

Research on Risk of Innovative Levels Based on Hierarchical System

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Abstract: In this paper, the innovation is divided into four parts that are technical innovation, product innovation, the industrial innovation and regional innovation based on theory about hierarchical system of innovation. The links between different levels of innovation and evolution were described and the different levels of risk and its causes progressively were identified in the paper. The conclusion is that the innovation is sustainable only when a clear analysis of different levels of innovation and risk that can prevent the innovation risk systematically. In the end of the paper, some innovation risk outlook of the research was presented.

Key words: Hierarchical system; Innovation level; Innovation risk; Risk analysis

1 Introduction

With the rapid development of knowledge economy and deepening of globalization, innovation has already become the motive power which drive modern economic to develop. For a rapid economic development and weakness of innovation ability country as China, innovation strategy has been the core of economic and technological development in China. Meanwhile, there is necessary requirement for enhancing the economic development. But innovation also has positive and negative effects, on the one hand innovate subject consumes a great deal of innovation resources because of the high risk in innovation. On the other hand, it makes the potential innovation subject not interested in innovation. Therefore, the risk of innovation should not be ignored.

Currently focusing on technology, product, industry, regional and other single-level innovation object, the academe has made farther research from the main body of innovation, elements, models, performance. But the research studied innovation risk is very rare. There are some mainly representative researches. Berglund (2007) analyzed the concept of innovation risk taking two Swedish enterprise, and identified three themes to illustrate the relationship between the risk and innovation process. Scott. F.L. atham, Michael Braun (2009) argues that the company with poor business performance will make itself faced survival crisis, if it continues to invest in innovation. P. C. Yang, H. M. Wee, B. S. Liu, O. K. Fong (2011) found that price of the product and the End-Users' demand showed a obvious decline law, through establishing economic mode to study the risk of rapid technological innovation, taking the high-tech products as a example. Chen Yuhe (2007) constructed a three-dimensional technology innovation risk analysis model including the dimensionality of process, the dimensionality of environment and the dimensionality of knowledge. Zhang Yunsheng (2009) considered that the innovative ecosystem of high-tech enterprises has co-operation, the system complexity, technology standardization, technology modularity and other essential characteristics, leading to six kinds of cooperation risk, which is dependency, structural, specificity assets, asymmetric information, resource loss, except the traditional R&D project management risk. Duan Bingqian (2006) studied the key risk factors for complex products, revealed the innovation risk dynamics characteristic of complex product innovation, made empirical test on the key risk model of complex product innovation, and discussed the organization of complex product innovation patterns and its role in risk control. Jia Xiaoxia and Zhou Xizhao (2006) studied the exogenous structural risk of the regional innovation system, proposed the concept and factors of the exogenous structural risk of regional innovation system, gave the coupling between the elements, and further constructed the quantification description model of the coupling.

From the existing results, current research mainly focuses on a level of innovation risk. But innovation is a complex dynamic system which includes product innovation, industrial innovation, regional innovation and other different levels of innovation activities, in addition to technological innovation. These factors link closely, and should be as a system to research. Therefore separating these links to study pure innovation risk is obviously insufficient. The paper analyzes the composition of multilayer innovation risk from the hierarchical system of innovation, and comprehensively analysis the hierarchical system of innovation and its formation mechanism.

2 The Hierarchical System of Innovation

Hierarchical method, is according to the need of research, put the whole issue by order into all sorts of hierarchical subsystem or elements. The concept of innovation hierarchical system is to use hierarchical view to study complex innovation system. Innovation is the process that the resources for innovation accumulate, integrate and optimize, the lowest level of technological innovation can also be seen as an integration process of the innovative element, the basic unit of innovation can be called innovation-neuron which representing scattered, immature innovative results, it could be abstracted as the hexagonal compound constituted of knowledge, information, capital, systems, talent and management. When innovation-neurons accumulate to a certain scale, get up to a certain equilibrium state, it will generate new technologies, technological innovation is the foundation, it is the source to improve innovation ability. To achieve higher level of innovation also need the accumulation and development of innovation-neuron. Through the effective combination, the new technologies provide foundation for product innovation, the success of new products will simulate industrial innovation through the relevant industrial structure adjustment, industrial innovation develop to a certain stage, it will put the request in order to promote regional innovation and industrial innovation, then regional innovation will form a more advanced and conducive platform of innovation. The individuals can't innovate alone, they demand industrial innovation and regional innovation in feeding back and rely on the networks formed by high-level innovation to breakthrough innovation limitation, so as to improve innovative efficiency. Whether regional level of innovation, the industrial level or the product level of innovation, they are not independent of each other, as they gradually evolve on the basis of lower level of innovation, thus formed a mutual connection, mutual interaction and mutual support, inter-constraint indivisible entirety. In this system, technical innovation and product innovation are at the microscopic level, technological innovation is not only build innovation foundation for product innovation, industrial innovation and regional innovation, at the same time it also stand by the restriction and influence of industry innovation and regional innovation; The industrial innovation lies in mesosphere, it is the linkage of technical innovation, product innovation and regional innovation, it plays the role of connecting bridge; Regional innovation is the macroscopic level of innovation, it must come to realize through the technical innovation, product innovation and industrial innovation, and eventually it will form a higher level of innovation platform with the advance of regional innovation to back the industrial innovation, product innovation, technology innovation activities.

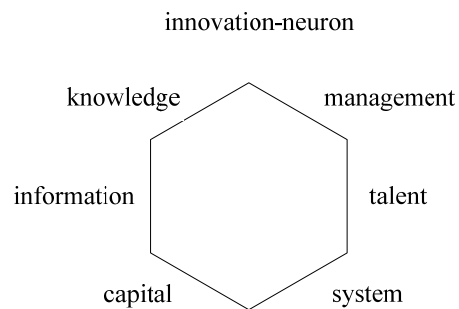


Figure 1 The Innovation-neuron

At a single level of innovation, the innovation subject completes the corresponding innovation activities in their respective layers independently, and because more participants in innovation, a variety of collaborative technologies, a variety of innovative product portfolio, they altogether connect different levels of innovation activities. From the surface observation, the relationship of the product innovation, industrial innovation, regional innovation is compared to a point, line and plane, through the technical innovation, product selection and reorganization, products and industries are combined; industries and regional sides are assembled; products, industries and regional sides are distributed synthetically, so we can make the three parts to cooperate with each other. Form the development modality of view, technological innovation, product innovation, industrial innovation, regional innovation follows the progressive rules from simple to complex, from low level to high-level, but this is not a linear progression, it is the performance of the spiral type of rise, constant loop optimization of dynamic balance process. There is a lot of paths for the different levels of innovation subsystem to achieve its

purpose, and often it's difficult to determine the optimal path, the main body of each level of innovation is always in the innovation development process, through the cycle of self-correcting, self-selection and self-optimization, thus making the entire innovation system showing the process of spiral oscillation, and they evolve to more advanced state with the characteristics of diversity and complexity. In sum, innovation hierarchical system is a spiral combination of function and structure, grade structure is a prominent manifestation of this system.

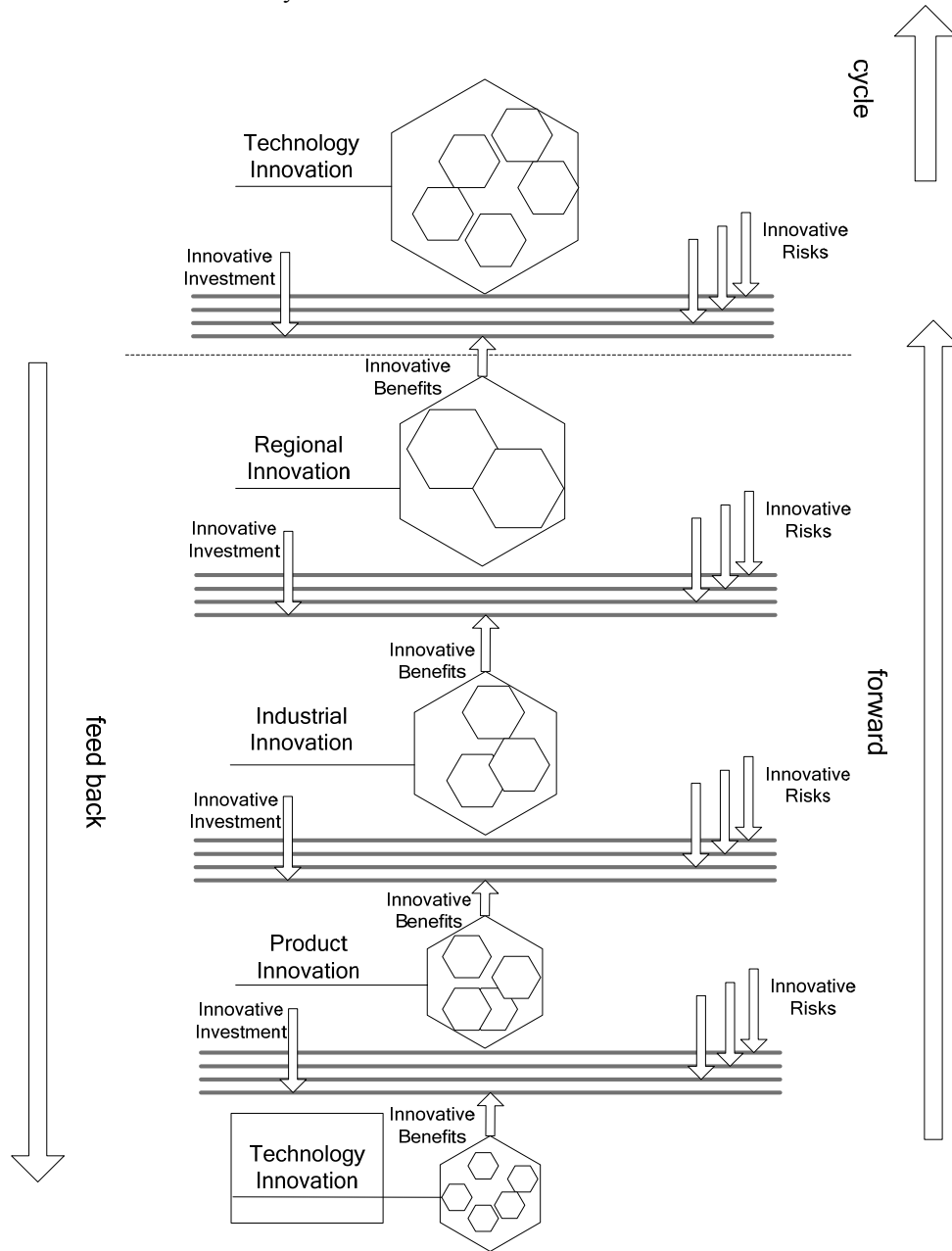


Figure 2 The Hierarchical System of Innovation

3 Risk Analysis of Innovation at All Levels

3.1 Risk at the level of technology innovation

3.1.1 The uncertainty of technological trajectory

Technological trajectory is an evolution contrail in the process of technological innovation, it also expresses a specific technical evolution and development direction. There may be several tracks to solve

a same technical barriers and the market will eventually choose one as the main track. But in the era of rapid technological change, it is very difficult to predict the future development directions of the market and technology accurately and make sure the dominant technology. The technical track is very difficult to change on the basis of a particular technology accumulation for a certain degree of rigidity. If forced to change. There will be a lot of sunk costs and opportunity costs if it was forced to change which is a serious impediment to technological innovation's continuity. This is surely the greatest risk of technological innovation.

3.1.2 Blind faith of technology

Technological determinism believe that technology will solve all problems and technical innovation is like the acceleration of gravity, will be more rapid, more likely to succeed. Being blind faith of technology and innovating blindly and excessively at all costs result in 'More haste, less speed' is often haste makes waste. The main problem is too fast and too impractical in innovation. Technological innovating too fast means the pure pursuit for update speed out of the market rhythm and lack of a relatively stable application process for innovation achievement. The fast continuous innovation and update meet the creative desire and create a good atmosphere for innovation. However, it neglects of economic performance. Technological innovating too impractical are two forms: one is not making patents and standards that can not bring a competitive advantage and technology monopolistic position; the other one is that technological innovation is only feasible in theory and can not be applied in practical production in order to bring economic benefits.

3.2 Risk at the level of product innovation

3.2.1 The cognitive biases to product concept

The products in traditional concept are generally deemed to industrial products and confined to the physical form. As the social and economic development, product concept has been greatly expanded and enriched. Kotler proposed richer product connotations that the products, including three levels: the core, form and addition. These form the integral product. Core products means that products can provide functions or services to meet the needs; the form products are reflect ways and carriers of core products, such as quality, packaging, brand, etc.; additional products are derivatives around the core and the form products, such as after-sales service, installation services, etc. The highly developed and mature technology leads to that the level of the product value not only depends on the core products and many form product and additional products have also become decisive factors. In the practical product innovation, the innovating subjects may only focus on the main core products in the traditional sense and ignore the form products and additional products, which lead to imperfect product innovation, a waste of resources for innovation and reduction of the product innovation effect. So that success rate will be greatly decreased.

3.2.2 The failure of advantages in innovation

The advantages of innovation are gained by take the lead in product innovation. In comparison to the follower, the first innovator can gain relatively prominent advantages from several ways, including preferential access to resources, cost reduction and producing consumers. But the temporary lead not means the permanent lead. In the product innovation process, first acting companies can not completely discern the future direction of development, so they have to cross the river by feeling the stones, which led to the increasing of development costs. The precursors need invest in technology research and development, new product manufacturing first. The failure of research and development or shift of consumers' preferences would result in a lot sunk costs and increase of the burden to enterprises. In contrast, later competitors can learn lessons from the experience of starting actors hitch and save a huge amount of development costs. Therefore, they could improve competitiveness in some ways, even surpass the precursors and dilute the proceeds of first taking product innovation.

3.2.3 The failure of marketing

Product innovation only be acknowledged by the market, can be obtain economic benefits. The advantages of product technology can not guarantee the success of product innovation. The result of empirical research showed that poor market response is the prominent risk of product innovation. The reason leading to the result is the uncertainty of market receipt time on one hand. There is a delay between launch time and inducing demand time for a new product especially high-tech product. If the delay is too long, the company will difficult to recover funds in developing new product. For example, Bell Labs introduced the image phone in the end of last century of 50 decade, but realized its business value after 20 years. Even after the new product is accepted by the market, it is difficult to predict the rate of the diffusion speed, and estimate the demand accurately. If the demand is estimated too large, the company will suffer the loss because of the difficulty recovering the large capital investment. If the

demand is estimated too low, the company can not meet the rapid growth needs, and make up for the cost of innovation. On the other hand, if a new product wants to be successful, it needs to have a potential market. Before the product development and innovation, although the market analysis is helpful for the companies to make better new product development plans, the business can not obtain the information of customer's demand accurately. For innovative products that have a potential market, it is difficult to get the effective information of customer's demand, because sometimes the customer can not know what they really need. Because of the changes, the latter may develop products that is more suitable for customer's demand, get to the ideal product characteristic and more appropriate product positioning, make the product innovation of before fell short.

3.2.4 The boundary of the product innovation is not clear

Define the boundary of the Product Development and Innovation is an important part of successful innovation. For differentiation strategy, the aims of the product innovation are to improve the quality of the products, increase product functionality and features, reduce the conversion cost from old products to new products. The management takes disperse the business risk as a principle; they may also implement the product diversification strategy. But if they emphasize diversification and differentiation blindly, expand the boundaries of product unlimitedly, leading to scattered resources and inefficiencies, inefficiencies associated with the development strategy or profitability of the core product strong position to be weakened, but fail to reflect the advantage of the product Innovative, and even lead to operational risk.

3.3 Risk at industry innovation level

3.3.1 Industrial structure adjustment unreasonable guided by innovation

The success of product innovation will makes the resources, knowledge and skills in related industries focused on the innovative products or its intermediate products, too much into the industry with innovative products as the leading, even highly focused on a single industry or a single product. All kinds of organizations constitute the industry system guided by the market will naturally focus on product innovation transformation, followed by re-combination. And this will break the original stable structure inside the industry. However, the speed of industrial structure transformation lags behind the speed of product innovation, that may lead to the organization continuously follow the product innovation and transformation their roles, thus causing an inefficiency product and the focus of the industrial structure will be unstable. In addition, with the popularity of innovative products, production processes and products over standard, the industry upgrade cost is too larger because of continuous investment in knowledge, technology, supporting facilities and the cumulative expenditure of the consumers on these products. Innovation update cannot be carry on timely in the industry maturation period or recession period, thereby threatening the healthy development of the industry.

3.3.2 Technology diffusion blocked

Industrial innovation is essentially an industrialization course of technology, products. Enterprises within the industry and related organizations are highly concentrated in geographically, frequent interaction, and gradually form a relatively closed and stable network relationship within the industry. Form a highly convergence innovative thinking in the industrial culture, economy, technology, production activities and other aspects. This will definitely weaken the power for the organization to gain new knowledge and new information from external, reducing the possibility of external knowledge sources inflow. In addition, because a large number of enterprises within the industry wants to enjoy innovation spillage instead of investing in innovation, thus leading to the flow channel of knowledge locked within the industry. Over time, they gradually lost the chance to communication with the outside and the ability to absorb innovation resources, further weakening the ability of industry innovation and delay the new thinking, new technology, and new product to appear.

3.3.3 Innovation inert

The inter-organizational networks in an industry can be abstracted as a complex network, the dissimilarity between technology needs and innovative power makes a one-way transfer of knowledge from the innovation ability to the weak main, lack of two-way interaction. With the strengthening of this transfer path, innovation gradually over-specialization and flexibility reduced. If the learning cost less than the cost of innovation, the main of weak innovation capability will be more dependent on the strong one, leading to innovation network rigidity, new knowledge and technology cannot continue to renewable, innovative thinking will eventually dry up.

3.4 Risk at the level of regional innovation

3.4.1 Policy risk

Regional innovation environment includes policy environment, economic institutional environment, economic environment, human environment, social environment and related technology's Application environment, and government action is one of the key factors. Government's macro-control policies or institutional reform lead to the direction of the adjustment of laws and regulations, the changes of planning, the adjustment of industrial policy and other changes, and all these will bring about more uncertainty and some impact on the development and operation of regional innovation at the macro. Especially when the government Takes direct administrative means to direct intervention in regional innovation activities, although to a certain extent, it can compensate for market failure, but sometimes there are unreasonable phenomena which restrict the speed and performance of regional innovation. On the other hand, the success of a policy brings about the demonstration effect, And it will also affect the backward regional innovative thinking, cause to form the dependence on the fixed policy model, and the dependence will be Strengthen as a policy-driven factors which greatly affect the characteristics of strategy in the various regions based on the facts of Zhongguancun, Suzhou electronic Industry Park and other parks greatly stimulated the regional policy-makers' enthusiasm of building the park mode ,and this led to the trend of blindly building the park when the intellectual resources, technology, industry institution, the basic elements of innovation atmosphere is not yet fully available. The elements didn't obtain the efficiency levels and caused the great loss. of opportunity cost which from regional characteristics and advantages.

3.4.2 Regional lockout

Regional lockout is the trend towards segregation of the surrounding environment, due to the regional businesses' closely associated, and this brings about the cooperation which has the regional characteristics, concentration of significant geographic, all these lead to the region's self-isolation. Regional innovation system is a network rooted in nature of local organizations, and the main body of innovation form a network to link with each other through formal and informal relation. The networking assumes the organizational function of innovation activities, has the characteristics of a self-reinforcing when it formed .On the beginning, it is the innovative element to promote the innovation, but eventually it could lead to "regional lock" and hinder innovation. There are two main reasons which Lead to regional lock in Regional Innovation System: at the macro of cultural and institutional level, the cooperation within the regional innovation system is rooted in the regional macro-network of social and cultural atmosphere, especially innovative atmosphere of innovation and System, and the formation of important system and practices are from this atmosphere. The innovative atmosphere has the features of self-protection and self-enhancement, and the cultural and regional characteristics will gradually solid down, eventually will lead to regional lock and the system will be rigid. The development vitality of the system will be lost .On the micro level of operating, although the advanced information communication technology has broken the regional restrictions and significantly reduce the cost of communication, research shows that face to face communication has irreplaceable advantages for the transmission of knowledge and information, especially the dissemination of tacit knowledge. As in the same region, geographical proximity makes the communication between the main body of innovation more convenient than outside of the region and long-term cooperation within the region has also bring about the mutual trust. This will gradually enhance communication of the innovation main body in the region, and the communication with the outside will continue to be weakened. Long-term effect will lead to regional self-enclosed which results in the rigidity and stagnation in innovation activities.

4 Conclusions

Innovation is a dynamic, open process, but also a risky process. The cause of the innovation risk is complex. Therefore the paper take the innovation hierarchical system theory as the breakthrough point , according to the hierarchically structured innovation hierarchical system, comprehensive analysis and describe all levels of the innovation risk from the perspective of the system, so as to understand every level of innovation risk more clearly and specifically. Faced with the innovation risk, all levels of innovation subject should use the system view too, and take innovation activities as a whole, enhance the co-ordination with different levels of cooperative innovation subject .Only doing this can most reduce the risk of innovation, and make innovation activities succeed continuously. Based on the present research, there are some questions needed to be further enriched and improved: the research of innovation risk conduction law. Through deep research of the risk for innovation linkage at different levels, the carrier relied conduction, the path or the channel and the change of the risk energy in the transmission process, recognizing the element in the transferring process of innovation risk can be

more objective understand the related characteristics of innovation risk, leading to more effective to prevent innovation risk. Study on early warning of innovation risk assessment. It has important value to innovation risk management making innovation risk in the monitoring state, through researching on the assessment method of innovation risk, using chosen precise and strict early-warning index of mathematical model, leading to setting up innovation risk pre-warning system.

References

- [1] P.C. Yang, H.M. Wee, B.S. Liu, O.K. Fong. Mitigating Hi-tech Products Risks due to Rapid Technological Innovation [J]. *Omega*, 2011, (39):456–463
- [2] Scott F.Latham, Michael Braun. Managerial Risk, Innovation, and Organizational Decline[J]. *Journal of Management*, 2009,(35):258-281
- [3] Hu Shuhua, Deng Hengjin. The Research of “Product Innovation Management” in The New Macro-Environment [J]. *Science & Technology Progress and Policy*, 2010,27(1):1-4(In Chinese)
- [4] Zheng Zheng, Yang Naiding. Enterprise Risk Analysis of Integrated Innovation[J]. *Science and Technology Management Research*, 2009,(6):391-393(In Chinese)
- [5] Huang Fan, Hao Wei. A study of The Risk in Industrial Clusters Based on the Technique Innovation [J]. *Scientific Management Research*, 2007, 25(12): 61-65(In Chinese)