INDUSTRIAL INTERNET OF THINGS (IOT) AND DIGITAL TRANSFORMATION

IOT, DIGITAL TRANSFORMATION AND THE ROLE OF ENTERPRISE SOFTWARE

KEY QUESTIONS:

IFS WHITE PAPER

By Charles Rathmann, Senior Marketing Communications Analyst, North America,

September 2017

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BY CHARLES RATHMANN, SENIOR MARKETING COMMUNICATIONS ANALYST

EXECUTIVE SUMMARY

Digital Transformation may be defined in a number of different ways by analysts or enterprise software vendors. But at its heart is the idea that as we use more digital technologies, those technologies change the way we live and, more pointedly, the way we conduct commerce. Businesses are introducing new technologies in innovative ways to reduce cost, create new revenue opportunities and improve the customer experience.

This inexorable trend of digital transformation is clear. What is less clear is exactly which concrete technologies are significant to digital transformation. Connected devices ranging from the Fitbit that monitors our activities and sleep patterns to the connected thermostat that allows us to manage the temperature of our house from a cell phone are both examples of how IoT has already impacted consumer products. In the industrial sector, the industrial internet of things (IoT) will likely have an even greater impact.

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Industrial companies were in many ways early adapters of IoT, and a rudimentary IoT environment has flourished for decades as manufacturing plants, utilities and other heavy industries came to rely on sensored equipment for industrial automation and condition-based maintenance systems. What is different today is that:

- The cost of adding sensors to equipment is falling.
- Cloud computing capacity to handle data from a large number of sensors is available.
- Enterprise software is evolving to operationalize data from these networked devices while also using the data as a source of information for decision support.

Manufacturing operations departments, maintenance departments and field service organizations are also finding that data from these connected devices can enable them to increase value to internal or external customers, reduce cost and even create new product or service offerings.

Often, data from these connected devices is consumed strictly on the plant floor—either by networking programmable logic controllers (PLCs) to each other, to a supervisory control and data acquisition (SCADA) network or to other point solutions. The greater potential for IoT to fully impact industrial organizations though will take place as enterprise

software like enterprise resource planning (ERP), enterprise asset management (EAM) and, increasingly, field service management, exposes this data in ways that adds value to customers and other stakeholders.

This study is based on a survey of 200 manufacturing and contracting executives with decision-making power over IoT purchases. The study results illustrate:

- The relationship between IoT and readiness for digital transformation
- How widely IoT data is used within industrial organizations
- Whether industrial organizations are adopting more advanced use cases for IoT data
- The degree to which enterprise software helps or hinders full IoT adoption
- How industrial companies plan to invest in IoT in the next two years
- How well IoT data is being used to facilitate aftermarket service of industrial machinery and other capital assets
- Future IoT investment plans of industrial companies

There is a strong correlation in the study between companies who said their enterprise software prepared them well for digital transformation and those who said their software prepared them well to consume IoT data, which is expected. Companies that said their enterprise software prepared them well for digital transformation however were able to make better and more complete use of IoT data than other respondents.

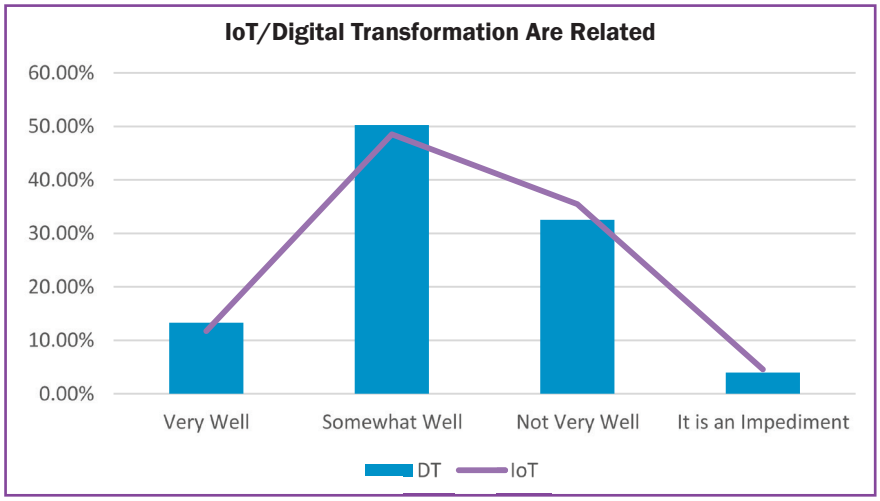
Also remarkable was the fact that 30 percent of respondents reported using IoT to support field service management initiatives in addition to or instead of their own internal operational processes. This suggests that IoT could give elite manufacturers and contractors a competitive edge when it comes to servitization and gaining revenue after the initial sale.

There is a strong correlation in the study between companies who said their enterprise software prepared them well for digital transformation and those who said their software prepared them well to consume IoT data, which is expected.

"IoT is a very specific thing. Digital Transformation is a concept. Trying to correlate these things is difficult. But here we offer a view of the current state of IoT and how it relates to digital transformation. And right now, the primary value industrial companies are seeking from IoT seems to be cost avoidance. The greater potential for IoT in these settings, however, is business growth. In order to realize this benefit, companies must not only think more creatively about IoT, but be able to use IoT data in the context of their business, which likely means tighter integration with applications like ERP."
Rick Veague, Chief Technology Officer for North America, IFS

KEY FINDING 1:

IoT and Digital Transformation are Closely Related in Industrial Companies

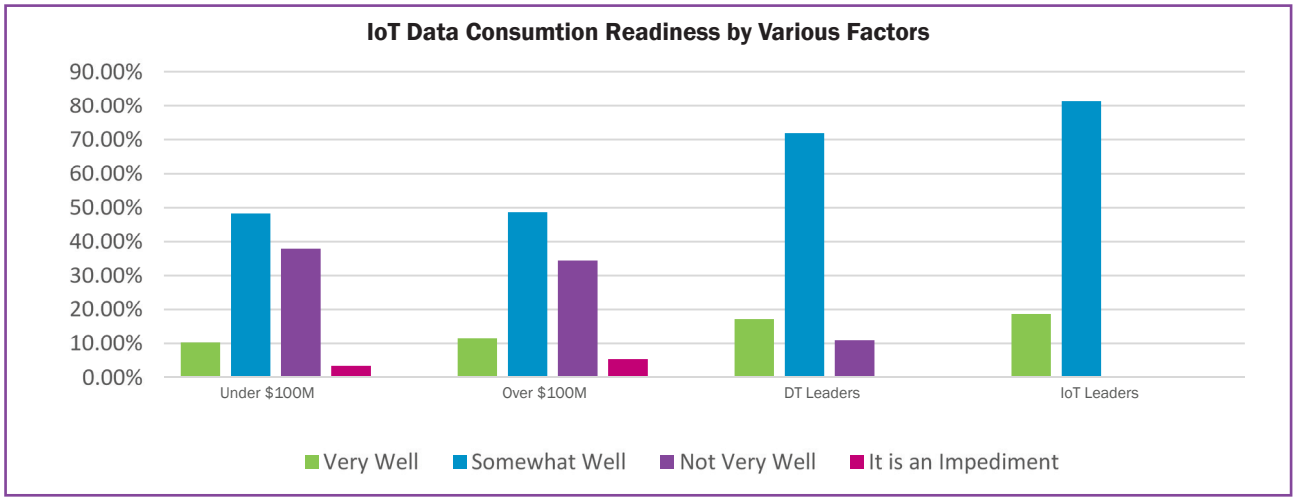


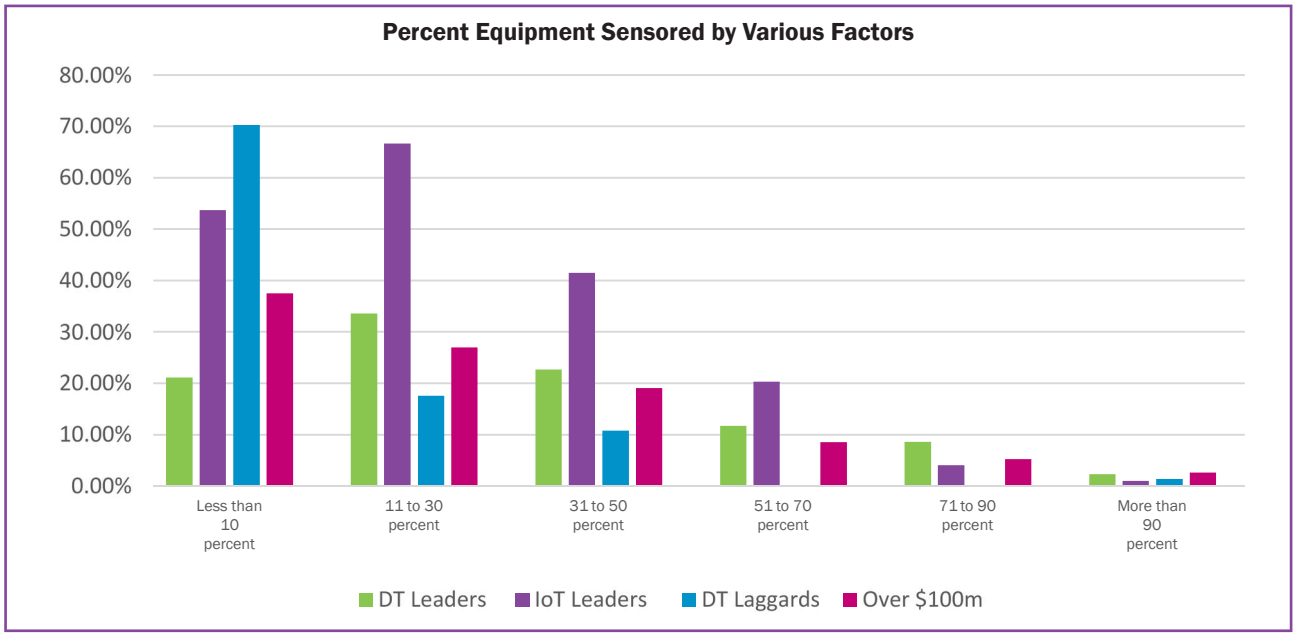
Study data shows that industrial digital transformation is tightly aligned with IoT. This becomes clear when we look at how respondents to this study answered two different questions:

- How well do you think your enterprise software prepares you for digital transformation?
- How well do you think your enterprise software like ERP or EAM facilitates consumption of IoT data?

We divided respondents into DT Leaders, who said their enterprise software prepared them very well or somewhat well for digital transformation, and DT Laggards, who said their enterprise software prepared them not very well or was an impediment to digital transformation. We also divided respondents into those who said their enterprise software prepared them very well or somewhat well to consume IoT data.

- This DT Leader status was the best predictor of which respondents were involved in more advanced IoT use cases—more so than company size or even IoT Leader status.
- IoT Leaders were more likely to sensor between 11-70 percent of their equipment. But they are still less likely than DT Leaders to be sensoring a very high percentage of their production equipment.





Status as an IoT Leader or Digital Transformation Leader also was more closely correlated with readiness for digital transformation than company size. This is remarkable since larger organizations will have deeper resources at their disposal, which is crucial in situations when there is no defined route for IoT data into enterprise systems. There are a few potential reasons for this pattern:

- Smaller businesses may have lower complexity and diversity of business models and divisions, making IoT data integration with the enterprise more straightforward.
- Larger organizations may have multiple enterprise applications, which also makes integrating IoT data with systems used company-wide more challenging.
- Smaller organizations may be running enterprise applications that are more open and easier to integrate with other systems than

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enterprise software used in larger organizations. Larger organizations were more likely to report that their enterprise software was an impediment to digital transformation, for instance, even though they are more likely than any other demographic to report sensoring more than 90 percent of their equipment. This would suggest large companies may have sensors on much of their equipment but lack the wherewithal to funnel the data from these connected devices into their enterprise systems.

The implication is clear—larger companies must get serious about ensuring their enterprise software streamlines bilateral integration with connected devices or risk losing the digital transformation race to smaller, more nimble, companies. Smaller companies, meanwhile, need to double down on efforts to adopt advanced IoT practices as a competitive differentiator. They may be less hidebound and rigid in their organizational structure and can progress more rapidly than companies many times their size.

One other important takeaway—regardless of company size, IoT Leader or DT Leader status, no subset of the list reported was more than 20 percent likely to say their enterprise software did "very well" in preparing them to consume data from IoT. This means most enterprise applications have a long way to go when it comes to creating real-time, robust and agile links between IoT and the systems used by senior executives and most line managers.

"It is interesting that not even the most advanced companies were very likely to say their enterprise software did a very good job helping them consume IoT data. This indicates the level of maturity of enterprise software in being able to support leading edge applications like IoT. There is obviously room for growth here because the ability of ERP and other software applications to support IoT is still not robust enough." Rick Veague, Chief Technology Officer for North America, IFS

From the time distributed control systems were introduced into industrial environments in the 1970s, we have seen a progression towards enterprise-wide integration of these plant floor systems not only with each other, but with systems used to manage the business on a financial, strategic and operational level.

KEY FINDING 2:

Enterprise Software Must Facilitate IoT

From the time distributed control systems were introduced into industrial environments in the 1970s, we have seen a progression towards enterprise-wide integration of these plant floor systems not only with each other, but with systems used to manage the business on a financial, strategic and operational level. The progression of industrial organizations towards digital transformation may rest largely on the ability of each company to extend IoT data from the plant floor or the field to the C-suite. Enterprise software must therefore facilitate two-way communication from connected devices—programmable logic controllers, temperature or vibration sensors or entire work cells united through SCADA systems—and the system of record used to manage the enterprise.

This direct communication between enterprise systems like ERP, EAM and field service management software and sensored devices on the plant floor—or distributed assets in the field—will be essential for these organizations to achieve the more advanced use cases for IoT.

Survey respondents who said their enterprise software did a good job preparing them for digital transformation were more likely to report being involved in most IoT use cases covered in the study than DT Laggards or even IoT Leaders. The exception was process automation, which 55.47 percent of DT Leaders reported involvement with, about 10 percent less than IoT Leaders at 65.38 percent. DT Leaders more frequently reported being involved in more challenging IoT use cases, including:

- Connected field service
- Asset performance management/operational efficiency
- Business intelligence/reporting
- Asset performance management
- Monitoring performance against service level agreements
- Monitoring overall asset portfolio management

Each of these IoT use cases require not only sensored, connected devices, but more advanced integration between those devices and enterprise applications. Condition-based or predictive maintenance might even be handled without any integration between a sensored device and the enterprise. In some cases, an alarm or indicator on the equipment would alert technicians to required maintenance work. Perhaps a light goes on in a control room, or the data is sent to a SCADA system where plant floor personnel can take appropriate action.

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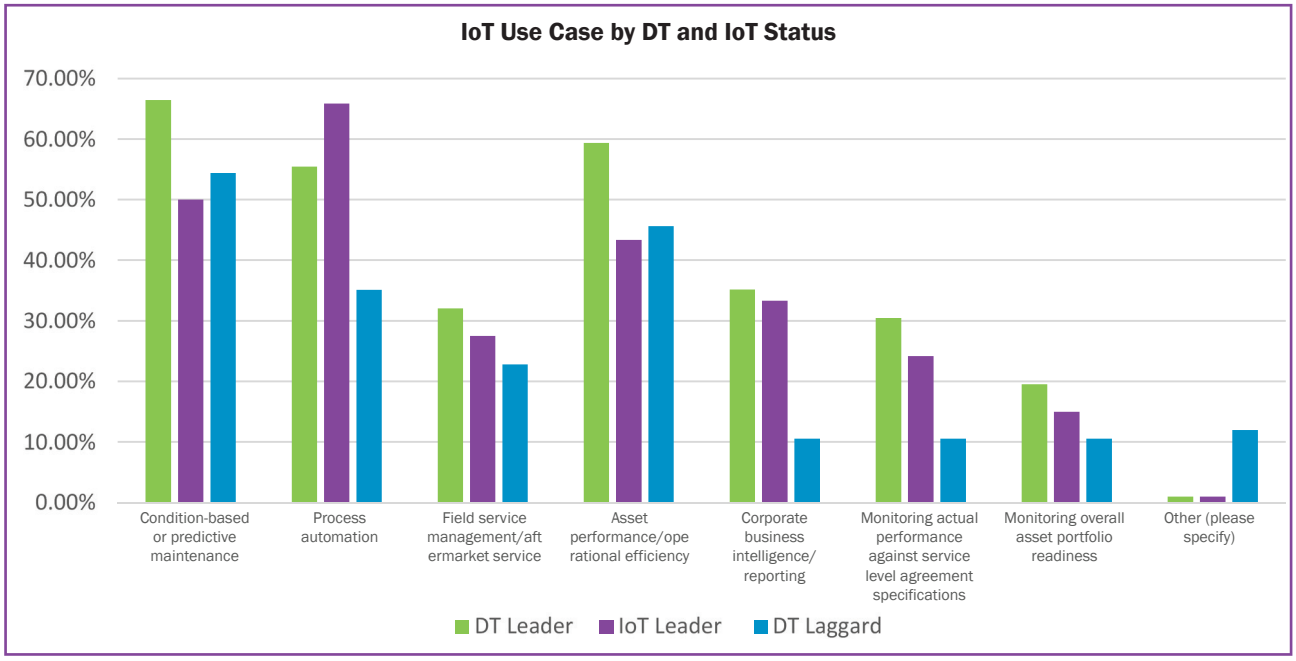
enterprise to meet an emergent field service need. These actions may be impacted by other enterprise data resident in contract management, human resources, scheduling and inventory systems. It obviously requires IoT data to be tightly integrated with the rest of the enterprise.

Asset performance management and operational efficiency represent the next realm of IoT sophistication. These disciplines require a business to integrate data from connected devices with the production schedule, capture fault data from a data historian, maintenance technician schedules and staffing, quality management systems and other parts of the enterprise.

Corporate business intelligence and reporting and monitoring against service level agreements (SLAs), beyond tactical information consumed on the plant floor, also requires that IoT data be displayed in the context of business goals, performance targets and other enterprise data. SLAs, whether they apply to promises made to internal or external stakeholders, are often specific to a given product, project, piece of equipment, division or customer. In a field service management environment, for instance, customers may negotiate different SLAs for how long it takes a technician to get to their site, required percentages of uptime or other metrics. The ability to monitor the performance of connected devices against multivariate metrics and ensure that goals are met requires deep integration with enterprise software.



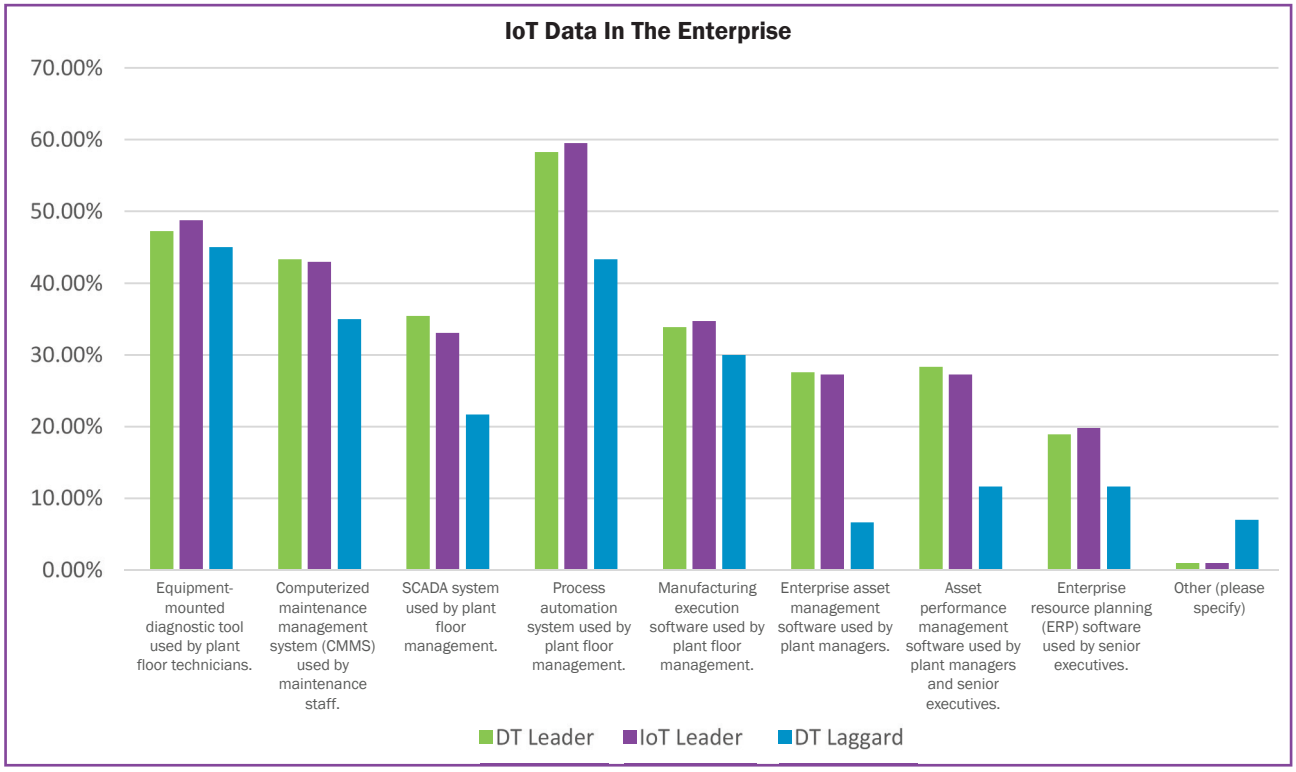
Organizations that integrate IoT to manage mobile assets like vehicle fleets and field service technicians have additional challenges of geolocation, integration with a service schedule and dispatch, and oftentimes monitoring sensors on equipment at customer sites to provide more proactive service. All of these must be managed in the

context of contractual SLAs that are often customer- or product-specific.

The smallest percentage reported using IoT to manage an overall asset portfolio. This requires a high degree of sophistication, and an enterprise application environment that can consolidate IoT data from multiple work cells and individual equipment objects in a way that conforms to asset structures, profit and loss centers and the broader goals of the organization.

In order to make full and more strategic use of IoT, IoT data must make it into the enterprise systems used by strategic executives. These software applications also make the IoT data visible to and actionable by various departments from throughout the company. DT Leaders and IoT Leaders reported that IoT data was making it into these more strategic systems at comparable rates.

One of the barriers to fully leveraging IoT data is ensuring that it is not consumed strictly by individuals closest to the sensor on the plant floor or in the field, but by senior management and line managers who can act on or consume this data for decision support. Enterprise software may also automatically operationalize IoT data, issuing work orders when certain equipment conditions are present, scheduling technicians in the field according to their proximity to an emergent service call or raising or lowering production rate and adjusting the production schedule depending on fault reports and overall equipment effectiveness (OEE) calculations. But this is all contingent on a sound gateway between a network of connected objects and the enterprise application.

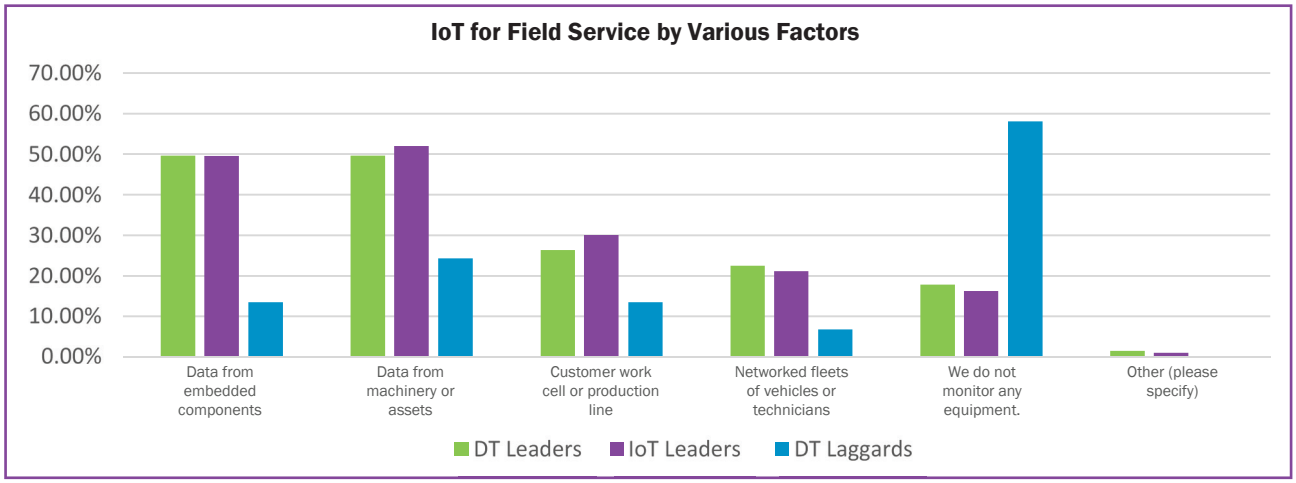


"The fact that industrial automation and condition-based maintenance are dominant IoT use cases in this study makes sense. Industrial machinery has had sensors on PLC controllers forever. Most factories, process manufacturing plants in particular, cannot run without those sensors. The question is, can IoT make it beyond the plant floor? These machines have delivered efficiencies like optimal equipment efficiency (OEE), condition-based maintenance and more. But in these use cases, visibility of what the machines are doing does not get very far up the ERP food chain. And once you are talking about machinery deployed in the field at a customer site, even condition-based maintenance becomes challenging because it is harder to achieve connectivity. Getting IoT data to support proactive aftermarket field service and using IoT data in context of enterprise data are two current challenges faced by respondents intent on getting more value out of IoT."
Rick Veague, Chief Technology Officer for North America, IFS

"On the plant floor, you use IoT data to make decisions about maintenance activities or adjusting speed of production. Most ERP systems assume that the machine is running at a certain rate, and there is no direct connection to the realities of production. In some cases, making real-time plant floor information available to the front office may result in better visibility and the ability to plan more effectively. But as an organization, does that deliver value to you? And are your planning and maintenance systems robust enough to make real time decisions based on this IoT data? In many cases, there may be nowhere in an enterprise application for this data to go, and this is something software vendors need to work on to help their customers be more progressive with IoT."
Rick Veague, Chief Technology Officer for North America, IFS

KEY FINDING 3:

Aftermarket Service Benefits from IoT



A surprisingly high number of study respondents reported using data from sensored devices not only to manage and maintain their own equipment, but to support service work for customers. Only 33 percent of respondents said they did not collect IoT data on equipment for aftermarket service work. In another question, 30 percent of respondents said they use IoT data to support field service management efforts. We will rely on the more conservative figure of 30 percent.

The degree of IoT sophistication for aftermarket service was comparable for DT Leaders and IoT Leaders. Sensors affixed to single, embedded components in equipment—like a compressor or a servo—represent the entry level for field service IoT. The next level of sophistication is an entire machine or other asset that has multiple sensors to deliver insights on equipment health, total usage or other metrics. Roughly half of both DT Leaders and IoT Leaders reported leveraging each of these two IoT approaches.

Fewer respondents overall reported capturing IoT data on an entire customer work cell or assembly line, with just shy of 4 percent more IoT Leaders engaging in the practice than DT Leaders. In many instances, this may be due to respondents supplying or providing service for only certain components or machines that are part of a production line or total value chain, while others may engineer, install or support work cells or assembly lines, building automation systems, wastewater treatment plants or other assets in their entirety. Respondents involved in contracting as opposed to manufacturing may also be more involved in sensors for their specific equipment as opposed to building automation as a whole.

These data points further suggest that servitization is one more element of digital transformation that DT Leaders and IoT Leaders will be well-prepared to take advantage of. Laggards, meanwhile, will benefit

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from implementing systems that enable them to profitably perform aftermarket service, introduce IoT data into these systems and operationalize in in ways that drive value for the customer.

"The fact that thirty percent of respondents overall are using IoT for aftermarket service is remarkable, even though the sample was heavily focused on equipment manufacturers and contractors with an aftermarket service component. We are obviously past the inflection point with this technology. IoT for aftermarket service is no longer a coming trend. It's here."

Rick Veague, Chief Technology Officer for North America, IFS

KEY FINDING 4:

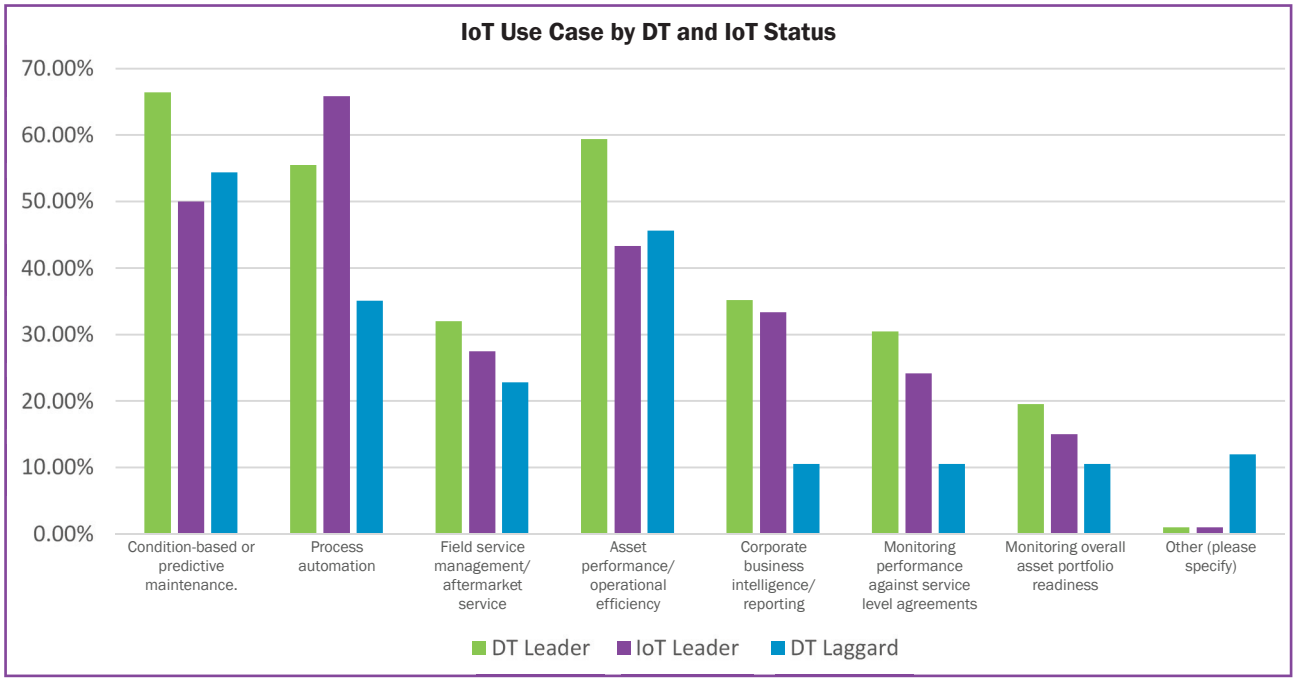
Planned Expenditures

While elements of IoT have been part of the industrial landscape for the last two decades or more, fully realizing the benefits of IoT in manufacturing, contracting and other organizations will require additional investment in both hardware and software.

Survey respondents were asked about their plans for future investments, and answered differently depending on their status as leaders or laggards with regard to IoT and digital transformation.

The fact that industrial IoT is in its infancy was borne out by the fact that regardless of sophistication level, respondents planned to invest the most in condition-based or predictive maintenance. However, IoT Leaders are less likely to plan these more basic expenditures than either DT Leaders or DT Laggards.

IoT Leaders however are more likely than other respondents to plan expenditures in process automation. The process manufacturing industry is an early adopter of SCADA and other IoT precursor technologies, but it is interesting that the most progressive IoT users in the study still see this as a major investment area.



Digital Transformation Leaders were significantly more likely to plan investments in:

- Field service management
- Monitoring performance against SLAs
- Asset performance management
- Asset operational efficiency

These planned investments share certain commonalities. Field service management and performance against SLAs are closely related. Regardless of whether a customer is internal and within the four walls or a remote customer covered by a contract, service organizations ensuring that asset performance meets agreed-upon SLAs and other requirements is a complex challenge. It requires IoT data be accessible across multiple parts of the organization, as part of a service or asset lifecycle or operational processes and in context of organization goals or contractual requirements. Contractors and manufacturers involved in aftermarket service and industrial maintenance organizations must also manage mobile resources outside the four walls of their organizations and track their performance to ensure they are delivering on promises to their customers.

"Condition-based maintenance is focused on the interrelated elements of reliability and cost. Cost avoidance is an important IoT driver for study respondents, but the more interesting potential for IoT comes when companies leverage it to maximize potential for growth. Monitoring performance against service level agreements can pave the way for increased revenue. If you can hit a higher SLA, can you charge more or offer a more stringent SLA at the same price, creating a competitive advantage? Can you leverage IoT data not only to prevent break-fix repair, but to understand how your customer is actually using your equipment to drive design changes?"

Rick Veague, Chief Technology Officer for North America, IFS

IFS then collaborated with the research arm of IEN, a joint venture between Thomas Register and Rich Media Group, which collected 200 survey respondents from a sample of manufacturing, automation/controls and other industrial executives.

METHODOLOGY

IFS in North America designed a survey instrument to capture insights on the current state of IoT among industrial companies and how IoT uptake was influenced by enterprise software. IFS then collaborated with the research arm of IEN, a joint venture between Thomas Register and Rich Media Group, which collected 200 survey respondents from a sample of manufacturing, automation/controls and other industrial executives. Respondents were asked a screening question on whether they were involved in decisions about IoT technology at their company, and only those who responded in the affirmative were allowed to take the survey. Data collection and tabulation were managed by Jeff Reinke of IEN. IFS North America reviewed these tabulations and cross-tabulations to draw inferences relevant to enterprise technology used to manage industrial organizations in specific NAICS codes including:

- Contractors:
  - 238220 - HVAC
  - 515 - Telecom
  - 517 - Telecom

- Manufacturers that service
  - 332* - Fabricated Metal Manufacturers
  - 333* - Machine Manufactures
  - 334510 – High Tech manufacturers
  - 3391 – Med Device

- General Manufacturing
  - 332*
  - 333*
  - 334*
  - 335*

- A&D Civil Aviation
  - 481*
  - 4881*
  - 488999

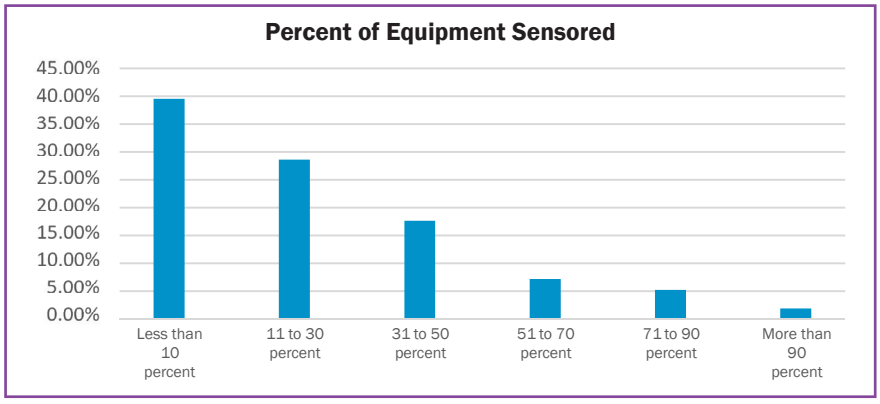
- Oil & Gas
  - 211*
  - 213111
  - 213112
  - 32411*
  - 4869*

- Food & Beverage
  - 311*
  - 312*

- Defense Manufacturing
  - 334511
  - 3364*
  - 336992

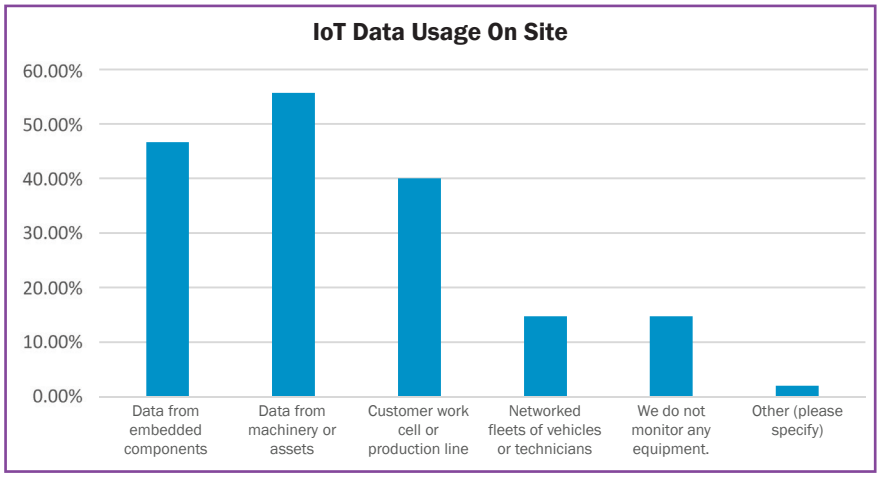
RESULTS

What percentage of your production equipment is IoT-enabled? (i.e. utilizing embedded sensors that provide performance data which can be used to make decisions or support automation).



Determining which equipment to sensor is one IoT decision industrial organizations must make. Most respondents currently seem to be picking their fights, sensoring more critical equipment as opposed to the totality of a production line, work cell or asset portfolio.

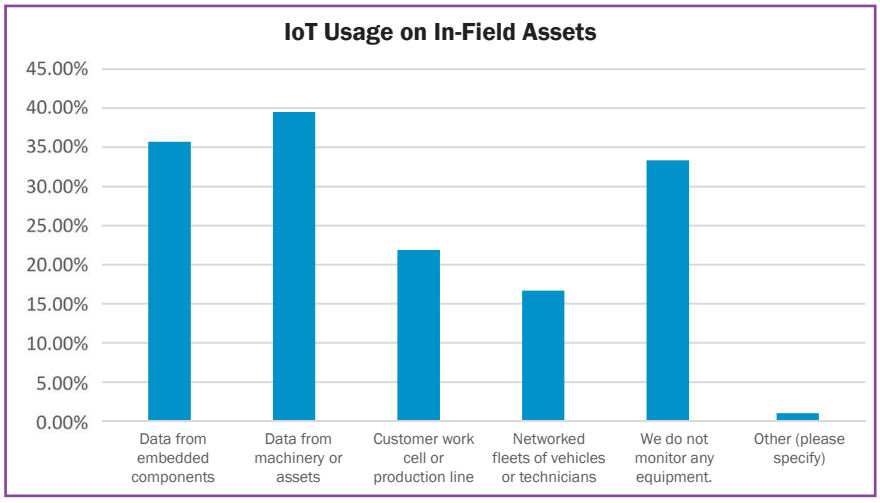
When it comes to production equipment used at your manufacturing site(s), from which of the following areas is your company collecting or monitoring data? (Check all that apply.)



Apart from sensoring data, respondents exhibited a broad spectrum of sophistication when it came to sophisticalion of their IoT data capture approach. There is a logical progression including:

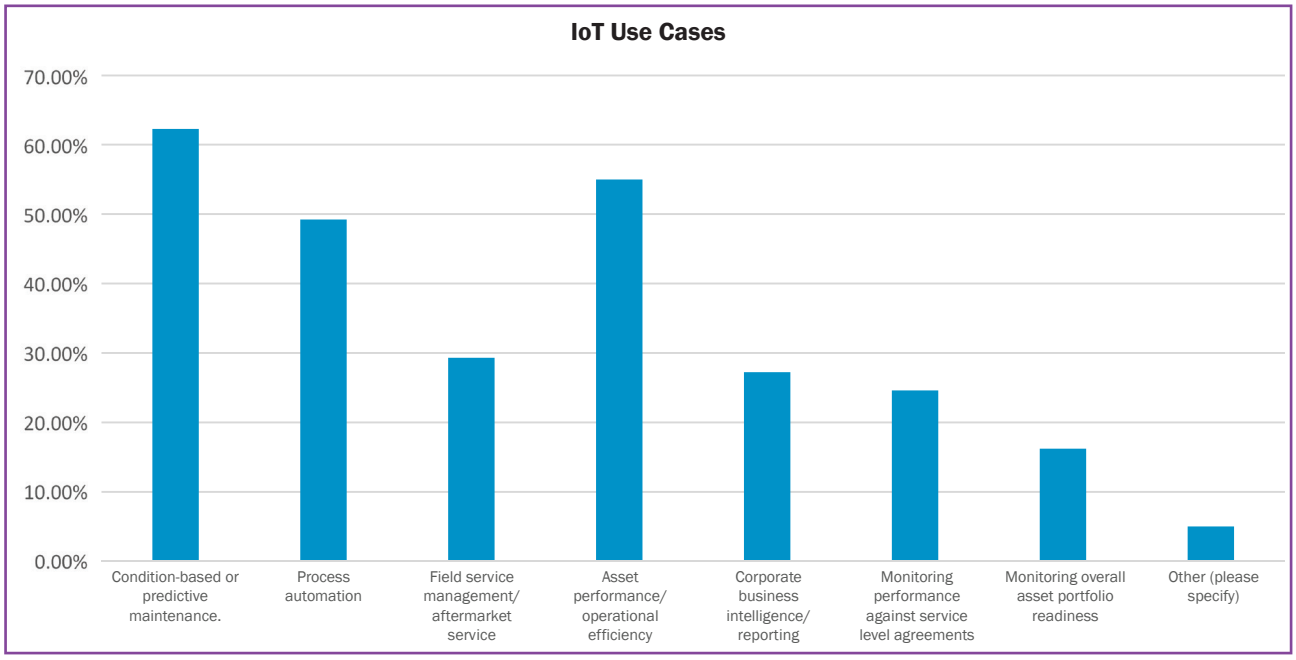
- Sensoring individual machine components (motors, drives, sensors) that have previously demonstrated the potential to create production bottlenecks or safety risks.
- Data from machinery or assets, which often requires sensoring multiple components and monitoring the relationship between these data points to determine equipment health or operational status.
- Work cell or production line performance—including multiple machines that enable automation or monitoring of a full production process.
- Networked fleets of vehicles or technicians with GPS-equipped mobile devices.

When it comes to distributed assets in the field that you may perform aftermarket or contracted service work on, from which of the following areas is your company collecting or monitoring data? (Check all that apply.)



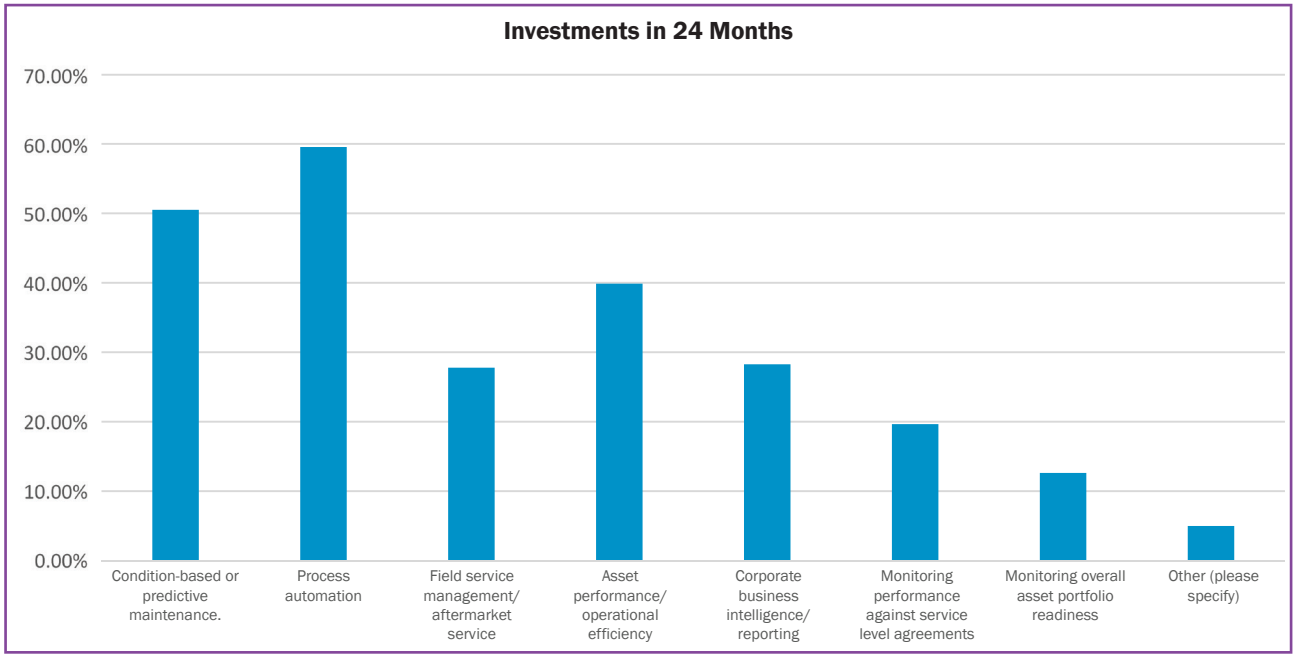
A significant percentage of respondents are using IoT to drive aftermarket service work. These respondents may be mechanical contractors, machinery OEMs, industrial controls companies or others who sell maintenance contracts or do warranty repairs, initiating some of these service activities or collecting system performance on the basis of IoT data.

What do you use data from these "smart" devices for? (Check all that apply)



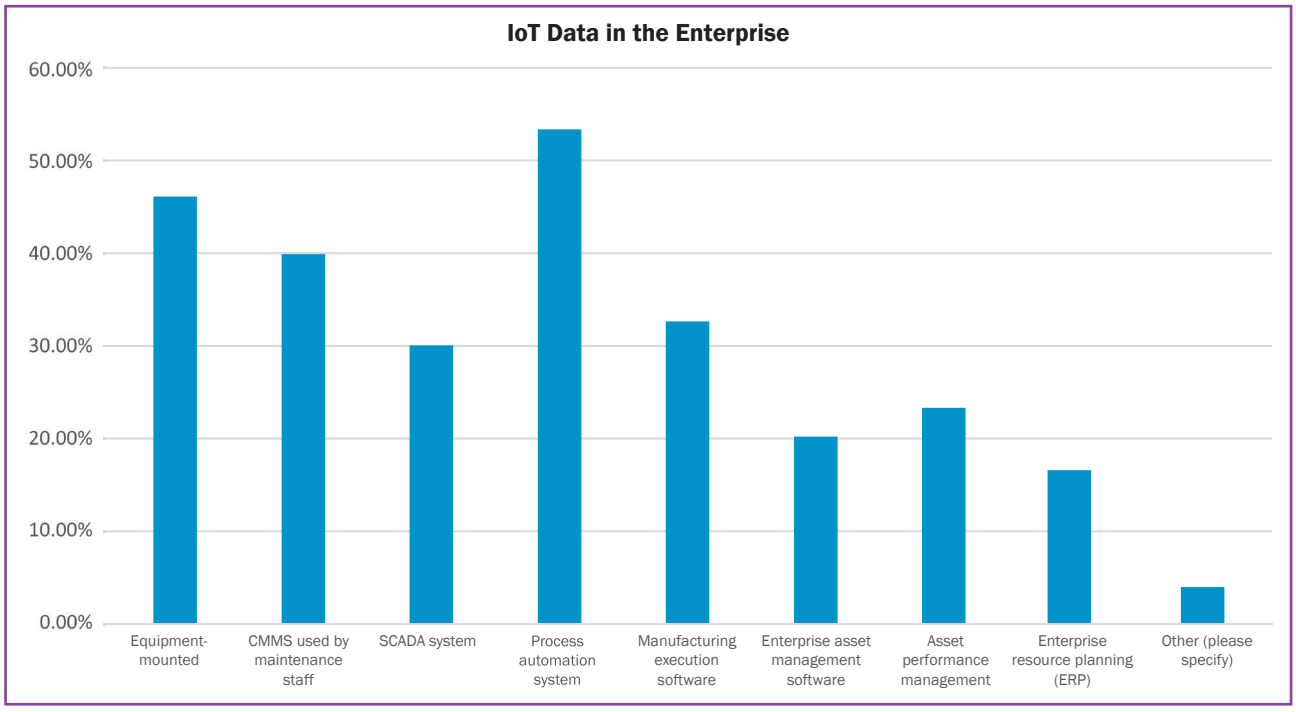
When it comes to how IoT data is used, respondents were more likely to report asset management-related use cases like condition based maintenance or asset performance management. Process automation was the next most frequent use case, with field service coming in third.

In which of the following areas do you plan to make additional IoT investments within the next 24 months? (Check all that apply)



While condition-based and predictive maintenance was already the most common use case mentioned by respondents, half still plan to invest more here, just 10 percent behind process automation. Asset performance management trailed at 40 percent.

How is your IoT data used, and how does it influence operations and decision-making? (Check all that apply)

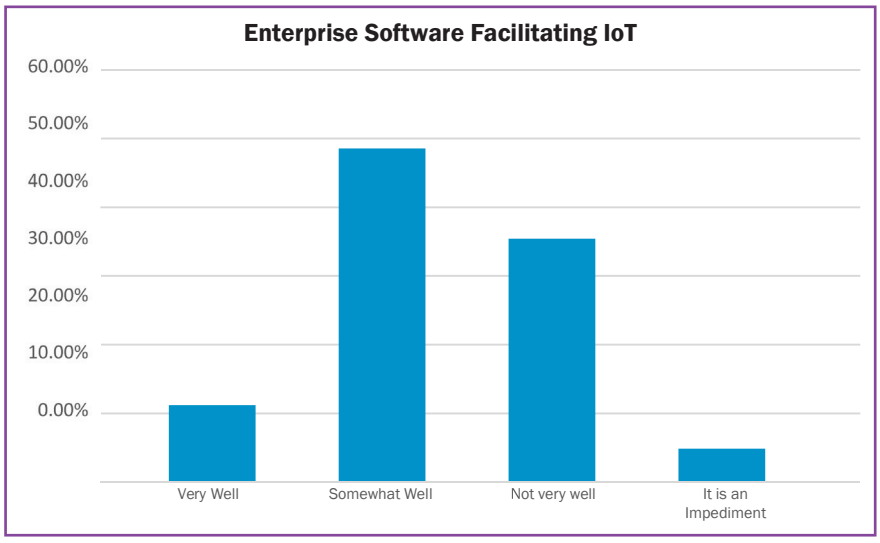


This question was designed to see how far IoT data extended through systems used at different levels of the organization. Is it exposed mostly in systems used in the plant floor, or is it also consumed by enterprise systems used to manage the enterprise? Respondents were asked if IoT data was consumed by:

- Equipment-mounted diagnostic tool used by plant floor technicians.
- Computerized maintenance management system (CMMS) used by maintenance staff.
- SCADA system used by plant floor management.
- Process automation system used by plant floor management.
- Manufacturing execution software used by plant floor management.
- Enterprise asset management software used by plant managers.
- Asset performance management software used by plant managers and senior executives.
- Enterprise resource planning (ERP) software used by senior executives.

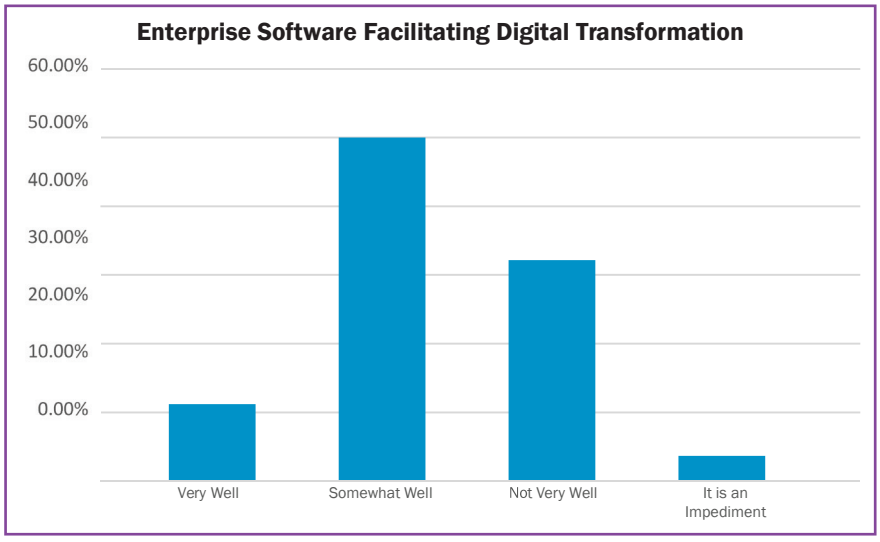
For most respondents, data made it as far as an industrial automation system, or perhaps a manufacturing execution system. Just more than 23 percent said their IoT data was used by an asset performance management system, and only 16 percent said it was accessible to senior managers and other line managers through an ERP system.

How well does your enterprise software (EAM, ERP) facilitate consumption of IoT data?



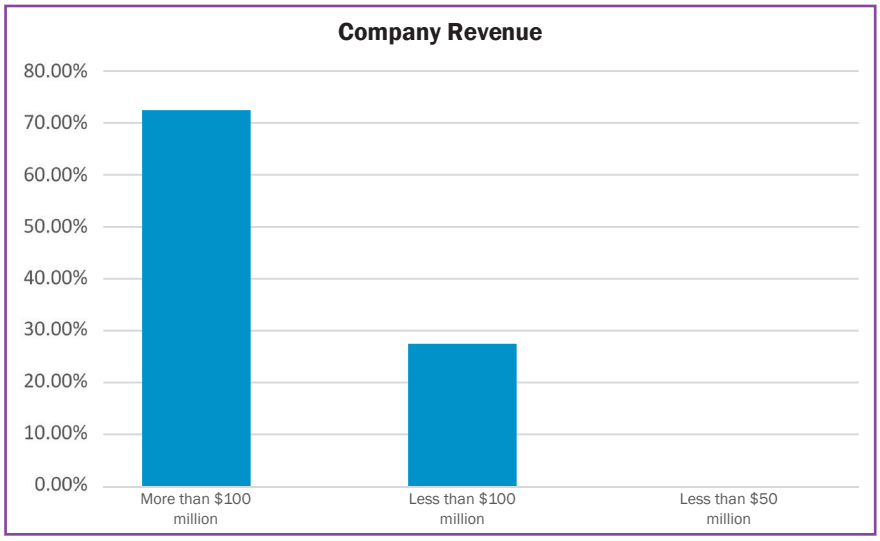
Almost 60 percent of respondents said their enterprise software facilitated consumption of IoT data very well or somewhat well while just over 40 percent said it performed not very well in this regard, or was an impediment.

How well do you think your enterprise software prepares you for digital transformation?



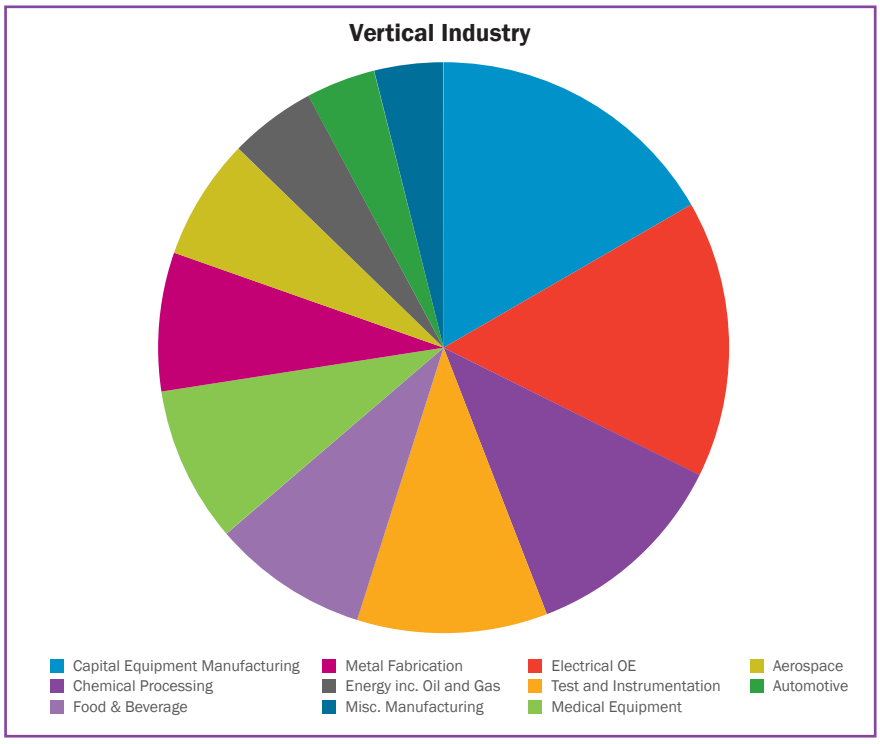
More than 63 percent of respondents said their enterprise software prepared them well for digital transformation. Just over 36 percent said it prepared them not very well or was an impediment.

What would you estimate your company's annual revenues at?



More than 72 percent of respondents were from companies with more than $100 million in revenue. More than 27 percent were from companies with between $50 million and $100 million. None were from companies with less than $50 million in revenue.

What vertical industry does your company operate in?



ABOUT IFS

IFS develops and delivers enterprise software for customers around the world who manufacture and distribute goods, maintain assets, and manage service-focused operations. The industry expertise of our people and solutions, together with commitment to our customers, has made us a recognized leader and the most recommended supplier in our sector. Our team of 3,300 employees supports more than one million users worldwide from a network of local offices and through our growing ecosystem of partners.

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En3535-1 Production: IFS Corporate Marketing, September 2017.