From Interpretation to Prediction
Unleashing the Value of the Industrial Internet of Things
Making another century of impact
德勤百年庆 开创新纪元
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Value of IoT in the Industrial sector

In today’s business world, all companies are facing a challenge that can be turned into a great opportunity: the transformation from a reactionary towards a visionary approach. Retrospective analysis and delayed responses are no longer suitable for today’s rapidly changing business environment. As with the increased use of sensors and improved quality of data, Internet of Things (IoT) allows companies to act with foresight, preventing significant losses and creating value.

According to Gartner, the number of IoT equipment installed worldwide reached 6.4 billion in 2016, representing a 30% year-on-year growth, and it is expected to reach 20.8 billion in 2020. The global endpoint spending on IoT was about USD 1.414 trillion in 2016, composed of USD 546 billion from consumer applications, USD 201 billion from cross-industry business applications, and USD 667 billion from vertical industry applications. By 2020, the total expenditure on IoT is expected to reach USD 3.011 trillion, and the afore-mentioned market segments are expected to grow to USD 1.534 trillion, USD 566 billion and USD 911 billion, respectively. This represents compound annual growth rates (CAGR) of 29%, 30% and 8%, respectively.
IoT projects are currently mostly used in the industrial sector. IoT Analytics believe that the manufacturing industry accounts for around 25% of IoT applications while Harbor Research and CISCO estimated its percentage at 27% and Gartner calculated a 15% share. Although estimates by research firms vary, the manufacturing industry takes the lead in IoT. The figure below shows Gartner’s forecast of the overall IoT market and Industrial IoT applications. (Figure 1)

In China, the ecosystem for IoT has become increasingly mature as demand for industrial IoT applications continues to increase. According to CIC estimates, the scale of Industrial IoT in China reached RMB115.7 billion in 2014, accounting for 18% of the overall industry of IoT, while it today reaches approximately RMB150 billion, a growth rate of 29%. By 2020, Industrial IoT is expected to account for 25% of the overall IoT with an industrial scale exceeding RMB450 billion.

Figure 1. Global Endpoint Spending on IoT and Industrial IoT

![Figure 1](image_url)

Source: Gartner, Deloitte Research
The source of value and how it works

Given the great potential of Industrial IoT, we need to reflect on the ultimate origin of its value. IoT creates an overall new type of value, which is particularly different from the one derived from products and services: self-managed information and insights. More precisely, IoT can turn almost anything into a source of relevant information.

As early as 2015, Deloitte for the first time published the concept of the new value source derived from IoT, the so-called "information value loop" (Figure 2). The core question of every company when defining a strategy is: how do we create value and how can this value be captured? The IoT is changing the way of how companies create value: traditionally, value creation was considered to be driven by the concept of the so-called "value chain" – a linear series of steps, that transforms inputs into outputs. The IoT technology allows to capture the information generated by these products and services – information that creates value in a fundamentally different way, put together and explained in the "information value loop".
The information value loop begins with the creation and interaction of information in a new environment. Sensing technology enables every action to produce information, leading to a stage of "creation". The network, typically provided and managed by the communication service providers, connects the "creation" and "interaction" stages. This connection releases information and activates the rest of the closed loop – leading to an all-new form of opportunity for cooperation.

It should be noted that the information value loop is a closed loop, which means behavior—the state or behavior of objects in the real world—generates information. This information is then used to predict future behavior. The information which makes the closed loop complete and creates value, will go through the various stages of the closed loop, whereas each stage is driven by a specific "technology." A "sensor" that creates information monitors every action. The information achieves interaction via a "network", and then "standards" of technology, law, regulation, or the society bring them together across time and space. "Augmented intelligence" is a generic term referring to analytical tools that support information analysis. The information value loop is ultimately accomplished by "augmented behavior ", i.e. technologies that help to be compliant concerning prescribed actions, leading to improved behavior.
IoT can significantly reduce the cost of computing and data storage, overturning previous definitions and frameworks for business value. We can think about the business value and opportunities generated by IoT via the following indicators (Figure 3).

**Figure 3. Dimensions for measuring the business value of IoT**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial indicators</strong></td>
<td>A company needs to maintain a balance of revenues, expenditures and assets to ensure its operation, while the management of most companies focuses on how to reduce costs, improve asset efficiency and relief the debt burden – and not on exploring ways to develop new sources of revenue through new and innovative programs.</td>
</tr>
<tr>
<td><strong>Operational indicator</strong></td>
<td>Changes in financial indicators reveal three core business processes of a company: customer lifecycle, product lifecycle and equipment lifecycle. At present, most companies invest mainly in the equipment lifecycle (such as optimizing equipment operation and boosting usage). For the customer lifecycle and product lifecycle, intelligently connected equipment can not only provide new analysis and performance, but also effectively manage the way companies develop customers and products. Moreover it can provide information about the customer lifecycle, the product as well as the related revenue and profit in detail.</td>
</tr>
<tr>
<td><strong>Business performance improvement</strong></td>
<td>Most of the current IoT solutions are used in specific circumstances, such as inventory reduction or mechanical breakdowns. Only a small part of these companies use the data from IoT to improve the overall production process and product design. If companies seek to make the most of IoT solutions, a long-term perspective is required, ensuring long-term performance improvement rather than focusing on a single transaction (such as a single transaction with customers or suppliers). Only then can companies compare past and future performance, and achieve sustainable value-added improvements.</td>
</tr>
</tbody>
</table>

Source: Deloitte University, Deloitte Research
The analysis from the above three dimensions clearly demonstrates that the business value of IoT will increase efficiency, promote business growth and enhance risk management, explained in more detail in Figure 4 below.

**Figure 4. Business avatar of the value of IoT**

<table>
<thead>
<tr>
<th>Efficiency improvement</th>
<th>Business growth</th>
<th>Business performance improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increase asset usage and reduce downtime</td>
<td>• Explore sources for core business growth</td>
<td>• Ensure product safety</td>
</tr>
<tr>
<td>• Improve business agility and response to changes</td>
<td>• Increase sources of income in after-sales market</td>
<td>• Improve asset security</td>
</tr>
<tr>
<td>• Streamline supply chain or reduce supply chain costs</td>
<td>• Deepen understanding and insight about customers</td>
<td>• Improve operational security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ensure stability and accuracy of planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve legal compliance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Effectively manage warranty and recall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhance cyber security</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Embodiment of the value of Industrial IoT applications in China

While China’s manufacturers recognize the importance of industrial IoT, they have not established clear-cut IoT strategies. The Deloitte Survey on the Industrial IoT Applications in the Chinese Manufacturing Industry shows that 89% of the companies surveyed believe Industrial IoT is critical to business success in the next five years. While 72% have started Industrial IoT applications in one form or another, only 46% have established clear-cut Industrial IoT strategies and plans. (Figure 5)
**Figure 5. Awareness and applications of Industrial IoT in the surveyed companies**

- Industrial IoT is critical to the business success: 89% Agree, 4% Disagree, 6% No Idea
- Have started to apply Industrial IoT to some extent: 72% Agree, 24% Disagree, 4% No Idea
- Have a clear Industrial IoT strategy: 46% Agree, 44% Disagree, 10% No Idea


**Figure 6. Companies surveyed use sensors to collect data**

- Use sensors to collect product data: 11% Use other tools to collect data, 13% No Plan, 31% Plan to start, 45% Already started collecting
- Use sensors to collect equipment data: 11% Use other tools to collect data, 26% No Plan, 53% Plan to start

Manufacturers are still in the beginning phase of data applications – the shift from interpretation to prediction takes time. Most companies surveyed have begun to use sensors to collect data from products and devices or are intending to do so. More precisely, in terms of product data, 45% of the companies surveyed have already begun to collect data and 31% intend to start the collection. In terms of equipment data, 53% of the companies have started to collect data while 26% have made plans for collection. (Figure 6)

However, these companies remain in the perception stage of data application, and have not reached the action phase yet (Figure 7).

In-depth Industrial IoT applications require companies to change the way they use data—a transformation from interpretation to prediction. After using the data collected from a variety of sensors to interpret patterns of historical performance and the root causes, companies need to adopt a forward-looking perspective: how can the collected data be used to improve intermediate process and product sales? What sort of products and services may bring in new sources of revenue in the future? And what kind of IoT applications may open up new markets?

Figure 7. How companies use the data collected (percentage represents the proportion of firms choosing this option)

| Data visualization                      | 65% |
| Root causes analysis                    | 57% |
| Generate management reports and KPI dashboard | 51% |
| Develop forecasting models and optimization models | 37% |
| Data mining to discover new insights    | 26% |
| Others                                  | 2%  |

Key drivers - optimizing supply chain for efficiency improvement, enhancing customer experience for revenue growth and improving product safety for better risk management.

Our findings show that the Industrial IoT applications of Chinese manufacturers are mainly driven by efficiency improvement although revenue growth and risk management promotion have started to attract increased attention.

• Efficiency Improvement

In terms of efficiency improvement, optimizing supply chains through Industrial IoT applications has received the most attention, with 116 out of the 156 companies surveyed (74%) desiring to improve the efficiency of their supply chains and reduce costs through Industrial IoT applications. Some 110 companies (70%) desire to use technologies such as predictive maintenance to improve operational efficiency and reduce downtime, while others hope to improve business agility and legal compliance (Figure 8).

Real-time data of supply chains can help pinpoint problems even before they occur. As a result, a company may reduce inventory and even capital requirements. Industrial IoT can help manufacturers better understand this information. By connecting factories to suppliers, all parties involved in the supply chain can track the interactions among them, the material flow, and the manufacturing cycle. Systems that support Industrial IoT enable location tracking, remote inventory monitoring and access to reports of parts and products moving in the supply chain. They can also collect and provide delivery information to enterprise resource planning (ERP), product lifecycle management (PLM) and other systems.

Figure 8. Key areas of efficiency improvement in the companies surveyed after the implementation of Industrial IoT applications (figures represent the number of firms choosing this option)

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain optimization</td>
<td>116</td>
</tr>
<tr>
<td>Capital operation efficiency improvement</td>
<td>110</td>
</tr>
<tr>
<td>Business agility</td>
<td>92</td>
</tr>
<tr>
<td>Compliance</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: 2016 Deloitte’s Survey on the Industrial IoT Applications in Chinese Manufacturing Industry, Deloitte Research
Revenue growth

When it comes to the value proposition of IoT, industrial companies focus not only on efficiency improvement and cost reduction but also on business growth. Through data analysis, including the previously undeveloped data, translating the data into applicable market insights helps companies to better serve their customers, providing new opportunities to improve customer loyalty and satisfaction.

Out of the 156 companies surveyed, 113 (72%) desire to improve their customer experience and generate revenue through Industrial IoT applications, while 107 companies (69%) hope to develop new products and services with the data generated by Industrial IoT and 95 companies (61%) want to use the IoT data to help them achieve innovation in their business models (Figure 9).

Figure 9. How companies intend to increase revenue (figures represent the number of firms choosing this option)

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer experience improvement</td>
<td>113</td>
</tr>
<tr>
<td>New products and services</td>
<td>107</td>
</tr>
<tr>
<td>New business models</td>
<td>95</td>
</tr>
<tr>
<td>New markets</td>
<td>91</td>
</tr>
<tr>
<td>Improvement in core business</td>
<td>73</td>
</tr>
<tr>
<td>Better pricing</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: 2016 Deloitte’s Survey on the Industrial IoT Applications in Chinese Manufacturing Industry, Deloitte Research
• **Enhance risk management**
  Regarding the optimization of the risk management, key areas the companies surveyed focus on are product safety (77%), asset security (65%), operational security (65%), and effective management of warranty and recall (61%) (Figure 10).

In terms of product safety, companies have improved quality control by maintaining the traceability of digital thread of products from raw materials to end products. Companies also use artificial intelligence algorithms and optimization programs to reduce rework and waste.

**Figure 10. Risk management improvement enabled by the Industrial IoT is mainly reflected in four areas. (The number represents the number of companies choosing this option.)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure product safety and quality</td>
<td>120</td>
</tr>
<tr>
<td>Improve assets security</td>
<td>101</td>
</tr>
<tr>
<td>Improve operational safety</td>
<td>100</td>
</tr>
<tr>
<td>Effectively manage warranty and recall</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: 2016 Deloitte’s Survey on the Industrial IoT Applications in Chinese Manufacturing Industry, Deloitte Research
The focus of future Industrial IoT applications will shift from equipment and assets to products and customers.

Industrial companies equipped with IoT may generate business growth mainly in two ways: new products and services and closer customer relationships. To develop more attractive products or to enhance existing customer relationships, a significant amount of data concerning products and customers is needed.

At present, there is much less information on products and customers available compared with the data on assets and equipment. Driven by the demand for efficiency promotion as well as business growth, companies will shift their attention from equipment and assets to products and customers.

When asked in which areas more detailed and constructive data is needed, 69% of the companies chose the product data while 61% selected the customer data, surpassing the operational data (53%), sales data (53%) and asset and equipment data (42%). (Figure 11)

Key challenges - lack of interoperability standards, data ownership and security as well as under-qualified operators (Figure 12).

![Figure 11. Areas need more detailed and constructive data](source)

Source: 2016 Deloitte’s Survey on the Industrial IoT Applications in Chinese Manufacturing Industry, Deloitte Research
Figure 12. Biggest issues for companies in applying Industrial IoT technologies (percentage represents the number of firms choosing this option)

- The lack of interoperability and standards: 52%
- Ownership and security of data: 46%
- Underqualified operators: 42%
- Data quality: 38%
- The lack of capability to carry out data analysis and provide new insights: 36%
- Coordination inside the company: 26%
- Cyber security: 24%
- Inadequate budget: 17%

Source: 2016 Deloitte’s Survey on the Industrial IoT Applications in Chinese Manufacturing Industry, Deloitte Research
• **The lack of interoperability standards**
  For 52% of the companies surveyed, the lack of interoperability standards is one of the major challenges in applying Industrial IoT technologies. Related studies show that due to the lack of interoperability 40% of the potential value of Industrial IoT cannot be realized.

• **Ownership and security of data**
  A total of 46% of the companies surveyed believe ownership and security of data are major challenges in applying Industrial IoT applications. The market has yet to agree on who owns the data, manufacturers or users of the equipment with which the data is collected. Most equipment suppliers tend to provide customers with an effective access to raw data, encouraging users to participate in manufacturing improvements. Regardless of the role they play—the data owner or the data guardian—equipment suppliers can reap their own profit from data generated by the Industrial IoT only after they share the data with and provide valuable services to their customers.

  Security is another obstacle for Industrial IoT. The sustained surge in the number of connected devices has provided industrial systems with unprecedented opportunities for growth and performance improvements. Nevertheless, this growth also poses new risks for industrial companies, especially considering the exponential risk of data breach. The security issue of Industrial IoT covers all aspects – from industrial processes and applications to safety and reliability requirements – and can therefore not be addressed in isolation.

• **Lack of relevant technical personnel**
  Lack of qualified technical personnel is another major challenge for 42% of the companies surveyed. Considering factors such as the big variety of Industrial IoT applications and circumstances, new data sources, changes in system architecture data as well as multi-structured data, today's manufacturing companies do not have adequate analytical capabilities and required talents. Although many manufacturers do have sufficient experience in data analysis, their experience, however, mainly concentrates on the descriptive analysis based on the structural data sets instead of the predictive and pattern analysis using collected real-time big data in conjunction with a variety of unstructured data.

  Although many universities are trying to develop appropriate talents in the field of data sciences, the number is still limited. Competition for high-end talents will become more intense. Thus, companies should recognize that building partnerships with educational institutions is becoming increasingly important.
Unleashing the business value of Industrial IoT

Industrial IoT will become a new source of revenue and improve efficiency and security, creating new value for businesses. To realize such value, companies need to take the following strategies into consideration:

**Aim high, start small, create value and accelerate upgrades**
Building an industrial IoT framework largely depends on a clear-cut strategy, which defines scopes and targets of IoT applications. A company without a clear-cut strategy always leans on a single-issue technology to solve diverse business problems while a company with a clear-cut strategy focuses on the comprehensive application of multiple technologies to change the overall way it operates and does business.

Industrial IoT has significant potential but applying it requires changes and adjustments in business culture, infrastructure, technical capability and human resource. Thus, if companies attempt to solve problems in a comprehensive manner, their growth might be stalled.

Consequently, companies should aim high but start small to create value and upgrade fast. Only when a series of small tasks is completed, big changes can happen. Companies should first launch specific pilot projects that will support the long-term goals, and find the necessary technologies for future promotion and fast upgrades only during this process.
Focus on the product and customer lifecycles
The value of industrial IoT does not only derive from management of products and equipment but also from management of products and customer lifecycles.

In order to extend these two lifecycles, identifying ways to convert a one-time transaction into a sustainable income source is crucial. One way to achieve this is for example the Manufacturing-as-a-Service (MaaS), which is based on Pay per Use. But many other ways that ensure closer customer relationships and sustainable value creation and fee charges can be considered.

Develop the ability to apply big data
The implication of big data is not to collect more data as such, but to be able to accomplish in-depth analysis to solve problems or to identify predictive policy decisions.

When companies build big data applications, they should start by designing a top-level framework based on business strategies and IT strategies. This framework should include the following elements: a) targets and strategies for big data applications, providing the roadmap for building applications and platforms; b) circumstances where big data analysis and modeling are used, providing clear configuration of big data applications based on value chain and customer lifecycle; c) big data analysis and modeling, which provides direction for problem solving through identifying challenges and applying multiple algorithms and d) a big data technology platform, which provides the necessity to track development trends of technologies and utilize all kinds of application systems in the company.

Improve security
Many companies decided to establish information security frameworks and mechanisms to minimize the risks. Information security mechanisms include information security targets (incidences, breaches, minimal value of production end time), security measures (physical measure, network, host, data, personnel, emergency preparedness and document management measures) and security management systems (for data centers, networks and sensitive devices and so on).

In addition to traditional information security risks, cyber risk has become an increasingly sensitive issue of IoT. Companies can manage cyber risk by applying the following measures:

- Define interoperability standards: following a universal standard can help ensure secured and effective communication and collaboration amongst devices.
- Use special devices and components instead of retrofitting the old systems: since old systems are not designed to cope with IoT security problems, companies should use new security technologies instead, specifically designed for IoT or components targeting cyber security problems.
Clarify areas of responsibilities for participants of the ecosystem: everyone in the IoT ecosystem should understand where their responsibilities begin and end, evaluating the potential risk at every juncture. Knowing the origin of a certain risk factor can help develop more secured solutions.

Develop data baseline: data baseline can help companies distinguish suspicious situations from normal ones, enabling companies to react when data goes out of the normal range.

Enhance data governance: management systems on data collection, usage and storage can help avoid damage and prevent negative influence from spreading.

Establish flexible coupling systems: if coupling systems are loose and flexible, the breakdown of a single system will not result in losses on a large scale.

Ensure proper positioning and cooperation in the ecosystem.

The overall system of Industrial IoT cannot be established by one single manufacturer. Rather, such system needs to be developed within a complete ecosystem.

GE Digital is now working with Dell, EMC, Microsoft, SAP, Nokia and dozens of other companies to develop an Industrial IoT platform, which allows these companies to develop new industrial applications and offer value-added applications to customers. And this is only one case among many others. Companies like Honeywell, Schneider, Cisco, IBM and Accenture are also in close cooperation, building an industrial IoT platform.

Of course, not every company can become an ecosystem builder and promoter like GE, especially if there are already too many IoT platforms on the market. The industry as a whole is expected to go through numerous integrations of IoT platforms while many existing ones will be eliminated. Whether companies should position themselves as builders of ecosystems, providers of modular products or establishers of channels will depend on how their businesses are designed and how profound their knowledge of their end users is.

Technological advances have unlocked the potential of IoT solutions in industrial applications. Such solutions improve operation efficiency, increase sources of revenue and inspire innovation. IoT has proved to be able to help companies create more and sustainable value and to convert one-time transactions in the past to long-term customer relationships. Although connectivity and security problems remain an issue, we still expect IoT to sweep through many important segments in the industrial sector.
IoT has proved to be able to help companies create more and sustainable value and to convert one-time transactions in the past to long-term customer relationships.
Endnotes


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5. Zhang Lili, Jiudao Tech “The four major areas of Industrial IoT and big data analysis”, https://kknews.cc/zh-sg/tech/ep93a4.html


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CQ-021EN-17

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