

# The Internet of Things

Exploring How Real-Time Data and Analytics  
Enable Operational Intelligence

WHITE  
PAPER





# A Note About This Research

January 2017

Ventana Research performed this research to determine attitudes toward and utilization of the Internet of Things (IoT) and technologies such as operational intelligence that enable it to be optimized and managed. This document is based on our research and analysis of information provided by organizations that we deemed qualified to participate in this benchmark research.

This research was designed to investigate IoT and its supporting systems and associated practices, needs and potential benefits. It is not intended for use outside of this context and does not imply that organizations are guaranteed success by relying on these results to improve such systems. Moreover, gaining the most benefit from an IoT investment requires an assessment of your organization's unique needs to identify gaps and priorities for improvement.

The full report with detailed analysis is available for purchase. We can provide detailed insights on this benchmark research and advice on its relevance through the Ventana On-Demand research and advisory service. Assessment Services based on this benchmark research also are available.

We certify that Ventana Research wrote and edited this report independently, that the analysis contained herein is a faithful representation of our evaluation based on our experience with and knowledge of the Internet of Things and operational intelligence, and that the analysis and conclusions are entirely our own.

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## Executive Summary

The Internet of Things (IoT) is a technology that extends digital connectivity to devices and sensors in homes, businesses, vehicles and potentially almost anywhere. This advance enables virtually any device to transmit its data, to which analytics can then be applied to facilitate monitoring and a range of operational functions. IoT can deliver value in several ways. It can provide organizations with more complete data about their operations, which helps them improve efficiencies and so reduce costs. It also can deliver a competitive advantage by enabling them to reduce the elapsed time between an event occurring and operational responses, actions taken or decisions made in response to it.

IoT utilizes what Ventana Research calls operational intelligence, a discipline that has evolved from the capture and analysis of data from instrumentation and machine-to-machine interactions of many types. We define operational intelligence as a set of event-centered information and analysis processes operating across an organization that deliver information to enable effective actions and optimal decisions.

The evolution of operational intelligence and its manifestation in IoT is encouraging companies to revisit their priorities and spending for information and other digital technologies. Ventana Research



Majorities of organizations said it is very important to speed the flow of information in their processes and to customers.

undertook this benchmark research to determine the attitudes, requirements and future plans of those who use IoT and operational intelligence systems and to identify their best practices. We set out to examine both the commonalities and the qualities specific to major industry sectors and across sizes of organizations. We considered how organizations manage IoT, issues they encounter in the process and how their use of it and related technology is evolving.

While the Internet of Things may still be an unfamiliar novelty to many consumers, organizations participating in our research are well aware of its applications and implications. Four out of

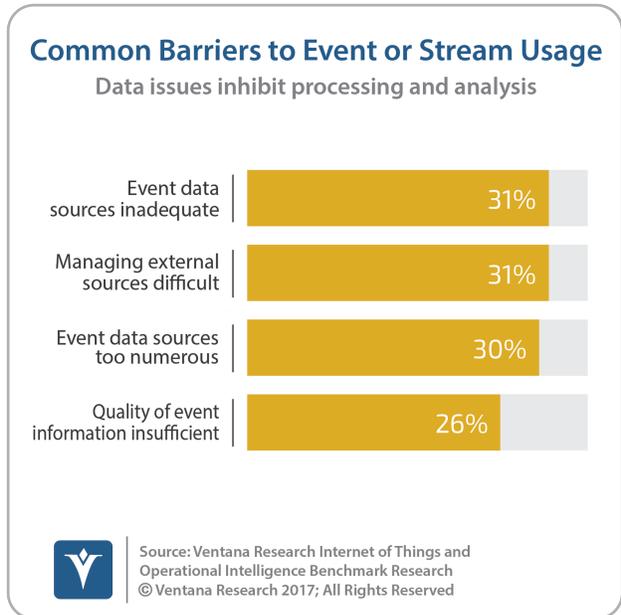
five (81%) said IoT is important to their future operations. Majorities said the use of IoT is very important to speed the flow of information and improve the responsiveness of individuals within their business processes (61%) and to speed the flow of information to customers or consumers (58%).

The most common uses of IoT are associated with customers (as in sensors on products, by 43%), employees (in wearable technology, 35%) and sensors on devices in the supply chain (31%). At this point, however, more organizations are able to capture IT events (such as a network or system security breach, 59%) than



business events (such as a customer contact, 45%). As organizations find more business uses, IoT and operational intelligence will become even more mainstream, and the research indicates that this will occur. Within two years, 95 percent of organizations said they expect to be capturing IT events and 92 percent to be capturing business events.

The research also finds that the intentions of organizations to embrace IoT and use operational intelligence often outpace their current capabilities. For example,



many can capture data but face challenges in using it. More than two-thirds (68%) said they are satisfied or somewhat satisfied with their organization's ability to capture and correlate data from events. After that, managing and using it becomes more complicated. Nearly one-third (31% each) reported difficulties with inadequate data or in managing external data. About half (48%) said they spend the most time reviewing event data for quality and consistency issues, which suggests a lack of standardization across the data sources that are collected.

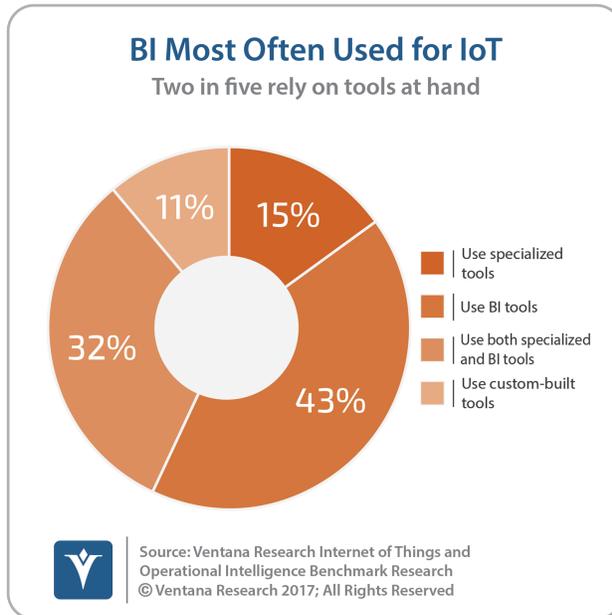
Furthermore, most organizations are not ready to derive maximum value from

IoT. The processes most commonly implemented, each by approximately half of organizations, are performing root-cause analysis, defining measurements and metrics, and monitoring and correlating activities or events. While these processes are necessary, they are only the first step in improving performance. Fewer have advanced to the point of automating processes, which will be necessary to make full use of the coming deluge of IoT data. For example, only about two in five use data from events to trigger automated processes such as predictive maintenance (38%) or automatically assigning thresholds for alerts (39%).

Deriving full value also will require providing event information and analysis to operational functions in real time or near real time. Currently the largest percentages of organizations use message-oriented middleware or message queue technology (36%) and enterprise service bus technology (33%) for this purpose and usage of these techniques will continue to grow, but within two years more than three-quarters said they expect to be able to perform real-time analytics within processes (78%), making it the most common technique for providing low-latency information. In addition, approximately two-thirds expect to have expanded their existing enterprise data warehouse and BI systems using in-memory technology (67%) or implemented specific operational intelligence tools for IoT activity monitoring (64%). In all these areas we find evidence of accelerating use.



The research also finds a split between established and new technologies currently in use for IOT efforts. Nearly three times more organizations (43%) use their existing business intelligence (BI) tools rather than specialized IoT tools (15%); however, one-third (32%) use both. Just 11 percent use custom tools developed in-house, and those organizations least often said they are satisfied with their tools. In contrast, three out of four that have purchased specialized tools expressed satisfaction with them, as did two-thirds of BI users. Those that don't use BI said most frequently that they don't because the tools are not integrated with operational intelligence for IoT data (43%) and not flexible enough (37%).



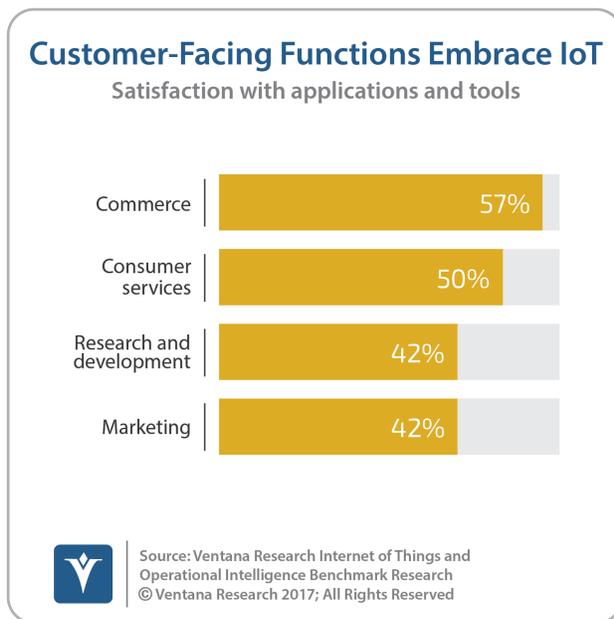
Likewise the technologies most commonly used to store sensor data are conventional systems: data warehouses and data marts (by 30%) and relational databases (22%). Yet participants were more likely to report being satisfied or somewhat satisfied with their ability to capture and correlate events when they use advanced tools: NoSQL databases (used by only 13%), Amazon S3 (20%) and Hadoop (also 20%). As IoT implementations proliferate, we expect to see movement toward tools designed to support them.

As noted, organizations told us that wearable devices for their employees are one of the most widespread types of IoT technology deployed in the business. Almost two-thirds (63%) said that smart watches are useful to their organization, more than half (54%) said fitness monitors are useful, and almost half (47%) said wearable environmental sensors are useful. More than half (53%) of all participants reported that wearable computing is important or very important to their organization's future, which we view as another sign of likely momentum for IoT and operational intelligence.

Despite the interest in wearables, the current emphasis is more on internal systems, which is understandable since there are many technological and mechanical devices that support an organization's processes. Regarding the importance assigned to sources of information, IT systems management alerts and events are most often cited as important (by 48% of participants), followed by applications (including CRM, ERP or OLTP, cited by 45%). The emphasis can be explained by the central role of IT executives and managers (67%), who most often define which events are captured and analyzed; 88 percent of participants who have IT titles said that it is important or very important to their jobs to monitor and analyze events.



The top four capabilities for IoT or event processing and analysis that organizations are implementing also reflect an IT focus, such as dealing with network or system outages (53%) or cyber attacks (48%). On the other hand, the goals of IoT deployments that this research identified as most important to organizations have business implications as well as IT ones: detecting fraud or security problems (60%), identifying opportunities for improvement (56%) and complying with regulations (53%). With the anticipated increase in capturing of business events noted above, attention to capabilities such as enabling the organization to improve responsiveness (currently ranked fifth at 40%) may also rise.



Further evidence of this impending shift to a business focus is that the users most often working with IoT technology, aside from the business intelligence and analytics team (where 48% use it), are in operations and customer service (each 35%); about one-fifth in sales (22%) and marketing (20%) use it. At least half of users in commerce activities and in customer service said that they and their colleagues are to some extent satisfied with their current applications and tools for IoT and operational intelligence processes; they are the most enthusiastic in this regard.

Thus this research finds indicators that businesses and their IT departments should plan for deployments that serve functions outside of IT itself. However, we caution that as they do this, they should be aware that functions within the business will face different challenges, which this research illuminates. For instance, manufacturing users most often said they face difficulty with incomplete or inadequate event data. Human capital management users most often have difficulty managing external event data. Commerce and customer service most often have issues with the quality of event data. Flexibility will be a key to tailoring IoT and operational intelligence to specific needs and solving particular problems.

One newer technology that could enhance flexibility is cloud computing, which has arrived in time to help organizations initiate new implementations in ways that do not add to the burden on their in-house IT resources. Despite what may be a lingering desire in IT groups to keep control of systems, nearly as many research participants said they prefer to purchase and deploy operational intelligence and IoT capabilities on demand through software as a service (23%) or hosted by the supplier (12%) as would rather have them on premises (41%). Another 24 percent expressed no preference and thus might be open to cloud deployment. In



addition 19 percent now deploy operational intelligence for IoT using public cloud approaches, 19 percent more will do so within a year, and a further 25 percent plan to do that within two years. Among current cloud users, more than half (53%) said they are satisfied with it.

This research overall finds strong momentum behind the emergence of the Internet of Things and operational intelligence, but it also is clear that a good many organizations have not caught up to the trend. Asked to cite the most significant barriers in establishing a business case for deploying such applications, four of the five barriers cited by 30 percent or more of participants reflect a low level of understanding or interest: lack of resources, lack of awareness, lack of experience and a weak business case. (However, the most cited, by 36%, is technical: that it is hard to integrate with existing tools or applications.) We conclude that proponents of such systems, including advocates within potential adopting organizations, should make efforts to educate this audience. IoT is here, and its impact on business will only increase ; almost all companies can benefit from paying attention to it.



## Key Insights

This benchmark research yielded the following important general findings and key insights regarding the Internet of Things (IoT) and operational intelligence as well as identifying trends based on our previous research on operational intelligence. (We discuss performance levels in the Performance Index portion of the full research report; the actual questions asked in our survey are in an appendix to the research report. Specifics of organization sizes are in the appendix “About This Benchmark Research.”)

### Performance varies widely in organizations’ use of IoT.

Our Performance Index analysis finds organizations’ performance evenly distributed across the four levels of our performance hierarchy, with no more than a 5 percent difference between any two levels. Our analysis places nearly one in four (24%) at the highest Innovative level of performance, meaning they are able to use IoT tools to innovate and compete effectively against others that use this technology less well. Overall, organizations’ ability to use operational intelligence, the technology underlying IoT, has not improved significantly over the last four years; comparison with our previous research shows slightly fewer organizations (2%) at each of the middle two levels of performance and slightly more (3%) at the Innovative level. This finding suggests that many organizations still need to improve their use of operational intelligence. It’s worth noting, though, that how well they perform is not an indication of interest in IoT: 93 percent of participants said that IoT is important to their organization’s future efforts.



Three often cited barriers to building a business case for IoT processes are lack of resources, lack of awareness and lack of experience.

Analysis of the four dimensions into which we segment business performance (People, Process, Information, Technology) finds one striking difference in performance: Two out of three organizations (65%) rank at the lowest Tactical level in the People dimension, which indicates a lack of familiarity with and understanding of IoT. Reinforcing this analysis is the finding that three of the four most-often cited barriers to building a business case for IoT processes are lack of resources (35%), lack of awareness (31%) and lack of experience (30%). The analysis finds organizations performing best in the Information and Technology dimensions, where more than one-quarter (28%

and 27% respectively) reach the top Innovative level. This is a pattern we often see in the case of new technologies.



## Organizations are not automating many of their IoT efforts.

The Internet of Things has become a factor in organizations' technology systems and planning. More than nine in 10 (93%) of those participating in the research reported that IoT is important to their future operations. Progress varies in using it, however. More than two-thirds (70%) said they are satisfied or somewhat satisfied with their ability to capture and correlate data on events and event patterns to support analytics and business processes. Somewhat fewer (62%) said they are satisfied or somewhat satisfied with their current IoT applications and tools. Not surprisingly, those who are already capturing event data are more satisfied than those who are not. However, merely capturing events is not sufficient. Organizations then must apply operational intelligence to that data to add value to their business processes.

Furthermore, most organizations have not put themselves in position to derive maximum value from IoT. The IoT-related processes most



Automation, user-friendly interfaces and self-service are important concerns for IoT end users.

commonly implemented, each by approximately half of organizations, are performing root-cause analysis (55%), defining measurements and metrics (51%) and monitoring and correlating activities or events (50%). Fewer have advanced to the point of automating processes, which will be necessary for them to make full use of the coming deluge of IoT data. For example, only about two in five (38%) are linking data about events to automated outcomes such as predictive maintenance. A similar proportion (39%) assign thresholds for alerts automatically.

Some other aspects of IoT use also are less than fully embraced. One-third of participants each reported difficulty in deploying an easy-to-use interface and in analyzing events from multiple sources, and 29 percent cited the inability of users to perform their own analyses as a source of dissatisfaction. Automation, user-friendly interfaces and self-service are important concerns for end users; without them, organizations will find limited success with their IoT efforts.

## IoT is implemented most often using established tools.

When it comes to IoT implementations, organizations typically use their business intelligence (BI) and data warehouse platforms. In some cases this works well, but in others it is a hindrance. The research shows that the largest percentage (43%) uses business intelligence tools rather than specialized IoT tools. The research indicates that using BI tools is a reasonable approach, with those organizations reporting levels of satisfaction about their ability to capture and correlate IoT events similar to those using specialized tools other than BI. However, those using specialized tools reported somewhat greater satisfaction than those using business intelligence tools: 74 percent said they are satisfied or somewhat satisfied, compared with 67 percent of BI users. But both groups reported satisfaction at



levels far higher than those reported by organizations that have developed their own custom applications and tools: Fewer than one-third (31%) of them said they are satisfied or somewhat satisfied. We conclude that while custom-coded IoT systems are least likely to produce the desired outcomes, organizations can achieve benefits from using the BI tools with which they are familiar.

The technology used to store data also impacts the outcomes of IoT implementations. However, organizations did not express strong opinions about which technologies produce the best results. Sensor data is stored most often in data warehouses and data marts (30%), followed by relational databases (22%), Amazon S3 and Hadoop (20% each). Organizations using NoSQL databases (only 13% of all participants) and Amazon S3 most often reported that they are satisfied or somewhat satisfied with their tools (91% and 76%, respectively). The users of NoSQL databases also most often reported satisfaction with their ability to capture and correlate events: Nine in 10 said they are satisfied or somewhat satisfied. Four out of five users of Apache Hadoop or Amazon S3 are satisfied or somewhat satisfied. In this case, reliance on familiar technologies seems to be limiting success. Adopting new data storage technologies does not eliminate all difficulty, especially with inadequate or incomplete sources of event data, but the research indicates that they should be considered.

### **Wearables and disconnected devices are important considerations.**

The Internet of Things encompasses a variety of devices, some of which are not always connected to the internet and others that are not “devices” in the usual sense. The balance between humans and machines is an important consideration in IoT deployments. This research shows widespread adoption of wearable devices; almost two-thirds (63%) of organizations said that smart watches are useful to



53% reported that wearable computing is important or very important to their organization's future.

their organization, more than half (54%) said fitness monitors are useful, and almost half (47%) said wearable environmental sensors are useful. More than half (53%) of all participants reported that wearable computing is important or very important to their organization's future, and another three in 10 (29%) said it is somewhat important. Organizations appear to recognize that people also are very important in the so-called internet of “things.”

In exploring how organizations handle disconnected sensors, the research finds that one-quarter have developed methods to deal with them;

another 13 percent plan to do this, and 22 percent said they are investigating doing so. Those that can process disconnected data are satisfied with their IoT applications and tools more often: 85% said they are satisfied or somewhat satisfied. Conversely, those that have no plans to deal with disconnected sensor



data most often reported dissatisfaction: One-third said they are not satisfied with their IoT applications and tools.

### **Organizations can capture data but face challenges in using it.**

While most organizations know how to capture data, they face other challenges in their IoT efforts. More than two-thirds (68%) said they are satisfied or somewhat satisfied with their organization's ability to capture and correlate events. Only 15

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More than two-thirds said they are satisfied or somewhat satisfied with their ability to capture and correlate events.

percent reported that event streams or messages are too large and fast to process. More than half (56%) are processing more than 10 data sources. Those processing 11 to 20 data sources reported the highest rates of satisfaction while those processing 10 or fewer reported the highest rates of dissatisfaction. These figures suggest organizations perceive that they are managing well enough the volumes, velocity and number of data sources involved in IoT applications.

However, the research finds that organizations face many issues when it comes to using the data collected and correlated. Nearly half (48%) said that of all the steps involved they spend the most time reviewing event data for quality and consistency issues. Nearly one-third (31% each) reported difficulties with incomplete or inadequate data or in managing external data. In this regard we note that many of the same issues that impact BI implementations appear to affect IoT implementations.

Another difficulty arises as the number of data sources increases. Half (51%) of those processing 11 to 20 data sources have difficulty managing external data, which the research shows is a common occurrence in IoT implementations. Organizations also face technology challenges in addition to data challenges. More than one-third (36%) said it is difficult to integrate IoT tools and applications with existing tools and applications. Many new technology efforts start as isolated implementations that are integrated only later into the organization's IT infrastructure.

### **Messaging infrastructure provides adequate latency.**

A common theme the research uncovers is the importance of speeding the flow of information throughout the organization and improving responsiveness in business processes. More than nine in 10 organizations identified these issues as important (32%) or very important (61%). A similar number said it is important (36%) or very important (58%) to speed the flow of information to customers or consumers. Yet it appears that such speed – that is, the interval between when an event occurs and when users or automated processes can determine how to respond – is relative. Only one in eight (13%) organizations said they consider it essential to



process with very low latency (milliseconds) or in real time, and 29 percent said that about near real time (seconds). The business functions in which low latency is most critical are technological: security or network management and IT service or systems management. These findings suggest that at least for the time being finding adequate technologies to speed up the flow of information will not be a major concern for organizations considering IoT deployments.

Organizations are using a variety of approaches to provide event information and analysis in real time. The most common tools that organizations use now or soon



Because it is mature, messaging technology could gain new life from rising interest in IoT.

will use to provide event information and analysis in real time or near real time are message-oriented middleware or message queue technology (36%) and enterprise service bus technology (33%). Because it is mature, messaging technology could gain new life from the rising interest in IoT. In the next 12 months nearly half (49%) of participants said their organization will implement or investigate messaging technology for event processing. In this context it is worth noting the success of dedicated hardware to implement messaging. Of organizations using dedicated hardware to

support their messaging technology, nearly all (96%) are satisfied or somewhat satisfied with it. In the same way that established BI technologies are aiding organizations' IoT efforts, being able to apply messaging to IoT may also enable organizations to implement initiatives more readily.

### **IT typically leads IoT activity.**

The research shows that IT departments drive much of the IoT activity in organizations. In two-thirds (67%) of organizations IT executives and managers most often define which events are captured and analyzed, followed by senior corporate executives (49%) and line-of-business executives (44%). Given the essentially technological and often mechanical nature of this discipline, this finding is not surprising. As a group, these executives said more often than management or users that it is important or very important to their job to monitor and analyze events (63% vs. 44% overall). IT systems management alerts and events are most often cited as an important source of information (by 48% of participants), followed by applications (including CRM, ERP or OLTP, cited by 45%).

Organizations, in most cases led by IT, do not rate themselves highly when it comes to defining events: Only 11 percent said the organization is excellent at identifying significant events or event trends. One reason for this may be that satisfaction is highest among participants who said customers or partners are defining events to monitor and analyze. However, there are likely to be challenges when customers and partners define events. Since they are external to the organization, there may be difficulty in managing those external data sources and



incomplete or inadequate event data in them. Nevertheless, despite the challenges, participating organizations indicated that having customers and partners involved adds value to the process.

### **IoT deployments benefit both business and IT.**

Of course, investments by businesses in technology ultimately must produce direct benefits. Participants in this research reported both business and IT benefits associated with their IoT deployments. The most frequently cited are detecting fraud or security problems (by 60%), identifying opportunities for improvement (56%) and complying with regulations (53%). While the four largest benefit percentages are for implementations focused on IT capabilities, others cited by about two in five are enabling improved responsiveness (40%) and improving business service management (38%).

With this application focus and the heavy involvement of IT noted above, it comes as no surprise that today organizations capture more IT events than business



Organizations today capture more IT events than business events, but indications are that this will even out.

events (59% vs. 45%), but indications are that this will even out in new implementations during the next two years. By then 95 percent of organizations said they expect to be capturing IT events and 92 percent to be capturing business events. Capturing business events eventually will be necessary to justify investment. Even though more IT events are captured today, organizations that capture business events are more often satisfied with their IoT processes than those that are capturing IT events. In addition, four out of five (81%) said that it is important or very important to relate business events to IT events. Those planning for and deploying IoT systems ought to take account of this emphasis as they design their implementations.

### **IoT has an important role in customer-related activities.**

By design many IoT devices will exist outside the four walls of an organization. This research investigated where those devices are being deployed and which have had the most success. The most common business use of IoT (reported by 43%) is customer-related, such as sensors on products. The second-most common (35%) is employee-related, for instance, wearable technology. Next most common are for supply chain (31%) and manufacturing (29%) processes. The users most often working with IoT technology outside of the business intelligence and analytics team (where 48% use it) are in operations and customer service (each 35%). Use by these customer-facing functions indicates that IoT has grown beyond internal processes.



Externally facing functions reported the highest levels of satisfaction with their IoT applications and tools. Among users in commerce activities, 57 percent said they are satisfied, and half of users in customer service said that. In contrast, 30 percent who use IoT in supply chain management and only 15 percent who use IoT in manufacturing are satisfied. As organizations deploy IoT in different functional areas they should be aware that they will face different challenges. Manufacturing users most often face difficulty with incomplete or inadequate event data. Human capital management users most often have difficulty managing external event data. The Utilities function, which concerns pipelines, grids and the like, most often has difficulty with the number of sources of event data. Commerce and customer service most often have issues with the quality of event data. IoT is not a one-size-fits-all technology, and challenges will vary by functional area.

### Cloud deployment is common for IoT.

Our research finds a correlation between cloud computing and IoT implementations. This is not surprising because IoT is a new technology for which few organizations have established on-premises presences. While the largest percentage (41%) of organizations said they prefer to purchase and deploy on-premises IoT capabilities, there are indications of increasing cloud adoption. More than one-third (36%) said they prefer access on demand or SaaS deployment for IoT, and about the same percentage (24%) expressed no preference (suggesting they might be open to cloud deployments). In general, 47 percent of participating organizations are using cloud computing tools today, and another 15 percent plan to do so within 12 months. Based on the data, cloud-based deployment is a viable



More than one-third (39%) of organizations are processing messages or events in the cloud today.

approach. More than nine in 10 (92%) said they are satisfied or somewhat satisfied with their cloud computing platform. In addition, organizations using cloud-based deployments have higher levels of satisfaction with their IoT applications and tools than those that do not use or have not yet implemented cloud-based deployments.

We also find cloud use common for processing messages or events. More than one-third (39%) are processing messages or events in the cloud today, and 31 percent more will implement cloud processing within the next 12 months. Among

those using cloud-based deployments, Amazon Web Services (60%) and Microsoft Azure (54%) are the most common platforms. Using cloud-based platforms for various elements of an IoT implementation can provide agility, and the research shows they are both popular and successful.



## 10 Best Practice Recommendations

This benchmark research reveals significant new insights into the evolving nature and use of Internet of Things (IoT) and operational intelligence processes and systems. For organizations considering how to optimize their use of these systems, we offer the following recommendations.

### **1. Educate your organization about the Internet of Things.**

Nearly all (93%) organizations participating in the research said that IoT is important to their future operations. Yet 30 percent or more cited a variety of barriers to establishing a business case for deploying such applications and tools, most of them related to a lack of understanding and preparation. Create a cross-functional team drawn from the lines of business as well as IT to assess and explain what these systems can do to benefit the business.

### **2. Make business events a central part of your IoT strategy.**

Organizations using IoT currently capture more IT events than business events (59% vs. 45%), but within two years 92 percent will be capturing business events (and 95% IT events). Most (81%) also said that it's important to relate the two types to each other. Commonly reported benefits include detecting fraud or security problems, identifying opportunities for improvement and IT improving business services. Make sure that the discussion of IoT focuses on how it can serve practical purposes such as these.

### **3. Automate your IoT efforts.**

IoT systems constantly generate large volumes of information. The only way to keep up with that flow and utilize it fully is to automate the processes that handle and respond to it. Yet few users are doing this automation today. As well as being able to monitor and correlate activities or events, include in your planning ways to link events to automated outcomes such as predictive maintenance and automatic alerts.

### **4. Improve your ability to define which events to monitor.**

Only 11 percent of organizations said they are excellent at identifying significant events or event trends for their systems to detect, monitor and analyze. Participants that most often said they are satisfied with their IoT applications and tools involve customers or business partners in defining events. Consider doing this, but prepare for challenges in managing external data sources.



## **5 Use the right technologies for IoT and operational intelligence.**

■ Many organizations currently manage IoT processes using tools and systems already at hand. The largest percentage (43%) use business intelligence tools rather than specialized IoT tools. They also store sensor data in data warehouses and data marts (30%) more often than in newer systems. However, organizations using advanced tools reported satisfaction with them more often than did users of more traditional ones. Evaluate the effectiveness of your technology and consider adopting NoSQL databases, Amazon S3 and Hadoop as part of your IoT architecture.

## **6 Embrace the cloud for IoT deployments.**

■ Cloud-based platforms, like IoT, are new technologies, and the research finds substantial adoption of them associated with IoT. Nearly one-quarter (23%) of participants said they prefer access on demand or SaaS deployment for IoT, and about the same percentage (24%) expressed no preference, suggesting they might be open to cloud deployments. Organizations using cloud-based deployments have higher levels of satisfaction with their IoT applications and tools than those that do not use them. Assess the benefits of placing your IoT systems in the cloud, which can be less expensive and less disruptive than bringing them in-house.

## **7 Plan to monitor and analyze disconnected data.**

■ Some devices may be offline periodically, but the data they generate then is nonetheless necessary for a complete picture of their operation. Plan to deal with data from disconnected devices as part of your IoT efforts. Only 13 percent are doing this today, although 22 percent more said they are investigating doing so. Those that can process disconnected data are satisfied more often: 85 percent said they are satisfied or somewhat satisfied with their IoT applications and tools.

## **8 Include wearables in your IoT planning.**

■ Make sure your IoT efforts take account of wearable devices that output event data. The research shows widespread interest in them; more than half of participants said that wearable computing is important or very important to their organization's future. Majorities said that smart watches, fitness monitors and wearable environmental sensors are useful. Think outside the box to determine advantages of these devices for your employees and business.

## **9 Focus on usability and reliability in selecting IoT systems.**

■ In evaluating IoT applications and tools, consider users' needs. One-third of research participants reported difficulty in deploying an easy-to-use interface and one-third in analyzing events from multiple sources, and 29



percent cited the inability of users to perform their own analyses as a source of dissatisfaction. More than half said that usability is a very important consideration in their ability to use IoT and operational intelligence. And half said reliability is very important to enable users to have confidence in these systems.

**10. Consider buying systems rather than building them.** Where possible, use commercial tools and applications rather than building your own. Organizations that have bought products rather than build custom solutions reported more often that they are satisfied with them. Fewer than one-third that use their own custom applications and tools said this. We conclude that custom-coded IoT systems are less likely to produce the desired outcomes.



## About Ventana Research

Ventana Research is the most authoritative and respected benchmark business technology research and advisory services firm. We provide insight and expert guidance on mainstream and disruptive technologies through a unique set of research-based offerings including benchmark research and technology evaluation assessments, education workshops and our research and advisory services, Ventana On-Demand. Our unparalleled understanding of the role of technology in optimizing business processes and performance and our best practices guidance are rooted in our rigorous research-based benchmarking of people, processes, information and technology across business and IT functions in every industry. This benchmark research plus our market coverage and in-depth knowledge of hundreds of technology providers means we can deliver education and expertise to our clients to increase the value they derive from technology investments while reducing time, cost and risk.

Ventana Research provides the most comprehensive analyst and research coverage in the industry; business and IT professionals worldwide are members of our community and benefit from Ventana Research's insights, as do highly regarded media and association partners around the globe. Our views and analyses are distributed daily through blogs and social media channels including [Twitter](#), [Facebook](#) and [LinkedIn](#).

To learn how Ventana Research advances the maturity of organizations' use of information and technology through benchmark research, education and advisory services, visit [www.ventanaresearch.com](http://www.ventanaresearch.com).



# Appendix: About This Benchmark Research

## Methodology

Ventana Research conducted this benchmark research on the Web from April through September 2016. We solicited survey participation via email, our website and social media invitations. Email invitations were also sent by our media partners and by vendor sponsors.

We presented this explanation of the topic to participants prior to their entry into the survey:

Ventana Research is conducting benchmark research to understand business and IT professionals' views on the Internet of Things (IoT) and operational intelligence (OI). OI is event-centered information-gathering and delivery technology that enables people to take action and make decisions. It includes automated processes to respond to events based on business rules and actionable information. OI supports IoT by processing the information that is collected in real time from sensors on devices such as wearables and on machines and physical assets. We believe many organizations can gain competitive advantages if they apply OI to reduce the elapsed time between events and taking action and to acquire the ability to monitor and analyze events to discover important patterns and relationships. This research will yield insights into the development and deployment of these systems and best practices that may help your organization improve its operational performance.

The following promotion incented participants to complete the survey:

What's In It For You? Upon completion of the research, all qualified participants will receive a report on the findings of this benchmark research to support their organization's efforts, along with a \$25 Amazon.com gift certificate. In addition, all qualified participants will be entered into a drawing to win one of 25 benchmark research reports and a 30-minute consultation, a package valued at US\$1,495 or €1,232. Thank you for your participation!

## Qualification

We designed the research to assess the use of and plans for spreadsheets across organizations and industries. Qualification to participate was presented to participants as follows:

The survey for this benchmark research is designed for IT professionals who support IoT, operational intelligence, event processing, BI, applications, middleware and data management; business professionals who are involved with IoT and related systems across all areas of operations; and business analysts who support these deployments. Solution providers, software vendors, consultants, media and systems integrators may participate in the survey, but they are not



eligible for incentives and their input will be used only if they meet the qualifications. Incentives are provided to qualified participants in the research and also are conditional on provision of accurate contact information including company name and company email address that can be used for fulfillment of incentives.

Further qualification evaluation of respondents was conducted as part of the research methodology and quality assurance processes. It entailed screening out responses from companies that are too small, questionnaires that were not materially complete, or those where the submission is from an inappropriate submitter or appears to be spurious.

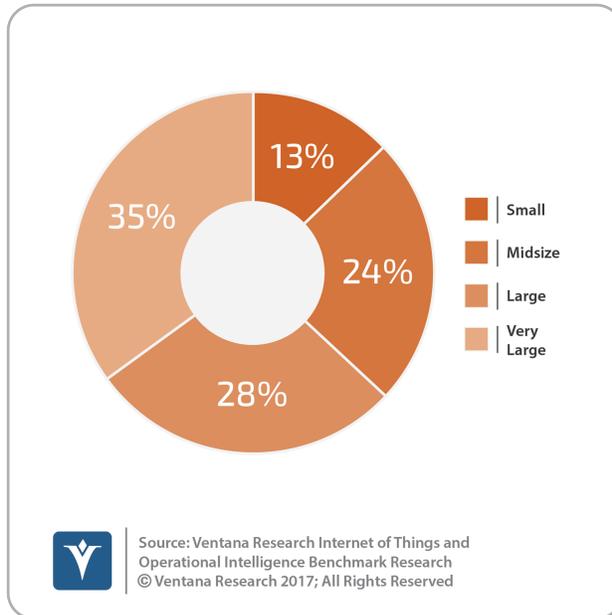
## **Demographics**

We designed the survey used for this research to be answered by executives and managers across a broad range of roles and titles working in organizations. We deemed 201 of those who clicked through to this survey to be qualified to have their answers analyzed in this research. In this report, the term “participants” refers to that group, and the charts in this section characterize various aspects of their demographics and qualifications.



## Company Size by Workforce

We require participants to indicate the size of their entire company. Our research repeatedly shows that size of organization, measured in this instance by employees,

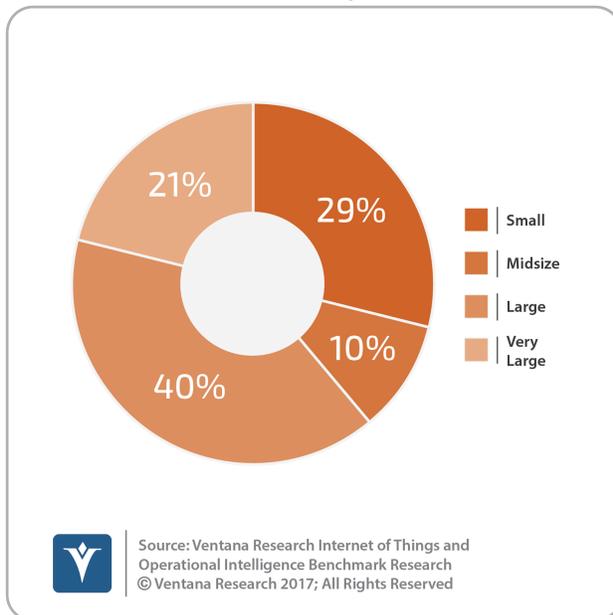


is a useful means of segmenting companies because it correlates with the complexity of processes, communications and organizational structure as well as the complexity of the IT infrastructure. In this research, participants represented a broad range of organization sizes in a range of numbers with larger ones predominating: 35 percent work in very large companies (having 10,000 or more employees), 28 percent work in large companies (with 1,000 to 9,999 employees), 24 percent work in midsize companies (with 100 to 999 employees), and 13 percent work in small companies (with fewer than 100 employees). This distribution is consistent with prior benchmark research and

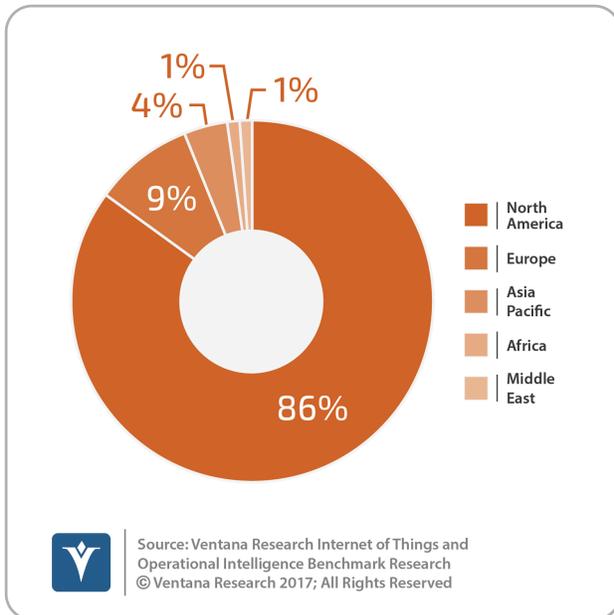
our research objectives and provides a suitably large sample from each size category.

## Company Size by Annual Revenue

When we measured size by annual revenue, the distribution of categories shifted downward; fewer companies fell into the very large and midsize categories and

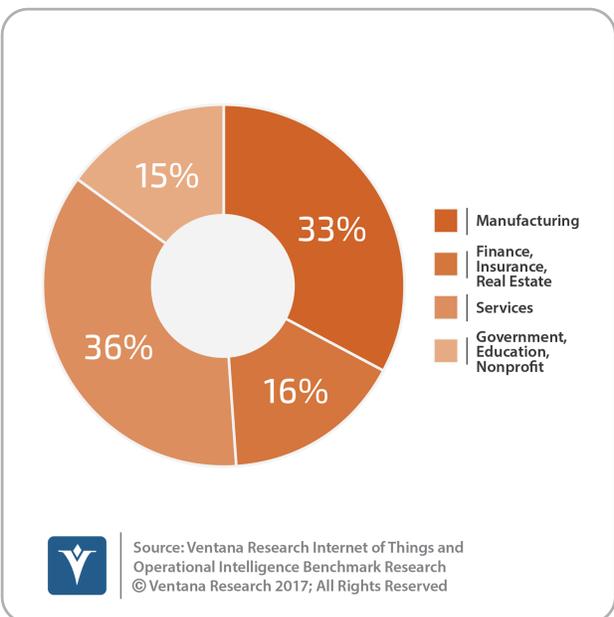


more than twice as many are small. By this measure, 14 percent fewer are very large companies (having revenue of more than US\$10 billion), but 12 percent more are large companies (having revenue from US\$500 million to US\$10 billion). Likewise, 14 percent fewer are midsize companies (having revenue from US\$100 to US\$500 million), but 16 percent more are small companies (with revenue of less than US\$100 million). This sort of redistribution is typical in our research projects when we measure by revenue instead of head count.



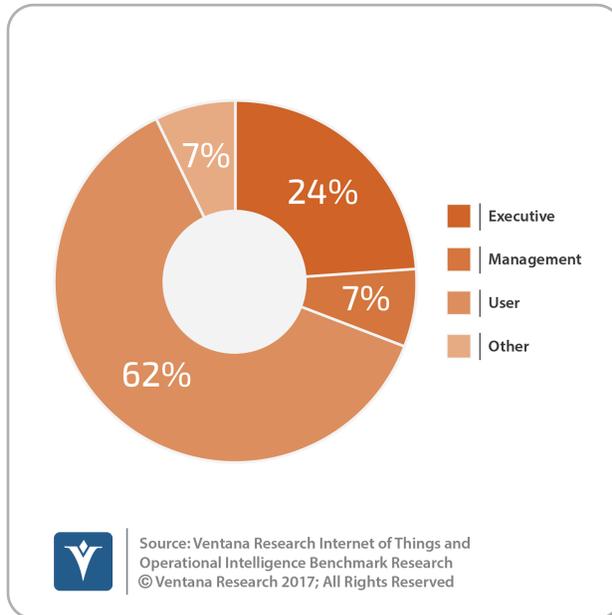
### Geographic Distribution

A large majority (86%) of the participants were from companies located or headquartered in North America. Those based in Europe accounted for 9 percent, in Asia Pacific for another 4 percent and in Africa and the Middle East for 2 percent. This result was in keeping with our expectations at the start of this investigation, since organizations participating in our research most often are headquartered in North America. However, many of these are global organizations operating worldwide.



### Industry

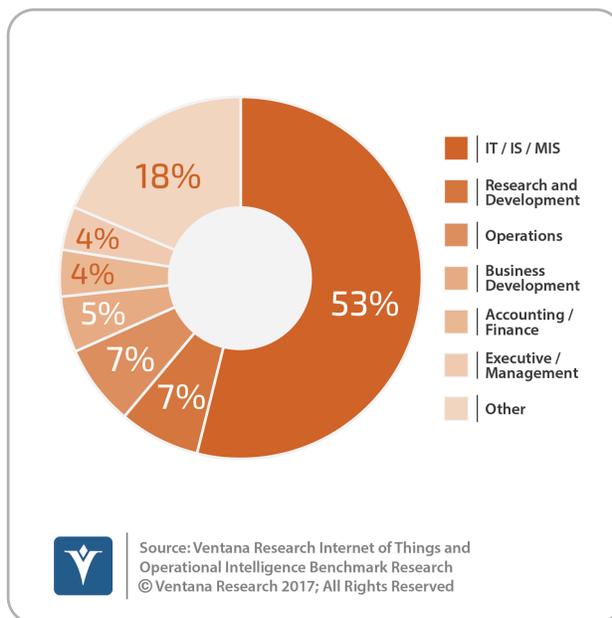
The companies of the participants in this benchmark research represented a broad range of industries, which we have categorized into four general categories as shown below. Companies that provide services accounted for 36 percent. Those in manufacturing accounted for 33 percent. Those in finance, insurance and real estate accounted for 16 percent. Government, education and nonprofits accounted for 15 percent.



### Job Title

We asked participants to choose from among 13 titles the one that best describes theirs. We sorted these responses into four categories: executives, management, users and others. More than half identified themselves as having titles that we categorize as users, a grouping that includes director (23%), senior manager or manager (23%), analyst (7%) and staff (7%). One-fourth are executives; the majority of them (15%) are CIOs. Another 7 percent are management, by which we mean vice presidents. Others, in this case consultants and professors or teachers, accounted for the balance. We concluded

after analysis that this response set provided a meaningfully broad distribution of job titles.



### Role by Functional Area

We asked participants to identify their functional area of responsibility as well. This enabled us to identify differences between participants who have differing roles in the organization. A bit more than half of the participants identified themselves as being in the IT function. Five business area roles accounted for 27 percent. Another 14 titles, none with more than 3 percent of the total, comprised the Other category.