

A Comparative Study on the Development of Engineering Ethics in China and the West and Strategies for Enhancement

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Abstract

Engineering ethics plays an increasingly important role in modern society, not only influencing the quality and safety of engineering practices but also relating to social development and human well-being. This paper compares the development of engineering ethics in China and the West, sorts out the similarities and differences between the two, analyzes the differences in engineering ethics concepts, practices, systems, and education, and on this basis, puts forward relevant suggestions for improving engineering ethics practices to promote the further development of engineering ethics on a global scale.

Keywords

Chinese Engineering Ethics; Western Engineering Ethics; Development Comparison; Improvement Suggestions

1. Introduction

In the course of historical evolution, engineering ethics has developed from its initial rudimentary form to a strong momentum, attracting global attention [1]. As a discipline that studies moral issues in engineering activities, engineering ethics aims to guide engineering technicians to follow moral norms and achieve sustainable development of engineering activities. With the development of globalization and technology, the scope and complexity of engineering practice are constantly increasing, and the importance of engineering ethics is becoming increasingly prominent [2]. At the same time, against the backdrop of China's rapid economic development, the position of engineering construction in the national economy is becoming increasingly prominent, and engineering ethics issues are also attracting widespread attention. By comparing the development of engineering ethics in China and the West and drawing on the advanced experience of Western engineering ethics, it is of great significance to improve the practice of engineering ethics in China. China

and the West have their own characteristics in the development of engineering ethics. By comparing the differences between the two, we can better understand and improve the practice of engineering ethics. This paper will compare the two in terms of engineering ethics concepts, practices, systems, and education, and on this basis, put forward suggestions for improvement.

2. The Connotation and Significance of Engineering Ethics

Engineering ethics refers to the code of conduct that engineers follow in engineering practice, adhering to moral principles and being responsible for technology, the environment, society, and stakeholders. Engineering activities are not only the process of humans transforming nature and making objects serve human needs, but also the process of transforming the subjective world and aligning subjective cognition and actions with the objective world [3]. The significance of engineering ethics is reflected in the following aspects: First, it ensures engineering safety and prevents engineering accidents caused by ethical lapses. Engineering ethics can ensure that engineers consider public safety, health, and well-being in engineering projects, thereby safeguarding the interests of the general public. Second, it maintains social equity and ensures the sustainable development of engineering projects. Third, it enhances the professional image of engineers. Engineers adhering to engineering ethics helps establish and maintain a good image and reputation for the entire industry, enhancing public trust in the engineering sector. Fourth, it addresses ethical challenges. With the development of technology and social changes, engineers will face more and more ethical challenges. Engineering ethics can provide guidance and support, helping engineers make correct decisions. In engineering practice, engineers and other relevant personnel encounter moral and ethical issues. Engineering ethics is not only related to the success of engineering projects but also to the sustainable development of society. Engineering ethics emphasizes the protection and rational utilization of the environment and resources, contributing to sustainable development. As engineering technology continues to develop and be applied, engineering ethics issues have become increasingly prominent. Therefore, studying the development of engineering ethics is of great significance for improving the quality of engineering practice and promoting sustainable social development.

3. Origins and Development of Engineering Ethics in the West and China

3.1 Origins and Development of Western Engineering Ethics

Western engineering ethics originated in ancient Greece when philosophers began to pay attention to moral issues in technological activities. In modern times, with the rise of the Industrial Revolution, engineering ethics gradually became an independent discipline. In the early 20th century, the American Society of Civil Engineers (ASCE) formulated the first code of engineering ethics, marking the formation of the

Western engineering ethics system. After that, following several engineering disasters, Western society began to attach importance to engineering ethics and gradually established a complete engineering ethics system. With the continuous development of Western engineering ethics, an engineering ethics system represented by the United States and Europe was formed. The development of Western engineering ethics concepts was influenced by ancient Greek philosophy, Christian ethics, and modern enlightenment thought, emphasizing individualism, free competition, and human rights and dignity. In the West, engineering ethics is regarded as part of the professional ethics of engineers, emphasizing the responsibility of engineers to society and the environment.

3.2 Origins and Development of Chinese Engineering Ethics

The development of Chinese engineering ethics began in the 1950s. After the founding of the People's Republic of China, China began to draw on the experience of the Soviet Union and carry out engineering ethics education. In the 1980s, with the advancement of reform and opening up, engineering ethics gradually received attention. In 1995, the Chinese Academy of Engineering was established, marking a new stage in the development of engineering ethics in China. In recent years, the Chinese government has attached great importance to engineering ethics issues and issued a series of policy documents to promote engineering ethics education and practice. The development of Chinese engineering ethics concepts has been influenced by Confucianism, Legalism, and Taoism, emphasizing collectivism, social harmony, and the unity of man and nature. The development of engineering ethics in China started relatively late, roughly in the 1980s, but has achieved remarkable results in recent years. Engineering ethics is regarded as an aspect of engineering practice, emphasizing the responsibility of engineers to the country and the people.

4. Main Differences in Engineering Ethics between China and the West

The differences in engineering ethics between China and the West are mainly reflected in value orientation, ethical subjects, and ethical goals. Western engineering ethics emphasizes individualism and free competition, while Chinese engineering ethics emphasizes collectivism and social harmony. In terms of ethical subjects, Western engineering ethics focuses more on the personal morality of engineers, while Chinese engineering ethics pays more attention to the social responsibility of engineers. Regarding ethical goals, Western engineering ethics emphasizes technological progress and human well-being, while Chinese engineering ethics emphasizes national development and the interests of the people.

4.1 Differences in Ethical Concepts

Western engineering ethics emphasizes individualism, liberalism, and utilitarianism, focusing on the personal responsibility and moral self-discipline of engineers. It

emphasizes utility, benefit, and gain, and measures actual function and interest. It regards morality as a tool and means, calculating how much happiness can be obtained through morality and what benefits can be gained from such behavior [4]. Chinese engineering ethics emphasizes collectivism, social responsibility, and national interests, focusing on the social benefits of engineering activities. In Western engineering ethics, the responsibility of engineers is usually defined as responsibility to clients, users, and the public, as well as to science and technology. In Chinese engineering ethics, the responsibility of engineers not only includes responsibility to clients and the public, but also responsibility to the country and the nation, as well as compliance with social ethics and professional ethics. In Western engineering ethics, moral norms are often based on universal ethical principles, such as honesty, fairness, and respect for human rights. In Chinese engineering ethics, moral norms, in addition to universal ethical principles, also incorporate socialist core values, such as prosperity, democracy, civilization, and harmony.

4.2 Differences in Ethical Norms

The differences in engineering ethical norms between China and the West are mainly influenced by their respective cultural backgrounds, value systems, social structures, and laws and regulations. In Western countries, engineering ethical norms are often closely related to laws and regulations, and engineers need to abide by strict laws and industry standards. Social responsibility mainly lies in the responsibility to the public, clients, and the environment. In China, engineering ethical norms are also related to laws and regulations, but engineers also need to abide by the policies and guidelines of the Party and the state, as well as industry norms and professional ethics. Engineers' social responsibility not only includes responsibility to the public, clients, and the environment, but also responsibility to the country and the nation. The Western engineering ethical norms system is relatively complete, covering multiple aspects such as engineers' professional ethics and engineering ethical guidelines. China's engineering ethical norms are still not perfect and lack a systematic engineering ethical guideline. These differences reflect the different focuses and practices of engineering ethics between China and the West. With the deepening of globalization and cross-cultural exchanges, engineering ethical norms in China and the West are constantly learning from each other and integrating.

4.3 Differences in Ethical Education

Western engineering ethics education started earlier and has formed a relatively mature education system. China's engineering ethics education started later and is still in the exploratory stage. The development of Western engineering ethics education can be traced back to the early 20th century. At that time, engineering education had already begun to pay attention to ethics education. With the development of engineering ethics concepts, Western engineering ethics education has gradually improved. Currently, Western engineering ethics education has formed a complete

system, including ethics courses, ethics practice, and ethics research, etc. China's engineering ethics education developed relatively late and is still in the development stage. Although the government and all sectors of society have gradually increased their attention to engineering ethics education, there are still some problems and challenges. Although China's scientific and technological innovation is developing rapidly, there are still problems such as an incomplete system and uneven development in engineering ethics education. It is necessary to further improve the engineering ethics education system and effectively prevent engineering ethics risks [5].

4.4 Differences in Ethical Practice

Western engineering ethics practice has strong institutional guarantees, such as strict professional qualification certification and ethical review, and there are also many experiences and cases of engineering ethics practice, such as the "Engineers' Responsibility Declaration" in the United States and the "Engineers' Ethical Code" in Europe. These experiences and cases provide guidance and support for Western engineering ethics practice. However, there are still certain deficiencies in China's engineering ethics practice, such as incomplete ethical review systems, insufficient supervision, conflicts of interest in engineering practice, engineering quality issues, and environmental problems. These problems need to be solved by strengthening engineering ethics education and improving engineering ethics systems.

4.5 Differences in Ethical Systems

The development of Western engineering ethics systems can be traced back to the late 19th century. At that time, engineering associations had already begun to formulate relevant ethical norms and standards. With the continuous development of engineering technology, Western engineering ethics systems have gradually improved. Currently, Western engineering ethics systems have formed a complete system, including ethical norms, ethical review, and ethical education. The construction of China's engineering ethics system started relatively late and is still in the development stage. Although the government and all sectors of society have gradually increased their attention to engineering ethics, there are still some problems in the construction of the engineering ethics system. For example, ethical norms are not yet complete, ethical review mechanisms are not yet sound, and ethical education is not yet widespread.

In summary, by comparing the development of engineering ethics in China and the West, it can be seen that there are certain differences in engineering ethics concepts, norms, systems, education, and practice. China's engineering ethics development is relatively late, but it still has great potential for development. To improve the quality of engineering practice in China and promote sustainable social development, it is necessary to further strengthen engineering ethics education, improve engineering ethics systems, and enhance the level of engineering ethics practice. At the same

time, it is also necessary to draw on the experience of Western engineering ethics development to promote the further development of engineering ethics in China.

5. Suggestions for Improving Engineering Ethics Practice in China

5.1 Strengthening Engineering Ethics Education

5.1.1. Enhancing the Status of Engineering Ethics Education in the Higher Education System

(1) Incorporate engineering ethics courses into the compulsory curriculum, strengthen interdisciplinary education, increase the proportion of engineering ethics education, and treat it as one of the core courses. Develop courses that include ethical theories, case studies, and ethical decision-making training to enhance students' ethical literacy during their school years. The education authorities should issue relevant policies to encourage and guide universities to strengthen engineering ethics education and provide necessary resource support. In student evaluations and engineering professional accreditation systems, engineering ethics education should be regarded as an important assessment indicator.

(2) Strengthen the construction of the engineering ethics teaching staff, improve teachers' professional qualities and teaching abilities, and introduce teachers with rich engineering practice experience and ethical education backgrounds to enhance teaching quality. Collaborate with the industry to jointly develop ethical education courses and invite enterprise engineers to participate in teaching to help students understand the ethical issues they may encounter in engineering practice. Through practical teaching links such as internships and training, let students experience the importance of engineering ethics in real working environments and cultivate their decision-making abilities when facing ethical challenges.

(3) Increase research efforts in engineering ethics education, promote the development of engineering ethics education theories, and create an atmosphere that values engineering ethics on campus. Through lectures, seminars, and theme activities, raise students' and society's awareness of engineering ethics.

5.1.2. Enriching the Content of Engineering Ethics Education

(1) Integrate ethical education with engineering professional education, allowing students to understand ethical norms while learning technical knowledge. Integrate diverse ethical theories, introduce ethical theories from different cultural and philosophical backgrounds, such as Confucian ethics, Western utilitarianism, and Kant's deontology, etc. Analyze the application and limitations of these theories in engineering practice to help students establish a multi-perspective ethical view. Promote autonomous learning and critical thinking in ethics, encourage students to participate in ethical research projects, and develop critical thinking and independent research abilities. Utilize online resources and discussion platforms to facilitate students' autonomous learning and communication.

(2) Introduce real cases, collect and organize real engineering ethics cases from both

domestic and international sources, covering different fields and types of ethical issues. Through case discussions, role-playing, and simulated decision-making, improve students' ethical analysis abilities and decision-making skills. Let students understand the manifestations of engineering ethics issues in real life and enhance their ability to solve practical problems. Strengthen the connection between ethics education and reality, invite industry experts and members of ethics committees to share real cases and experiences. Keep track of the latest ethical norms and laws and regulations, and update teaching content in a timely manner.

(3) Enhance interdisciplinary cooperation, incorporate knowledge from disciplines such as philosophy, psychology, and sociology into engineering ethics education. Help students understand engineering ethics issues from multiple perspectives. Jointly conduct courses with other majors such as environmental science and public health to explore interdisciplinary ethical issues. Incorporate ethical assessment links into internships and projects to enable students to identify and handle ethical issues in actual work. Conduct practical activities such as mock courts and ethical consultations to improve students' ethical practice abilities.

5.1.3 Innovate Engineering Ethics Education Methods

(1) Adopt discussion-based, inquiry-based, and case-based teaching methods to stimulate students' interest in thinking and enhance their ethical literacy. Implement interactive teaching, conduct group discussions, and encourage students to discuss specific engineering ethics cases or issues in groups to promote idea exchange and viewpoint collision. Simulate engineering ethics conflict scenarios in the classroom, have students play different roles, and analyze and solve problems from different perspectives. Use ongoing or recent engineering ethics cases to have students track and analyze them in real time, enhancing the timeliness and practical significance of the cases. At the same time, start from negative cases and have students explore how to avoid similar ethical mistakes, strengthening preventive education.

(2) Utilize modern information technology, such as online courses and virtual laboratories, to increase the interest and interactivity of engineering ethics education. Integrate the ethical challenges brought by new technologies, such as artificial intelligence and gene editing, into teaching. Discuss the long-term impact of technological progress on society, the environment, and human well-being. Use VR technology to simulate complex engineering ethics scenarios and have students make ethical decisions in a virtual environment. Establish online forums and social media groups to encourage students to continue discussing ethical issues outside the classroom.

(3) Strengthen practical teaching, organize students to participate in engineering projects, and let them experience the importance of engineering ethics in actual operations. Develop simulation games based on ethical decision-making to increase students' participation and decision-making abilities through gamification. Organize mock court activities, have students play roles such as lawyers and defendants, and

deepen their understanding of ethical issues through the process of debate and trial. Offer specialized ethics leadership training courses to teach students how to play a leading role in engineering practice and promote the implementation of ethical decisions. Establish a mentorship system to have students learn how to apply ethical principles in engineering practice under the guidance of experienced engineers.

5.2 Improve Engineering Ethics Systems

5.2.1 Establish and Improve Engineering Ethics Norms System

(1) Formulate targeted engineering ethics norms, establish specific and clear ethical principles, and clarify the moral responsibilities of engineers in engineering projects. Ensure that the ethics norms cover all aspects of engineering practice, including environmental protection, professional conduct, and social responsibility. Integrate the learning of ethics norms into engineering education and cultivate ethical awareness from the student stage. Provide regular ethics norms training for in-service engineers to strengthen their ethical responsibilities.

(2) Strengthen the publicity and popularization of engineering ethics norms to enhance engineers' ethical awareness. Conduct ethical reviews before the start of engineering projects to ensure that they comply with ethics norms. Establish specialized ethics supervision institutions to monitor the ethical compliance of engineering practices. Formulate laws and regulations in line with ethics norms to ensure that the implementation of ethics norms has legal binding force. Provide legal knowledge training for engineers to make them aware of the legal consequences of violating ethics norms.

(3) Establish a dynamic update mechanism for engineering ethics norms to revise and improve the content in a timely manner. Encourage industry associations to participate in the formulation and supervision of ethics norms to enhance industry self-discipline. Implement ethics norm certification and provide certification to engineers and engineering projects that comply with ethics norms. Establish an anonymous reporting system to encourage engineers to report ethical issues. Conduct timely and fair investigations into ethical issues and take corresponding measures based on the investigation results.

5.2.2 Strengthen Engineering Ethics Supervision

(1) Establish and improve engineering ethics review systems to conduct ethical reviews of engineering projects and ensure that they meet ethical requirements. Formulate comprehensive engineering ethics laws and policies to provide legal basis for supervision. Set up specialized institutions responsible for engineering ethics supervision, clearly define their duties and authorities. Strengthen ethical review and assessment, conduct ethical reviews of engineering projects to ensure that they meet ethical standards before initiation. Regularly conduct ethical evaluations of engineering practices and supervise the implementation of ethical norms. Utilize modern information technologies such as big data and artificial intelligence to en-

hance regulatory efficiency and accuracy. Develop ethical supervision software to assist regulatory authorities in tracking and analyzing engineering ethical risks.

(2) Strengthen ethical assessment of engineers and incorporate it as a crucial factor in professional title evaluation and promotion. Intensify ethical education and training, emphasizing ethical education in engineers' vocational education to enhance their ethical awareness. Regularly provide ethical training for in-service engineers to update their ethical knowledge. Implement transparency and openness principles, requiring engineering projects to publicly disclose ethical review reports and compliance situations, and accept social supervision. Establish an information disclosure platform to release regulations, standards, and guidelines related to engineering ethics.

(3) Increase the penalties for violations of engineering ethics to create a strong deterrent effect. Establish a reporting and complaint mechanism by setting up a hotline and an online complaint platform, encouraging the public and professionals to report ethical violations. Protect the legal rights of whistleblowers and prevent retaliation. Implement a strict accountability system for individuals or organizations that violate engineering ethics, including fines, license revocation, and criminal liability. Establish a responsibility tracing mechanism to ensure that violations can be promptly discovered and addressed.

5.2.3 Establish an engineering ethics incentive mechanism

(1) Set up dedicated engineering ethics awards to honor individuals and teams that have made outstanding contributions in engineering ethics. Provide recognition and rewards to individuals or teams that perform well in engineering ethics. Regularly hold award ceremonies to increase the social recognition and influence of the winners. Incorporate ethical performance as an important consideration in salary, bonuses, and promotions to encourage engineers to adhere to ethical norms. Impose economic penalties on those who violate ethical norms, even affecting their career advancement. Establish an engineering ethics research fund to support academic research and practical exploration related to ethics. Encourage engineers to participate in ethics research projects to enhance the industry's attention to ethical issues.

(2) Encourage enterprises to incorporate engineering ethics into their corporate culture to improve the overall ethical level of the enterprise. Set ethical role models and promote exemplary deeds to inspire and encourage more engineers to learn and follow. Encourage senior engineers to serve as mentors to impart ethical experience and knowledge. Encourage enterprises to participate in social responsibility and public welfare activities, extending ethical practices to social service areas. Recognize and reward engineers who participate in public welfare activities. Increase the transparency of the incentive mechanism to ensure the fairness and impartiality of the incentives. Regularly disclose incentive results and accept social supervision. Promote cooperation among different departments within enterprises to jointly implement ethical incentive measures. Collaborate with industry associa-

tions, academia, and other stakeholders to jointly develop ethical incentive projects.

(3) Provide ethical training and professional development opportunities for engineers to enhance their ethical literacy. Engineers who perform well in engineering ethics will be offered more career development opportunities, such as training, seminars, and international exchanges. Incorporate ethical literacy as an important evaluation criterion in job promotions and professional qualification certifications. Implement an engineering ethics certification system, awarding certifications to engineers and engineering organizations that meet ethical standards. Rate the ethical performance of engineering projects and publicly disclose the results, affecting the reputation and market competitiveness of enterprises. Provide free ethical education and training, encouraging engineers to actively participate and enhance their ethical awareness and knowledge. Award certifications or credits to engineers who complete ethical training as part of their professional development.

5.3 Strengthen international cooperation in engineering ethics

5.3.1 Establish an international cooperation framework

(1) Actively participate in the formulation of international engineering ethics standards to align our country's engineering ethics norms with international practices. Organize international seminars and workshops to share engineering ethics standards and best practices from different countries and regions. Provide technical assistance and ethics training to developing countries to help improve their engineering ethics standards. Consider the unique circumstances of developing countries in international cooperation projects to ensure fairness and applicability of the ethical standards.

(2) Establish an online database to collect engineering ethics regulations, guidelines and case studies from various countries, participate in the formulation of international engineering ethics norms, and promote the formation of universally recognized ethical standards. Encourage enterprises to follow high-standard ethical norms in cross-border operations and showcase their social responsibilities through international cooperation. Establish an ethical alliance among multinational enterprises to jointly promote the implementation of corporate social responsibility.

5.3.2 Strengthen exchanges and cooperation with international engineering ethics organizations

(1) Introduce advanced engineering ethics education resources and experiences from abroad, strengthen exchanges in ethics education and training, establish international engineering ethics education exchange programs, send scholars and engineers for mutual learning and research, develop cross-border ethics training courses, and enhance engineers' international ethics perspectives. Initiate cross-border research projects to jointly explore the challenges and solutions of global engineering ethics.

(2) Support multi-national researchers to collaborate on cross-cultural engineering

ethics research. Encourage Chinese engineers to participate in international engineering projects, promote cross-border ethics dialogue, and regularly hold international engineering ethics forums to facilitate ethical dialogue among different cultural backgrounds.

(3) Advocate an open and inclusive discussion atmosphere, respect the ethical values of different cultures and regions, and jointly carry out ethics awareness-raising activities. Enhance the ethical awareness of engineers worldwide through media, educational institutions and public campaigns. Issue joint statements and promotional materials to emphasize the importance of engineering ethics in global sustainable development.

6. Conclusion

China is advancing from a major engineering country to a powerful one. Compared with Western engineering ethics, the development of engineering ethics in China is relatively late, but it still has great potential for development. Therefore, how to ensure the good and fast construction and development of engineering, improve the quality of engineering practice in China and promote sustainable social development is an urgent issue before us. This article starts from the comparison of the development of engineering ethics between China and the West, analyzes the differences between the two in terms of engineering ethics concepts, practices, systems and education, and on this basis, puts forward relevant suggestions for improving engineering ethics practices. In a word, the improvement of engineering ethics is a long-term and systematic process, which requires the joint efforts of the government, enterprises, schools and all sectors of society. By strengthening engineering ethics education, improving engineering ethics systems, and enhancing international cooperation in engineering ethics, it is helpful to improve the ethical quality of Chinese engineers and promote sustainable development in the engineering field. We should take this as an opportunity to continuously improve the level of engineering ethics and contribute to building a community with a shared future for mankind.

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