

Analysis of Ethical Responsibility for Risk in the Perspective of Engineering Ethics

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Abstract: In the analysis and research on the problem of project risk, most of them consider it from the perspective of engineering technology and management, that is, to improve and perfect the technology and strengthen the management of project risk, so as to avoid the occurrence of risk. In addition, there are some scholars who explore the risk problem of the project from the social and psychological perspectives. However, there is a lack of analyzing and studying the engineering risk problem from the perspective of engineering ethics. Since engineering construction is a complex social behavior closely related to public welfare, health and safety, fairness and justice and other ethical issues, there is an urgent need to carry out in-depth research and discussion on the risk problems in project construction from the perspective of engineering ethics in order to achieve effective prevention of project construction risks. This paper analyzes the respective ethical responsibilities of the members within the engineering community in engineering practice from the perspective of responsibility ethics, explores the various complex factors constraining the members of the engineering community from fulfilling their ethical responsibilities through the ethical analysis of engineering risks, and summarizes the ethical preventive mechanism of the project risks, so as to achieve the purpose of preventing the engineering accidents and risks in a safe manner.

Keywords: Engineering Ethics; Risk Liability; Engineering Management.

1. Introduction

From the birth of the first steam engine in the United Kingdom, to the first generator was created, and now the rapid development and wide application of communication technology and computer technology; human society from manual labor gradually transformed into mechanical operation, the industry has experienced the steam era, the electrical era, and now the information age. With the continuous development and progress of production technology, the requirements of production are also increasing day by day. Large-scale mechanized production and engineering technology construction have reduced production costs, improved production efficiency, and played a positive role in the modernization and development of human society. Engineering activities as a catalyst for rapid socio-economic development has played a huge role in promoting. However, engineering technology is a "double-edged sword", people enjoy the benefits of engineering at the same time, but also face its possible negative effects, placing mankind in an unprecedented insecurity after the society, such as environmental pollution, engineering safety accidents, social gap between rich and poor expanding and so on. Among the many uncertainties, the one that has the greatest impact on human beings is the safety of engineering projects, which is also known as the risk of engineering projects. This is mainly due to the fact that safety accidents that occur during the construction process often result in casualties and property damage, posing a great threat to the safety, health and well-being of the people. Among them, the "principle of life" and "humanitarianism" are the basic principles of all practices, which should be put in the first place.

As we all know, our country has become one of the world's leading engineering nations. However, it is also a country where engineering accidents occur more frequently. For example, the hazardous materials explosion that occurred in

Tangu Development Area of Tianjin Binhai New Area on August 12, 2015 is one of the most serious engineering accidents since the founding of our country, and the engineering problems reflected behind its tragic results are worthy of our deep thoughts. Engineering is a large-scale human production activities, its risk is inevitable, however, the risk of the project is not simply the project itself, but an ethical problem. Engineering activity is a dynamic transformation of the material world by people in accordance with their subjective needs, and it carries a strong ethical color. Engineers are the main bearers of engineering ethical responsibility. Because of the special status of engineers in engineering practice, it is particularly important to regulate the ethical risks in the whole engineering process. Therefore, it is necessary to explore the ethical responsibility in engineering risk.

2. Literature References

2.1. Current Status of Foreign Research

Regarding the research on engineering risk issues, German sociologist Ulrich Beck was the first to put forward in *The Risk Society*[1] published in 1986 that the social risk of current human life has been different from the early industrial risk, and the social risk has a wider scope of influence, produces consequences that are difficult to compensate for, and the loss is more difficult to estimate. After that, other scholars began to put forward the research on engineering risk from different perspectives, for example, British scholars Mary and Lash explored the theory of engineering risk construction from the cultural level. American scholars Schrader Frechette from the perspective of ethics on engineering risk evaluation research[2]; American scholars Diana Vaughan from the perspective of engineering ethics on engineering risk generation research, in its work on the national organizational institutions of organizational culture,

organizational ethics on the generation of social engineering risk impact[3].

2.2. Current Status of Chinese Research

Domestic ethical issues of engineering risk are also more concerned, the main concern from the perspective of engineering philosophy, engineering sociology and other different perspectives. How Jiangbo analyzed the reasons for the formation of engineering risk from the perspective of engineering sociology. With the depth of research, domestic scholars focus more on the technical field of risk prevention. Wang Qian in 2011 put forward the ways of avoiding technological risks[4]; Mao Mingfang put forward the construction of perfect global ethics, long-distance ethics and responsibility ethics to prevent and control modern technological risks[5].

3. Engineering Risks

3.1. Definition of Engineering Risks

Generally speaking, "engineering risk" mainly refers to the many uncertainties triggered in the course of or as a result of engineering activities. Some Chinese scholars define engineering risk as: "a collection of uncertainties that affect the realization of the objectives of engineering activities". American scholar Lawrence defines engineering risk as "the likelihood of the occurrence of negative impacts and their overall intensity" in engineering projects. On this basis, the concept of engineering risk is proposed, that is, engineering risk is defined as the sum of various factors that cannot be excluded by human beings in the process of engineering practice, due to human reasons and lead to the project can not realize the expected goals.

3.2. Types of Engineering Risks

Engineering risks are universal, and they are ubiquitous throughout the engineering process. According to the overall process of engineering can be divided into the following three categories: pre-engineering risks, mid-engineering risks and post-engineering risks.

(1) Pre-engineering risks

The preliminary preparation of the project includes the materials and personnel required for the project. In the process of preparing the materials for the project, it is likely that there will be the risk that the purchased raw materials will be of low quality or that the purchaser will deliberately purchase inferior raw materials for the sake of profit. It can be said that in order to construct a high-quality building, it is necessary to have enough materials to be able to do so. Every towering high-rise building is put together with a block of bricks, and every piece of machinery is put together with different parts. Therefore, the risks associated with the procurement of raw materials will have a direct impact on the quality of the project, which in turn will cause safety incidents in the construction. Therefore, it is necessary to pay attention to risk avoidance and be cautious in the preparation process.

In the process of engineering construction, the resources needed are mainly manpower and materials. In the preliminary preparation of the project, in addition to the preparation of raw materials, components and other material resources, it is also necessary to carry out the recruitment, allocation and training of personnel. However, in this process, there are also risks such as recruitment risk, staffing risk, training risk and other risks. At present, some domestic

enterprises have a great deal of subjectivity and arbitrariness in the recruitment work, the recruitment work lacks scientific and scientific, resulting in some risks in the recruitment work. After the recruitment is completed, there are still some risks when determining the hired personnel and assigning them to their positions. For example, without understanding the quality and ability of the personnel, it is impossible to arrange suitable jobs for them according to their skills and character.

(2) Mid-construction risks

Mid-engineering includes engineering design stage, engineering implementation stage and engineering application stage.

Engineering design is only the beginning of a project, and every project should be carefully considered and planned, and a design plan should be made as perfect as possible, and finally implemented according to the plan. However, in the engineering design, due to the engineer's "design flaws, errors, and irregularities", can lead to errors in the engineering design, bringing damage to the project.

The implementation phase is the critical phase of a project, where the construction personnel use their expertise to create an engineering entity based on the existing engineering design plan. At the same time, this period is also a period of construction safety accidents, due to the construction personnel's technical level is not high, or not strictly in accordance with the operating procedures for the operation, to bring the construction of the safety hazards. Material and equipment risks due to insufficient construction materials or poor quality of raw materials, natural disasters due to irresistible causes, etc.

There are three main aspects of the risks faced during project implementation: first, the risks caused by the quality problems of the project itself; second, the safety risks caused by the lack of professional knowledge of the users and technicians and their failure to properly apply the engineering entities in accordance with the specifications; and third, the natural disasters caused by a variety of irresistible factors.

(3) Risks in the late stage of the project

The late stage of the project includes the after-sales service link and the recycling link of the engineering output products and other stages.

After-sales service refers to the seller in the product sales, continue to provide a series of perfect service for the buyer (customer), in order to create a physical product with the desired value of use for the purpose of science and technology as a means of engineering activities, after-sales service is the entire supply chain is a very important link. At present, most enterprises in order to develop core business, enhance competitiveness, maximize the advantages of their own resources, have taken the "after-sales service outsourcing" strategy, their own after-sales responsibility to the customer, entrusted to the contractor to undertake and implement. The emergence of service outsourcing, brings a variety of risks. On the one hand, there is the risk of equipment technology; but on the other hand, it also brings credit risk.

Product recycling refers to the recovery and recycling of used products by manufacturing enterprises in their sales of products to meet technical and ecological needs and to achieve the purpose of resource reuse. Enterprises may face various risks in the recycling process, such as supply risk, logistics risk and environmental risk.

3.3. Characteristics of Engineering Risks

(1) Objectivity

Engineering risk is objective, that is, whether people want it or not, there may be lurking in the project, once the vigilance is lowered, it may lead to a variety of engineering accidents. Marxist philosophy holds that "everything in the world contains both relative and absolute aspects, and anything is both absolute and relative". For the risk and safety of engineering, we can also analyze it from Marx's philosophical point of view: the risk is absolute, unconditional and eternal, and the safety is relative, conditional and temporary; the absolute danger exists in the relative danger, while the relative danger is another form of it. At the same time, engineering risk is also an objective existence, which runs through the whole process of project development. The risks in the three stages of project preparation, mid-construction, and post-sale and recovery have been discussed earlier. Therefore, the project risk has an objective nature, there are risks everywhere in the project, people can not completely eliminate the risk, but only to take a variety of ways to avoid the risk.

(2) Uncertainty

Risk by its very nature is uncertain. American economist Knight regards risk as a measurable uncertainty. The American scholar Witley defined risk as an objective reflection of the uncertainty of unexpected events. From this point of view, an important characteristic of risk is uncertainty. Engineering risk also exists in the project decision-making, design, construction, use, maintenance and other stages, and this leads to engineering accidents. Among them, in the past hundred years, bird strikes have shown a significant upward trend globally, bringing great economic losses to people. U.S. civil aviation a year due to bird strikes caused by the loss of up to billions of dollars, a year can not fly more than 10,000 hours. Because the flight trajectory of birds in the sky is uncertain, so even if humans can accurately predict and control the flight trajectory and speed of the aircraft, they can not accurately determine the flight trajectory of the bird. However, for uncertain engineering risks, people are not completely without coping strategies, but can effectively avoid and utilize the speculative nature of risk to create value for themselves.

(3) Preventability

"Since risk is a measurable uncertainty about the future, project risk is preventable to a certain extent." It can be said that the project risk has preventability, which is the theoretical basis for the study and prevention of project risk. Imagine that if there is no preventable project risk, no matter how hard people try, they can't make effective avoidance of it, it will lead to engineering accidents. Because of the preventable nature of project risks, we should not only do a good job of risk prevention in the early stages of the project, but also implement the analysis and summary of the later stages of the project. Our research on project risk, its ultimate goal and destination is the prevention of project risk, so that the project risk to minimize the damage caused by man and nature. In terms of how to prevent project risks, scholars at home and abroad have carried out a large number of studies and put forward corresponding economic, legal and management countermeasures, but the study of preventing project risks from an ethical point of view is still superficial and needs further development.

4. Ethical Responsibility in Engineering Risks

4.1. Subject of Ethical Responsibility

In modern Chinese, the meaning of responsibility is usually associated with roles or institutions, referring to the duties of a particular position, i.e., the things that should be done well within its own responsibility or the punishments for failing to do so. In ethics, the concept of responsibility is a comprehensive concept that integrates morality and institution, unifies "must do" and "should do", and has multi-level, multi-functional and complexity.

The subject of ethical responsibility for engineering activities is recognized as an engineer. However, as individual activities continue to evolve and become more complex, this taken-for-granted viewpoint needs to be reconsidered when studying the subject of responsibility for engineering activities. With the refinement of the division of labor and the differentiation of roles in society, engineering activities require the joint participation of different roles in society, and people gradually find that the subject of engineering activities is no longer an individual, but a group, or even an organization. Therefore, we need to admit that when studying the subject of ethical responsibility of engineering activities, we are no longer facing individuals, but groups as well as organizations.

There are many difficulties in defining the subject of ethical responsibility of engineering activities, and these difficulties come from two reasons, on the one hand, it is due to the complexity of the wide scope of engineering activities, because there are a lot of subjects participating in engineering activities, and the roles played by different subjects in engineering activities are not the same, and there is a great deal of difference; on the other hand, it is due to the complexity of the engineering activities themselves, because in order to determine the subject of responsibility of engineering activities, first of all, it is necessary to know the engineering activities, and then to determine the subject of responsibility of the engineering activities. Responsible subject, first of all, we must know the mechanism of engineering activities and the process of occurrence, otherwise it will be difficult to define the scope of the responsible subject. These two reasons make it difficult for us to define the responsible subject of engineering activities. However, we still try to define it in this way: the responsible subject of engineering activities refers to the individual or organization that participates in the process of engineering implementation and bears the corresponding ethical responsibility.

4.2. Engineering Risks of Objective Factors

Since engineering is realized by the comprehensive participation of technical and non-technical factors, it is necessary to strictly follow the laws of science and the principles of technology to ensure that the quality and safety of engineering is the most fundamental requirement for engineering activities, which requires that any engineering should put the responsibility of quality and safety in the first place. In addition, engineering activities belong to the creation of things, the conduct of engineering activities will inevitably have a certain impact on the original natural resources. Therefore, in the process of engineering activities to focus on the harmony between man and nature, environmental responsibility in engineering activities is

increasingly important. Finally, after World War II, the reflection on the Manhattan Project, so that more and more engineering activities subject began to pay attention to the social responsibility of engineering activities, therefore, social responsibility in engineering activities has become an important form of responsibility.

(1) Safety Ethical Responsibility

Safety means being free from threats and dangers. If the risk of a thing is fully recognized by a rational person and judged as acceptable according to the established value, then the thing is safe; if the risk of a thing is unacceptable to us, the thing is unsafe. A good project always focuses on safety. With the increasing impact of technology on society, the public is also becoming more and more concerned about the safety of technology. In addition to the recognizable risks of consumer products in the process of production and use in factories, the effects of technologically inconspicuous risks are also gradually attracting the attention of the public.

As a result of the increasing number of product quality and safety problems and incidents such as "rotten buildings" in recent years, the public's concern for engineering quality and safety has been raised to the top of the decision-making agenda of policy makers. Decision makers should try their best to achieve the goal of ensuring the quality and safety of engineering when making decisions in engineering activities. From the perspective of ethical responsibility, the ethical requirement for a sound decision in engineering activities is that the decision is scientific and ethical. In fact, the essence of decision-making is its own ethical decision-making. Therefore, when making decisions, the decision-making body should prioritize the quality and safety of the project, ensure the scientific, timely and safe decision-making, especially weigh the relationship between long-term interests and immediate interests, and be responsible for the safety of the public, society and the environment, so as to ensure that the project is for the benefit of mankind and brings well-being to mankind.

(2) Responsibility for environmental ethics

Safety responsibility is a basic responsibility of engineering activities, from the point of view of safety responsibility of engineering activities, the scope of responsibility of engineering activities exists between human beings, however, with the continuous development of technology and the increase of technological activities and engineering projects, the impact of human engineering activities on the natural environment has become more and more profound, and even due to the irresponsible behaviors of engineering activities have caused serious damage to the natural environment, resulting in serious ecological evils. How to deal with the relationship between human beings and the natural environment has become an important issue that needs to be faced by today's engineering activities. As a matter of fact, human engineering activities have a wider and deeper impact on the natural environment than any other activities. Therefore, engineering activities should not only strictly abide by the safety responsibility to ensure the safety of human lives and properties, but also take the environmental responsibility to protect the environment and maintain the ecological balance.

Environmental ethical responsibility runs through the whole process of engineering activities. Before engineering activities, engineers should assess and predict the possible impact of engineering activities on the environment, and put forward corresponding countermeasures to solve the problem

and formulate programs that can promote the sustainable development of the environment; in engineering activities, engineers should use the professional and technical means at their disposal to reduce the harm to the environment caused by the engineering activities, so that the ever-developing technology can really play a role in ensuring that the whole engineering process is zero environmental pollution. To achieve zero environmental pollution; in the completion of engineering activities, but also the best tracking and testing of the project, do a good job of environmental feedback of engineering activities.

(3) Social and Ethical Responsibility

Since World War II, scientists and engineers have created a large number of lethal weapons, seriously threatening the safety of human life, the social responsibility of engineering has gradually come to the fore. Engineers to the public to "create" the social environment, guiding the direction of society is related to the public's personal interests, if engineers on their own behavior is not restrained, there is no high sense of social responsibility, will bring harm to others and society. The increasingly expanding influence of engineering activities on society requires engineers to assume corresponding social and ethical responsibility for the social impact of engineering activities.

In contemporary times, modern engineering is implemented in large quantities, changing to a large extent the social outlook as well as the people's way of life and production. In the past two centuries, all kinds of engineering activities have brought about great changes in human transportation, communication, residence and other aspects, and the more the large-scale engineering projects are, the closer the connection between engineering projects and the interests of the general public is, and the more the hazards on the safety of property of the general public are in the event of danger, the more it is required for engineers to be able to The more engineers are required to actively undertake social and ethical responsibilities.

5. Conclusion and Implications

Engineering risks, if not well prevented, will affect the process of engineering or even lead to engineering accidents, resulting in significant economic losses. Therefore, how to study engineering risks from the perspective of ethics and build corresponding ethical prevention and control mechanisms on this basis is an urgent problem to be solved in the current research. Taking the Tianjin Binhai New Area explosion accident as the object of analysis, this paper discusses the definition and implementation of ethical responsibility in engineering risks and engineering accidents, and assigns ethical responsibility from four main objects: enterprise, industry, government and society.

From the ethical point of view, suggestions are given to improve the awareness of each subject's responsibility. Enterprises should establish a constraining mechanism to enhance the awareness of risk-preventive responsibility, educate their personnel on safety awareness, standardize their behavior, and formulate an enterprise safety management system to improve the regulatory system; the industry should form an internal guiding mechanism to take the enterprises with rich experience in safety management as an example, as well as to strengthen the supervision of the industry and implement the main responsibility of safety production in the industry; as the government, it should improve the safety supervision and management system and Give full play to the

supervisory function. Improve the legal system of enterprise safety management responsibility, establish an effective law enforcement and supervision mechanism, standardize safety law enforcement behavior, increase law enforcement efforts, and prompt enterprises to form a self-regulatory mechanism for assuming responsibility for safety production management. The public should raise the awareness of safety responsibility, spontaneously form the supervision of enterprises, and reduce the occurrence and loss of engineering risks.

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