

Original Paper

Research on Framework of Knowledge-Oriented Innovation Risk Management System

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Abstract

Innovation is the inexhaustible motive force for the prosperity of one nation, and also the life source of enterprise. However, the high risks of innovation activities require managers to implement the scientific and effective innovation risk management (IRM). On the basis of a general review of the IRM, this paper integrated theories and methods of knowledge management into the process of risk management, built a framework of knowledge-oriented IRM system, and proposed relevant strategies and references for practical application of knowledge-oriented IRM. By means of acquiring, storing, sharing, and transferring innovation risk knowledge and knowledge innovation, this approach can ensure the knowledge supply for the whole process of innovation operation management and risk management, effectively blocking the evolution and transmission of risks in innovation, and improving the performance of innovation.

Keywords

innovation, innovation risk, risk management, Innovation Risk Management (IRM), Knowledge-oriented

1. Introduction

Innovation is the soul of a nation's progress, an inexhaustible force for the prosperity of a nation, and the life source of enterprises (Siwei Cheng, 2009, p. 1-14). Without innovations, enterprises would not be able to upgrade their production structures. With weakening competitiveness, enterprises will die. However, innovation is a “double-edged sword”, with characteristics of high potentials, high inputs, high returns, and high risks. Particularly, high risks from technologies, markets, and management may frustrate or even kill many innovation activities, which in turn may even threaten the healthy

development of human society. Therefore, to manage innovation risks is significant.

Because of the innovation project is unprecedented, it might bring about damages or bad influences on enterprises, industrial chain, or even the entire society, i.e., the risk. At present, most discussions on innovation focus on the approaches and patterns for promoting enterprises' independent innovation. Only few researches are about the innovation risk. In addition, the existing literatures usually just discuss the economic risks of innovation project, mostly from the point of the innovation project failing to reach the expected return. This paper will not only consider the economic risks, but also think about the social risks of innovation project, including the environmental risk, human health risk, etc., from the long run. As an innovation project, its impacts are still unclear in the future. Therefore, managers should adopt a set of scientific and effective management approaches to identify problems and revise decisions immediately, in order to achieve the purpose of comprehensive risk control.

Innovation risk management (IRM) is a cross-field of innovation management and risk management. It focuses on how to control the factors that may cause negative effects on the normal operation of innovation and their impacts, and how to ensure the realization of innovation management goals. The implement of IRM can not only defend innovation risks effectively, but also reduce losses as much as possible after the occurrence of risks.

The process of IRM will produce amounts of knowledge associated with innovation risks, such as cause-effect relations, effects of risk events, and strategies of handling risk events. The knowledge is very important for IRM. Without the knowledge, innovation risk management is empty. To manage the knowledge well is bound to improve the effect of IRM.

Currently, most researches on innovations are about methods and modes that promote enterprises to develop independent innovations, seldom focus on innovation risks. Xiaofang and Jianjun Hao (2010) built an application framework for high-tech enterprises implementing overall risk management, according to characteristics of risks in front of high-tech enterprises. Mei Zhao, Hongzhi Yue, and Yan Yang (2007) studied the whole process of continuous risk management of high-tech enterprises. Rong Liu and Keyi Wang (2009) proposed a synthesized risk management mode for enterprises' cooperative innovations based on the meta-synthesis method. Yujun Miao (2010), Xiaofeng Li, and Jiuping Xu (2010) put forward the risk management strategy in the process of technological innovation, which could help to achieve effective risk prevention. Zhaoyang Pan and Yunzhi Liang (2009) studied the risk management of technological innovation in perspective of venture capital. All these literatures were studies on different stages of risk management, including risk planning, risk identification, risk analysis, and so on.

In the theoretical field, there are researches on IRM. Zhe Song, Shu'en Wang, and Zhou Liu (2010) proposed the synthesis evaluation method based on the Analytic Network Process and the Grey Relational Analysis and applied it to the risk evaluation of enterprises' technological innovation. Junwen Xing, Yang Chen and Yuejin Tan (2007) studied the risk estimation methods for personalized product innovation projects from the characteristics of products' market life cycle. Xiaofeng Li, Jiuping

Xu and Jinjiang Yan (2010) built a risk pre-warning system for enterprises' technological innovation projects. Andrew Kusiak (2009) proposed a production innovation program driven by market or customer data. These researches promoted the scientific decision of technological risk management, but the application is unsatisfying. On one hand, these methods are too complicated to use in enterprises. On the other hand, most quantitative studies focus on the risk evaluation, but seldom on risk management.

Currently, few studies concern the application of supply chain risk management by knowledge management. Wang, Stößlein and Wang (2010) proposed an advanced method that takes into consideration typical problems in group decision-making processes by applying linguistic operators derived from the field of decision theory and fuzzy-sets theory and offered advice on the mitigation of risks in Knowledge Supply Networks (KSN). Tuncel and Alpan (2010) showed that the system performance could be improved by using risk management actions and the overall system costs could be reduced by mitigation scenarios. Giannakis and Louis (2011) developed a framework for the design of a multi-agent based decision support system for the management disruptions and mitigation of risks in manufacturing.

These articles present some research lines for how to manage innovation risk. But they seldom study how to apply the theories and methods of knowledge management to the implementation of innovation management. Innovation risk management and knowledge management respectively belong to separated and independent study field. In this paper, we analyzed the characteristics of IRM under the influences of knowledge, built a framework of knowledge-oriented IRM system, and proposed relevant strategies and references for practical application of knowledge-oriented IRM.

2. The Process of Risk Management of Innovation Project

The process of risk management of innovation project includes five stages, i.e. risk identification, risk pre-assessment, risk decision-making, risk monitoring, and emergency-response to risk. See to Figure 1.

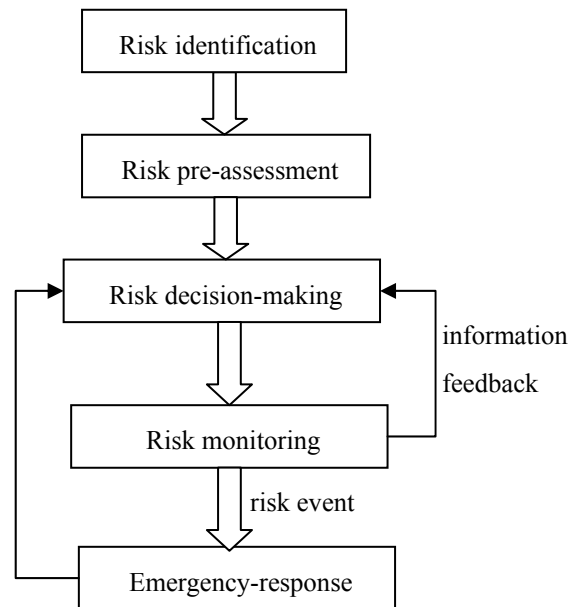


Figure 1. The process of risk management of uncertain innovation project

Risk identification refers to identify the risk sources of innovation project, such as economic risk, industrial chain risk, environmental risk, human health risk, etc.

Risk pre-assessment means: before the application of innovation project, invite some professionals to form an expert team, ask them to make a comprehensive assessment of the risk, predict the consequences, and make a feasibility analysis of the project in perspective of the potential risk.

Risk decision-making means: on the basis of comprehensive assessment of all potential risks, make relevant decisions about project inputs and operations. At this stage, we could not completely control the consequences of decision. So, it is called risk decision-making. The risk decision-making is the most key stage in the process of risk management.

Risk monitoring means: during one decision-making cycle for the trial operation of innovation project, investigate and follow the progress of the project, collect relevant data and information feedback, and monitor the positive or negative effects of the project on all social fields. According to the analysis of new information, identify problems and make risk pre-warning, adjust relevant risk decisions of innovation project in time, and achieve the purpose of risk control.

Emergency-response to risk means: if unexpected risk event happens during the running cycle of project, we must perform the emergency management, according to the pre-established plans for emergencies. For example, call an emergency stop to the innovation project, or make immediate product recalls. By this way, we can reduce the risk consequence to the minimum level.

Here we should further emphasize one point, i.e. the risk management of uncertain innovation project needs to repeat the application of the risk decision process in cycle, adjust the risk decision in time, and carry out the dynamic risk management of innovation project, in order to adapt to the constantly-changing social environment and help managers to achieve the scientific management of

innovation risk.

3. The Constitution of Knowledge-Oriented Innovation Risk Management System

Based on analyzing the process of IRM, we can see that there are a lot of knowledge has been generated in the process of IRM. We considered that by reforming the acquirement, storage, sharing, and transformation of innovation risk knowledge and knowledge innovation, we can improve the supply of risk knowledge during the entire IRM process (risk identification, risk assessment, risk decision-making, and risk monitoring), and build a perfect knowledge management system, integrating the business processes of enterprises, controlling elements of risks effectively, reducing the probability of risks, alleviating consequences of risks, improving the knowledge level of managers and employees and their recognition to innovation risks, driving the use of knowledge, and enhancing the overall level of IRM.

In order to make sure to conduct the whole process of knowledge acquirement, application, and innovation in knowledge- oriented IRM orderly, we built a framework of knowledge-oriented IRM system, composed of the level of knowledge sources, the level of knowledge generation, the level of knowledge storage, and the level of knowledge application (see Figure 2). This system takes innovation risk management as the core. The key is to integrate the knowledge management into IRM systems, provide a unified open network platform achieving immediate knowledge exchange, and reduce time and space restrictions of knowledge sharing.

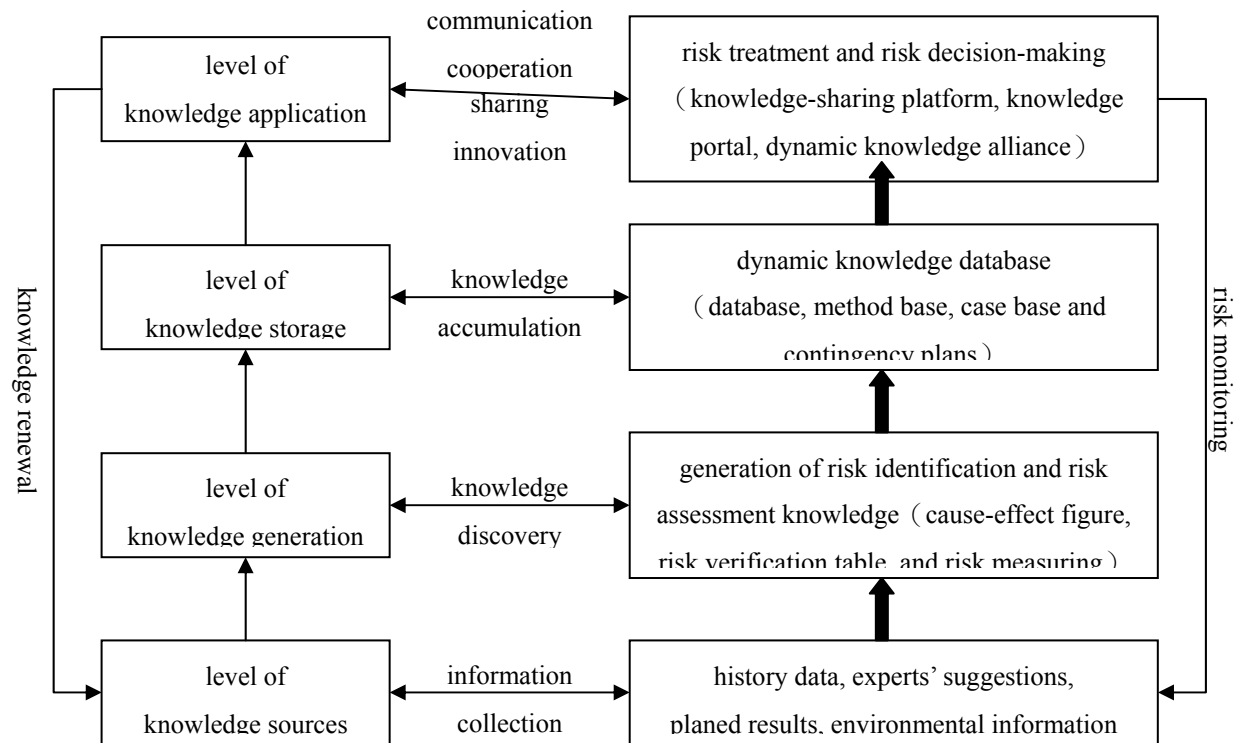


Figure 2. The Framework of Knowledge-Oriented IRM System

3.1 Level of Knowledge Sources

Collect the individual information and overall information of innovation, such as history data, experts' suggestions, planned results, and environmental information as the sources of generating risk knowledge, including internal knowledge sources and external environmental knowledge sources.

3.2 Level of Knowledge Generation

By data mining and knowledge discovery, acquire and abstract risk knowledge, such as knowledge of risk identification, and knowledge of risk assessment. Display them in certain forms, such as cause-effect figure, risk verification table, and risk assessment measuring.

3.3 Level of Knowledge Storage

Set up technological standards for knowledge presentation, storage, and communication, and use the information platform that covers all enterprises in innovation, connecting all participants enterprises' knowledge sources together by network. Store the collected risk knowledge in a dynamic knowledge database, and build a platform for exchanging knowledge between participants in innovation by knowledge map, expert system, and other technologies.

3.4 Level of Knowledge Application

Form a dynamic knowledge alliance, and make the communication and coordination between all participants such as project sponsors, related experts, government regulators, most customers, and so on, achieving knowledge sharing, application, and innovation, offering basis for risk treatment and risk

decision. Knowledge portal and knowledge-sharing platform supply an interface for knowledge operation. Participants of knowledge alliance can find and use specific information and knowledge based on needs.

4. The Implement of Knowledge-Oriented Innovation Risk Management

4.1 Emphasize on the Accumulation and Renewal of Innovation Risk Knowledge

Innovation risk management-related knowledge can be divided into internal knowledge and external knowledge according to the sources. External knowledge includes systematic theories of innovation operation management and risk management, knowledge of innovation operation environment, other enterprises' experiences of risk management and best practices, etc. Internal knowledge includes risk management experiences, rules and system, technological standards and product regulations, cooperation contracts, etc.

IRM is a process of combining theoretical knowledge, practical experiences, tools, and methods together. The application of knowledge-oriented IRM should emphasize on the knowledge of project running, systematically mining, storing, and transforming the explicit knowledge and tacit knowledge accumulated in the process of risk management practice. Meanwhile, it is necessary to absorb ordinary external knowledge and learn best practices from others, providing managers with explicit knowledge in the form of information materials and assisting tools, and providing them with tacit knowledge in the form of cases.

Participants in innovation should store and renew their internal and external knowledge into the dynamic knowledge database, and offer intelligent fast retrieving services for others knowing sorts of knowledge. A powerful knowledge supply guarantees more effective risk identification, assessment, decision, and monitoring.

4.2 Build a Dynamic Knowledge Alliance and Achieve Knowledge Sharing

4.2.1 Form a trans-organizational risk management agency, build a dynamic knowledge alliance, and achieve the trans-organizational flow and sharing of knowledge

The key for the application of knowledge-oriented IRM is to across the organizational obstacles, achieving the close cooperation of participants at all nodes of innovation. The core member in the innovation takes the lead and forms a trans-organizational IRM agency to coordinate the risk management activities. Build a dynamic knowledge alliance, constitute the risk management planning, and supervise the application of IRM, such as establishing a good knowledge-sharing incentive mechanism and mutual trust mechanism. Select alliance partners that possess strong learning abilities. The knowledge levels of participants in innovation are complementary and coordinative. Build an organizational culture of mutual trust and mutual learning. By this way, it can satisfy participants' requirements for knowledge. Improve the quality and functions of products and services by good knowledge collaboration, improving the overall performance of innovation.

4.2.2 Standardize Knowledge of Innovation Risk, Build an Information Platform, and Develop

Knowledge Portals to Improve the Efficiency of Knowledge Communication

Establish technological standards for knowledge representation, storage, and communication. Build a knowledge exchange platform covering participants in innovation based on information platforms, connecting the knowledge sources of participants by the net. Use knowledge map, expert system, and knowledge engineering to develop a dynamic knowledge system for innovation management. Open a network connection for external knowledge, extend the knowledge sources, and help all participants to acquire new knowledge dynamically and effectively, achieving the acquirement, transfer, application, and innovation of risk management knowledge, and guaranteeing the knowledge supply at all links of IRM.

4.3 The Coordinative Innovation Based on Innovation Risk Knowledge

The coordinative innovation based on innovation risk knowledge is an important content of knowledge-oriented IRM. Knowledge is a new thought derived from complex information, providing knowledge services for the reengineering of innovation management organization, procedures, and operation modes, in order to improve the overall competitiveness of innovation. Knowledge portals, running by one account, provide a unified entrance for enterprises at all nodes accessing useful knowledge, and facilitate the knowledge coordination between participants. Evaluate and amend the knowledge during the interaction of knowledge according to changes of market environment, and achieve the knowledge innovation that meets the goal of innovation management. The coordinative innovation based on innovation risk knowledge is displayed in Figure 3. To collect all kinds of information feedback and reduce the operation risk of innovation is an important aspect of coordinative innovation.

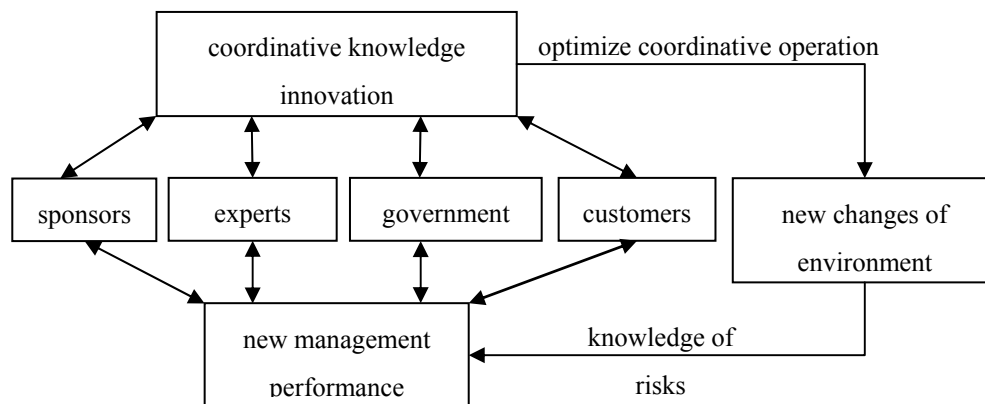


Figure 3. The Coordinative Innovation based on Innovation Risk Knowledge

5. Conclusion

Risk management of innovation is vital to the survival and the development of society, enterprises, and industrial chain. It is believed that the risk management of innovation is an issue of big system. The

risk management of innovation project needs to motivate all social powers to be involved, including project sponsors, related experts, government regulators, most customers, and so on. The scientific IRM involves many social aspects: not only the economic risk, but also social risk; not only the short-term risk, but also the long-term risk. Some project sponsors are eager for quick success. They just care about the short-term economic interests, but not consider the long-term consequences and social risks, which might cause serious damages to the industrial chain, social environment, or even human survival. In order to avoid such kind of tragedies, all managers at different social levels should take responsibilities and perform scientific risk management of innovation project.

In the process of innovation operation and risk management, the timely, sufficient, and proper supply and sharing of specific knowledge is the essential reason for improving of innovation risk management level. In this paper, we studied how to integrate theories of knowledge management and methods into the process of risk management, and built a knowledge-oriented IRM system. Innovation risk knowledge's acquirement, storage, sharing, and transformation, and knowledge innovation can supply knowledge for the whole process of innovation operation management and risk management, reducing the possibility of risks and negative consequences of innovation, and improving the performance of innovation. The research on knowledge innovation mechanism in innovation risk management will be the direction of further studies.

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