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The New Engineering Education in Chinabased on 207 new engineering research and practice projects

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The New Engineering Education in China: Based on 207 New Engineering Research and Practice Projects

Abstract

Under the background of accelerating new industrial revolution, China's higher engineering education is in urgent need of cultivating a group of innovative talents in engineering science and technology. In order to improve the quality of engineering education, China proposed the "New Engineering Research and Practice Project" in June 2017. This study attempts to conduct a system review based on the 207 projects of the top engineering universities in China’s New Engineering Research and Practice Project. It discovered the common key issues such as mechanism, ability, and discipline issues that are raised in the existing projects, in the meanwhile discussed how to meet industry demand in the process of new engineering construction. The research findings are as following: (1) The commonness of programs’ schemes is emerging. In terms of mechanism construction, the mechanism of collaborative education receives the most attention, while the cultivation of soft ability and engineering innovation ability are focused most in terms of the talent ability; (2) Most of the construction plans are aimed at the transformation of traditional disciplines, and there is little construction of corresponding disciplines for national key industries such as energy conservation, environmental protection and new materials; (3) The overall design of the project somewhat lacks innovation and features, and certain construction schemes are similar with minor differences, failing to effectively combine the advantages of universities and disciplines to serve local industries and truly show its characteristics.

1 Introduction

As cutting-edge technologies such as artificial intelligence, big data, and cloud computing gradually make technological breakthroughs, the new round of scientific, technological, and industrial revolution led by the intelligent industry provides important strategic opportunities for the accelerated development and transformation of higher engineering education in the world, China's higher engineering education reform and development has stood at a new historical starting point.**[1][2]** In order to improve the quality of engineering education and accelerate the progress of China from a major engineering to a powerful engineering education country, China launched the "Excellent Engineer Education Training Plan" in 2010. The Ministry of Education of the People’s Republic of China established the CDIO engineering education alliance in 2016, with 105 universities joining.

In June 2017, Lin Huiqing, the vice minister of Ministry of Education of the

People's Republic of China, pointed out that "Universities should take the initiative to serve national strategic needs and industrial enterprises, to accelerate the construction and development of new engineering, and to create an upgraded version of 'Excellent Plan'". Ministry of Education then launched the "Excellent Engineer Education and Training Plan 2.0", namely "the New Engineering Research and Practice Project". Three policies mainly guide the construction of new engineering projects in China， which are "Fudan Consensus", "Tianjin University Action" and " Beijing Guidance", and are called a trilogy of new engineering projects."Fudan Consensus" was the first initiative to start the new engineering research and practice project."Tianjin University Action" further defined the direction development, and "Beijing Guidance" set up a new engineering research and practice expert group. Based on this structure, the new engineering research and practice project became an essential clue throughout the trilogy of new engineering construction in China. In early 2019, Tsinghua university launched its engineering development program, which focuses on innovating academic ideas and leads technological development, laying emphasis on strengthening basic engineering research, promoting interdisciplinary study, and improving engineering education.

According to the different functions played by Chinese universities in engineering education, universities are divided into three groups: top engineering universities, comprehensive universities, and local universities. Top engineering universities play a major role in engineering technology innovation and industrial innovation, and comprehensive universities play a leading role in giving birth to new technologies and industries, while local universities play a supporting role in regional economic development and industrial transformation and upgrade.**[3]** As a university with traditional engineering characteristics and industry characteristics, top engineering universities have strong overall strength in leading technology research and development advantages, and close relationship with the industry. Comprehensive universities mainly rely on their own advantages such as multi-disciplinary nature, solid basic disciplines, and diversity of resource allocation, which promote the extension of applied science to engineering in the phase of development of new technologies and new industries in the future. Local universities are characterized by based on the regions and supported by local resources, with the integration of production and education as their main advantage.**[4]** Top engineering universities are more closely connected with industries compared with comprehensive universities, while the basic research of their engineering superiority is more solid compared with local universities. The paper uses a system review method to proceed text analysis through 207 projects of top engineering university group in the new engineering research and practice project. We found out common issues focused in the existing projects and explored how to actively dock industry demand across the border from education and promote personnel training. We expect to outline the innovation of the collaborative production and education practice teaching mode in the Chinese engineering education reform, and give suggestions for the construction of the second round of new engineering research and practice projects.

2 Background

At the end of 20th century, international engineering education reform was surging. Return to Engineering Practice, STEM Education, Engineering Integrative Education, Engineering With a Big E, An Integrative & Holistic Engineering Education, CDIO, Holistic Engineering, Systematic Engineering, Engineering Education as a Complex System, Engineering Education Ecosystem, and other concepts have been proposed successively, all of which reflect the international development trend of innovative engineering education.**[5]** With the gradual technological breakthroughs in cutting-edge technologies such as artificial intelligence, big data, cloud computing and quantum information, the new round of technological revolution, industrial revolution, and innovation revolution led by intelligent industry is gradually showing a trend of integrated development, therefore future-oriented engineering and technology talents training has become a global urgent need.

In the process of continuous innovation of engineering education, the ability requirements of engineering talents are also progressing, and the definition of ability scope is becoming more and more extensive. Early training of engineering talent was more practical, and many institutions developed engineering courses to help develop individuals with more practical skills needed by industry, even as engineering projects became more theoretical.**[6]** The University of Michigan released “Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education” in 2008, which pointed out that engineering changes require engineers to not only master knowledge and skills, but also possess a wide range of comprehensive capabilities and applied research capabilities. The US-based National Academy of Engineering and Engineers Canada have urged engineering educators to supplement technical coursework with multiple domains of professional skills development, which began to infuse leadership education into undergraduate engineering programs**[7]**, and was also concerned about the disconnect between creativity and engineering. Corpley(2015) pointed out that disciplines and majors competed for a limited number of students and continued to drill down into narrow areas of expertise. This over-specialization made it difficult to cultivate students' design ability, creative thinking, and abstract thinking ability in the curriculum. To solve this disjointed phenomenon, an overall reform of engineering education is needed.**[8]**

In China, engineering education and engineering talent training have received extensive attention, but some problems have emerged. There are problems in the training of traditional engineering talents, such as inadequate student engineering practice training, deviation from engineering practice, lack of engineering background of engineering teachers, and obsolete teaching mode. All these problems drive the reform of engineering education.**[9][10]** As an idea of engineering education reform, the essence of new engineering is also the reform of engineering talent training. The new engineering construction aims to cultivate outstanding engineering talents who can meet the needs of the industry, the world, and the future.**[11]** “Fudan Consensus” puts forward three kinds of target talent: technical advantage to cultivate engineering science, technology and industrial innovative talents in top engineering universities, the comprehensive universities to cultivate scientific thick foundation, engineering ability and high comprehensive quality talents, and local universities to cultivate a large number of practical and technical skills talents. Li Deyi, academician of the Chinese Academy of Engineering, mentioned in his speech that China's engineering education should learn from Germany and cultivate senior technical engineering talents with craftsman spirit.**[12]** “Tianjin University Action” emphasizes that engineering students should strengthen their patriotism, global vision, legal awareness and ecological awareness, cultivate design thinking, engineering thinking, critical thinking, and digital thinking, and improve innovation and entrepreneurship, interdisciplinary integration, independent lifelong learning, communication ability, and engineering leadership.**[13]** “Beijing Guidance” stresses the importance of cultivating people with morality and ethics, and strengthens engineering students' sense of patriotism, international vision, rule of law, and ecology and engineering ethics.**[14]** It can be seen that there have been many studies on project construction and talent cultivation of engineering education in China, but there is still a lack of empirical research on the whole engineering education.

3 Methodsand analysis

System reviews, used to promote development in the field of engineering education, have strong potential to become model and seminal publications. We followed steps in conducting a systematic review by Borrego et al. (2014), which is: (1)Deciding to do a systematic review; (2)Identifying scope and research questions; (3)Defining inclusion criteria; (4)Finding and cataloging sources; (5) Critique and Appraisal; (6) Synthesis.**[15]** Justin(2018) adapted and extended the steps, which included (1) Deciding to engage in a systematic literature review; (2) Defining and redefining research questions and sub-questions; (3)Identifying where and how to look for literature; (4)Gathering literature and creating a database; (5) Reading each article, making notes, developing a coding framework, and excluding articles that did not meet the required criterion or that could not be coded; (6) Re-reading each article and applying coding framework; (7) A second coder was trained in and applied the coding framework to five articles and the reliability between the coders was evaluated; (8) Calculating descriptive statistics for developed categories and comparing; (9) Identifying what the results indicate, and tying results to the literature; (10)Writing an overview of the research findings.**[16]** We referred these two studies and suggested the system steps as following:

(1)Reviewing: Review and decide to do a system literature review

(2)Defining: Identify and define research questions

(3)Cataloguing: Catalogue sources and create a database

(4) Developing: Read each project declaration and develop a coding framework

(5) Applying: Re-read the project declarations and apply the coding framework

(6) Checking: Coders check each other's workout and evaluate the reliability between the coders

(7) Quantizing: Quantize descriptive statistics

(8) Identifying: Identify what the results indicate and synthesis

3.1 Defining

There is a lack of empirical research on engineering education research in China currently. We tried to explore the path of production-teaching integration and curriculum system in engineering education by systematically analyzing the existing research and practice projects in Chinese engineering education. Specifically, the following research questions guided the study:

The main research question is: "what are the common key issues that Chinese engineering educators are most concerned about? ". The secondary research questions are: "What has been the construction of engineering education mechanisms concerning about the new engineering in China?", "Which aspects of the new engineering research and practice projects of top engineering university group pay most attention to cultivate students' abilities?", "Which traditional engineering disciplines do the projects focus on?", and "Which emerging engineering disciplines do the projects focus on?".

3.2 Cataloguing

The study utilized 207 projects of top engineering university group, which contains 43 universities across China in the new engineering research and practice project. Among them, the universities with the largest number of projects to be identified are Tianjin University, Zhejiang University, Beihang University, and Harbin Institute of Technology, which run 9 projects, 8 projects, 7 projects, and 7 projects respectively. Table 1 shows the basic information of the database.

Table 1. Basic Information of the projects

Ranking	University	Province	Number of projects
1	Tianjin University	Tianjin	9
2	Zhejiang University	Zhejiang	8
3	Beihang University	Beijing	7
3	Harbin Institute of Technology	Heilongjiang	7
5	Xi'an Jiaotong University	Shanxi	6
5	Shanghai Jiao Tong University	Shanghai	6
5	Southeast University	Jiangsu	6
5	Beijing Institute of Technology	Beijing	6
5	Dalian University of Technology	Liaoning	6
5	Tsinghua University	Beijing	6
11	Harbin Engineering University	Heilongjiang	5
11	Hohai University	Jiangsu	5
11	Tongji University	Shanghai	5

3.3 Developing

In the process of specific operation, the relevant text of the study was first read, and the initial coding analysis of 207 project declaration documents was conducted to generate the coding framework. Therefore, the coding scheme is deductive and inductive, that is, "learning from previous achievements and independent innovation". Deductive codes involves preconceived coding concepts. Examples included Zhao's(2010) findings for postgraduate training mechanism, such as: (1)Organization and management mechanism, (2)Competitive incentive mechanism**[17]**; Lu's(2018) findings for training path of engineering talents, such as: (1)Faculty construction mechanism, (2)International cooperation mechanism. On the contrary, inductive codes concepts are mainly based on the extraction of key statements and preliminary coding analysis of text.**[18]**

3.4 Applying

The three authors first formed the key statement extraction work of 69 projects in the form of "labeling". Author 2 and author 1 discussed repeatedly, formed the coding framework through deductive coding and inductive coding, and reviewed and amended the framework with author 3 in a meeting, adding some open coding options. Then, the authors reformed the open encoding of each text under the new encoding framework(See Table 2). Upon completion, the coding framework included 8 categories with 33 binary items, not including study overview information.

Table 2. Overview of coding framework

Category	Item
1.Emerging engineering construction process	Resource sharing mechanism Practical training mechanism [illegible]
2.Emerging engineering construction content	Cross cultivating mechanism Uniting cultivating mechanism Cooperative education mechanism
3.Emerging engineering construction support	Organization and management mechanism Evaluation and assessment mechanism Faculty construction mechanism International cooperation mechanism
4.Practicalness	Professional basic ability Practical ability
5.Comprehensiveness	Systematic thinking ability Soft ability
6.Innovativeness	Engineering innovation ability Computational ability Active learning ability
7.Emerging engineering disciplines	Artificial intelligence Intelligent manufacturing Big data New materials engineering New bioengineering
8.Traditional engineering disciplines	Electronic Information& technology of Instrumentations Mechanical engineering Aviation and space& traffic transportation Mining engineering& geology& geomatics Civil engineering& ocean engineering Computer engineering& Software engineering Energy engineering& electrical engineering Materials engineering& chemical engineering Environmental engineering& Light chemical Engineering Bioengineering& Pharmaceutical engineering Food engineering& Eagroforestry chemical engineering Safety engineering& Armament technology Automation

3.5 Checking

The three authors exchanged the new coding results, from which each author randomly selected 10 items for "triangulation", that is, author 1 checked author 2's coding work, author 2 checked author 3's coding work, and author 3 checked author 1's coding work. Author 1 calculated and reviewed the consistency level, which was at 92.5% agreement at this stage. At last, the authors discussed the coding controversy at the next meeting, reached a consensus and revised the original code.

3.6 Quantizing

The initial secondary question addressed is, “what has been the construction of engineering education mechanism concerning about the new engineering in China?”. The most frequent mechanism showed is cooperative education mechanism, which means two or more of governments, universities, enterprises, and other entities working together to promote the integration of science and education, industry and learning, and university-enterprise cooperation. It was 109 times, accounting for more than half of all projects. For instance, Dalian Maritime University has learned from the European "sandwich" engineering education model, and formed a "3+1" joint training model with three years of study in school and one year of practical study in enterprises. Hohai University, in association with the Ministry of Transport, the Export-import Bank of China, China Communications Construction Group co., LTD., has established a comprehensive education development and training complex involving politics, production, study, research and finance.

The practical training mechanism accounts for the second largest proportion, with a frequency of 98. For instance, in the major of agricultural water conservancy engineering, China Agricultural University based on "reverse design/positive construction" design concept, has established the whole process of engineering practice "training objectives - learning outcomes - course system" of the logical relation matrix, constructed of a station network, and selected leading companies in the field of agricultural water conservancy as well as a number of dynamic engineering construction and after-building management site as of engineering practice education base.

Table 3. Typical mechanism constructed coding data

Item	Description	N	%
Resource sharing mechanism	Optimize the allocation of campus resources, promote the use of online resources, and actively obtain social resources	62	30%
Practical training mechanism	Engineering practice education system and practice platform construction oriented to new engineering; innovation and entrepreneurship education into new engineering construction	98	47%
Competitive incentive mechanism	Subsidy for excellent students and performance incentive for teachers; subject competition and engineering training competition	16	8%
Cross cultivating mechanism	A new type of interdisciplinary integration of institutions and cross-integration of engineering personnel training	92	44%
Uniting cultivating mechanism	Combination of major and minor major; combination of general and professional courses; cultivating combination of undergraduate and graduate students	39	19%
Cooperative education mechanism	Governments, universities, enterprises and other entities working together to promote the integration of science and education, industry and learning, and university-enterprise cooperation	109	53%
Organization and management mechanism	University leading and working groups; Expert advisory board	16	8%
Evaluation and assessment mechanism	Engineering education certification and talent training quality standards, teacher evaluation standards and professional evaluation system for emerging engineering	73	35%
Faculty construction mechanism	Double-professionally-titled teachers and double tutorial system	36	17%
International cooperation mechanism	Student international exchange and international joint training; international education alliance	27	13%

Another question addressed is, “Which aspects of the new engineering research and practice project of top engineering university group pay most attention to cultivate students' abilities?”. The most frequent ability illustrated here is soft ability, which is mentioned in almost all projects. The connotation of soft ability is relatively extensive, including professional ethics and social responsibility awareness, expression ability, management ability, international vision, collaboration ability, engineering leadership ability, humanistic and social quality, communication ability, and international competitiveness. For instance, University of Electronic Science and Technology of China's "construction of challenging learning and research teaching system, engineering practice and innovation ability training into the whole process" and Beijing Jiaotong University’s "School of intelligent traffic big data" puts forward the requirements on students' ability to solve complex engineering problems.

Table 4. Typical ability characteristics coding data

Item	Description	N	%
Professional basic ability	Scientific research ability, basic theoretical ability, professional technical ability	66	32%
Practical ability	Tool use ability, engineering practice ability	106	51%
Systematic thinking ability	Systematic thinking ability, comprehensive ability, cross-border integration ability, interdisciplinary thinking ability, engineering thinking ability, ability to solve complex engineering problems	154	74%
Soft ability	Professional ethics and social responsibility awareness, expression ability, management ability, international vision, collaboration ability, engineering leadership ability, humanistic and social quality, communication ability, international competitiveness	200	97%
Engineering innovation ability	Critical thinking ability, thinking judgment and analysis ability, innovation and entrepreneurship ability, engineering innovation spirit	176	85%
Computational ability	Engineering design ability, computational thinking ability	20	10%
Active learning ability	Lifelong learning ability, adaptability, learning and application ability	63	30%

The rest questions are about disciplines of new engineering in China. The two research questions, “Which traditional majors are more concerned about?”, and “Which new majors does the program focus on?”, are discussed together here. We define the traditional engineering disciplines as machinery, electrical, civil engineering, and chemical engineering represented by a long history of development. On the whole, the construction of this kind of disciplines is based on the transformation and upgrading of the traditional engineering major, which is basically unchanged, or the new engineering that is constructed through the cross integration with other disciplines, the expansion of connotation, the transformation or improvement of training objectives and standards, and the reform and innovation of training mode. Emerging engineering disciplines is defined as a new and unprecedented new discipline. It mainly refers to a discipline that is bred, extended, and expanded from other non-engineering disciplines, such as applied science and other basic disciplines, and is oriented to the development of new technologies and new industries in the future. These disciplines not only give birth to a batch of new technologies represented by new energy, new materials, and biological sciences, but also give birth to a batch of new industries represented by photovoltaic, lithium ion battery, and genetic engineering. The classification of majors also refers to the notification document of "new engineering research and practice project" issued by the Ministry of Education.

Table 5 shows the results of the classification of disciplines in the projects. The total number of traditional engineering disciplines is 104, while the total number of new engineering disciplines is only 32.According to our coding results, traditional engineering disciplines and emerging engineering disciplines have different priorities. Traditional engineering disciplines pay more attention to multi-party collaborative education, innovation and entrepreneurship training, the integration of this research, and personalized talent training, etc. Emerging engineering disciplines pay more attention to the construction of new majors based on cross integration, and thus they pay more attention to cross cultivation mechanism, collaborative cultivation mechanism, and evaluation mechanism. It is worth noting that the total number of traditional engineering projects and emerging engineering projects is not the total number of the 207 projects, because there are still some top-level design projects in the projects, such as the "new engineering talent training quality standard research under the background of new engineering construction" of East China University of Science and Technology. Another example is Beihang University's "research and practice of training new senior engineering talents integrated with this research" project, which does not aim at a specific major, but carries out the design of talent training programs for multiple majors such as microelectronics engineering, cyberspace security and biomedical engineering.

Table 5. Typical discipline characteristics coding data

Item	Disciplines	N	%
Emerging engineering disciplines	Artificial intelligence	8	4%
	Intelligent manufacturing	6	3%
	Big data	5	2%
	New materials engineering	4	2%
	New bioengineering	2	1%
Traditional engineering disciplines	Electronic Information& technology of Instrumentations	17	8%
	Mechanical engineering	15	7%
	Aviation and space& traffic transportation	13	6%
	Mining engineering& geology& geomatics	12	6%
	Civil engineering& oceaneering	12	6%
	Computer engineering & Software engineering	11	5%
	Energy engineering& electrical engineering	9	4%
	Environmental engineering& Light chemical Engineering	6	3%
	Food engineering& agriculture and forestry	4	2%
	chemical engineering	4	2%
	Safety engineering& Armament technology	3	1%
	Automation	2	1%

3.7 Identifying

(1)Large commonality in the projects

As can be seen from the coding results, both the most concerned mechanisms and the most mentioned talent abilities have higher frequency. In the process of coding, we also find that there is some overlap in the text writing of many projects. On one hand, it helps us find out what Chinese engineering educators are most concerned about the construction of new engineering. On the other hand, it also shows the convergence of Chinese engineering education in strategic development, that is, similar development positioning and mutual imitation. From the perspective of new institutionalism, in order to survive and develop, the external form, internal structure, and operation mode of an organization will be forced and induced by the environment to converge, which is the manifestation of the organization's pursuit of legitimacy. The phenomenon of convergence of engineering education in Chinese universities in the popularization stage is the instinctive response of universities to seek legitimacy in the fierce competition and uncertain environment.**[19]** Universities, as actors, are easy to imitate other successful universities when the goals are vague and the environment is uncertain, thus leading to the convergence of colleges and universities.**[20]** In particular, engineering superior universities have a good foundation of engineering subjects and strong abilities, and are more likely to compete with each other and imitate each other.

(2)Attention attracted in the integration of industry and education

Industry-education integration is the word most programs mentioned. In recent years, China has regarded the integration of industry and education as one of its development priorities. On October 10, 2019, China published the national pilot implementation plan for the integration of industry and education, which requires the organic connection of education chain, talent chain, industrial chain, and innovation chain, and the formation of an innovative mechanism for the integration of industry and education in higher education.**[21]** In fact, the integration of production and education is reflected in many mechanisms, such as the "university + enterprise" double tutor system in the faculty construction mechanism; the practice platform, practice base and laboratory of university-enterprise co-construction in the practice training mechanism; the enterprise to provide some modules such as courses in the resource sharing mechanism. However, the implementation of industry-education integration in our project is quite different. Some projects have carried out clear demonstration and analysis of industrial demand, which can reflect the industrial demand of countries and regions and the development trend of national industry in the future, while other projects only falsely mentioned "to meet the needs of local industries". There was no specific demonstration and analysis on the industries where the universities were located, which could not reflect the matching between professional construction and industrial development. In addition, the implementation of enterprise participation also differs. For example, the project of "exploration and practice of new engineering specialty construction of materials for life and health needs" of Beijing University of chemical technology lists 15 cooperative enterprises. These enterprises cooperate with each other in the form of enterprise mentors and divide the types of mentors, such as enterprise mentors regulated by laws and regulations, enterprise mentors of medical materials, and enterprise mentors of biological elastomers. However, some projects simply mentioned the need for industry-university cooperation. For example, one project only mentioned "the close integration of professional cultivation process and industrial production", but did not explain specific plans and measures.

4 Conclusion

4.1 Research findings

We use a method of system review to analyze 207 projects of top engineering universities in China’s new engineering research and practice project, discussed the common mechanisms and students’ abilities Chinese engineering educators are most concerned about, as well as different characteristics traditional engineering disciplines and emerging engineering disciplines focus on. The conclusion shows that:

(1) Under the background of new engineering construction, the common features of construction schemes arise. In terms of mechanism construction, cooperative education mechanism, practical training mechanism, and cross cultivating mechanism are the most mentioned, which the frequency is 109, 98 and 92 times respectively. The integration of industry and education is the most concerning issue in the top engineering universities, and has gradually developed into school-enterprise cooperation colleges, innovation practice base, university-enterprise co-built laboratories and other more abundant forms.

(2) In terms of talent cultivation, the concept of "top innovative talents" has been mentioned for the most times. In terms of talent abilities, soft ability receives great attention and is mentioned 200 times, accounting for 97% of the total text. Engineering innovation ability and systematic thinking ability are also widely concerning, which are mentioned 176 times and 154 times respectively. The improvement of soft abilities should be reflected in the teaching modules of engineering education rather than in the form of specialized courses.

(3) In terms of discipline construction, top engineering university group have begun to promote the construction of interdisciplinary and emerging disciplines, and a number of construction schemes for emerging disciplines have begun to emerge, mainly focusing on the direction of artificial intelligence, intelligent manufacturing, and big data, covering 8, 6 and 5 projects respectively. On the discipline category distribution, most of the construction plans are aimed at the transformation of traditional engineering disciplines such as machinery, electricity, civil engineering, and chemistry, among which electronic information has the largest number with 17 items, and machinery and transportation were next, with 15 and 13items respectively. Both traditional engineering and emerging engineering pay great attention to the construction of courses, but traditional engineering pays more attention to the cultivation of multi-party cooperation, cultivating innovation and entrepreneurship ability, while emerging engineering pays more attention to the construction of new majors based on cross integration.

(4) Some problems are also summarized in the coding analysis process: The overall design of the project lacks innovation and characteristics, and many construction schemes are similar or even copied. In general, the design of the project lacks theoretical support and top-level design, and even lacks teaching in accordance with local conditions and aptitude. It fails to effectively combine the advantages of universities and disciplines to serve local industries and truly show its characteristics. For some of the key industrial construction projects planned in the national planning policy file such as "Made in China 2025", "guideline on emerging sectors of strategic importance during the 13th Five-Year Plan period (2016-20) ", such as energy conservation, environmental protection, new materials and high-performance medical equipment, and other disciplines corresponding almost no subject construction and industry fails to realize the coordinated development,

and thus it is difficult to form a long-term, sustainable industry-academic cooperation mechanisms.

4.2 Policy suggestion

we put forward the following suggestions to improve the construction in the second round of the new engineering research and practice projects:

(1)The application of the second batch of new engineering research and practice projects should be strictly checked, and the requirements for the application of personnel training program homogenization, obsolete curriculum system construction, and unclear industry-university-research cooperation mode should be revised or not approved. The application should strive for the characteristics and diversification of the projects.

(2)Encourage top engineering universities to aim at the future technology and industrialization of pilot build college, such as robotics institute, institute of big data. Top engineering universities should promote engineering education resources to service the discipline convergence need of the regional leading industry and characteristic industry, gradually build system of disciplines compatible with national and regional economic development.

(3) Universities and enterprises should strengthen interaction. It is suggested that universities should conduct analysis of industrial demand in the early stage of the projects, especially the localization and personalized customization of subsequent project construction plans based on their own disciplinary advantages and local industrial structure. The government should issue relevant teacher standards for enterprise teachers, stipulate the entry threshold, and supplement by online guidance to improve the teaching quality of enterprise teachers.

4.3 Limitations and future research

There are 2 limitations in this study:

(1)This study is aimed at the project application documents of the top engineering universities. Without the tracking data of the follow-up of the project, it is impossible to dynamically show the construction status of the first round of new engineering research and practice projects in China.

(2)The coding analysis in the study is only a preliminary exploration of the content of the project declaration, but fails to demonstrate the more specific situation of industry-university-research cooperation, innovation and entrepreneurship, and teacher construction, etc..Further research and analysis still need more professional coding software and a larger workload to support.

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