

# *Research on the Influencing Factors of Innovation Ecosystem Resilience of High-tech Enterprises*

Yuqiong Tong\*, Qiang Liu, Kui He, Ming Liu

*School of Economics and Management, Liaoning University of Technology, Jinzhou, Liaoning, 121001, China*

*\*corresponding author*

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**Abstract:** The advancement of globalization has made innovation the core driving force for the development of high-tech industries. Currently, China is in a critical period of transforming the economic development mode, and the establishment of market-oriented innovation ecosystem has become an inevitable requirement for high-tech enterprises to move forward. The complex and changing internal and external market conditions of high-tech enterprises make them pay more attention to ecosystem resilience. Based on the perspective of influencing factors, this paper conducts an in-depth study on innovation ecosystem resilience of high-tech enterprises, and extracts five influencing factors, such as resilient thinking, environmental uncertainty, tolerance, evolutionary capacity, and hidden resources. Through an in-depth analysis of the mechanism of these influencing factors on innovation ecosystem resilience, conclusions are drawn, which provide a certain theoretical basis for subsequent research on innovation ecosystem resilience. The study shows that these five factors have a significant impact on the resilience of innovation ecosystems. The study shows that these five factors have a positive influence on innovation ecosystem resilience, and the stronger the effect, the more they help to enhance innovation ecosystem resilience.

## 1. Introduction

Currently, the innovation paradigm has entered the 3.0 time period. Under the open innovation model, high-tech enterprises achieve internal innovation with the help of external resources [1], and all innovation subjects interact with each other in the innovation environment, thus forming an innovation ecosystem with sufficient flow and efficient allocation of innovation factors. The development of innovation ecosystem promotes the implementation of national development strategy and is conducive to enhancing the overall innovation level and innovation efficiency of the country. High-tech enterprises, as the main force to promote the high-quality development of China's economy, occupy an important position in the process of establishing the innovation system. The development of information technology drives the continuous development of high-tech enterprises and the speed of updating and iterating new technologies and products is

accelerating [2]. However, in recent years, trade protectionism has prompted technology blockade, the prevalence of counter-globalization and the deterioration of the new crown epidemic, which are external uncertainties that bring impact to the innovation ecological chain, stall economic development and deal a fatal blow to each enterprise subject in the innovation ecosystem. In the complex and changing international environment, building a highly resilient innovation ecosystem is the key for high-tech enterprises to resist external shocks and disturbances. This paper delves into the influencing factors of innovation ecosystem resilience of high-tech enterprises to provide some reference value for the subsequent development of innovation ecosystem resilience theory.

## 2. Innovation Ecosystem Theory

With the progress of science and technology, international competition has become more and more intense, and eco-development has become a new development trend [3]. Innovation is an important driver of ecological development, and the innovation paradigm has changed from linear paradigm to system paradigm and then to ecosystem paradigm, and innovation has entered the 3.0 era. The innovation ecosystem theory originated from Moore's business ecosystem theory, who believes that enterprises inject new vitality into the business ecosystem perspective, which can drive enterprises to create new value and promote the development of enterprises [4]. Adner pointed out that innovation ecosystem is a collection of enterprises constructing multilateral relationships, and within the innovation ecosystem, core enterprises and other enterprises influence each other, cooperate with each other [5], and jointly Adner pointed out that an innovation ecosystem is a collection of multilateral relationships in which the core enterprises and other enterprises interact and cooperate with each other to realize value co-creation. Domestic scholar Tang pointed out that the dynamic evolution between elements within the system and between elements and the environment could promote the development of innovation ecosystem [6]. Based on the characteristics of self-organization and dynamic interaction of innovation ecosystem, Liu believed that complex and dynamic innovation ecosystem could realize value co-creation in specific situations [7]. Wei saw innovation ecosystem as a cooperative relationship among market players, and he believed that innovation ecosystem was based on market transaction relationship, with the characteristics of physical nature of offline transactions and limited scale of participants [8]. Chen constructed a model of enterprise innovation ecosystem, and he believed that the symbiotic evolution of the elements within the ecosystem was based on the core of innovation subjects inside and outside the enterprise [9], and the coordinated development through core competencies, so as to obtain the competitive advantage of the enterprise, thus solving the group dilemma and opening up new markets, and enabling the enterprise to gain sustainable momentum. The innovation ecosystem enhances the innovation capability of the enterprise through the development of a common value proposition, which enables the enterprise to obtain faster market responsiveness, thus satisfying the needs of each subject within the system, consolidating the market position of the enterprise, and enabling the enterprise to achieve better development [10].

## 3. Theory of Resilience

Professor Holling has conducted a detailed study on theories related to resilience, and gradually divides the transformation of resilience into three stages: engineering resilience, ecosystem resilience, and socio-ecological resilience from an ecological perspective. He believed that resilience enabled society and ecology to achieve adaptive cycles and systemic feedback, and ultimately obtained cross-scale dynamic interactions. The Intergovernmental Panel on Climate Change defined resilience as the ability of a system to maintain its original structural and functional stability under disturbance, and this ability included self-organization and stress resistance. Walker

considered resilience as the ability of a system to adapt and change when facing stress; Meerow pointed out that resilience was the ability of a system to return to its original equilibrium state or generate a new equilibrium state after disturbance Meerow pointed out that resilience was the ability of a system to return to its original equilibrium or produce a new one after being disturbed; Zhang proposed that resilience was a collection of the ability to maintain stability, self-recovery and self-adaptation. "Reggiani introduced resilience into the field of spatial economics, and then further extended it into the field of economics, and made macro and micro analysis of regional economy from the perspective of resilience, which was of great significance to the sustainable development of regional economy. Meyer introduced resilience into the field of organizational management, which laid the theoretical foundation for the subsequent research on enterprise resilience. Organizational resilience is mainly embodied in resilience and recovery, by helping organizations to cope with unexpected events, so that the organization can recover from the crisis and can continue to develop and become stronger. Zhang proposed that enterprise resilience was the ability of enterprises to recover and grow, and that resilient enterprises were able to cope with crises and grow in crises, thus gaining the ability to sustain development. Resilient companies can recover quickly from external difficulties and adjust themselves to bring positive impact on the development of the company.

#### **4. Innovation Ecosystem Resilience of High-tech Enterprises**

Professor Holling's research on resilience provides important theoretical support for the study of innovation ecosystem resilience, which is defined as the ability of a system to sustain itself without changing its structure and function when subjected to external disturbances. Ecosystems can also be defined in terms of resilience as the ability of a system to recover and adapt to external shocks and internal stresses. Resilience determines the ability of an innovation ecosystem to respond to external shocks, allowing companies to respond to disturbances and make changes in order to receive feedback. According to Su, ecosystem resilience is a function of the length of time. it takes for a firm to recover from a disruption, the amount of pressure the firm can bear, and the threshold size of the firm's innovation ecosystem to maintain stability. Based on this, Liang defined innovation ecosystem resilience as the ability of the system to recover its functional state when sudden changes occurred in the external environment, and this recovery ability was expressed as self-learning and self-regulating ability. The innovation ecosystem resilience theory emphasizes that the system relies on sufficient internal resources to resist external shocks so that the firm can generate buffer capacity, and this capacity can adjust the innovation ecosystem so that the functional level of the system can be improved [11].

#### **5. Factors Influencing the Resilience of Innovation Ecosystem of High-tech Enterprises**

##### **5.1. Resilience Thinking**

Resilience thinking has an important influence on the formation of innovation ecosystem resilience, and this thinking includes resilience thinking at the individual level and resilience thinking at the organizational level in the system [12]. Based on the individual perspective, resilience thinking refers to the solidarity and cooperation spirit of the company's employees and executive team. Human resources play an important role in the formation of innovation ecosystem resilience, and good relationships and networks among employees, between employees and management, and between management can enhance the system resilience, so that the enterprise innovation ecosystem can be united in the face of crisis and develop good strategic guidelines to deal with the crisis. It also helps to persuade corporate employees to cooperate with the policy and promote its

implementation. Based on the organizational level, resilient thinking includes a robust organizational structure and flexibility in organizational strategy, which enables high-tech companies to grow against the odds and improve their overall risk resistance [13]. In addition, organizational resilience thinking enables organizational practices to remain orderly, and this orderliness can positively influence the increase in the level of resilience of the innovation ecosystem, which can enhance the resilience of firms facing adversity and enable them to anticipate potential crises within the system to mitigate the cost of crises when they occur. The higher the acuity of resilient thinking at the individual level and organizational level, the higher the innovation ecosystem resilience value of high-tech firms will increase, and the firm's resilience to risk will improve [14]. Based on the above analysis, the following hypotheses are proposed.

H1: Resilient thinking can positively influence the innovation ecosystem resilience of high-tech enterprises, and the innovation ecosystem resilience value increases with the increase of resilient thinking acuity.

## 5.2. Environmental Uncertainty

Schumpeter believed that uncertainty is a prerequisite for the development of enterprise productivity. This uncertainty is different from the measurability of known risks, which often cannot be accurately measured and calculated, and this is the problem that high-tech enterprises' innovation ecosystem has to face [15]. Uncertainties faced by high-tech enterprises include fierce market competition, unpredictable market demand, changing macroeconomic policies, fluctuations in microeconomic cycles, and changes in the political environment. The right decisions made by enterprises in the midst of uncertainty and a positive attitude in the face of challenges are the keys to enhance the resilience of enterprises. The fluctuation of the economic cycle will have an impact on the political environment and market environment, and thus will also have a greater impact on high-tech enterprises. This uncertainty will have a certain impact on the development speed and behavior of enterprises and make them undergo innovative transformation [16]. Based on the above analysis, the following hypotheses are derived.

H2: Environmental uncertainty can positively influence the innovation ecosystem resilience of high-tech enterprises, and the greater the environmental uncertainty, the stronger the self-defense awareness of the innovation ecosystem, and thus the resilience value will be improved, so as to promote the development of the innovation ecosystem.

## 5.3. Tolerance

Tolerance represents the endurance of the innovation ecosystem in the face of uncertainty. Companies with a high level of tolerance have a positive attitude toward challenges and see them as an opportunity for upward mobility, leading to innovative ideas and behaviours [17]. Within the innovation ecosystem, firms are able to tolerate different information and decision options, take risky decisions, and believe that they are capable of solving such risky problems within the innovation ecosystem. Tolerance stimulates the firm's strengths in dealing with complex problems and uncertain environments, enabling the firm to effectively filter information and improve the firm's decision-making efficiency. On the contrary, an innovation ecosystem with low tolerance tends to face external pressures negatively and is prone to make negative interpretations, unable to bear the development risks of the enterprise, which negatively affects the resilience of the enterprise innovation ecosystem [18]. In addition, high tolerance can have a positive impact on the sense of corporate efficacy, which can increase the expectation of corporate resilience against risk duration and make the corporate innovation ecosystem resilience spiral. Therefore, the innovation ecosystem of resilient high-tech firms has a higher tolerance for external pressures and risks, and these firms

are able to actively respond to crises and continuously adapt to the changing environment in the midst of crises. Based on the above analysis, the following hypotheses are proposed.

H3: Tolerance can positively influence the innovation ecosystem resilience of high-tech enterprises, and the higher the tolerance, the higher the innovation ecosystem resilience value.

#### 5.4. Evolutionary Capability

Evolutionary capacity refers to the ability of an enterprise innovation ecosystem to evolve and develop progressively. This evolutionary capacity is based on the criterion of adaptation and aims to change or repair the environment in which the enterprise innovation ecosystem is located, so that the enterprise can develop in a better direction [19]. Compared with the ecological evolution in nature, the evolutionary capacity of innovation ecosystem largely reflects the dominance of enterprises, which enables them to adapt to the environment in a proactive and directional manner. This evolutionary ability can further optimize the system elements, reorganize the structure of the innovation ecosystem, and improve the resilience value of the innovation ecosystem [20]. Facing the complex and changing external environment, enterprises constantly adjust the structure of the innovation ecosystem and improve their adaptability to ensure their sustainable core competitiveness. Only by continuously evolving in the complex environment can the innovation ecosystem resist the uncertain risk factors in the external market and enable the enterprise to develop sustainably. The stronger the evolutionary capacity, the greater the resilience value of the innovation ecosystem, and the enterprise can continue to grow on the basis of maintaining its own survival; on the contrary, the weaker the evolutionary capacity, the poorer the adaptive capacity of the innovation ecosystem, and the smaller the resilience value of the system, the weaker the competitiveness of the enterprise will be, and the enterprise will eventually face the risk of market elimination [21]. Based on the above analysis, the following hypotheses are proposed.

H4: Evolutionary ability can positively influence the innovation ecosystem resilience of high-tech enterprises, and the higher the evolutionary ability, the greater the innovation ecosystem resilience value.

#### 5.5. Implicit Resources

Implicit resources are the key factors in building the resilience of innovation ecosystem, and such resources determine the ability of high-tech enterprises to build resilience. Implicit resources include human resources, financial resources, social network resources, learning resources, entrepreneurial talents, personal skills. Human resources are the strong support for building the resilience of innovation ecosystem, which can make high-tech enterprises generate resistance to destructive events; financial resources include both internal financial flows of enterprises and financial support from the government, and financial resources are the solid foundation for the resilience of innovation ecosystem, which is the prerequisite for helping enterprises to overcome difficulties, and is conducive to enhancing enterprises' confidence in coping with crises and grasping the overall development trend, so that enterprises Social network resources can promote the interaction of various stakeholders within the innovation ecosystem of enterprises and enhance the resilience of the innovation ecosystem by strengthening the ties of the social network of enterprises [22], thus making the innovation ecosystem stronger as a whole; the occurrence of crisis events will stimulate the learning motivation of enterprises, and learning resources are an important way for enterprises to acquire knowledge, and rich learning resources will Learning resources are an important way for enterprises to acquire knowledge, and rich learning resources will help enterprises find ways to cope with crises [23], thus resisting risks and enhancing innovation ecosystem resilience; entrepreneurial talent and employees' personal skills are the cornerstones of

innovation ecosystem resilience, which can enhance the strength and resilience of enterprises and promote their sustainable development [24]. Therefore, hidden resources have an important impact on the innovation ecosystem resilience of high-tech enterprises, and abundant hidden resources help enterprises grow bigger and stronger and cope with crises and external pressure with ease [25]. Based on the above analysis, the following conclusions are drawn.

H5: Implicit resources can positively influence the innovation ecosystem resilience of high-tech enterprises, and the richer the implicit resources, the greater the innovation ecosystem resilience value.

## 6. Conclusions

The current domestic and international environments are becoming increasingly complex and severe, and enterprises need to enhance their self-adaptive and self-regulating capabilities to cope with external pressures. Improving the innovation ecosystem resilience of high-tech enterprises is the key to their sustainable and stable development in the industry. The study of innovation ecosystem resilience can help enterprises understand the operation mechanism of innovation ecosystem more deeply, provide certain theoretical reference value for enterprises to cope with risks reasonably, and effectively promote the development of enterprises. From the research process, it can be seen that resilient thinking, environmental uncertainty, tolerance, evolutionary ability and implicit resources can positively influence the improvement of innovation ecosystem resilience value, and strengthening the force of these influencing factors on the innovation ecosystem resilience of high-tech enterprises can make high-tech enterprises have sustainable core competitiveness, which is conducive to the long-term development of enterprises.

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