

# A Comparative Study on the Development of Engineering Ethics Between China and the West and Improvement Suggestions

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**Abstract:** With the advancement of modern science and technology, technology-based engineering activities have proliferated and become increasingly intertwined with daily life. To examine the ethical issues inherent in engineering practice, this study adopts a chronological approach, integrating morphological analysis to compare the development of engineering ethics in China and the West, identifying their similarities and differences, and proposing corresponding recommendations for improvement. The findings reveal both convergences and divergences in the historical trajectories of Chinese and Western engineering ethics. In the context of contemporary globalization, engineering ethics practices can be enhanced through measures such as strengthening education, establishing norms, intensifying oversight, fostering communication, and raising awareness. This research holds significant positive implications for advancing the global development of engineering ethics and facilitating international exchange and collaboration in engineering ethics practices.

**Keywords:** Chinese and Western engineering ethics; Engineering ethics thought; Morphology.

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## 1. Introduction

### 1.1. The Concept of Engineering Ethics

Engineering ethics refers to a system of moral principles applied to engineering, serving as the applied ethics of engineering practice. It defines the responsibilities engineers owe to employers, clients, colleagues, the government, designs, and the environment [1]. The term "engineering" here encompasses general engineering across various fields, while "ethics" originates from Chinese philosophical traditions: "lún" denotes hierarchical order and classification, and "lǐ" signifies reasoning and principles. In early Chinese culture, ethics primarily addressed "the principles of human relations", governing behavioral norms and rituals among family and kinship ties. In contemporary Chinese discourse, ethics has expanded beyond interpersonal relations to include interactions between humans and objects, as well as humans and the environment. In Western scholarship, engineering ethics is predominantly viewed as professional ethics. Unlike Western approaches, Chinese academia examines it through value-theoretical methods, analyzing relationships between humans and objects, and how changes in these relationships affect interpersonal dynamics.

### 1.2. Research Objectives and Significance

With the advancement of social and technological development, engineering activities have assumed an increasingly vital role in daily life. Making ethically sound value judgments in engineering has thus become ever more critical. Engineering ethics holds significant importance for society, individual engineers, and engineering practice itself. For society, engineering ethics serves as a crucial standard to ensure engineers prioritize public welfare when conducting engineering activities. It encourages engineers to consider environmental and resource protection, public safety, and property security; demands compliance with laws, respect for cultural diversity, and human rights; and urges adherence to ethical standards in practice. These measures help mitigate

social conflicts and engineering disputes, contributing to a more harmonious society. For engineers, studying engineering ethics not only enhances their professional competence but also clarifies their social responsibilities and vocational mission. It sharpens their moral sensitivity and judgment, enabling them to uphold ethical principles and make sound decisions when confronting complex challenges. For engineering practice, engineering ethics ensures quality and safety. By adhering to ethical requirements, engineers can reduce accidents and minimize risks. Driven by ethical imperatives, engineers balance technological innovation with environmental and social considerations, steering engineering toward greener, more sustainable development.

Currently, domestic research on engineering ethics primarily focuses on theoretical explorations, pedagogical practices in China, or discipline-specific studies. Investigations into Western engineering ethics tend to examine the evolution of American or European contexts in isolation, lacking comparative analyses between Chinese and foreign frameworks. This paper addresses this gap by systematically comparing the development of engineering ethics in China and the West, identifying their differences and commonalities, and proposing actionable improvements. Such research will help synthesize the strengths of both traditions, refine China's engineering ethics system, and foster its robust development.

### 1.3. Research Approach

This paper centers on the development of engineering ethics in both China and the West, elaborating on their respective developmental trajectories. Specifically, following a chronological order, it divides the development of engineering ethics in China into three historical stages: ancient, modern (here, "modern" in the Chinese context often encompasses a period starting from the late Qing Dynasty to early 20th century, but for the sake of general understanding, we keep it as "modern" with the note that it refers to the stage after ancient times in China; a more precise term could be

"early-modern to contemporary" if detailed historical context is needed), and contemporary times, and expounds on the ideological aspects and practical manifestations of engineering ethics in China during different periods. Furthermore, employing morphological methods, it categorizes the development of Western engineering ethics into three forms: primary form, secondary form, and tertiary form. It also elaborates on the development of Western engineering ethics in conjunction with the social backgrounds of the respective periods. Through a comparative analysis of the development of engineering ethics in China and the West, this paper identifies two commonalities: a shared pursuit of moral responsibility and professional integrity in engineering practice, as well as an emphasis on public interests and environmental protection in engineering activities. Additionally, it highlights differences in cultural backgrounds, responsible entities, and practical applications. Finally, based on these differences and in light of the current status of engineering ethics practice in China, it puts forward suggestions for improving engineering ethics practice.

## **2. Historical Trajectories of Engineering Ethics Development in China and the West**

### **2.1. Overview of Engineering Ethics Development in China**

#### **2.1.1. Engineering Ethics Thoughts and Practices in Ancient China**

The Pre-Qin period marked a time when China laid a rich theoretical foundation in thought and culture, while also witnessing the germination and growth of technological ethics and practices. During this period, the concept of "harmony between heaven and humanity" emerged, signifying the initial appearance of the idea that humans and nature should coexist harmoniously and thrive together [1]. The philosophical notion of "governing technology with the Dao (the Way)" also emerged at this time, indicating that ancient Chinese craftsmen already regarded morality as the foundation or prerequisite for exercising their craftsmanship skills [2].

#### **2.1.2. Engineering Ethics Thoughts and Practices in Modern China**

During the late Qing Dynasty, with the infiltration of Western technology, a group of early professional engineers emerged in China. They not only absorbed Western engineering technologies and the underlying engineering ethics but also remained deeply rooted in China's traditional ethical concept of "governing technology with the Dao," thereby forming unique new standards for engineering ethics in modern China. In 1905, engineers led by Zhan Tianyou combined theoretical knowledge of engineering ethics with engineering practice to formulate two important regulations for the construction of the Beijing-Zhangjiakou Railway, namely, the "Regulations on Determining the Character and Competence Standards for Engineer Promotion and the Methods for Student Progression in Engineering Projects" and the "Working Regulations for Engineers and Staff of the Beijing-Zhangjiakou Railway." The former regulation clarified the criteria for assessing engineers' character, emphasizing that "character is more important than knowledge." Its issuance not only underscored the importance of moral qualities but also constrained engineers' behavioral

norms in engineering practice. The "Working Regulations for Engineers and Staff of the Beijing-Zhangjiakou Railway" set forth specific requirements for different positions, emphasizing rational division of labor and clear delineation of responsibilities and powers. It elaborated on the relationships among engineers, colleagues, and employers, as well as the appropriate attitudes towards their work responsibilities, providing clear guidance for collaboration and efficiency within engineering teams. These two regulations injected new vitality into the development of modern engineering ethics in China and set new benchmarks [7].

During the Republic of China era, the Chinese Engineers' Association merged with the China Engineering Society and was officially renamed the Chinese Engineers' Association. The establishment of the Chinese Engineers' Association represented the integration of China's engineering community in the early Republic of China with overseas engineering intellectuals, marking it as the most influential professional academic organization for engineering at the time. In 1933, the Chinese Engineers' Association proposed the "Code of Conduct for Chinese Engineers," which served as the precursor to the professional ethics code for Chinese engineers [5]. This code of conduct encompassed six core principles, explicitly stipulating the responsibilities that engineers should assume when dealing with clients, employers, colleagues, and their work duties. Specifically, engineers must adhere to their positions without abandoning or betraying their responsibilities; they should refuse any unfair remuneration to maintain professional integrity; engineers should compete fairly and refrain from excluding or suppressing their peers. Meanwhile, they are required to respect and uphold the reputation and business of their peers, refraining from directly or indirectly damaging their interests; when competing for business or positions, they must employ lawful means and reject all despicable competitive behaviors; they should refuse any false propaganda or other actions that undermine professional dignity to safeguard the reputation and dignity of the engineering profession. These six principles not only provided engineers with clear guidance on professional behavior but also laid a solid foundation for the development of professional ethics among Chinese engineers [2, 6].

#### **2.1.3. Engineering Ethics Thoughts and Practices in Contemporary China**

After the founding of New China, influenced by domestic political factors, the country was enveloped in political discourse, demanding that engineers be responsible for their own work, superiors, society, and colleagues. During this period, engineering ethics in China generally exhibited the characteristic of being both "politically reliable and professionally competent." Engineers at the time not only possessed superb technical skills but also had a high degree of political awareness. They emphasized collectivism in engineering activities, sacrificing individual interests for the benefit of the collective.

With the rapid development of science and technology, research and education on professional ethics for engineers in China have been continuously improving. Since the reform and opening-up, China has established various professional societies, such as the Civil Engineering Society, the Chinese Chemical Industry Society, and the Chinese Hydraulic Engineering Society. As regulations and policies have matured, China's registered engineer system has entered the

implementation stage, with each profession standardizing the responsibilities and obligations of engineers. For instance, the Chinese Mechanical Engineering Society advocates adhering to a people-oriented design philosophy, while the Chinese Hydraulic Engineering Society promotes the principle of achieving harmonious coexistence between humans and nature in construction projects [3]. Additionally, the vast majority of professional fields require engineers to maintain confidentiality, ensure quality, and, while enhancing their professional expertise, also safeguard environmental and ecological security, uphold social security, ensure safe production and public safety, balance economic and social benefits, and uphold scientific spirit and attitudes.

## **2.2. Overview of Engineering Ethics Development in the West**

The primary method employed in studying Western engineering ethics is the morphological approach, which focuses on the evolutionary patterns of Western engineering ethics. Based on different historical contexts and the corresponding social environments in the West, combined with the morphological method, the development of Western engineering ethics can be divided into three forms: the primary form, the secondary form, and the regenerative form. The primary form is characterized by an emphasis on experience, pursuit of morality, and veneration of virtue; the secondary form manifests as a focus on rationality, pursuit of utilitarianism, and adherence to rules; while the regenerative form achieves a transition from experience and a revival of virtue and morality.

### **2.2.1. Primary Form of Western Engineering Ethics**

The primary form of Western engineering ethics refers to the engineering ethical prevalent during ancient Greece, Rome, and the Middle Ages. Engineering activities during these periods were based on technological development. The society of ancient Rome can be considered as part of the Iron Age, with iron smelting being the predominant activity, and iron tools primarily used in the military sphere. Although military activities are practical endeavors, intuition and skill in military techniques require theoretical knowledge. Military engineering during this period was a combination of theory and practice, existing as a form of empirical science. Empiricist engineering emerged during this era, with engineering activities relying on the empirical constructions of engineers. However, a complete and specific theoretical framework for engineering ethics had not yet been formed at this time.

During the Middle Ages, ancient Rome placed great emphasis on warfare and military might, vigorously enhancing military strength and developing military engineering, which led to continuous progress in engineering during this period. Engineering received significant attention, and the status of engineers was elevated, with the term "engineer" emerging as an independent concept. However, due to a lack of theoretical knowledge, it was impossible to accurately describe concepts or engage in design and conceptualization during this period [8].

### **2.2.2. Secondary Form of Western Engineering Ethics**

The form of engineering ethics is like a flowing river, constantly evolving dynamically rather than being confined to a fixed framework. Throughout the grand sweep of history, particularly from the latter half of the 15th century to the 19th century, with the rise of capitalism, economic prosperity,

technological advancements, and a leap in social productivity, Western engineering ethics also gave birth to its unique secondary form amidst this tumultuous historical river [8].

As the modern capitalist mode of production took the lead and military demands diminished, the focus shifted towards civilian needs. Capitalists' economic pursuits grew increasingly fervent, with rising demands for production efficiency and cost control. Against this backdrop, corresponding changes occurred in the model of technological selection. Technology, as the cornerstone of engineering choices and implementations, directly shapes the future of engineering through its developmental trends. Throughout history, whenever the technological foundation has changed, engineering has inevitably undergone corresponding adjustments, with economic needs becoming a key driving force for the application of technology in engineering.

Modern engineering activities place greater emphasis on the comprehensive application of technology. The role of modern engineers differs significantly from that of ancient craftsmen. While ancient craftsmen relied solely on their skills for production, modern engineers must possess systematic professional theoretical knowledge and rich practical experience. They are not only executors of engineering projects but also designers and planners, bearing responsibilities far beyond those of traditional craftsmen [7].

In the 19th century, engineers regarded engineering practice as a vital tool for promoting social development and progress. To better disseminate engineering knowledge, starting from France, engineering education became institutionalized, leading to the widespread dissemination of engineering knowledge. Scientists gradually began to collaborate closely with engineers, integrating scientific theories with engineering practice and promoting the establishment of an engineering science system. By this time, engineering teams had developed independent engineering ideologies and assumed occupational ethical responsibilities. They were able to adhere to professional ethics, uphold occupational integrity, and take responsibility for each engineering project. Relevant engineering associations also formulated engineering ethics codes to regulate engineers' behavior [8].

### **2.2.3. Regenerative Form of Western Engineering Ethics**

The regenerative form of Western engineering ethics has continuously evolved and developed on the basis of inheriting ancient and modern engineering concepts. Engineering knowledge has gradually diversified, and the scientific system has become increasingly sophisticated. Ancient engineers primarily focused on personal role ethics, whereas modern engineers have gradually become more professional and have strengthened their occupational ethical responsibilities. In modern society, engineers' responsibilities have expanded to multiple levels, encompassing the public, society, and the environment. Modern engineering philosophy adopts a more pluralistic perspective, integrating engineering traditions, humanistic traditions, empiricism, and rationalism to form a more comprehensive and enriched ethical outlook [9].

Entering modern society, the regenerative form has inherited and developed from both the primary and secondary forms. During this period, technology and the economy have accelerated exponentially on their existing foundations, giving rise to a series of emerging engineering fields such as bioengineering, information engineering, and nuclear engineering. Modern engineering, relying on advanced

science and technology and grounded in natural sciences, has gradually assumed an increasingly important position in people's social lives and the economy. Changes in the model of technological selection have led to corresponding alterations in the direction, mode, and even pace of engineering development. With engineering construction scales (continually expanding) and increasing consumption of energy and resources, modern engineering has become intertwined with politics, the economy, culture, and other aspects within the complex system of this diversified society. Throughout this evolutionary process, the engineering form has gradually taken shape [7].

### **3. Analysis of Similarities and Differences between Chinese and Western Engineering Ethics**

#### **3.1. Differences between Chinese and Western Engineering Ethics**

##### **3.1.1. Differences in Cultural Backgrounds**

From the perspective of the evolutionary patterns of engineering ethics forms, Western engineering ethics has undergone a transformation process that can be summarized as shifting from "virtue-rule-virtue" to "morality-utilitarianism-morality" and then to "experience-rationality-experience," displaying an overall spiral upward evolutionary pattern. Thus, in general, the development of Western engineering ethics primarily explores moral issues in engineering practice based on Western philosophical and ethical systems. They often guide engineers' behavior in engineering practice by formulating specific ethical codes and guidelines. In contrast, Chinese engineering ethics is more deeply integrated with Confucian ethical thoughts, emphasizing the cultivation of engineers' moral qualities and social responsibility through self-cultivation, family harmony, governance of the state, and bringing peace to the world.

##### **3.1.2. Differences in Responsible Entities**

From the perspective of responsible parties, Western engineering ethics places greater emphasis on the individual responsibilities and obligations of engineers. In their view, engineers, as direct participants in engineering practice, should be accountable for their actions as well as the safety, health, and well-being of the public [9]. This responsibility is specific and clear because it can be traced back to individual engineers. However, in China, although the individual responsibility of engineers is also emphasized, engineering ethics is more often regarded as an integral part of the entire engineering entity. Therefore, in the event of issues arising during engineering practice, the responsibility should be borne by all individuals involved in the entire project. This collective responsibility perspective underscores cooperation and coordination among engineering team members and reflects the cultural value in China that "collective interests outweigh individual interests."

Furthermore, there are differences between China and the West in terms of accountability. Compared to the Western approach of pursuing individual responsibility through legal means, China places greater emphasis on prompting collective accountability through moral education and public condemnation. Of course, this does not mean that China does not value the use of legal means for regulation; rather, it places more emphasis on the role of the collective in moral education and public opinion guidance.

##### **3.1.3. Differences in Practical Applications**

In actual engineering practice, Western engineering ethics places greater emphasis on constraining engineers' behavior through explicit moral codes and guidelines when addressing practical and specific engineering issues. Meanwhile, in terms of engineering theory education, they focus more on analyzing real-world cases to familiarize engineers with the moral dilemmas they may encounter in engineering activities, thereby enhancing their judgment and ability to handle complex situations.

In contrast, in China, engineering ethics norms emphasize social responsibility, patriotism, and national spirit, with practical applications of engineering ethics more closely integrated with social responsibility and national interests. Compared to the Western emphasis on fairness and morality in engineering practice, China places greater emphasis on the crucial role engineers play in national construction and economic development. Similarly, in engineering ethics education, while China also cultivates moral values and professional ethics and conducts practical teaching, its capacity for fostering practical abilities in engineering ethics remains relatively weak compared to the West. This is closely related to China's cultural background and educational system, which place greater emphasis on the inculcation of theoretical knowledge and moral norms.

#### **3.2. Commonalities between Chinese and Western Engineering Ethics**

Despite certain differences in engineering ethics between China and the West, there are indeed shared aspects in terms of the common pursuit of moral responsibility and professional integrity in engineering practice, as well as the emphasis on public interests and environmental protection in engineering activities.

##### **3.2.1. Common Pursuit of Moral Responsibility and Professional Integrity in Engineering Practice**

Both China and the West emphasize that engineers should possess a high degree of moral responsibility in engineering ethics. They should recognize that any actions they take in engineering activities will have a certain impact on society, the public, and the environment. Therefore, regarding moral responsibility in engineering practice, both Chinese and Western engineering ethics jointly stress that engineers should consistently uphold moral boundaries and pursue fairness, impartiality, and justice.

Secondly, both China and the West attach importance to cultivating professional integrity among engineers. As professionals, engineers may deal with a great deal of specialized knowledge and trade secrets in their work, so they should possess basic professional integrity such as respecting intellectual property rights and protecting information. This approach not only better ensures the quality of engineering projects but also safeguards the good professional reputation of engineers themselves.

In addition, both Chinese and Western engineering ethics emphasize that engineers should safeguard the safety, health, and well-being of the public, respect the natural environment and diverse cultural histories, and adhere to principles of fairness, impartiality, and transparency in their engineering activities.

##### **3.2.2. Emphasis on Public Interests and Environmental Protection in Engineering Activities**

Both Chinese and Western engineering ethics emphasize

that engineers should prioritize public interests in engineering practice. Western engineering ethics underscores that engineers bear direct responsibility for the safety, health, and well-being of the public, requiring them to fully consider public interests during the design and construction processes. Similarly, Chinese engineering ethics also stresses that engineers should safeguard public interests, particularly in national construction and public infrastructure projects, where they must pay even closer attention to meeting the needs and expectations of the people.

Furthermore, in terms of environmental protection, both China and the West recognize the impact of engineering activities on the natural environment and thus place great importance on environmental conservation. Western engineering ethics mandates that engineers fully consider environmental impacts during the design and construction phases and take necessary measures to minimize environmental damage, achieving harmonious coexistence between engineering and the environment. Chinese engineering ethics also emphasizes that engineers should protect the natural environment, advocating green, low-carbon, and environmentally friendly engineering construction concepts to promote sustainable development.

#### 4. Suggestions for Improving Engineering Ethics Practices in China and the West

By comparing the development of engineering ethics in China and the West, we can observe significant differences in cultural backgrounds, responsible parties, and practical applications. Western engineering ethics places greater emphasis on individual rights, obligations, and responsibilities, highlighting the independence and autonomy of engineers in engineering practice. In contrast, Chinese engineering ethics attaches more importance to the engineering community, emphasizing collective interests, social responsibility, and moral standards, as well as the harmonious coexistence between engineering practice and society and nature.

In light of these differences between Chinese and Western engineering ethics, this paper offers the following suggestions for improving engineering ethics practices:

(1) Strengthen engineering ethics education: It is essential to enhance engineering ethics education in both the West and China. By integrating theory with practice, engineering ethics theories can be incorporated into engineering ethics practices, aiming to cultivate engineers' conscious adherence to ethical norms in engineering activities, thereby safeguarding social and public interests and protecting the natural environment.

(2) Establish a comprehensive engineering ethics code system: Drawing on the characteristics of both Chinese and Western ethics, a comprehensive engineering ethics code system should be established. This system should clearly define engineers' obligations, responsibilities, and rights, stipulate their behavioral norms and ethical guidelines in engineering practice, and provide clear guidance for engineers' activities.

(3) Strengthen supervision and evaluation of engineering ethics: A robust supervision and evaluation mechanism for engineering ethics should be established to monitor and assess

engineers' behavior in engineering practice. Appropriate penalties and sanctions should be imposed for violations of ethical norms to uphold the authority and effectiveness of engineering ethics.

(4) Promote exchanges and cooperation in engineering ethics between China and the West: Enhance exchanges and cooperation in engineering ethics between China and the West to jointly advance the development of engineering ethics. By organizing international seminars, collaborative research, and other means, experiences and lessons can be shared to collectively improve the level of engineering ethics practices.

(5) Emphasize the cultivation of engineers' public awareness and sense of responsibility: In engineering practice, engineers should not only focus on public interests and environmental protection but also actively participate in social welfare initiatives to contribute to sustainable social development.

In conclusion, improving engineering ethics practices is not only an individual endeavor but also requires collective efforts from the entire society. By strengthening education, establishing norms, enhancing supervision, promoting exchanges, and cultivating awareness, we can continuously raise engineers' ethical awareness, elevate the level of engineering ethics practices, and contribute to sustainable social development.

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