



2017

Annual IIoT Maturity Survey

Adoption of IIoT in Manufacturing, Oil and Gas,
and Transportation

Executive Summary

A survey of senior-level, experienced Industrial Internet of Things (IIoT) decision-makers and influencers in the manufacturing, oil and gas (O&G), and transportation industries confirms that IIoT has progressed beyond hype to widespread use. Eighty six percent of participants in the Bsquare 2017 Annual IIoT Maturity Survey have adopted IIoT solutions and 84% believe their solutions are very or extremely effective.

Almost all respondents believe that the technology provides a significant or tremendous global impact on their industry and that setting clear business objectives prior to deployment, such as better managing devices, increasing production volume, or reducing operating costs, is an important driver of deployment maturity and return on investment (ROI). Fewer than 2% of respondents are not considering an implementation within the next 12 months.

The survey results validate that IIoT adoption is a maturity progression where companies realize increasing levels of benefit as they expand from basic machine connectivity to advanced approaches including analytics, automation, and edge computing. Current adopters overwhelmingly cite device health as the top business challenge they are addressing followed by logistics, operating cost reduction, and increasing production volume. In spite of high adoption rates, only 54% of all the devices deployed in the adopter organizations are IIoT technology-enabled, leaving ample opportunity for growth.

As organizations see the increasing benefits of implementing IIoT, 73% of adopters say their investment will increase in the next 12 months, with transportation and manufacturing leading O&G. As the result of this continued investment, respondents expect to see increases in achievement of business priorities such as automation and real-time monitoring over the next year.

As the use of technology in industrial businesses continues to advance, an ever-growing percentage of machinery and tools now have the ability to collect data from connected equipment. This Industrial Internet of Things (IIoT) market is substantial with businesses projected to have over 3 billion devices deployed by the end of 2017. Connected devices are predicted to grow to more than 7.5 billion by 2020¹.

To extract business value from this growing population of connected equipment, the manufacturing, transportation, and oil and gas (O&G) industries are turning to IIoT technology platforms and software solutions to advance their digital transformations. These systems offer a host of benefits across the value chain. They can save millions of dollars by anticipating downtime or machine failures before operations are impacted. They can also streamline repair and maintenance processes, improve inventory management, and help make more efficient use of personnel such as repair technicians. These benefits serve to reduce operational costs and improve productivity.

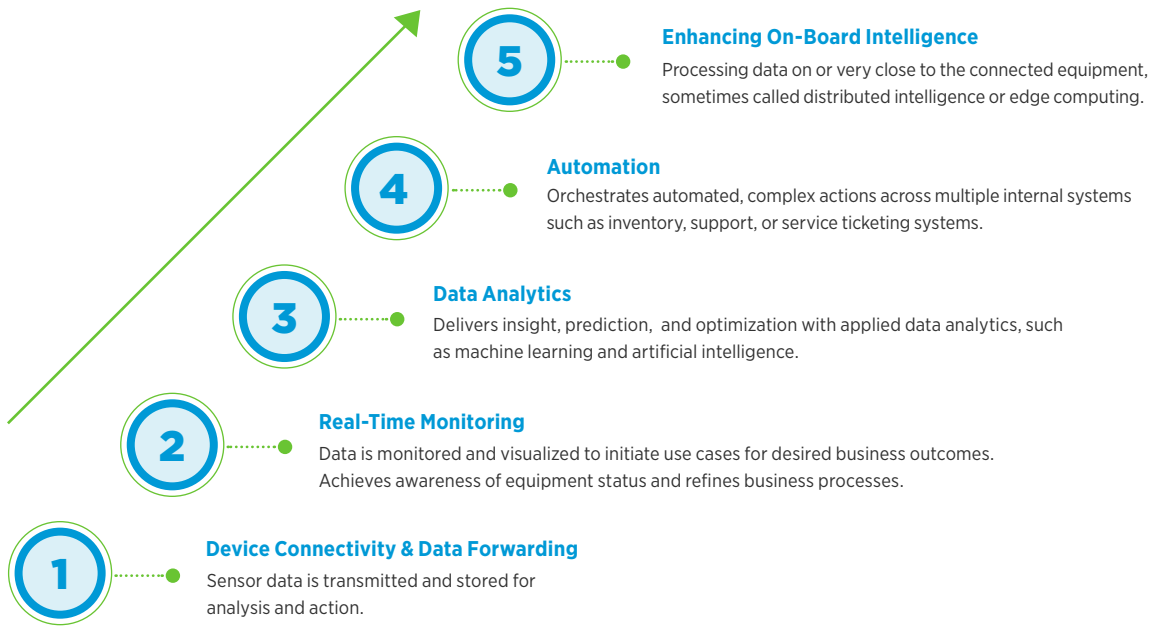
The Bsquare 2017 Annual IIoT Maturity Survey was conducted across these industries to understand participants' awareness and current use of IIoT solutions, what business goals are driving implementation, perceptions and expectations of IIoT, and what barriers are inhibiting adoption. The online survey was conducted in the United States between August 15 and September 1, 2017, and reached 310 respondents at companies with annual revenues of more than \$250 million for transportation and manufacturing, and in excess of \$400 million for O&G.

Participants were evenly divided among the three industry groups and titles covered a wide spectrum of senior-level personnel with operational responsibilities, most of whom had spent an average of six years in their organizations. A majority held operations roles or were line-of-business leaders or owners, with a significantly higher proportion of C-level respondents within transportation. More than 80% of respondents expressed a high level of knowledge about IIoT and have ultimate IIoT decision-making and/or influencing capacity within their organizations.

Of 310 total study participants, only five said they are not considering IIoT solutions. Among this small sample, the lack of senior management knowledge or commitment was cited as the primary reason for not implementing an IIoT technology solution in the next 12–24 months.

Evolution of a Connected Business Model: Stages of IIoT Maturity

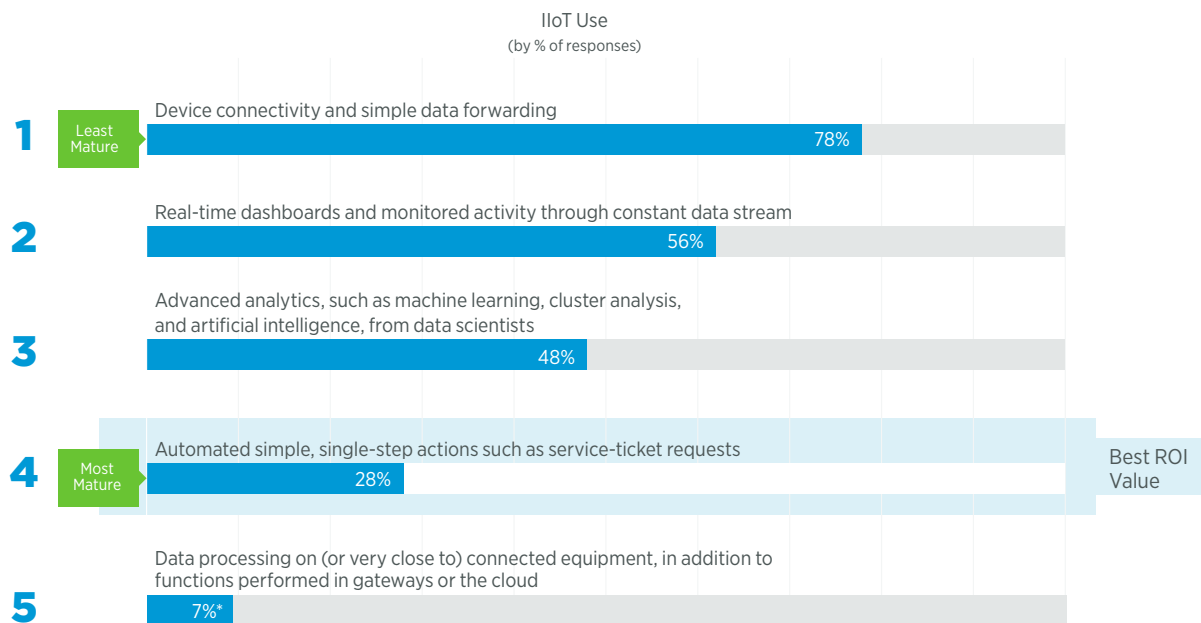
The Bsquare IIoT Maturity Index outlines the stages commonly associated with Industrial IoT technology adoption. Each phase typically builds on the previous one, allowing organizations to drive maximum value as they progress through the index. The stages include: 1) Device Connectivity – on-board logic to collect data and transmit to cloud databases, 2) Data Monitoring – dashboard and visualization tools to monitor real-time data, 3) Data Analytics – machine learning and complex analytics used to develop device models and insight, 4) Automation – development and execution of logic rules that automate business activities and device configuration, and 5) Edge Computing – distribution of analytics and orchestration to the device level.



¹ <https://www.gartner.com/newsroom/id/3598917>

The Current State of IIoT Adoption

Respondent organizations are taking a staged approach to IIoT adoption, based on their responses when asked how they are using IIoT. This aligns with the Bsquare Maturity Model, which outlines a multi-stage framework for IIoT advancement and return on investment (ROI) realization in industrial environments. Respondents validated that IIoT is a maturity progression, starting with basic device connectivity and advancing to fully automated business processes.



*Oil and gas only, transportation and manufacturing not surveyed

The dramatic drop between the number of respondents who have achieved basic connectivity and those who are using advanced capabilities such as automation and enhanced on-board intelligence represents a significant opportunity for organizations to derive greater ROI and business value from their IIoT investments.

Enhancing Operations Performance with IIoT

Gaining better visibility into and control over business-critical equipment is a top objective for respondents. More than 90% of adopters cited device health-related goals as drivers for IIoT adoption, including real-time device information, better device management, and device optimization. Nearly two-thirds (67%) cited logistics goals, followed by operating cost reduction (24%) and increased production volume and better compliance (18%).

There are many diverse options for selecting and implementing IIoT solutions, with organizations choosing their approaches based on business priorities. No clear one-size-fits-all approach emerged from survey results, indicating that organizations are carefully considering the approach best suited to their objectives.

When asked whether they were using IIoT to improve internal operations or processes, integrated into external products or services, or both (partly internal/partly external), more than two in five adopters and intenders use or plan to use IIoT technology for both internal and external uses. Only 36% plan to use IIoT only to improve internal operations, and just 20% are using IIoT solely to integrate into external products or services.

The ability to have convenient and customizable solutions was selected as the top driver for how respondents choose and implement their IIoT solutions, which aligns with the general consensus that IIoT initiatives can be complex. Responses also indicate that having a flexible IIoT partner is important to support changing implementation strategies based on evolving business priorities. Sixty percent said that existing, purpose-built applications designed for specific business outcomes was the preferred type of solution.

Among licensing options of an annual subscription license, SaaS (Software-as-a-Service), or a perpetual license, a little over half of all companies use an annual subscription license for their IIoT solution, with nearly 70% of O&G companies taking this approach. SaaS is the second most-popular option at 32%, and perpetual license the least often used, with only 14% choosing this method (totals add to more than 100% because many organizations will employ multiple models). Cloud-based implementation is by far the preferred method, likely due to ease of use and lower costs, with 77% using this approach. Amazon Web Services (AWS) and Microsoft Azure were tied for the top cloud provider at 14%. Twenty-three percent prefer an on-premise solution.

IIoT is Working

Companies across the board indicate that their IIoT solutions are effective and provide organizational performance improvement. When asked whether their IIoT solution has been extremely, very, moderately, somewhat, or not at all effective, 84% said their IIoT solutions have been extremely or very effective. In ranking organizational performance improvement as significant, fair, a little, or not at all, 91% indicated a significant or fair amount. Markedly more transportation respondents noted significant solution effectiveness and organizational improvement.

Those in O&G were slightly less enthusiastic on both counts, with the majority of respondents stating that their IIoT solutions are very, rather than extremely effective, and have shown a fair, rather than significant, amount of performance improvement. This is likely due to the relatively recent uptake of IIoT in their industry.

A Connected Future with IIoT

As companies see the positive impact IIoT is having on their businesses, they plan to continue their investment. Nearly 100% of respondents expect to invest the same or more over the next 12 months, with nearly three-fourths projecting an increase during that time frame. Fifty-one percent of transportation respondents say their investment will increase a lot, while O&G expects investment to either remain stable or increase a little.

The majority of companies expect that their existing uses will continue to be their primary focus over the next 12 months, with 79% citing data analytics and 71% real-time monitoring as the core planned use areas for their IIoT solutions. At the same time, responses indicate a projected increase in advanced uses, including a 35% increase in automating simple, single-step actions, and a 29% increase in real-time monitoring capabilities.

IIoT Impact by Industry

MANUFACTURING

The manufacturing industry has a long history of automated machines and systems. IIoT is part of larger Industry 4.0 and digital transformation efforts to help connect critical assets, extract data, and improve factory operations.

Current IIoT Adoption

Manufacturers are strongly committed to IIoT and place a very high level of importance on it for their organizations.

77% Currently have an IIoT solution in place **20%** Plan to implement an IIoT solution this year



44% have used IIoT for 12 months or more



98% of adopters indicated their solutions are very or somewhat important for their company



33% established their IIoT solution in the past 12 months

Solution implementation is based on business needs. Seventy-six percent have chosen a cloud-based solution compared to 24% for on-premise. This preference is likely driven by the ease of deployment offered by cloud-based solutions.

IIoT Business Maturity

In keeping with the Bsquare Maturity Model framework, manufacturing respondents indicated their use of the IIoT adoption stages:

- Device connectivity and simple data forwarding: 67%
- Real-time dashboards and monitored activity through constant data stream: 62%
- Advanced analytics, such as machine learning, cluster analysis, and artificial intelligence, from data scientists: 47%
- Automated simple, single-step actions such as service-ticket requests: 32%

IIoT ROI increases once businesses apply advanced analytics, such as machine learning, to identify data correlations in real-time, and automation of processes such as repair tickets. Because the use of these two stages lags behind device connectivity and real-time monitoring, manufacturing companies have significant opportunity to advance their IIoT capabilities for greater future impact. When asked how large of an impact IIoT technology and related solutions will have on their industry in the future, 90% of respondents said it will have either a significant or tremendous global impact.

Operational Impact of IIoT

Current adopters were asked to cite the top business challenges they were targeting with their IIoT solution. Logistics-related items and machine health topped the list, indicating that maintaining and optimizing equipment and operational parameters are closely tied to supply chain efficiency.

- 95% indicated logistics, including that on the factory floor
- Machine health followed with 82%
- Operating costs were cited by 34%

In terms of effectiveness of their IIoT solutions, 84% of respondents felt that their IIoT solutions are either very or extremely effective.

- 39% consider them extremely effective
- 44% consider them very effective

Organizational performance has improved with IIoT. Forty-four percent of respondents indicated that it has improved significantly, and another 44% said it has improved a fair amount.

Future Outlook

Given the positive operational and organizational impacts cited by respondents, it is not surprising that they plan to continue their investment into IIoT, and the majority plan to invest more. Within the next 12 months, 78% plan to increase their investment and 20% plan to spend about the same as the past 12 months.

Looking ahead, respondents plan to address the following business challenges:

- Orchestrating complex actions across multiple systems (such as equipment to inventory): 29%
- Orchestrating single-step actions (such as service ticket requests): 11%
- Using a data stream to populate real-time dashboards: 8%

TRANSPORTATION

The transportation industry, including off-road construction and agriculture equipment, is made up of both heavy-duty equipment manufacturers and operators, and is a leader in using IIoT when compared to manufacturing and O&G.

Current IIoT Adoption

Ninety-three percent of respondents currently have an IIoT solution in place and virtually all believe IIoT is important for their company.

93% Currently have an IIoT solution in place

6% Plan to implement an IIoT solution this year



58% have used IIoT for 12 months or more



99% of adopters indicated their solutions are very or somewhat important for their company



42% established their IIoT solution in the past 12 months

Sixty-eight percent of respondents indicate that they prefer a cloud-based deployment model over on-premise. As with their manufacturing counterparts, this is likely due to the ease of use and lower costs.

IIoT Business Maturity

The transportation industry has attained a greater level of IIoT maturity due to the widespread use of telematics and regulatory mandates such as emission regulations and Electronic Logging Devices (ELD). Survey statistics bear this out:

- Device connectivity and simple data forwarding: 88%
- Real-time dashboards and monitored activity through constant data stream: 66%
- Advanced analytics, such as machine learning, cluster analysis, and artificial intelligence, from data scientists: 50%
- Automated simple, single-step actions such as service-ticket requests: 26%

Transportation respondents also have a significant opportunity to gain additional business value from IIoT with continued investment into advanced analytics, including machine learning to diagnose repairs and predict failures before they occur, and automation of actions such as service-ticket requests.

Nearly 100% of respondents feel that IIoT has either a tremendous or significant impact on their industry at a global level.

Operational Impact of IIoT

Vehicle performance tops the list of business challenges current adopters are targeting with IIoT, followed by logistics and operating costs.

- Vehicle performance: 95%
- Logistics: 65%
- Operating costs: 23%

A vast majority (96%) of adopters feel that their IIoT solutions are either extremely or very effective. Organizational performance has also improved, according to 98% of respondents, with 54% saying it has improved significantly, and 44% say a fair amount.

Future Outlook

Building on their positive experiences with IIoT, 85% of transportation organizations plan to increase their investment over the next 12 months, with 15% planning the same level of investment. No respondents said that they will reduce their IIoT investment.

Within the next year, respondents will continue to focus on current business challenges. Twenty-four percent also expect to focus on orchestrating single-step actions such as automated service ticket requests.

OIL AND GAS

The digital transformation of O&G environments is in the early stages and is driving the adoption of IIoT. However, the average number of connected devices in the O&G industry is just under 40%, which is significantly lower than the 66% in transportation and 54% in manufacturing. This may be a contributing factor into O&G's relatively late entry into IIoT adoption.

Current IIoT Adoption

The O&G industry falls between transportation and manufacturing in rate of adoption, with nearly 90% having an IIoT solution in place. However, the majority have just installed their solutions within the past 12 months.

89% Currently have an IIoT solution in place **10%** Plan to implement an IIoT solution this year



26% have used IIoT for 12 months or more



77% of adopters indicated their solutions are very or somewhat important for their company



63% established their IIoT solution in the past 12 months

Like their counterparts, O&G respondents also expressed a preference for a cloud-based implementation, with 88% choosing this model versus 13% for an on-premise approach.

IIoT Business Maturity

It is clear from the processes being used by the majority of O&G respondents that this industry is early in IIoT maturity as outlined by the Bsquare Maturity Model. The largest majority is using the first stage of device connectivity and data forwarding.

- Device connectivity and simple data forwarding: 76%
- Real-time dashboards and monitored activity through constant data stream: 49%
- Advanced analytics, such as machine learning, cluster analysis, and artificial intelligence, from data scientists: 46%
- Automated simple, single-step actions such as service-ticket requests: 27%
- Data processing on (or very close to) connected equipment, sometimes called edge computing, in addition to functions performed in gateways or the cloud: 7%

Even more than its counterparts, the O&G industry has ample opportunity to expand their IIoT ROI by expanding investment into and focus on the advanced stages of IIoT.

Nearly 100% agree that IIoT has a positive global impact on their industry, although they are slightly less enthusiastic than their counterparts – likely due to the nascent nature of IIoT in the O&G industry. Seventy-eight percent feel that IIoT has a significant impact and 21% feel that it has a tremendous impact.

Operational Impact of IIoT

Nearly all O&G adopters state that machine health is the primary business challenge they are targeting with IIoT, followed by device connectivity and automated actions.

- Machine health, including predictive failure: 95%
- Device connectivity: 76%
- Automated actions: 27%

In terms of effectiveness and organizational improvement, O&G responses lag their counterparts, again likely due to the short amount of time solutions have been in use. Seventy-three percent feel that their IIoT solutions are either very or extremely effective. Seventy-three percent also state that they have seen a fair amount of organizational performance improvement, with 13% seeing significant improvement.

Future Outlook

O&G adopters expect to be more conservative than their counterparts over the next year. Slightly more than half (56%) plan to increase their investments, and 41% plan the same level of investment. It is important to note that 71% of IIoT adopters have fewer than 50% of their deployed devices connected and/or IIoT-enabled.

Seventy-one percent plan to focus on orchestrating single-step actions such as service ticket requests over the next 12 months. Twenty-four percent will focus on orchestrating complex actions across multiple systems, such as equipment tie-ins to repair parts inventory. Similarly, 24% plan to use IIoT to perform historical data analysis.

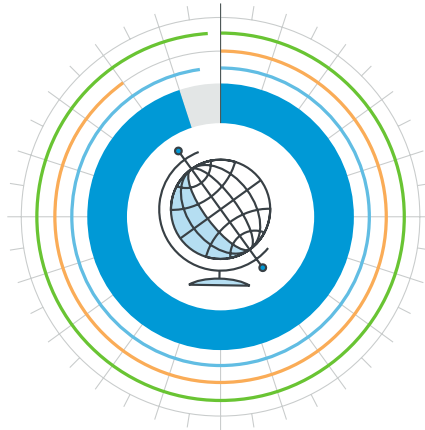
In Summary

IIoT is clearly here to stay and is providing companies with tangible business benefits. More than 90% of study participants stated that IIoT has an important positive impact on their industry and their organizations. Nearly the same percentage already has IIoT solutions in place and feels that their solutions are effective. Setting clear business goals prior to deployment, such as reducing operating costs, better managing devices, or increasing production, is a key driver of deployment maturity and At the same time, almost every respondent acknowledged that implementing IIoT is complex, leading to the selection of solutions that help simplify initiatives. Most said that device health, logistics, and reducing operating costs were the primary reasons they have embraced IIoT.

Considered Industry Impact at a Global Level

95%

consider IIoT to provide a tremendous or significant industry impact at a global level



● 98% Transportation

● 98% Manufacturing

● 98% Oil and Gas

The manufacturing and transportation industries lead O&G in terms of maturity and results; however, O&G is adopting IIoT at a more rapid rate than the more technologically seasoned manufacturing industry.

Input into and influence over IIoT initiatives come from a diverse set of leaders within organizations. Those who have already adopted IIoT had clearly stated business goals they were trying to achieve with their solutions as well as buy-in from upper management, indicating that holistic benefit across the organization is important to their proven success.

Looking ahead, the majority of manufacturing and transportation respondents plan significant increases in IIoT spending in the next 12 months. O&G respondents project more conservative spending, with slightly more than half planning increases and slightly less than half investing the same. Virtually no respondents expect to reduce their spending.

Across industries, most respondents will continue to focus on existing business objectives and processes. There is increasing interest in more advanced applications of IIoT such as orchestrating simple and complex actions across their organizations.

About Bsquare

For more than two decades, Bsquare has helped its customers extract business value from a broad array of physical assets by making them intelligent, connecting them, and using the data they generate to optimize business processes.

Bsquare DataV software solutions can be deployed by a wide variety of enterprises to create business-focused Internet of Things (IIoT) systems that more effectively monitor device data, automate processes, predict events, and produce better business outcomes. Bsquare goes a step further by coupling its purpose-built DataV software with comprehensive analytic and engineering services that help all types of organizations make IIoT a business reality.

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