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Discussion on the Present Situation and Development Trend of the Characteristic Course System of Engineering Management at Home and Abroad

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Abstract: The Ministry of Education encourages categorized development and characteristic development in the "Notice of the General Office of the Ministry of Education on Implementing the "Double Ten Thousand Plan" for the Construction of First-class Undergraduate Majors", which makes it particularly important to develop the characteristic construction of the curriculum system as an important support for first-class undergraduates. The engineering management professional curriculum systems of domestic and foreign universities have commonalities, but also have their own characteristic directions. This paper uses the methods of investigation, comparative research and inductive analysis to explore the characteristic courses and construction reasons in the engineering management professional curriculum system of 5 domestic and international universities. Finally, combining the resource advantages and social needs of the school, it puts forward the countermeasures for the construction of the characteristic curriculum system.

Keywords: Engineering management; Undergraduate education; Curriculum system; Characteristic construction

INTRODUCTION

In April 2019, the Ministry of Education issued the "Notice of the General Office of the Ministry of Education on the Implementation of the "Double Ten Thousand Plan" for the Construction of First-Class Undergraduate Majors" to build first-class undergraduate majors for different types of ordinary undergraduate colleges and universities, and encourage categorized development and characteristic development. With the acceleration of the development of modern engineering construction and project management in China, the society's demand for engineering management professionals has increased in quantity and quality requirements. The construction and improvement of the first-class undergraduate curriculum system directly affects the quality of the training of engineering management professionals [Zhao, *et. al.*, 2020]. At the same time, the globalization of education has closely integrated domestic and foreign universities. In terms of engineering management, the curriculum systems of domestic and foreign universities have both commonalities and unique characteristics [Liu, *et. al.*, 2020]. Therefore, understanding the high-level engineering management characteristic curriculum system at home and abroad is very necessary for the training of engineering management talents. This paper proposes countermeasures for the construction of the school's engineering management characteristic curriculum system in accordance with social development, and provides a reference for the construction of engineering management characteristic curriculum system in Chinese universities based on the analysis of the current situation and development trend of the construction of engineering management characteristic curriculum system at home and abroad.

This paper selects some domestic and foreign universities as the research object, namely Tsinghua University, Tongji University, Dalian University of Technology in China, and Stanford University and Purdue University in the United States. These five schools are internationally recognized famous schools specializing in engineering management, and their students have a high degree of recognition in engineering management. Based on the in-depth investigation of the professional undergraduate training programs of these five universities, this paper analyzes their development trend, and then analyzes and compares them with the undergraduate curriculum system of Engineering Management Major of North China Electric Power University.

ANALYSIS ON THE CONSTRUCTION STATUS OF CHARACTERISTIC CURRICULUM SYSTEM OF ENGINEERING MANAGEMENT AT HOME AND ABROAD

Tsinghua University

The engineering management specialty of Tsinghua University is set up in Civil and Water Conservancy College. Focusing on both technology

and management, they are committed to developing a strong international vision and competitiveness, solid engineering, economic, management and legal knowledge and skills, proficiency in foreign languages and computer applications, a certain amount of Engineering experience, and good at solving practical problems in engineering and managing engineering projects efficiently, and with excellent leadership and team spirit, "research-oriented, management-oriented, innovative, international" construction industry leaders and reserve commanders. The course setup is mainly divided into six parts: public basic courses, cultural quality courses (science and engineering), basic courses of mathematics and natural science, professional related courses, practical links, comprehensive paper training.

Public basic courses cover ideological and political theory, sports, foreign languages and other fields, and focus on training students' political thoughts and basic quality. The course of cultural quality (science and engineering) includes the classification of philosophies and ethics, history and culture, art and aesthetics, emphasizing humanistic care and building cultural and artistic atmosphere. The purpose of basic courses in mathematics and natural sciences is to enable students to master basic tools and to pave the way for further study, including courses in mathematics, physics, computer and biochemistry. Specialty-related courses are divided into two major categories: subject-based courses are divided into technical, management, economic and legal categories, and professional related courses are divided into required courses, limited courses and optional courses, which cover many fields such as civil engineering, real estate, project cost, architectural design and so on. On the basis of professional related courses, the practice link carries out in-depth practice on theoretical knowledge, setting up three major courses: Projects, Internships and optional courses. The core of comprehensive paper training is design practice and scientific research practice, which is helpful for students to summarize their undergraduate learning results. The curriculum system of Tsinghua University is distinct and interrelated, which is suitable for training comprehensive engineering management personnel.

Tongji University

The engineering management major of Tongji University is set up in the School of Economics and Management. Cultivate to meet the needs of socialist modernization, develop morally, intellectually, physically and aesthetically, have basic knowledge of civil engineering technology and management, economics and law related to engineering projects, master the theory, methods and means of modern management science, and obtain engineer basic training, can be engaged in project decision-making and whole-process management in the field of engineering construction at home and abroad, and have strong practical ability, innovation ability, and application-oriented senior engineering management talent. The curriculum is mainly divided into four parts: public basic courses, professional basic courses, professional courses, and practical links.

Public basic courses include ideological and political courses, language and literature quality courses, retrieval tools and computer application courses, art appreciation courses, etc., to cultivate students' comprehensive quality in an all-round way. Professional basic courses cover mathematics, cartography, economics, law, management, etc., emphasizing the mastery of basics and principles. The professional courses are further refined under the foreshadowing of the professional foundation, strengthen the professional characteristics, and describe the professional portrait. The courses are carried out around the project from various perspectives such as valuation, quality management, contract management, construction, and evaluation. Practical links are interspersed in each semester, including practice and design, emphasizing the application of knowledge, deepening the course content, and improving students' abilities. The characteristics of the engineering management curriculum system of Tongji University are solid professional foundation, comprehensive professional scope, deepening students' understanding of engineering, and improving students' comprehensive ability in engineering management.

Dalian University of Technology

The engineering management major of Dalian University of Technology is set up in the Department of Construction Engineering. Cultivate successors who have an international vision, scientific and humanistic quality and innovative spirit, possess a broad theoretical knowledge base in the field of civil construction technology and management, master the technical, economic, management, information and legal knowledge in the field of modern engineering construction. In the field of engineering construction at home and abroad, a compound senior management talent who is engaged in whole-process project planning, engineering construction, engineering business, whole-process engineering consulting and operation ability, and has gradually developed into an industry leader and a high-level leader in the all-round development of morality, intelligence, physique, beauty and labor. The curriculum is mainly divided into six parts: public basic and general courses, major categories, professional basic and professional courses, professional practice and graduation design (thesis), innovation and entrepreneurship education and personality development courses, the second classroom, special innovation and integration honor courses.

The public basic and general courses involve ideology and politics, military sports, general

education, foreign languages, mathematics and natural sciences, with a total of 66 credits, accounting for 41.25% of the total credit requirements for graduation. Major categories, professional basic and professional courses, compared with other schools, it is special to set up elective module courses for professional orientation or elective courses for this study, which provide targeted learning opportunities for subsequent employment or further study. Both professional practice and graduation design (thesis) require the formation of corresponding design or practical results, so that students have the ability to contact practical engineering projects of a certain degree of difficulty and solve practical problems. Innovation and entrepreneurship education and personality development courses focus on long-term training, guide students to clarify their future career development paths, and stimulate their professional potential. The second class and the specialized creative integration honor course are not counted in the total credits. By carrying out educational classes, students are encouraged to develop their physical and mental health, and students are encouraged to actively participate in competitions and social practice. The curriculum system of Dalian University of Technology is student-oriented, respects and guides students' choices, and advocates the development of individual characteristics.

Stanford University

The Management Science and Engineering major of Stanford University is set up in the School of Engineering. The department's mission is, through education and research, to advance the design, management, operation, and interaction of technological, economic, and social systems. The department's engineering research strength is integrated with its educational program at the undergraduate, master's, and doctoral levels: graduates of the program are trained as engineers and future leaders in technology, policy, and industry. Research and teaching activities are complemented by an outreach program that encourages the transfer of ideas to the environment of Silicon Valley and beyond. The curriculum is mainly divided into five categories: Math and Science, Technology in Society (TiS), Engineering Fundamentals, Writing in the Major, and Engineering Depth.

Math and Science include mathematics, biology, chemistry, and physics. The engineering academic atmosphere is strong, aiming to broaden students' knowledge. Technology in Society (TiS) includes topics such as ethics, international security, and digital media. The content is rich and varied. It is not limited to engineering management and is conducive to diversifying students' thinking. Engineering Fundamentals is Programming Methodologies and Introduction to Optimization. Through the study of programming languages and programming thinking, students can master problem-solving tools. Engineering Depth is divided into two parts: Core and Area Courses: the core course includes five courses including Programming Abstractions, Principles of Economics, Senior Project, Organizations: Theory and Management and Economic Analysis, which all students must study; the area courses are divided into Finance and Decision Area, Operations and Analytics Area and Organizations, Technology, and Policy Area. There are three fields, and students need to choose one of them to study four courses, and the other two only need to choose two courses. Writing in the Major is similar to the domestic practical course, participating in a senior project and recording after completing the study of the systematic course. Stanford University's curriculum system is rich in content and practical, focusing on cultivating students' ability to solve practical problems, giving students full freedom in the choice of professional deepening direction, and exploring students' personal interests.

Purdue University

The industrial engineering major of Purdue University is set up in the College of Engineering. Industrial engineering education combines the study of science, mathematics, engineering fundamentals, design, and management principles to provide a unique background and sound foundation for career development in engineering practice, research, or management. Cultivate complex talents who use mathematics and knowledge of physics, engineering, management and behavioral sciences to act as problem solvers, innovators, designers, coordinators and systems integrators. The curriculum is mainly divided into three categories: Industrial Engineering Major Requirements, IE Technical Electives, and Other Departmental/Program Course Requirements.

Industrial Engineering Major Requirements are based on industrial engineering, covering many aspects of engineering, such as probability and statistics, engineering economics, and industrial engineering design, and requires students to be proficient in it. IE Technical Electives includes the topics of Basic Requirement Courses and IE Technical Electives. In addition to theoretical study, the course also includes case studies, experimental assignments and project participation, etc., with complete content. Other Departmental/Program Course Requirements include calculus, linear algebra, mechanics, electrical engineering foundation, general education foundation, etc., covering the basic knowledge space other than professional courses. The curriculum system of industrial engineering at Purdue University has distinctive features and focuses on multi-line and multi-level development of industrial engineering, and is committed to cultivating outstanding talents in industrial engineering.

ANALYSIS ON THE DEVELOPMENT TREND OF CHARACTERISTIC CURRICULUM SYSTEM OF ENGINEERING MANAGEMENT AT HOME AND ABROAD

Emphasize Theoretical Foundations

All colleges and universities require students to have deep theoretical basic knowledge in mathematics, physics, computer and other fields, especially colleges that award engineering management graduates with a bachelor's degree in engineering. The cultivation of undergraduates pays special attention to the basic training of disciplines and the profound accumulation of relevant knowledge and methods. The proficiency and application of theoretical foundations are also conducive to the development of follow-up characteristic courses. Only with a solid foundation can we achieve higher achievements in advanced and creative courses.

Aim for Professional Positioning

The discipline development of Tsinghua University has always been aimed at the frontier of international disciplines, facing the major needs of the country, and carrying out innovative research on the basic theories and key technologies of urban and infrastructure construction and management. Tsinghua University has formed special disciplines such as "urban science and management", "safety and health", "sustainable construction", and "intelligent construction". Purdue University's professional core courses revolve around industrial engineering. Professional required courses and technical elective courses are closely linked with the production process. From manufacturing, integration, control, and analysis, a complete process system is built for students.

Set Up Flexible Courses

The selected universities for research all contain elective courses with a wide range and rich content. In addition, Tsinghua University has set up a choice of two courses in the compulsory courses, and even stipulates that the SRT that has been reviewed and met the regulations can replace the Project course. The Second Classroom and Specialty Innovation Honors courses set up by Dalian University of Technology are not included in the total credits, and students are encouraged to actively participate in extracurriculars to obtain the honorary certificate of innovation and entrepreneurship practice. In foreign universities, some schools can also develop separate study plans to meet the individual requirements of students.

Focus On the Practical Process

The engineering management major is a highly practical major, which requires students to directly participate in the practice of engineering construction after graduation. The domestic and foreign universities surveyed all have practice links, which generally include design and practice, and the content is different. The practical links of Tsinghua University involve architectural design, construction organization design, construction practice, real estate market research, etc. The practical links of Tongji University are mainly project bidding, evaluation and management, while Stanford University requires students to participate in advanced projects as a practical process. The setting of practical courses emphasizes the combination of theoretical knowledge and practice, and practical courses occupy an important position in the entire curriculum system.

Combine School Resources

The engineering management major of Tongji University has the "Tongji University-Autodesk BLM" joint laboratory, the Complex Engineering Management Research Institute, the Tongji University Construction Industry Innovation and Development Research Institute, the Tongji Jingwei Real Estate Research Institute, the Engineering Management Research Institute, the Real Estate Research Institute and Housing Land Resources Experimental teaching and professional research institutions and other experimental teaching and professional research institutions to provide students with high-quality professional development conditions. Stanford University's Management Science and Engineering program interacts with other departments of Stanford University, Silicon Valley industries and organizations around the world, applying school resources to professional training, broadening professional horizons, stimulating students' imagination and creativity, and practicing from the forefront of the industry to promote the development of new theories.

CONSTRUCTION COUNTERMEASURES OF CHARACTERISTIC CURRICULUM SYSTEM OF ENGINEERING MANAGEMENT

The engineering management major of North China Electric Power University is set up in the School of Economics and Management. Cultivate senior professionals who have good moral character, physical and mental health, have a high sense of social responsibility, a solid theoretical foundation, a strong sense of innovation, a certain international perspective and good development potential, master the theory, methods and means of modern management science and basic knowledge of engineering technology, and be familiar with energy and power engineering projects Management content, principles and methods, with the ability to expand and penetrate into engineering management-related fields, and be able to engage in construction project investment management, engineering project

management, professional and technical work such as construction supervision, investment economic evaluation and construction management. The curriculum is mainly divided into six categories: public basic courses, subject basic courses, professional basic courses, professional core courses, practical links, and professional elective courses.

On the basis of investigation, comparison and inductive analysis of the construction of the characteristic course system of engineering management in five domestic and foreign universities, the inspiration from the construction of the characteristic course system of engineering management in North China Electric Power University is as follows:

Closely Centered Around Professional Orientation

Grasp the main line of professional development by referring to the talent training programs of colleges and universities for engineering management majors; understand the demands of students and employers through interviews with graduates and fresh students, and clarify the development direction of professional characteristics; through the relevant documents issued by the Ministry of Education and the Ministry of Housing and Urban-rural Development, master Requirements for this professional curriculum system. North China Electric Power University's engineering management major focuses on engineering construction project decision-making and whole-process management, integrates engineering and management, and trains who "not only grasps technology, but also understands economics, management and law" and has high-quality compound talents with good humanistic quality, strong engineering practice ability, strong innovation ability, and international competitiveness for power engineering construction systems and other industrial engineering construction.

Make Full Use of the School's Advantages

North China Electric Power University has built a professional system of "big power" disciplines "based on advantageous disciplines, focusing on emerging energy disciplines, and supported by liberal arts disciplines", and has always maintained its advantages in the field of energy and power. The engineering management major relies on the "New Energy Electric Power and Low-Carbon Development Research Center" Beijing Key Laboratory, the New Energy Electric Power Construction and Management Virtual Simulation Laboratory and the off-campus practice base to set up Introduction to Electric Power Market, Electric Power Engineering Measurement and Evaluation, and Electric Power Engineering Projects Courses such as cost cases are mutually infiltrated and integrated with advantageous disciplines such as electricity and power, so that the connotation of each discipline forms its own characteristics, and jointly builds a discipline and professional system that highlights the characteristics of "big power".

Accurately Implement Training Goals

The engineering management major of North China Electric Power University has standardized and refined the graduation requirements according to the characteristics and professional orientation of the school, according to the professional evaluation standards of the Ministry of Housing and Urban-Rural Development and the documents of the Ministry of Education, which are consistent with the evaluation documents of the Ministry of Housing and Urban-Rural Development of the engineering management major. Adhering to the training objectives of "electricity characteristics, engineering practice, scientific research and innovation", systematically study characteristic backbone courses such as electric power engineering project management, engineering economics, engineering measurement, engineering cost basis, engineering structure, construction technology, etc. The role of the course is demonstrated through the "Correspondence Matrix Table of All Compulsory Courses and Graduation Requirements", "Engineering Management Professional Curriculum System and Compulsory Course Pre- and Post-Making Relationship Diagram", and through cognitive practice, production practice, graduation practice, and innovation ability training , course training, etc. to enhance students' practical ability.

Fully Respect the Law of Development

Educating people is student-oriented, educating people in all directions, and educating people in the whole process. It requires a strong sense of responsibility and responsible behavior to achieve perfection; cultivate students' good intelligence, shape students' healthy minds, and internalize responsibility awareness into The self-quality of students is one of the essentials of the cultivation of contemporary high-quality talents. The construction of the characteristic curriculum system should fully respect the law of individual development of students, and the engineering management major should adjust the total credits and required credits appropriately to give students sufficient space for development. The elective courses should be more abundant, and the scope may include energy technology, economic management, power market, engineering cost, computer technology, innovation and entrepreneurship, public art, etc., so as to fully tap the personal potential of students.

CONCLUSIONS

Under the background that the Ministry of Education issued the "Notice of the General Office of the Ministry of Education on the Implementation of the "Double Ten Thousand Plan" for the Construction

of First-Class Undergraduate Majors", the construction of the engineering management major undergraduate characteristic curriculum system is an important task for the construction of engineering management majors in domestic colleges and universities. Carrying out the discussion on the current situation and development trend of the construction of the characteristic course system of engineering management at home and abroad will not only help to discover the unreasonableness and inadequacy of the existing course system, but also draw lessons from the experience and ideas of the construction of the characteristic course system in domestic and foreign universities. Under the goal of "classified development and characteristic development", the curriculum system will be continuously adjusted and improved to cultivate engineering management professionals with analytical, practical and innovative abilities.

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