

On the Innovation of Engineering Management

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Abstract — With the development of economy and society, numerous projects are becoming increasingly difficult to manage. Modern engineering management presents diversification and complication, so the requirement of engineering management innovation is becoming higher and higher. In this paper, the author analyzes the connotation and characteristics of project management innovation, and points out that engineering management innovation is the soul of project management theory and practice, which needs to be carried out under people-oriented concepts with the focus on the application of modern information technology.

Keywords - engineering, management, engineering management innovation, people-oriented concept, modern information technology

I. INTRODUCTION

Engineering is the organized activity of human transforming the objective world for a specific purpose according to the laws of nature. Engineering management is the process which is composed by plan, organizes, command, coordinate and control. People can efficiently use resources to achieve the intended purpose through engineering management [1]. Now there are five hot research topics in the field of international engineering management. One is the research of object-oriented modeling language. The second is the research of product development and related technology. Three is the research of reengineering the corporation or restructuring the corporation. Four is the related research of quality management. Five is the research of innovation management [2]. However, no matter what kind of engineering management the innovation is necessary.

The connotation of innovation is abundant. It includes technology innovation, management innovation, system innovation and organizational innovation and so on a series of innovation. Schumpeter believes that the management innovation is a new combination of production factors and production conditions. Management innovation will change the management way, improve organizational performance and eventually achieve the organization goal. In a sense, the engineering management is the innovation management in essence. Engineering management innovation refers to innovation in the activities of engineering management, namely the innovation activities in the engineering decisions, plan, organize, command, coordinate and control. In terms of the content of the engineering management, engineering management innovation includes idea, organization, system, technology, methods, and many other aspects of innovation. It is necessary to further point out that the innovation also is needs to manage and how to manage forms the engineering innovation management

II. THE CONNOTATION AND MAIN CHARACTERISTICS OF ENGINEERING MANAGEMENT INNOVATION

Engineering management innovation has the following several characteristics. One is integration. Engineering management innovation is the integration of technology innovation and management innovation [3]. Two is the whole process of attribute. It is embodied in the whole process of decision-making, planning, organizing, coordinating, commanding and controlling. Three is systemically. It includes ideas, organization, system, technology, methods and other aspects, and every aspect has relevance, they serve to achieve the goal of the whole system together. Four is a property of the organization. Though it is the person that specific engaged in engineering management innovation, the person is restrained by organization and is engaged in management innovation under the arrangement of the organization. Five is practical. Engineering management itself is the practice of engineering management, the process of engineering management practices often is the process of innovation, and innovation is not only the theory innovation or logical deduction but also is based on the practice of engineering management [4]. Six is expansibility. Engineering management innovation is a dynamic, continuous and development. Especially entering the 21st century, many new theories and methods applied to the practice of engineering management, such as Engineering Philosophy, Synergetic Theory, Innovation Management, People-oriented Management, Knowledge Management, Integrated Management, Concurrent Engineering and so on [6]. They greatly promote the development of engineering management innovation.

III. ENGINEERING MANAGEMENT INNOVATION IS THE SOUL OF THE ENGINEERING MANAGEMENT THEORY AND PRACTICE

A. *Engineering management innovation is the soul of the Engineering management theory*

Mr. Yang Shanlin indicates that in theory of engineering management people is management main body, the facilities with artificial activity is management object, the process of planning, organizing and controlling is management carrier, improving the effect, efficiency and benefit of artificial facilities is the goal [6]. The starting point and the foothold of engineering management theory are the practices of engineering management [7]. In my opinion, engineering management innovation is the soul of the project management theory, mainly based on three aspects. One is the thinking mode of engineering management develops through innovation. At present, the thinking mode of engineering management has comprehensive. It contains engineering thinking, ethical thinking and philosophy thinking. On the contrary, the fusion of engineering thinking, ethical thinking and philosophy thinking has enriched the theory of engineering management. As manager of engineering, he not only solves practical problems by using the Operational Research, Organizational Theory and Information Theory to, also need to consider the staff's moral risk, the influence of the engineering to the stakeholders and the natural environment. Two is engineering management theory and the theory system of modern engineering management comes from the engineering management innovation. The main emphasis of the engineering management theory system are the logical relationship between different theoretical perspectives, the relationship between different theoretical content, the applicability of the different management method, its purpose is to constitute the theoretical system of each part together, forming an organic link and multi-level theory network. Normally, engineering theory system consists of the basic theory module, engineering management activities and applied theory modules. However which modules need be realized in engineering management innovation. Three is the application of engineering management theory embodies engineering management innovation. Due to the deference of engineering project, engineering organization and the engineering implementers, the methods to solve practical problems using engineering management theory is also different. The engineering management theory will succeed only through the application of the engineering management innovation.

B. *Engineering management innovation is the soul of the Engineering management practice*

Based on the following two aspects we believe engineering management innovation is the soul of the engineering management practices. One is the relationship between the engineering management theory and engineering management practice. Two is the process of engineering management practice is the course of engineering management innovation. The relationship of

engineering management theory and engineering management practice is dialectical. Engineering management practices is the basis of the engineering management theory. The engineering management theory is created by the engineering management practice. Engineering management theory and engineering management practice promote mutually and develop together. Engineering management practice is directed by engineering management theory and is the process of engineering management innovation. The development trend of modern engineering is one of the large-scale and complicated. For such great system engineering, we should need to integrated management methods and implement engineering management innovation [8].

IV. HOW TO REALIZE MODERN ENGINEERING MANAGEMENT INNOVATION

Modern engineering management is more diverse and complicated. Setting targets and achieving management objectives is often the result of multiple factors coordination considered. In the future, the development trend of engineering management has four aspects. One is the theory, method and means of engineering management become more scientific. Two is engineering management itself become more social and scientific. Three is engineering management become more standardized and standardized. Four is engineering management become more international. So the innovation of engineering management is facing unprecedented challenges, how to correctly use project management innovation in engineering practice has the extremely important theoretical and practical significance.

A. *Engineering management innovation is directed by engineering philosophy*

Engineering philosophy is the philosophy that researches activity of human changing the material world, it is philosophy theory about the whole engineering field; it also is a philosophical thinking about major engineering problems and engineering common law or general law. Engineering philosophy includes engineering development view, engineering dialectical view, engineering systemic view, engineering ecological view and engineering values. These views should direct the engineering management innovation.

According to the requirements of engineering development view, engineering management innovation should be directed by Scientific development concept, its theoretical innovation and practice should be comprehensive consideration coordinated and sustainable development of man and nature, man and society, and comprehensive consider the immediate interests and long-term interests, local interests and global interests, social benefits and economic benefits, the humanities environment and natural ecology. We should establish the idea of "harmony between man and nature" instead of the concept of "conquer nature".

According to the requirements of engineering dialectical view, engineering management innovation should meet the requirement of engineering dialectical view. For example, with human activity and social dialectics there are dialectical relationship between engineering management innovation

and engineering management standard. On the one hand, the scientific engineering management standard is the premise and foundation of engineering achieving the established value goals, and also is the guarantee of normally implement modern engineering construction activities, on the other hand, any engineering standard are not constant long rationality and scientific, engineering managers can revise and perfect engineering standard based on the changes of subjective and objective, so the engineering standard will be innovation and development. In addition, the innovation of the engineering management standard should reflect the characteristics of the ecological society, reflect the changing structure of the people's needs, reflect process thinking with as the core of knowledge, reflect global vision and adapt to the increasingly fierce international competition.

According to the requirements of engineering systemic view, engineering management innovation should be equipped with system thinking and the whole system as the starting point and the foothold. Systems Thinking, first clearly put forward by P. Checkland in Systems Thinking, Systems Practice, and its core idea is to grasp the integrity of things [9]. Engineering management systems thinking refers to the engineering management process should start from the engineering system whole, geared to the whole life period of engineering, focusing on the interrelation and function between whole and parts, parts and parts, system and environment, putting the engineering as a dynamic whole integrated management of the various relations, in order to obtain scientific management thinking which its overall goal is optimum in the whole life period of engineering system. Because any engineering is a complex system composed of a variety of elements the engineering management innovation should be directed by engineering systemic view, through local innovation to promote the better realization of the goal function and the whole system. At the same time, for a better implementation of the whole system function and goal, we should need to use thinking of engineering systemic view to implement management creation throughout the method of steps, project, in stages and layers.

According to the requirements of engineering ecological view, engineering management innovation should don't destroy the ecological environment and the ultimate goal is harmony between man and nature. The construction of the engineering and engineering management innovation should comply with and obey the ecological cycle rule and understand them as ecological social phenomenon of ecological circulation system. In fact, one of the main target and content of engineering management innovation is to minimize and repair engineering damage to the natural and ecological system.

According to the requirements of engineering values, engineering management innovation should be directed by correct values. The research contents of engineering values is the significance of engineering function attributing to human, with what kind of standard to evaluate and how to evaluate it. Engineering values both incorporate general value theory, and include coordination of all kinds of different value criteria in a specific project. Engineering management innovation should not only conform to the general value

theory, also give full consideration to the purpose, effect and significance of innovation on the basis of the specific engineering practice.

In addition, the engineering development view, engineering dialectical view, engineering systemic view, engineering ecological view and engineering values should be considered overall. If one aspect is lacked, the engineering management innovation is not successful.

B. The core of engineering management innovation is people-oriented

"People-oriented" is first be proposed by GuanZhong as governing ideas on era of ChunQiu [10]. The opium that the core of engineering management innovation is people-oriented can be embodied in the following several aspects.

One is the engineering management essentially is the management to person. The subject of engineering management is person; even the organization of engineering management is made up of person. The organizational behavior of engineering management need give play to person's subjective initiative. Engineering organization is not only to manage person, but more to rely on person. The ultimate goal of engineering organization is for people and the core of the engineering organization is people-oriented.

Two is engineering management innovation is human innovation activity in the final analysis. It not only embodies respecting people, also reveals the fundamental aim and the ultimate power of engineering activities for emphasizing people-oriented in engineering management. The entire contents of people-oriented are everything for the people, everything depending on people. Engineering management innovation is the innovation in engineering management activities and it is the process creating ideas and turning it into useful products, services, or work method. The process condensed the person's knowledge and creativity. Knowledge has gradually become the primary resource of economic growth with the rapid progress of science and technology. Modern engineering is more and more becoming the public affairs which are constituted for large number of science and technology and knowledge. With the increasing of knowledge intensity, a new engineering management mode, namely, knowledge operating management mode was be created. In terms of engineering management, the core elements of engineering management innovation are creating, using, saving and transferring knowledge and intelligence [11]. So the engineering management innovation can be realized only with people-oriented.

Three is engineering management innovation is restricted by engineering ethics. The starting point of engineering ethics is what responsibility should the engineering technical personnel and engineering management personnel be undertaken for employers, the public, environment, society and the future, they shall abide by the basic principle is humanitarian principle, respecting life principle, principle of all men's equality. So, the foundation of engineering ethics is people-oriented. Engineering management innovation is restricted by the engineering ethics; we should not implement engineering technology and management

innovation in the cost of harming other people and social interests. That is the embodiment of the people-oriented.

C. The core of engineering management innovation is people-oriented

The wide application of modern information technology is one of the important symbols of modern engineering management. With the rapid development of modernization progress in our country, large-scale construction engineering is becoming more and more and modern much information technology had to be used. Even the general scale of the engineering, because the factors considered tend to be more complicated, the analysis of these factors depends on the application of modern information technology. So how do we implement engineering management innovation through using modern information technology? In my opinion, we can commence from the following several aspects.

Firstly, we should grasp the connotation of modern information technology and pay close attention to the development of modern information technology. Modern information technology is a broad technology group. It includes microelectronics, optoelectronics technology, communication technology, network technology, sensor technology, control technology, display technology, etc. The current trend of the development of modern information technology is digital, network and intelligent. Now we should need to paid close attention to the development of internet building technology, big data technology, microelectronics technology, information transmission technology and wireless network attack technology [12].

Secondly, we should grasp the rule of information technology development and actively use information technology to implement engineering management innovation. The development of modern information technology presents the characteristics of step type. In the field of information technology, each over a period of time will appear a discrete mutation, and the period has a tendency to gradually shorten. These mutations profoundly affect people's style of work and life. It also causes significant change in the enterprise management and operation mode, including engineering management. In the practice of engineering management, the study and application of information technology such as ERP, GPS, EDI, RFID and so on is not enough, the more important is the mode innovation of engineering management through actively using new information technology.

Thirdly, we should pay high attention to the big data technology and improve the purpose and effectiveness of engineering management innovation for using it. Big data technology is the technology which can rapidly acquire valuable information from various types of huge amounts of data. At present, the global amount of data is growing exponentially. The mount of data produced in the past 3 years has been more than the sum of the past. An important job of engineering management innovation is to collect and analyze all kinds of related data. We can find innovation direction, solve innovation problem, and improve the innovation effectiveness through the data analysis.

Fourthly, we should improve the efficiency of engineering management innovation through the widely use of internet technology. At present, the internet technology has been widely used in the production and the modernization of information management in enterprises. One of the main components of German Industry 4.0 is realizing the change of production process from the informatization to the intelligence through the upgrading of information platform and information system [13]. However, the using of mobile internet technology is lacking now. Engineering management innovation is still subject to the restrictions of time, place and organization. The effectiveness need to further promote. So we should increase mobile internet technology in the application of the engineering management innovation.

V. CONCLUSIONS

Modern engineering construction has new quality, especially the application of large data, internet and mobile internet; it is the major changes in the concept, strategy, organization, system, theory, method, etc. Modern engineering management is more emphasis the scientific application of modern management theory, method and means in engineering practice; Emphasizing to solve complex engineering projects through systemic engineering management; Emphasizing to realize engineering target and reflect engineering value by effective engineering management. These are all being realized through engineering management innovation, and engineering management innovation is directed by the engineering philosophy, its core is people-oriented, the key is the application of modern information technology. Of course, not any engineering need to be management innovation. Engineering management innovation is conditional, for some small and regular engineering need to adhere the standardization of engineering management. Grasping well the dialectical relations between engineering management innovation and engineering management standardization is also a master of engineering management innovation.

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