

# Research on the Major Construction of Internet of Things Engineering under the Background of Emerging Engineering Education

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**Abstract:** The construction of emerging engineering is an important measure for universities to deepen education and teaching reform, and it is also a powerful lever and important entry point to promote the connotative development of higher education. According to the construction goals of the new engineering discipline, this paper will focus on the problems that exist in the major construction process of the Internet of Things engineering. In order to promote the talent cultivation of the Internet of Things engineering major, it will conduct research from the aspects of talent cultivation, curriculum system construction, student practical and innovative ability cultivation, teacher teaching ability and teaching mode, etc. Then, it will propose measures for the major construction of the Internet of Things under the background of new engineering.

**Keywords:** Emerging engineering education, Internet of Things engineering, disciplines construction

## 1. Introduction

In order to cope with a series of challenges brought by the new round of global education, science and technology and industrial revolution, adapt to the new situation of international competition, meet the new needs of national strategic development, promote China's engineering education reform and innovation, help China's higher education power construction, at the same time lead the global engineering education, occupy the strategic commanding heights in the future global innovation ecosystem, there is an urgent need to transform and upgrade traditional engineering majors, break through core key technologies, build first-mover advantages, accelerate the training of a large number of engineering science and technology talents in emerging fields, and lay out the training of talents in future strategic fields. Based on this goal and strategic plan, it is the strategic consideration of the Ministry of Education to reform the traditional engineering education and explore the new model of emerging engineering education. On February 18, 2017, the concept of "new engineering" officially entered the public eye. Since then, the Ministry of Education has formed the "Fudan Consensus", "Tianda Action" and "Beijing Guide", and issued a series of important documents such as "Notice on carrying out new engineering research and practice" and "Notice on promoting new engineering research and practice projects" to actively promote the construction of new engineering. In April 2018, the General Office of the Ministry of Education issued the "Notice on the announcement of the first batch of new engineering research and practice projects". The construction of new engineering in universities began to enter the implementation stage, and remarkable achievements have been made<sup>[1]</sup>. New engineering is the general name of a series of new engineering, which is to meet the new needs of national strategic development, conform to the international competition of new talent training situation, train new type of high quality engineering talents with practical ability, innovation ability, international competitiveness<sup>[2]</sup>. Centering on the construction of new engineering majors, the Ministry of Education has approved new engineering majors such as the Internet of Things, big data, artificial intelligence and cloud computing. Through the project of industry-university-research collaborative education plan, the reform of talent training in colleges and universities as well as the evaluation system and resource allocation methods of schools was promoted with the latest needs of industrial and technological development<sup>[3]</sup>. At present, the construction of new engineering is moving from concept to practice. In the process of construction and

practice, problems such as professional structure, curriculum system, practice link and teacher construction will be encountered<sup>[4,5]</sup>. Therefore, the reconstruction of personnel training system has become the key to the effectiveness of the new engineering reform<sup>[6]</sup>.

As a strategic emerging major set up by the state for the development of Internet of Things technology, the major of Internet of Things engineering has a large span of disciplines, comprehensive and practical requirements, mainly involving computer, communication, electronic information, control and other multidisciplinary professional knowledge. In general, it is a new frontier cross-technical major in new engineering. The Internet of Things industry covers a variety of applications from sensors, controllers to cloud computing and big data, and its products are widely used in smart home, smart agriculture, smart security, smart campus, industrial monitoring, environmental protection, personal health, industrial Internet of Things, smart city, car networking and other fields<sup>[7]</sup>. Due to the more extensive application of Internet of Things technology in various fields, the demand for Internet of Things engineering and technical talents is increasing, and the talents will be in short supply. Thus, the training of applied talents in Internet of Things engineering is crucial to the development of Internet of Things industry. Disciplines and majors are the contact point of talent training and talent needs, which are also the carriers of talent training. Scientific and technological progress, social change and talent training must take the initiative to adapt and reform in order to meet the market demand for talents. The success or failure of the major construction of Internet of Things engineering based on new engineering depends on the fit between the training goal setting of Internet of Things engineering professionals based on new engineering and the demand for new engineering talents<sup>[8]</sup>. Therefore, in the process of building a new mode and training new engineering talents, the construction of new engineering major based on the Internet of Things is extremely critical.

## **2. Current situation of professional construction of Internet of Things**

The major of Internet of Things engineering is a new engineering formed by the integration of several independent disciplines. The construction of new engineering needs to retain its own uniqueness, completely distinguish from traditional engineering majors, and highlight the professional characteristics and breakthroughs of new engineering. Each university's Internet of Things engineering major should establish its own structural framework, a set of their own teaching system and professional goals. Since the Ministry of Education approved the Internet of Things as a new undergraduate major for colleges and universities in 2010, so far more than 600 colleges and universities in China have successively set up the Internet of Things engineering major. However, there are not many excellent cases in the process of talent training for the Internet of Things engineering<sup>[9]</sup>. Therefore, according to their own professional positioning and school characteristics, colleges and universities should take the characteristics of the condensed industry as a breakthrough, and cultivate Internet of Things technology professionals who meet the needs of professional development of the Internet of Things and have obvious advantages<sup>[10,11]</sup>. After investigation, the following problems exist in the construction process of Internet of Things engineering in colleges and universities.

### ***2.1 Professional characteristics are not prominent***

Some colleges and universities do not develop training programs for Internet of Things engineering combined with their own characteristics when setting up majors. At present, the professional orientation of many colleges and universities is not combined with economic needs, resulting in the lack of competitive advantages in employment. Most Internet of Things engineering majors are not distinctive. When some colleges and universities set up the majors, the professional training program for Internet of Things engineering is not developed in combination with their own characteristics, but is only a simple modification of the training program of other colleges and universities. The curriculum is also copied from the original traditional curriculum, and the existing curriculum is simply cut and stacked. Thus, the curriculum is not reasonable, and the teaching thinking and teaching methods are also lack of innovation. In addition, even if some colleges and universities carry out teaching under the new engineering concept, they have not well condensed professional characteristics, resulting in students of this major "learning everything, nothing fine". In other words, the cultivation of students is not very different from other similar majors. Students generally learn more courses but do not have a more in-depth study of any course. Learning more but not in-depth is not an advantage in employment, which will have a certain impact on the training of Internet of Things talents.

## ***2.2 The quality of teachers does not match the professional needs***

As a new frontier cross-technical major in the new engineering, Internet of Things engineering involves the professional knowledge of computer, communication, electronic information, control and other disciplines. Compared with other new engineering majors, the Internet of Things engineering major has higher requirements for practitioners in terms of knowledge structure. In addition to require practitioners to be proficient in multidisciplinary professional theoretical knowledge, they should also pay close attention to and track the development of the Internet of Things industry and related technologies, enrich the practical experience of Internet of Things engineering, and timely update and expand their own knowledge reserves. However, most of the existing teachers of this major do not have the professional education background of the Internet of Things, and they have not systematically learned the curriculum system of the Internet of Things engineering. The vast majority of teachers come from similar majors such as computer, communication, automation, electrical, network engineering, etc. They all have problems in varying degrees, such as relatively simple knowledge structure, lack of engineering practical experience, and difficulty in subject integration. As a result, some teachers are not sensitive to the new technologies in the Internet of Things and often use traditional technologies to teach, resulting in the lagging professional skills learned by students, as well as the disconnection between the knowledge students learn at school and the application of enterprise technology. On the other hand, in the teaching process, most of these teachers use the previous teaching methods and mode, as well as the inherent teaching thinking, to carry out traditional teaching for students. Such teaching methods and thinking can't meet the requirements of talent training for the new major of Internet of Things engineering. Thus, relevant policies and measures are urgently needed to accelerate the professional quality and multi-disciplinary integration of relevant teachers to better match professional needs.

## ***2.3 Lack of engineering education***

The training goal of engineering education is to train qualified engineers. Although there are many engineering majors in universities of China, these engineering majors lack engineering education to a great extent, and the Internet of Things engineering major is no exception. The major of Internet of Things engineering aims to train excellent Internet of Things engineers, but the employment rate of Internet of Things engineers in our country is very low. The reasons mainly include several aspects. Firstly, the concept of teacher engineering education is not clear enough, and the concept of engineering education is not deepened to students. Secondly, the engineering education system of many local universities is not perfect, and the engineering education mode is too simple, which can't meet the diversified needs of enterprises for engineering talents. Thirdly, the influence of engineering education in society is insufficient, and the general public holds a biased attitude towards engineering education. These are the important reasons for the lack of research and implementation of engineering education in universities of China.

## ***2.4 Insufficient practical teaching***

Internet of Things engineering is an engineering major combining theory and practice. The training goal of this major is to train students to have strong practical ability. However, in the actual training process, the proportion of theoretical teaching is too heavy while the proportion of practical hours is too small, and the practical teaching link is weak. This teaching method will cause students to be confined to the classroom environment, unable to realize the physical simulation and connection. Through course learning, students can only master the basic theoretical knowledge and professional skills of the subject, and lack professional practical experience. In addition, due to the laboratory construction funds and other reasons, it is lack of comprehensive training room and practical instructors with rich experience in engineering practice. Due to the limitation of class hours and practical conditions, the practical teaching arrangement is limited to the shallow teaching operation in the laboratory, which is very different from the actual project of the enterprise, resulting in insufficient practical ability training of students, who are unable to adapt to the needs of the progress of Internet of Things technology and industrial development.

## **3. Measures for professional construction of Internet of Things under the background of new engineering**

In view of the above problems in the construction of the Internet of Things major, the construction of the Internet of Things engineering major in new engineering needs to explore how to highlight

professional characteristics<sup>[12,13]</sup>, innovate teaching mode<sup>[14,15]</sup>, improve teachers' teaching ability, closely combine theoretical knowledge with new technology and new technology, and cultivate students' engineering consciousness, practice and innovation spirit, and ability to combine theory with practice<sup>[16]</sup>. This paper mainly expounds from the three perspectives of curriculum setting, student training and teacher team construction, so as to cultivate high-quality composite Internet of Things talents with strong engineering practice ability, strong innovation ability and international competitiveness for the development of future industries and new economy, and effectively promote economic and social development and progress. The overall research idea of the professional construction of the Internet of things is shown in Figure 1, and the specific solutions are as follows.

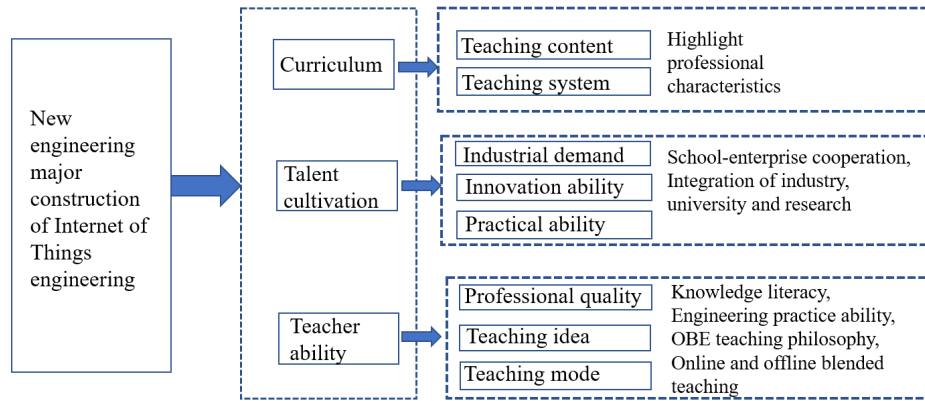


Figure 1: Research ideas for the construction of Internet of Things engineering.

### 3.1 To solve the problem of matching the training objectives of Internet of Things engineering with the needs of industrial talents

The Internet of Things industry is a strategic emerging industry with a wide range of application prospects, which needs a large number of high-quality professionals. The orientation of the training objectives of the Internet of Things engineering profession should be consistent with the national development strategy, and should be matched with the demand for talents in the development of the Internet of Things industry. The knowledge structure and professional ability of students majoring in Internet of Things engineering are recognized by the market, which is an important goal of the professional talent training. In order to solve the problem of the fit between the training goal of professional talents in Internet of Things engineering and the talent demand of emerging strategic industries, colleges and universities should actively visit and investigate enterprises related to the Internet of things according to the actual situation, explore the talent needs of enterprises, take the industrial demand as the guidance, take employment as the goal, take the optimization of training objectives as the starting point, take the curriculum system as the guide, and take the evaluation results as the reference, and establish the effective docking between talent needs and training objectives and curriculum system.

### 3.2 Reshape the curriculum system to highlight the characteristics of Internet of Things engineering

The professional courses of the Internet of Things involve many disciplines, and it is impossible to include all the course contents of relevant disciplines when constructing the course teaching system. The course teaching content needs to be designed in layers according to the needs of the Internet of Things engineering major and the goal positioning of the Internet of Things professional education. Besides, combined with the market demand for talent quality and integrated the relevant content of various disciplines a course system sufficient to support the Internet of Things system architecture should be formed. At the same time, it is necessary to strengthen the construction of digital resource library. Relying on the network teaching platform, it can be built from the leading learning resources, offline course resources, skills improvement resources, engineering example resources and other modules. Focusing on training students' professional quality and professional ability as the goal, students' learning break the constraints of space and time. In addition, colleges and universities need to combine their own school orientation to clear teaching direction and determine specific research objects (such as smart agriculture, smart transportation, smart medical care, etc.). They should establish new teaching concepts, optimize professional structure, promote multidisciplinary integration of professional courses, improve the professionalism of teachers, and formulate reasonable quality standards for talents, so as to highlight the characteristics of Internet of Things engineering in colleges and universities and improve the employment

quality of Internet of Things talents.

### ***3.3 To achieve school-enterprise cooperation and strengthen practical teaching***

In view of the phenomenon that Internet of Things engineering majors in colleges and universities are too heavy in theoretical teaching and insufficient in practical teaching, colleges and universities can adhere to the professional talent training mode and characteristics, adhere to the combination of theory and practice, classroom and extracurricular, explore multi-faceted practical teaching mode, and create a multi-faceted practical teaching mode based on production cognition, basic training, engineering application and innovation training, so as to gradually improve students' practical ability. Schools should seize the opportunity of school-enterprise cooperation and introduce enterprise resources to improve teaching practice content and students' learning environment. The school and enterprise cooperate to carry out classroom teaching, practical guidance and graduation design guidance, and hire industry engineering and technical personnel, management personnel or "dual dual ability" teachers with rich industry practice experience to teach, so that students can truly integrate into the project practice in the study. By establishing practice bases in cooperation with enterprises, we can provide stable practice and training conditions for Internet of Things engineering majors, help students deeply learn Internet of Things technology in practical links, achieve the purpose of practical training for students, and ensure the quality and effect of students' practice links.

### ***3.4 Deepen the combination of production, university and research, and exercise students' innovation ability***

Innovation ability is an important goal of training new engineering talents, and the deep cooperation between industry, university and research institute is an important way to practice innovation ability training. If colleges and universities lack industrial support and enterprises with relevant professional backgrounds participate in and support professional construction, it will lead to a disconnect between schools and industries, which is not conducive to the cultivation of students' practical innovation ability. University-enterprise in-depth cooperation, school-enterprise joint training, school-enterprise cooperation innovation and entrepreneurship base, which is conducive to students' innovation ability cultivation through practice. In addition, students are encouraged to participate in various key national college student competitions. Students are supported to actively participate in the "Internet +" College Student Innovation and Entrepreneurship competition, "College Student Innovation and Entrepreneurship Training Program", electronic design competition, program design competition, "Challenge Cup" National College Student Extracurricular Academic Science and Technology Works Competition, and entrepreneurship plan competition at all levels and various competitions, so as to comprehensively improve students' innovative practical ability, train students' logical thinking ability, and promote the cultivation of application-oriented and innovative talents.

### ***3.5 Innovate teaching mode and improve teachers' teaching ability***

The improvement of the construction of the Internet of Things engineering major needs to rely on the change of the core figure of teachers. Teachers of this major need to be proficient in multi-disciplinary professional theoretical knowledge, have rich practical experience in Internet of Things engineering and new concepts of talent training under the background of new engineering, as well as new thinking in teaching process, and practical experience in Internet of Things engineering. Colleges and universities can carry out professional system training for teachers of this major to help teachers improve professional knowledge. By carrying out engineering project training and enterprise temporary training, the practical experience of Internet of Things engineering is enriched, so as to effectively improve the teaching ability and level of teachers.

In personnel training, teachers can adopt the Outcome based Education (OBE) education concept. Fully embodied the engineering education concept of "student-centered, results-oriented and continuous improvement", we always take students as the main body in teaching activities, and design appropriate curriculum teaching objectives, teaching content and classroom ecology. Through assessment and evaluation, we can continuously improve teaching, change the traditional evaluation system of "final examination paper + usual score". We can increase the assessment proportion of learning process. Taking the assessment of students' learning process as the core of the assessment, we incorporate classroom performance, in-class testing, interactive question answering and other aspects into the assessment indicators. A dynamic evaluation mechanism is established to enhance the high-level and challenging

degree of the course, and improve the teaching effect.

The new engineering construction should cultivate excellent engineering talents and enhance students' engineering consciousness, practical ability, innovative spirit and craftsman spirit. In the process of talent training, we not only attach importance to the cultivation of basic and professional ability, but also attach importance to the close relationship with the scientific frontiers, engineering practices and social application practices, so as to form a structure and system in which learning output drives the whole teaching activity and students' learning output evaluation. We should actively construct innovative classrooms, make full use of the wisdom tools of online platforms, adopt the mixed teaching mode of online and offline, break the boundaries of space, time and knowledge, guide students to conduct independent, cooperative and inquiry learning, pay attention to cultivating students' innovation and collaboration ability, cultivate students' ability to solve complex engineering problems, and promote students' comprehensive quality and comprehensive ability to improve.

#### 4. Conclusion

This paper focuses on the construction goal of new engineering, aiming to solve the problems existing in the construction process of Internet of Things. In the process of exploration and research on the construction of the Internet of Things specialty, professional training objectives are set based on the industrial needs. The problem of the fit between the training of professional talents in the Internet of Things engineering and the demand for talents in the Internet of Things industry is solved. When reshaping the curriculum system, the professional characteristics is highlight. Through strengthening engineering education, practical teaching and innovation ability training, high-quality talents with strong practical ability and innovation ability are cultivated for the Internet of Things industry, so as to meet the talent needs of the industry and improve the employment quality of graduates. Through optimizing teachers' knowledge structure, reforming teaching methods, innovating teaching modes, improving teachers' teaching ability, the construction level of professional teachers in the Internet of Things is improved. Thus, they can serve for better training talents.

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