

## Industrial IoT High-skilled Talents Training under the Background of Intelligent Manufacturing

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### Abstract

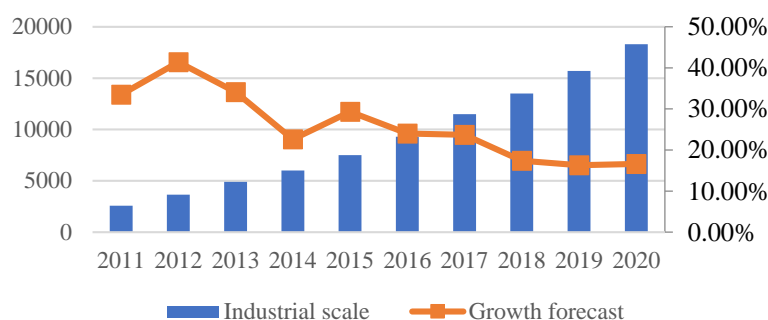
Industrial IoT is developing rapidly. The training of highly skilled talents can't meet the large demand of the industry development. Based on the investigation of the employment needs of enterprises in this area, this paper refines the talents' scarce posts and ability needs. Some suggestions are put forward to optimize the training program. The results can provide theoretical guidance for the talents training of the industrial IoT.

### Keywords

Industrial IoT, high-skilled talents, vocational skills, training program.

### 1. Introduction of IoT Development

Recent years, policies in the field of IoT (Internet of Things) have emerged frequently to support the development of IoT. From the perspective of top-level design, we can clearly see that IoT industry has gained widespread concern and fast development. In January 2017, the 13th Five-Year Plan of IoT issued by the Ministry of Industry and Information Technology clearly defined the development objectives of the 13th Five-Year Plan of IoT industry was to improve the system of technological innovation, to build and improve the standard system, to promote the scale application of IoT, to improve the public service system, and to enhance the ability of security and other specific tasks [1]. In June 2017, the General Office of the Ministry of Industry and Information Technology issued a circular on the overall promotion of the construction and development of the Mobile Internet of Things (NB-IoT) [1]. The notice mentioned that we should comprehensively promote the construction of wide coverage, large number of node connection and low power mobile Internet of Things (NB-IoT), aiming to achieve universal coverage and deep coverage of NB-IoT network for the whole country by 2020.



**Figure 1.** The overall industrial scale and growth forecast of the Internet of Things in China from 2011 to 2020

According to the development trend in recent years, CIC Consulting Industry Research Center predicts that 77 billion devices will be connected to the Internet, with a market scale exceeding trillion US dollars by 2022 [2].

The ecological environment of the development of IoT in China is becoming more and more mature. The application demand of in the industrial field is gradually strong[3]. As the second largest industrial city in China, Suzhou has been committed to promote the development of manufacturing industry from automation to intelligent manufacturing. "The Outline for the Implementation of Made-in-China 2025 Suzhou" proposes to speed up the upgrading of Suzhou's industrial economy and build a new industrialization system considering the characteristics of Suzhou. By 2025, Suzhou is aimed to become a leading and world-renowned advanced manufacturing city in the country. In "The Four Major Progresses of Making an Advanced Manufacturing Base with International Competitiveness in Suzhou", the decision of the action plan clearly shows that the value-added rate of manufacturing industry will reach 23% and 25% respectively in 2020 and 2025. In the process of vigorously promoting intelligent manufacturing in Suzhou, the industrial IoT is an indispensable part of the development of the whole industry.

In 2014, the overall industrial scale of industrial IoT reached to about 115.7 billion RMB, accounting for 18% of the total IoT. In 2015, the scale was close to 150 billion RMB, with a growth rate of 29%. By 2020, the industrial IoT will account for 25% of the total IoT industry, and its scale will exceed 450 billion RMB. At present, manufacturing enterprises generally agree with the importance of industrial IoT, but have not yet formed a clear strategy. According to Deloitte's 2016 survey, 89% of the surveyed enterprises agreed that the industrial IOT is crucial to the success of enterprises in the next five years. 72% of the enterprises have begun to apply the IOT system to a certain extent, but only 46% of the enterprises have formulated relatively clear strategies and plans for the industrial IOT. Therefore, the next few years will be a period of rapid development of industrial IoT[2].

## 2. Talent Demand of Internet of Things Industry

### 2.1. Demand for Professionals

The IoT industry continues to grow at a high speed, and the training of highly skilled talents is far from meeting the needs of the industry. Zhao Fu who is the deputy director of the IoT Research and Development Center of the Chinese Academy of Sciences introduced that the demand for talents in the field of intelligence will exceed 200,000 in the next few years at the annual meeting of the deans of the National Institute of IoT in 2018[4]. Now, there are more than 1000 colleges and universities offering IoT majors in China, with less than 100,000 graduates each year. The situation of shortage of supply and demand is obvious. By the end of 2017, the demand for skilled technicians in Suzhou had reached to 796,000 people, among which, there was a shortage of skilled technicians in the direction of the IoT. In the Catalogue of Shortage Talents Demand for Key Industries of Suzhou in 2018, 31 new generation of vacant positions in the field of electronic information have been published, of which 6 are in the direction of IoT, and the degree of shortage is 4 (the maximum is 5)[5]. At present, IoT personnel training is mainly oriented to smart home, smart city and other directions. With the advancement of intelligent manufacturing, the demand for professional talents in the direction of industrial IoT will become a new growth point.

### 2.2. Position Analysis

At present, the structural contradiction of talents in IoT industry is significant. High-level talents and skilled talents are in short supply, which restricts the development of industry. Although IoT talents are constantly being trained, the proportion of high-level skilled talents is

relatively low. Technical talents who are familiar with IoT equipment installation, maintenance, project implementation and after-sales service are very popular. Considering that IoT covers a wide range of industries, we conducted in-depth research on 20 related enterprises in this area. 45% of these enterprises are engaged in the IoT overall solution. By investigating the exhibitors of the IoT exhibition and the online survey, the results show that the proportion of enterprises engaged in the overall solution design is higher than other enterprises in IOT industry, and the results are consistent with the distribution of the enterprises we surveyed. In addition, it also includes electronic, communication and Internet enterprises.

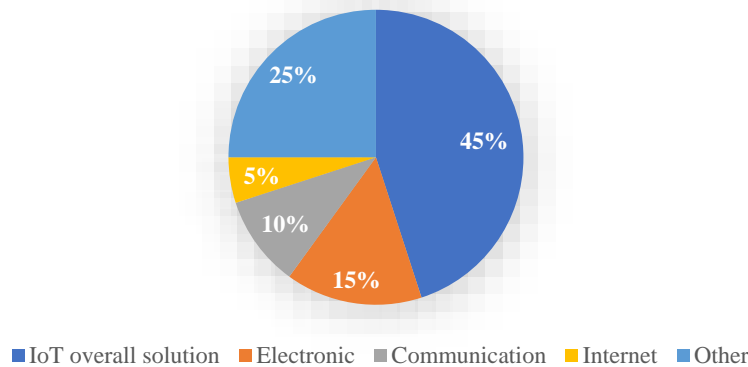


Figure 2. The distribution of survey enterprises

By survey, the main shortage positions of these enterprises were investigated. The results showed that pre-sale, post-sale and project implementation engineering were very scarce. 60% of the surveyed enterprises had a demand for these positions. Such talent demand is also determined by the characteristics of IoT enterprises. Taking the related companies of overall solution design as an example, most companies are not selling standard products, but mainly providing solutions and implement them according to different project needs. For project-oriented enterprises, each project needs to be equipped with corresponding pre-sale, after-sale and project implementation personnel. Such personnel also need solid professional knowledge to support their job content. Product testing engineers, sales staffs, assistant R&D personnel are also demanded. At present, the training of these talents is not enough to support the rapid development of industry.

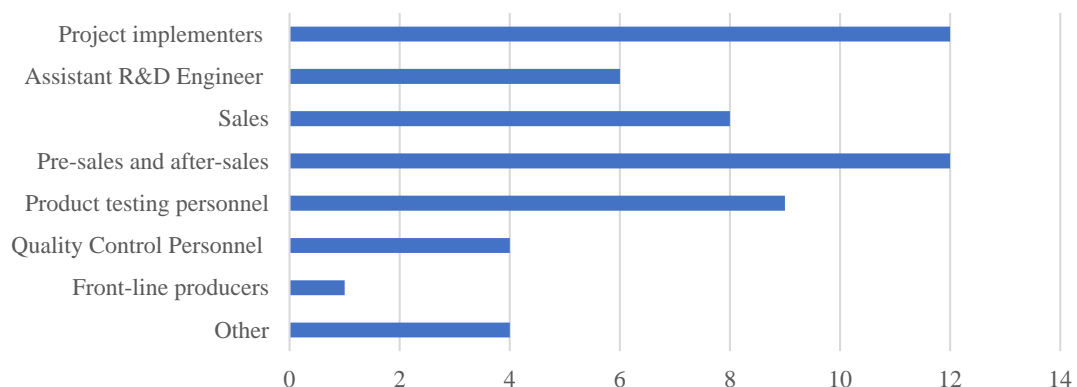


Figure 3. Demand post distribution of survey enterprises

According to the above research results, the development of enterprises under the background of "Made in China 2025" will influence talent demand and the post will also change. The rapid development is also impact higher vocational education. The talent training standards and market posts is changing quietly. In response to the development opportunity of "Made in China

2025", higher vocational colleges should re-examine the professional orientation, upgrade the teachers, and strive to narrow the gap between teaching content and enterprise needs.

### 2.3. Position Analysis

Different posts need different abilities. The following is an analysis of the post abilities, taking the Project implementation, project designer and pre- and after- sales as examples.

#### (1)Project implementation

The implementation, operation and maintenance of the IoT project are mainly oriented to the project site and need to be responsible for two aspects.

On one hand, the engineers need to install, debug, detect and troubleshoot the electronic and electrical channels. The basic abilities include electronic circuit diagram recognition, electronic circuit testing, electronic circuit debugging, welding technology and so on. On the other hand, they also have to install and configure network paths.

**Table 1.** Correspondence between the position, abilities and related courses

| Position                                | Ability  |   | Course   |
|---|--|---|--|
|   | Job skill  | Basic ability   |  |
| Project implementation                  | 1.install, debug, detect and troubleshoot the electronic and electrical channels | Welding of Electronic Circuits  | 1.Welding Technology of Electronic Components  |
|   |  | Electronic Circuits Testing and Debugging                                       | 1.Design and debugging of intelligent electronic circuit<br>2.Digital circuit      3.Analog Circuit                    |
|   |  | Reading and analysis Circuit Diagram  | 1.Analysis and Measurement of Electronic Machine   |
|   | 2. install and configure network paths   | Design, production, implementation and acceptance criteria for wiring of IoT    | 1.IoT Integrated Cabling Technology  |
|   |  | Reading and Drawing of Construction Routing Map                                 | 1.AutoCAD  |
| IoT Programmer<br>Pre-sale<br>Post-sale | 1. design IoT architecture   | Configuration and debugging of network, routing and switch                      | 1. Operation and Maintenance of Data Communication Network   |
|   |  | familiar with the architecture of the IoT                                       | 1.Introduction to Internet of Things Project   |
|   | 2. select optimization devices   | familiar with Perception Layer Technology                                       | 1. Sensor technology      2.RF Technology<br>3.SCM Technology<br>4.Embedded Technology                                 |
|   |  | familiar with Network Layer Technolog   | 1. Wireless Communication Technology<br>2. Industrial Bus Technology   |
|   |  | familiar with Application Layer Technolog                                       | 1.Mobile Application Development      2.Desktop Application Development<br>3.Application Development of Cloud Platform |
| 3. design overall solution              | Integrated application of IoT  | 1.Practice of Integrated Application of IoT<br>2.Overall Solution Design of IoT |  |

## (2)IoT Programmer, Pre-sale and Post-sale

The staff need to be familiar with the architecture of the IoT, including the mainstream technology and the latest technology of the perception layer, network layer and application layer. They should know the advantages and disadvantages of various technologies and give the professional project program and advice to customers.

## 3. Training Program Design

To meet the demand of the target position, training program should be designed. Research has already been carried out in the IoT talent training [6]. But the results are not aimed at industry. There are some particularities in the industrial field. For example, cable networking is still the first choice for industry considering the requirements of speed and reliability. While, the wireless networking is more popular in other applications. The following Table 1 gives the correspondence between the position, abilities and related courses. Two types of most scarce positions are listed in Table.1. For each position, the necessary job skills are listed. Job skills are too board for the course design. After further analysis, the basic abilities are obtained. According to the basic skills, we can design corresponding courses.

## 4. Conclusion

In order to support the transformation of traditional manufacturing industry, reserve of high-skilled talents for IoT became more significant. This paper clarifies the general shortage of talent posts in related enterprises through in-depth research. The requirements of post skills are refined. Through further analysis of post skills requirements, basic skills are obtained. The targeted talent training program is set up. The results of this study will be helpful to the training of talents in this field. At the same time, it can also be used for reference for other related majors.

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