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Research on Governance of Higher Engineering Education Quality in China after Accessing the Washington Accord

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Abstract

As an important quality assurance mechanism, the program accreditation of engineering education has become the basic mechanism for improving the quality of engineering education in various countries. Under the guidance of the CPC Central Committee and the State Council, China has established quality assurance mechanism of engineering education. In June 2016, China officially accessed the *Washington Accord*, which symbolized that its engineering education accreditation system has been recognized by the international engineering community. However, China's accessing the *Washington Accord* as a full signatory is only the beginning of integrating into the international engineering community. China must actively respond to the contrasts with international engineering education, and optimize the accreditation system of engineering education. Thus, this research attempts to propose an emerging concept, i.e., governance of higher engineering education quality; draw on the Governance Theory to establish a logical framework for the governance of higher engineering education quality in China around the dimensions of governance motivation, subjects, objects, purposes and approaches, so as to provide "China Solution" in the context of global quality assurance in engineering education.

Key words: higher engineering education; program accreditation; quality assurance; Governance Theory; China

1. Introduction

Since the end of the 20th century, promoting the quality of higher engineering education through evaluation or accreditation has gradually become the common experience of many countries, and promoted the formation of the *Washington Accord* and the *European Network for Accreditation of Engineering Education*. As a relatively mature means, the program accreditation system of engineering education has become the basic mechanism for many countries to ensure the quality of engineering education. Currently, the global engineering education accreditation embodies diversified development trend, i.e., outcome-orientation, international connection, continuous improvement, industry-university cooperation [1].

Undoubtedly, there are differences amongst the engineering education accreditation system of different countries. Especially, the *Anglo-Saxon* program accreditation system represented by the U.S. and U.K. is rooted in their own historical and cultural traditions. Under the guidance of the CPC Central Committee and the State Council, and with the joint promotion of the engineering education academic community, the industry and enterprise circles, China has established the quality assurance mechanism of engineering education based on program accreditation. Generally speaking, the program accreditation of engineering education has brought positive

impact on the establishment of the internal quality assurance system of higher education institutions (hereinafter referred to as HEIs), as well as the reform of engineering talents cultivation.

The program accreditation system of China's engineering education follows a top-down driven compulsory system construction model affected by the external environment. In June 2016, the China Association for Science and Technology, on behalf of China, was unanimously approved the application for becoming a full signatory at the International Engineering Alliance Meetings, and became the 18th official signatory of the *Washington Accord*. China's formal accession to the *Washington Accord* marks that its engineering education accreditation system has been recognized by the international engineering community. The accession to the *Washington Accord* is the basis and key to promote the international mutual recognition of Chinese engineers' qualifications, and is of great significance for China's engineering and technology field to cope with international competition [2].

China's accessing the *Washington Accord* as a full signatory is only the beginning of integrating into the international engineering community. After the official accession, China must actively address the gap with international higher engineering education and optimize the program accreditation system of engineering education. Therefore, this research attempts to introduce the analytical framework of Governance Theory, establish the logical framework for governance of higher engineering education quality in China around the dimensions of governance motivation, subjects, objects, purposes and approaches. It intends to explore the governance model of higher engineering education quality with Chinese characteristics so as to bring enlightenments to the signatories of the *Washington Accord.*

2. The Connotation of Governance of Higher Engineering Education Quality

As an important mechanism of education quality assurance and international mutual recognition of engineering degrees and engineers, the establishment and implementation of engineering education program accreditation system has a potential impact on higher engineering education. However, how to promote the establishment of effective self-improvement mechanisms through program accreditation is still a topic worthy of discussion. With increasingly frequent transnational cooperation and exchange of engineering talents in the era of globalization, the engineering education is faced with multiple challenges. Therefore, it urgently requires us to go beyond the traditional cognition and path dependence on the quality assurance in higher engineering education. This research attempts to put forward the concept of "governance of higher engineering education quality" on the basis of analyzing the relevant concepts, i.e., higher engineering education, quality assurance, governance and so on.

2.1 Higher engineering education

The engineering education system is very complex. From primary and secondary education to graduate education, the objectives and priorities of engineering education at different stages are different. For example, engineering education in the U.S. can be divided into three stages: K-12 engineering education, higher engineering education, and continuing engineering education [3]. Higher engineering education is an important part of the engineering education system in the U.S. It trains different types of engineering talents through research universities, state universities (colleges) and community colleges [4]. Specifically, engineering leadership talents are trained through the engineering schools of research universities such as MIT, UC Berkeley, Stanford University; engineering applied talents through the engineering colleges of San Francisco State University, San Jose State University and other state universities (colleges); professional engineering talents through community colleges such as Green River College in the U.S. Therefore, the engineering education that this research focuses on is mainly aimed at higher engineering education.

2.2 Quality assurance

Due to people's different worldviews and values, it is difficult to form a universal definition of quality. Inspired by Edward Sallis' factor analysis of the education system [5], quality is defined as the view and understanding of how to meet or exceed the demands of all stakeholders. For the complexity of higher engineering education system, it is more difficult to define the quality of engineering education. Since 1990s, the concept of quality has frequently appeared in the engineering education, and the principles of quality assurance have also begun to be introduced into the engineering education research. Relevant research began to investigate the quality concept and quality assurance concept of engineering education, and tried to introduce related concepts of quality assurance into engineering education research [6][7].

In a broad sense, quality assurance has rich connotations, involving diverse dimensions and levels. For example, the objects of quality assurance can be divided into quality assurance of teaching, scientific research, social service, or organization management, student service, resource utilization, and academic. Among them, academic quality assurance can be divided into quality assurance of HEIs, program and course, teaching and learning, classroom. It is not only challenging, but also unscientific and irrational to carry out comprehensive research on the quality of higher engineering education. Nevertheless, it is not difficult to find that the quality at the program level is the dimension that can best reflect the quality of higher engineering education. It is an important bridge and link connecting external program accreditation and internal quality improvement, and can be the core and focus of the quality improvement of higher engineering education. If there is no special explanation, the governance object of higher engineering education quality will be positioned in the narrow sense of higher engineering education quality, that is, the

engineering education quality at the program level.

2.3 Governance

The broad concept of governance has always existed in history. For a long time, it has been used interchangeably with the term “government”, which is mainly used in the management and political activities of public affairs related to the sovereign country [8]. Since the 1990s, the term “governance” has become popular in academic circles, especially in the fields of economics, politics and management. Governance in the modern sense appeared in the late 1980s and early 1990s. The word “governance” began to appear in the works of international relations as an academic term. James N. Rosenau, the main founder of the Governance Theory, defined “governance” as “the management mechanism of a series of activities” in his representative book *Governance without Government* [9].

The governance in the modern sense has its own characteristics. Governance is not completely equal to management which emphasizes policy implementation and specific administrative act. Governance is essentially a process of negotiation and cooperation which emphasizes the diversity of governance subjects, and enables all or part of the members of the organization share the decision-making power. This research draws on the definition of governance in the 1995 report of the Commission on Global Governance titled with *Our Global Neighborhood*, that is, governance is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co- operative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interest [10].

2.4 Governance of higher engineering education

To sum up, the governance of higher engineering education quality is a complex process in which the government, HEIs, social forces, industries and international organizations work together to govern the quality of higher engineering education. In accordance with this new concept, it urgently requires us to establish the logical framework for the governance of higher engineering education quality by taking the governance connotation of engineering education quality as the logical source, fully analyzing the governance motivation of higher engineering education quality. The framework should be composed of diversified governance subjects, clear governance purposes and strategic governance approaches, so as to provide inspiration for strategic choice of deeply participating in the global governance of higher engineering education.

3. The Governance Motivation of Higher Engineering Education Quality in China

Driven by modern information technology, transportation technology and transnational corporations, economic globalization shows the internationalization of industry and production, capital and market, scientific and technological development and engineering application. Whether China can occupy an important position in the global complex engineering problems and lead the global development and smoothly promote the construction of new industrialization depends on the establishment of strong human resources, and the development of multi-level, multi-type and high-quality higher engineering education. Strengthening the governance of higher engineering education quality is mainly driven by following internal and external motivations.

3.1 Internal motivation: realistic need to improve the quality of higher engineering education

From the perspective of actual operation, compared with developed countries, China faces many issues and challenges in terms of organization, practice and technology [11]. First of all, from the perspective of organization, in the initial stage of accreditation system, the China government mostly played the role of direct participant and controller. Later, although China improved the independence of accreditation agency through CEEAA under the leadership of the China Association for Science and Technology, it still took the official as the leading role. To a large extent, the government's excessive intervention in program accreditation not only directly leads to the low enthusiasm of HEIs, especially research universities, to participate in the program accreditation, but also affects the effectiveness of program accreditation agency, reducing the scientificity, impartiality and transparency of program accreditation. Secondly, from the perspective of practice, the construction of the number, structure and quality of China's accreditation expert team is relatively lagging behind. For instance, the number of experts is relatively small, and it is difficult to complete such a large number of program accreditation work with high quality; the experts who actually participate in the accreditation are mainly in-service teachers and academic administrators of HEIs, while the proportion of personnel from enterprise and industry associations is very small; a considerable number of experts have difficulty in mastering the concepts, principles and criteria of program accreditation. Thirdly, from the perspective of technology, at present, most programs' accreditation has always been in a relatively isolated status and has not been effectively connected with the engineer registration system. This directly leads to the lack of training of students' engineering awareness in the actual training process in HEIs. The phenomenon of valuing theory and neglecting practice still exists. The engineering practice ability of graduates is still low. The number and qualification of engineering talents trained by HEIs cannot fully meet the actual needs of industry. Finally, from the perspective of HEIs' programs, there still exist following issues, i.e., how to ensure continuous quality improvement? how to implement scientific quality

evaluation? how to carry out effective quality management? [12] how to ensure stakeholders' participation?

The quality assurance system of engineering education is an organizational structure in which the government, industry and enterprises, HEIs interact, cooperate and coordinate with each other. The quality assurance in engineering education involves all aspects of talent cultivation, including all stakeholders and various resources. Only when students, teachers, managers, employers, industry and enterprises, and governments participate in the quality assurance agenda of engineering education, can the quality assurance in engineering education be solidly promoted. It believes that the governance of engineering education quality based on the participation of stakeholders is not only an important prerequisite but also the only approach for the quality assurance in engineering education. With the in-depth development of program accreditation of engineering education in China , under the opportunity that China has officially become the full signatory of the *Washington Accord*, it has become an urgent demand for the reform and development of engineering education at present and in the future, to closely combine the requirements of the national strategic planning, make full use of the program accreditation mechanism of engineering education, organically integrate the program accreditation and reform practice of engineering education, and lead the systematic and in-depth reform of engineering education.

3.2 External motivation: challenges of integrating international rules and norms

The tide of globalization has driven countries to actively carry out educational exchanges with countries around the world. In order to share educational resources and gain international recognition, many countries attach importance to the internationalization of engineering education, actively participate in the global exchange and dialogue of engineering education, and actively participate in the world's major engineering education accreditation system. Among the signatories s of the *Washington Accord*, the U.S., Canada, U.K., Ireland and Australia have not only signed the *Washington Accord*, but also accessed important international engineering education cooperation projects such as the Sydney Accord, the Dublin Accord and the Seoul Accord. With these projects, on the one hand, they can actively absorb international advanced engineering education concepts and practical experience; On the other hand, it actively attracts students from member countries to study and exchange in the country, and provides talent reserves for the development of the country. China has only acceded to the *Washington Accord so far*, which is not the end of achieving internationalization of engineering. The *Washington Accord* only corresponds to engineering education at the undergraduate level. As far as the China is concerned, engineering and technology education at the higher vocational level is responsible for cultivating millions of high-quality front-line engineering and technical talents. China has not yet accessed the *Sydney Accord* for the accreditation of engineering and technical experts, while Hong Kong China and Chinese Taipei

have taken the lead. It seems imperative for China to access the *Sydney Accord*. As a part of the engineering education and the international mutual recognition system of engineers, the *Sydney Accord* is mainly aimed at the program education of engineering technology for 3 to 4 years. Some of its contents are compatible with the talent training specifications of some higher vocational colleges of science and engineering in China, and some ideas and objectives in engineering education are also worthy of reference. However, it can't provide a specific paradigm for the development of higher vocational education specialties, nor can it improve the speed and level of the development of higher vocational education specialties, lead to the deviation of the training direction of higher vocational education talents in China. Therefore, it isn't the due time for China to access the *Sydney Accord* yet.

To some extent, the level of internationalization of higher engineering education accreditation has also become the epitome of the internationalization of overall higher engineering education in China. The most significant sign of the internationalization of higher education is reflected in the scale of international students, the quality of talent training and its influence. At present, the internationalization of China's higher engineering education still has the following shortcomings [13]. First, the scale of outstanding international students attracted by China's higher engineering education is still relatively small. China has become the largest destination country for overseas students in Asia, and the scale and structure of overseas students have been continuously optimized. Chinese language, western medicine and engineering have become the most attractive majors for foreign students to come to China. However, there is still a large gap between the number of outstanding engineering students in China and other higher education powers. Secondly, China's higher engineering education is not competitive enough to cultivate international talents. On the one hand, due to the imperfection of the international talent training system, there are deficiencies in the interdisciplinary integration, the integration between industry and education, and the international cooperation in education, affecting the international competitiveness of graduates. On the other hand, if teachers do not have the teaching ability to improve the international level of students, it is not conducive to cultivating high-level international engineering and technology talents. Finally, there is a long-term imbalance in the two-way flow of international students at home and abroad. Although the international influence of China's higher engineering education continues to increase, in the field of natural science and engineering, few outstanding students from developed countries come to Chinese HEIs to study for credits or degrees.

The establishment and implementation of the program accreditation system of engineering education has a potential impact on China's higher engineering education. However, as engineering education is undergoing unprecedented historical changes, many tasks cannot be accomplished overnight. This determines that the program accreditation is still at the stage of "similarity in form", far from reaching the state of "similarity in spirit" [14]. Accessing the *Washington Accord* means that China

should follow international rules and establish institutional norms consistent with them. However, there are still many cognitive and practical contrasts between China's higher engineering education and the *Washington Accord*. First, the *Washington Accord* advocates quality improvement, while China is used to implementing quality assurance. The quality concept of higher engineering education in China is still at the "assurance" stage, and regards the external accountability and government policies as the main means; while the quality improvement advocated by the *Washington Accord* places more emphasis on internal improvement and development, and highlights the aspirations of HEIs. Secondly, the *Washington Accord* called on stakeholders to fight together, while China is used to fight alone. These contrasts have challenged the international integration of higher engineering education in China, and how effectively deal with it has become the key to integration into the international environment [15].

According to the relevant resolutions of the IEAM, China has been undergoing the periodic inspection of the *Washington Accord* since 2022, and the IEAM will vote in 2023. According to the relevant arrangements of the IEA, the CEEAA has been seriously preparing for the inspection, taking the inspection as an opportunity to further improve the engineering accreditation system. For all signatories, the periodic qualification inspection brings great pressure and challenges rather than severe threats. However, for the new signatory like China, the qualification inspection actually bring threat to the status of legitimacy. Additionally, more and more Asian countries apply to access the *Washington Accord* in recent years, including Bangladesh, Philippines, Myanmar, Thailand and Saudi Arabia as provisional signatory, Pakistan and Indonesia as full signatory, which bring potential pressure on China. According to the lessons of Japan Accreditation Board for Engineering Education (JABEE), accreditation agency must implement active reform of program accreditation of engineering education, by shaping a strong sense of crisis, adhering to the basic concept of accreditation, and taking scientific and practical reform measures [16]. Accreditation agency will be confronted with survival crisis without long-term strategic vision and mission.

4. The Governance Subjects of Higher Engineering Education Quality in China

To achieve the governance of higher engineering education quality, it requires to strive to establish a governance community of higher engineering education quality through a comprehensive and open organizational form, form a relatively stable group relationship among multiple governance entities, and continue to optimize internal and external relationships. Under the macro background of establishing a community with a shared future for mankind, the governance of higher engineering education quality is an inevitable choice to promote the modernization of engineering education governance system and governance capacity, and is also an important global education governance topic. At the organizational level, the governance of higher engineering education quality requires us to establish a communication and

cooperation mechanism between the government, HEIs, enterprise and industry associations, and pool our ideas and efforts to promote the formation of program accreditation system with Chinese characteristics.

For HEIs, it requires us to pay attention to shaping the subjectivity culture and forming the joint force of quality assurance. HEIs' leaders and managers at all levels, relevant departments, teachers and students should work together to ensure the quality of engineering education. As for leaders and managers at all levels, they should attach great importance to program accreditation, fully mobilize the enthusiasm of leaders and team members of relevant departments and colleges, and form their team spirit of mutual cooperation. On the basis of extensive investigation, education managers should revise talent training objectives and corresponding talent training programs to form a continuous improvement mechanism. As far as engineering departments are concerned, they should reasonably position the talent training objectives of their programs, and prepare for the implementation of program accreditation through self-evaluation. As far as teachers are concerned, they should treat program accreditation with a positive attitude, recognize that the implementation of program accreditation will become an important opportunity to promote their own development and improvement, and realize a win-win situation of self-development and program construction by actively participating in self-evaluation and rectification. As for the majority of students, it is necessary to clarify the talent training objectives of this program, understand the role of each course in achieving its objectives, and study more actively and purposefully.

5. The Governance Purposes of Higher Engineering Education Quality in China

5.1 Generating quality standard

The fourth industrial revolution, represented by cloud technology, big data, the Internet of Things, and AI, is developing at an exponential speed. Its breadth and depth indicate the transformation of the entire production, management and governance system. Facing the opportunities and challenges of the new industrial revolution, the governance of China's higher engineering construction quality aims to create new quality and new standards of engineering education for the industry, the world and the future through connotative development, so as to meet the requirements of new industrial revolution on the objectives, contents and methods of engineering education. Due to the timeliness and regional differences of accreditation criteria, in the context of promoting the modernization of the governance system and governance capacity of higher education, it is urgent to attract multiple stakeholders to promote the collaboration, participation and common interests of engineering education, and build accreditation agency with strong dynamic adjustment capabilities to respond to the actual or potential needs of the new industrial revolution, generate new quality standards for engineering education [17].

5.2 Shaping quality culture

The lack of evidence culture is the lack of fairness and objectivity in the evaluation of education quality, the lack of initiative in the face of public accountability, the lack of continuity in improving education quality, and the lack of scientific education management and decision-making. For Chinese HEIs, it is necessary to take the opportunity of participating in the engineering program accreditation, truly shape and strengthen the evidence-based quality culture, and then popularize and promote the quality culture to all HEIs. The purpose of program accreditation is not only to give a conclusion of pass or fail for a certain program, but also to have an inspection of China's engineering education to provide guidance and help to improve the quality of engineering education. Under the background of vigorously promoting and implementing the PETOE in the engineering education field, it is necessary to focus on the shaping of quality culture throughout the engineering education practice of HEIs, and make the pursuit of excellence become a consensus of HEIs [18].

6. The Governance Approaches of Higher Engineering Education Quality in China

With the in-depth development of program accreditation of engineering education, under the opportunity that China has become the full signatory of the *Washington Accord*, it is necessary for us to go beyond the Anglo-Saxon model, systematically plan the approaches and countermeasures of quality assurance in engineering education based on the strategic vision, and explore the quality assurance model of higher engineering education with Chinese characteristics.

6.1 Innovate the accreditation system and deepen the essence of equivalence

After formal accession to the *Washington Accord*, China should actively deal with the contrasts with international higher engineering education and establish mutual recognition standards in line with international standards. China should use big data technology and modern information tools to establish monitoring and improvement mechanisms to ensure the accreditation system in the process of timely adjustment and innovation [19]. Under the premise of maintaining the accreditation criteria and operating procedure design requirements of the *Washington Accord*, China should re-innovate the accreditation objectives, criteria, procedures and personnel composition according to the current situation of large differences in the number, structure and level of engineering education, so as to establish a flexible accreditation system to meet the different needs of HEIs and programs.

6.2 Reflect on the philosophy of accreditation and integrate the characteristic accreditation culture

China should change the logic of imitating and catching up with the accreditation system of developed countries, deeply analyze the accreditation philosophy of

international organizations, and cultivate accreditation culture with Chinese characteristics [20]. Thus, China should internalize and continuously improve the accreditation philosophy, pay attention to the guidance and leading role, and promote the in-depth development of engineering education quality; pay more attention to the needs of national and local economic and social development, such as emphasizing the cultivation of students' devotion to family and country; emphasize inclusiveness and innovation, reserve space for emerging disciplines, trans-disciplines and multi-disciplines in the application of criteria, timely absorb the innovative results of practical tests into the accreditation criteria, so as to improve the vitality and innovation of accreditation agency.

6.3 Reduce direct government intervention and explore market operation model

The program accreditation of engineering education in China is still in the exploration stage, and the accreditation system of engineering education follow the mandatory institutional change based on nationalism. In the face of the rapid development of the fourth industrial revolution, independent and non-governmental accreditation agency is more flexible to cope with changes. China should pay attention to breaking the path dependence, transforming to indirect management and legal management, and gradually reducing the direct intervention of the government in accreditation at the mature stage; shift to an independent market-oriented operation model, explore the construction of an independent market-oriented accreditation agency, and promote the modernization of the governance system and governance capacity [21].

6.4 Strengthen the effective interaction between industry and HEIs, and give play to the unique functions of the industry

Engineering education accreditation should be an open process of effective interaction between industry and HEIs, and further promote the effective participation of multiple stakeholders such as industry and enterprises [22]. China should formulate working system as soon as possible, clearly define the basic functions of industry and professional associations, timely improve them according to the problems in the implementation process, and finally form an efficient and transparent internal operating mechanism. Industry and professional associations should fully participate in the formulation of accreditation criteria, and pay attention to the basic standards and requirements of industry for engineering graduates with different levels. China should fully involve the front-line engineers with rich practical experience in the industry and professional associations in all aspects of practice, gradually improve the practical links, so as to enhance the recognition of the industry and professional associations on the accreditation system.

6.5 Improve the operation mechanism and realize the dynamic adjustment of criteria

China's accreditation agency of engineering education should improve the two-way

communication mechanism of bottom exploration and top design, establish cooperation and communication mechanism of government, HEIs, industry associations and other stakeholder groups [23], gradually form an efficient and scientific stable operation mechanism, and realize the dynamic adjustment of accreditation criteria. China should strengthen the decentralization of power, give more power to the professional accreditation committees to revise criteria, and respond quickly to changes in professional fields; improve and implement internal rules and regulations, optimize the environment for effective participation of industry associations, and enable them to give equal feedback and participate in decision-making; set up special revision departments and personnel of accreditation criteria, widely collect the opinions of professional accreditation committees, member societies and professional assessors in the whole process of criteria revision, implementation and evaluation, and provide strong intellectual support for optimizing and adjusting accreditation criteria.

6.6 Optimize the organizational structure and improve the quality of accreditation personnel

The effective implementation of professional certification requires a considerable number of evaluation experts with reasonable structure, high quality and rich experience as the backing. China should appropriately increase the number of accreditation experts to meet the growing demand in HEIs; optimize the personnel structure, attract more people with industry background to participate in accreditation, increase the proportion of front-line experts from industry and industry associations, and evaluate the quality of engineering education from the perspective of client [24]; and strengthen the professional quality training for the accreditation expert team. In addition, for the structure of accreditation agency, an industry advisory council can be established to collect the opinions of the industry on the accreditation criteria.

6.7 Strengthen internal quality assurance and improve the construction of core mechanisms

The program accreditation of engineering education is the external power to lead the quality assurance of engineering education. The internal quality assurance mechanism should be established accordingly [25]. HEIs should thoroughly implement the concept of continuous quality improvement; scientifically establish the technical mechanisms for quality assurance in engineering education, deepen the outcome-based philosophy to promote the reform of engineering education curriculum and teaching, and shape the evidence culture based on data and the quality culture of continuously pursuing excellence; systematically establish the management mechanisms, improve the organizations of quality assurance, formulate the policies of quality assurance, and improve the institutional basis quality assurance; gradually improve the power mechanisms, promote the reform of student-centered teaching model, and form the joint force of quality assurance.

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