that senior business executives are driving IoT decisions, stakeholders from across the organization must participate in scoping out and implementing the plans. This includes line of business executives, who can ensure that investments closely align with business goals, and IT staff, who can detail what technology will be required to successfully collect, network, and secure data. Operations managers are essential for expertise about the role of IoT to improve core systems outside IT's purview.

Bringing all three groups together will also help organizations reduce the friction that may arise between IT and operations personnel during IoT implementations. "These two groups have different motivations and don't always speak the same language," IDC's MacGillivray says. "As organizations go down the IoT path, IT stakeholders have to be there to balance out the hiccups that might arise during deployments relating to networking, computing, storage, and security."

VMware's Iyer has a unique perspective on this area; he's a CIO who started his career as an operational-technology (OT) engineer, so he understands the concerns of each group. Operations managers sometimes see the IT staff's focus on standards and policies as a hindrance to IoT rollouts. On the other hand, operations managers often don't know how to achieve enterprise-class cybersecurity for IoT devices. "My bet is that many in operations routinely use the default passwords that come with IoT equipment," he says.

In addition, no one in OT may be assigned to the ongoing administration of the IoT technology after it's implemented, he says. CIOs can help bridge this gap by offering to act as an advisor to the operations department.

2. Formulate a detailed plan for data management. Organizations need to establish common formats to efficiently aggregate and analyze the large volumes of data they're collecting from sensors throughout the enterprise and perhaps from customer locations. In addition, the team that's guiding IoT projects should create

Executives in all regions name **modernizing existing operations** to accommodate IoT as the biggest roadblock.

IOT TRENDS DIFFER BY REGION AND INDUSTRY SECTOR

Across North America, Europe, Asia, and the rest of the world, business leaders overwhelmingly agree the need for adopting IoT technologies will grow over the next two years. But the survey found regional variations in what executives hope to gain from their IoT projects. For example, respondents around the world place the highest potential value of IoT on increasing customer service and satisfaction. However, close runners-up among Asian executives are improving the quality of products and services, along with reducing operational costs. Executives in Europe and North America highly rank IoT's potential for developing new products and services.

Global executives will face a common challenge when it comes to adopting IoT. Executives in all regions name "modernizing existing operations" to accommodate IoT as the biggest roadblock. But secondary challenges vary by geographical area. The second-biggest worry among North American and Asian respondents is uncertainty about how to gain business value from the data and analyses they collect. In Europe, a significant concern is change management relating to staff and workflow processes.

It's clear that wherever in the world they're located, executives will be working hard to overcome their biggest roadblocks. Seven out of 10 executives in North America and Europe say having a successful IoT strategy will become a competitive differentiator in their industry within two years. In Asia, the competitive pressure will be even greater—82% see IoT as the key to gaining an edge over market peers.

While there's widespread agreement about the need for IoT across all major industrial sectors, executives in different industries will be prioritizing business benefits differently. Two-thirds of those in telecom are looking for IoT to enable new products and services, a far higher percentage than in automobile/transportation (28%) and energy/utilities (32%) sectors. The top benefit for respondents in those groups is the opportunity to reduce operational costs. By a wide margin over those in other industries, executives in health care/pharma hope IoT can enhance customer service and satisfaction.

When outlining technology investment plans, executives across the board say they'll continue to acquire data-collection sensors and analytics. In addition, applications for preventive and predictive maintenance will become top spending priorities for those in automotive, energy, and construction/manufacturing. Senior managers in technology and telecom plan to be the most aggressive adopters of cloud services designed for IoT applications.

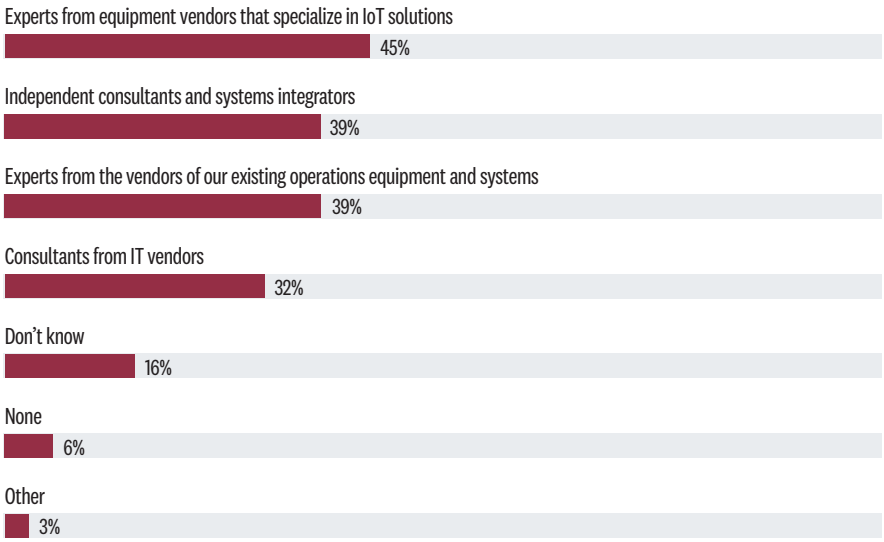
As companies move forward with IoT projects, executives in certain industries may be forced to accelerate their adoption plans faster than others. For example, 87% of senior managers in both the automotive/transportation and telecommunications sectors say having a successful IoT strategy will become a competitive differentiator for their industries within two years. By comparison, 69% and 71% in energy/utilities and health care/pharmaceuticals, respectively, see the same competitive imperative. About three-quarters of those in construction/manufacturing and technology see the growing need to compete using IoT.

When choosing potential partners, IoT teams should evaluate a vendor's willingness to **engage in long-term relationships** versus just helping launch initial implementations.

FIGURE 5

CHOOSE PARTNERS CAREFULLY

Where executives will be looking for help with IoT strategies [MULTIPLE REPLIES PERMITTED]



SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

policies for securing and storing the raw information and analytic results.

3. Address gaps in internal IoT expertise. As noted earlier, companies that commit to IoT often struggle with knowing how to move forward with their plans. Many will look to vendors of IoT hardware and software that have expertise and services staffs to act as advisors play an advisory role in future projects. Forty-five percent of the respondents say they'll rely on partnerships with IoT vendors when looking outside their own companies for guidance. To plug any remaining gaps in third-party expertise, four in 10 executives will turn to consultants and systems integrators as well as vendors of operations equipment and systems. FIGURE 5

When choosing potential partners, IoT teams should evaluate a vendor's willingness to engage in long-term engagements versus just helping launch initial implementations. Long-term commitments hinge on a vendor's knowledge of the client's industrial sector and on the ability to co-create IoT solutions that evolve over time. "IoT is a living, breathing thing," MacGillivray points out. "In the vast majority of cases, these projects scale quickly, and it is best to have a vendor that is going to be there for the journey from the initial rollout to a mass deployment."

4. Define metrics for quantifying the ROI of IoT. Quantifying the return on IoT investments remains a struggle for most organizations. Only a relative handful of respondents—10%—say they can accurately measure ROI for most or all IoT initiatives. The rest can't accurately measure ROI for some or any of their projects.

There is good news regarding ROI; within the elite group that can accurately measure returns, 40% are seeing paybacks relatively quickly—in the 13-to24-month range. Nineteen percent report even faster results in a year or less. Only 16% say returns are taking more than two years. FIGURE 6

Zhou, at the IoT Systems Research Center, says companies can better understand the ROI potential by launching small pilot projects in areas where cost savings or other business benefits can be easily demonstrated. One example is monitoring the reliability of a component in a product line to avoid downtime. Insights from pilots can also help companies identify product development opportunities within their markets, which may further contribute to investment returns.

5. Develop a plan for incorporating emerging technologies into IoT roadmaps. Two of the pillars of any IoT initiative are analytics for processing large volumes of information and sensors for data collection. So, it's not surprising that the highest responses when it comes to future technology investments are the 53% of executives who say they'll earmark new spending for analytics and the 50% of respondents who will invest in data-collection sensors. FIGURE 7

Moving forward, IoT teams should identify technologies best suited to promote their evolving business models. For many global executives, that means cloud. Nearly half (45%) plan to invest in cloud services designed for IoT, which can quickly give their organizations the latest tools for gaining insights from their data-collection efforts. Over time, cloud options will continue to evolve. "Today, we often see data being collected locally and sent to the cloud for storage and analysis," Zhou explains. "But in the long run, more cloud systems will go beyond data collection to automatically control the machines they're connected to."

Respondents who have already moved IoT to production systems are especially enthusiastic about cloud options. Fifty-five percent of executives in this group rank cloud services among their top investment area. In addition, 63% of these firms will target spending for analytics, a sharp contrast to the 49% of those still planning implementations.

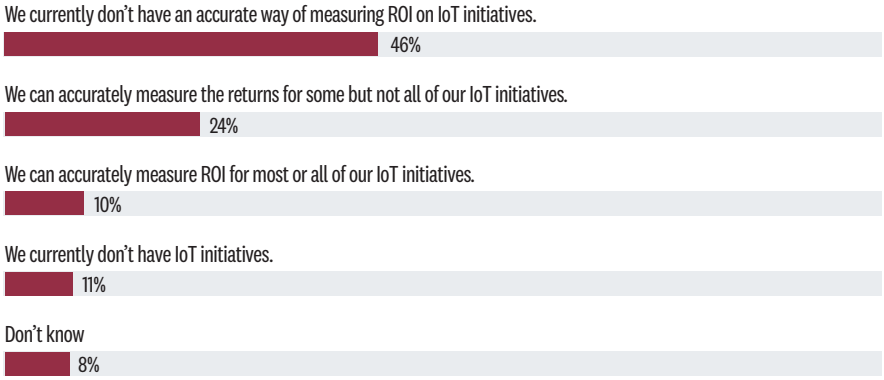
While more than a third (36%) of the overall sample name cybersecurity among the top concerns, almost half (44%) of companies with production IoT rank it as an area that deserves close attention. The takeaway is that planners should capitalize on the opportunity to bake in security while projects are still being developed.

Also high on the investment wish list for the entire sample are applications for preventive and predictive maintenance, presumably to bring greater efficiency to internal operations and those of their customers.

FIGURE 6

QUANTIFYING ROI REMAINS DIFFICULT

Organizations struggle with assessing the financial impact of IoT investments.



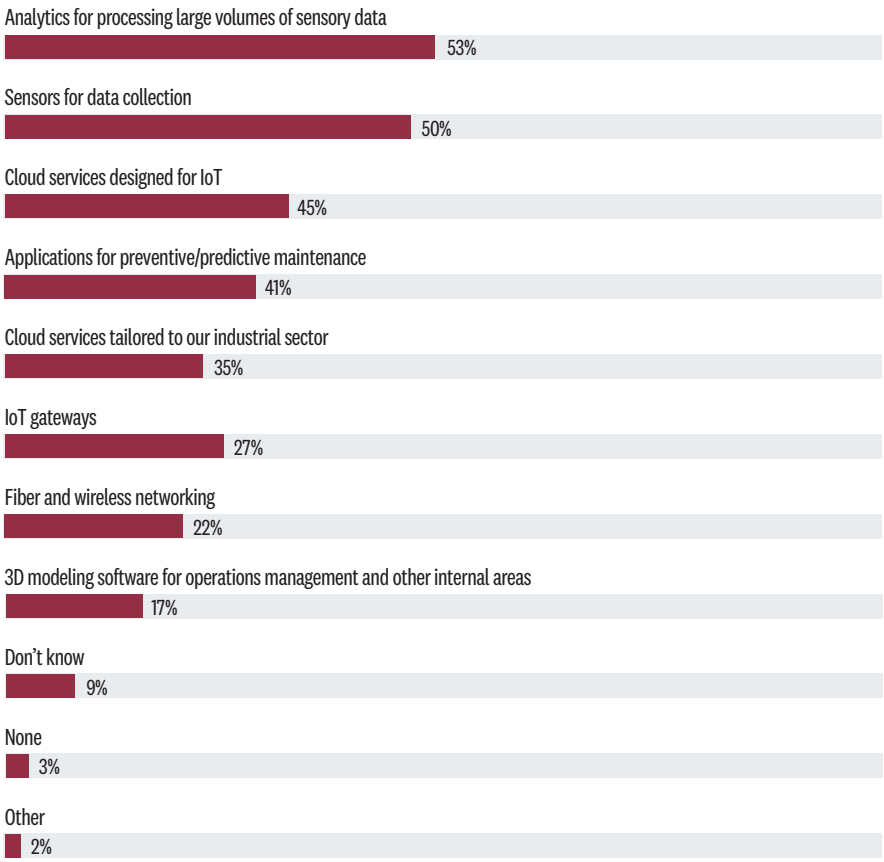
SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

FIGURE 7

BUSINESSES ARE EARMARKING FUNDS FOR IOT

The technologies that will attract the most IoT-related investments over the next two years

[MULTIPLE REPLIES PERMITTED]



SOURCE: HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, JANUARY 2019

As IoT **continues to evolve from leading-edge innovation to mainstream technology**, enterprise leaders around the globe understand its business potential.

A Data-Driven Future

As IoT continues to evolve from leading-edge innovation to mainstream technology, enterprise leaders around the globe understand its business potential. Annual spending will spike by double-digit rates through 2022, showing that executives are beyond wondering why they should adopt IoT and now are focusing on how best to do that. There's no definitive answer yet, but some success factors have emerged, including the need for cross-functional teams to guide projects and delineate data management requirements. Forming long-term partnerships with the right vendors and consultants while making careful investments in new technology will also improve the odds of success. But no matter how executives choose to move forward, one thing is clear: they see data and analytics as the fuel for business success in the years ahead.

METHODOLOGY AND PARTICIPANT PROFILE

A total of 741 respondents drawn from the HBR audience of readers (magazine/ enewsletter readers, customers, HBR.org users) completed the survey.

SIZE OF ORGANIZATION

33% FEWER THAN 500 EMPLOYEES

7% 500 – 999 EMPLOYEES

19% 1,000 – 4,999 EMPLOYEES

9% 5,000 – 9,999 EMPLOYEES

33% 10,000 OR MORE EMPLOYEES

SENIORITY

19% MANAGER/ SUPERVISOR

18% SENIOR MANAGER/ DEPARTMENT HEAD

13% DIRECTOR

8% CEO/PRESIDENT/ CHAIR

8% EXECUTIVE MANAGER (EVP, SVP, GM, MANAGING DIRECTOR, ADMINISTRATOR)

6% OTHER C-LEVEL (CFO, COO, ETC.)

6% OWNER/PARTNER

6% VICE PRESIDENT

16% OTHER TITLE

KEY INDUSTRY SECTORS

21% MANUFACTURING

20% TECHNOLOGY

13% CONSULTING SERVICES

11% HEALTH CARE

7% TELECOM

6% ENERGY/ UTILITIES

6% EDUCATION

6% PHARMACEUTICAL/ LIFE SCIENCES

REGIONS

46% NORTH AMERICA

27% EUROPE

15% ASIA PACIFIC

6% LATIN AMERICA

5% MIDDLE EAST AND AFRICA

Figures may not add up to 100% due to rounding.

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