

# The Formation Mechanism of Enterprise Quality Immune System Resilience from the Perspective of Scientific and Technological Innovation and GVC Embeddedness

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**Abstract:** Technological innovation and GVC embedding perspective are the most important factors in the development of enterprises today, and the resilience formation mechanism of enterprise quality immune system has become the focus of attention from the perspective of scientific and technological innovation and GVC embeddedness. Through a literature review, this paper reviews the existing studies to reveal the formation mechanism of the resilience of the enterprise quality immune system. First, scientific and technological innovation can improve the production efficiency and product quality level of enterprises, thereby strengthening the quality immune system of enterprises and making them more resilient to external risks and challenges. Secondly, the embedding of GVC enables enterprises to obtain more resources and information, strengthen cooperation and coordination with supply chain partners, so as to build a more complete quality management system, improve the efficiency of quality monitoring and feedback mechanisms, and further enhance the resilience of enterprises' quality immune system. Therefore, the dual role of scientific and technological innovation and GVC provides a solid support for the resilience of the quality immune system of enterprises, and helps enterprises achieve sustainable development in a highly competitive market environment.

**Keywords:** Scientific and Technological Innovation; Global Value Chains; Enterprise Quality; Immune System; Resilience

## 1. Introduction

With the deepening of globalization and the

continuous development of scientific and technological innovation, enterprises are facing an increasingly complex and changeable market environment. Against this backdrop, companies need to be resilient to market changes, supply chain risks, and technological challenges. The resilience of the quality immune system has become a key element for enterprises to maintain the stability of product and service quality. The embedded perspective of scientific and technological innovation and global value chains (GVC) provides new opportunities and challenges for the resilience of the quality immune system of enterprises. Technological innovation provides companies with new tools and methods to better monitor and manage product quality, thereby improving the stability and reliability of products. The application of advanced technologies such as data analysis and artificial intelligence enables enterprises to monitor key indicators in the production process in real time and quickly identify and resolve potential quality issues. At the same time, by working closely with suppliers and partners, companies can build resilient supply chains and ensure the quality of raw materials and components under control, thereby improving the resilience of the overall quality immune system. The embedding of GVC makes enterprises face a more complex supply chain environment, and the resilience of the quality immune system is an important guarantee for enterprises to cope with supply chain risks. Companies need to work closely with suppliers, partners, and customers around the world to build resilient supply chains. By adjusting the supply chain layout and optimizing supply chain management in a timely manner, enterprises can effectively deal with problems such as raw material shortages and transportation delays, and ensure the quality and stability of products

and services. In this context, the resilience formation mechanism of the enterprise quality immune system has become more important. Enterprises need to pay attention to the construction of quality culture, continuously improve the importance and awareness of quality within the organization, and take quality as the responsibility and mission of all employees. At the same time, enterprises also need to establish a flexible quality management process, introduce advanced technology and tools, and realize real-time monitoring and analysis of quality data, so as to quickly find and solve quality problems.

## 2. The Concept of Mass Immune System

Enterprise quality immune system refers to the ability of enterprises to maintain stable product and service quality in the face of market changes, supply chain risks, and technological challenges [1]. This concept is derived from the understanding of the immune system in biology, which is analogous to the immune system within an organism, and the corporate mass immune system has a similar function. By establishing a quality management system, implementing quality control and quality assurance measures, and continuously improving the quality of products and services, enterprises can build a quality immune system that can resist changes and shocks in the external environment. The core of the quality immune system is to build a complete set of quality management mechanisms and processes within the enterprise, including quality control, quality assurance [2], quality monitoring, quality improvement and other aspects. Enterprises need to rely on scientific and technological innovation, use advanced technical means and data analysis tools to achieve real-time monitoring and control of product quality, as well as rapid response and resolution of quality problems. At the same time, companies need to work closely with partners in the global value chain to build resilient supply chains and ensure that the quality of raw materials and components is controlled.

By establishing and continuously improving the quality immune system, enterprises can improve the level of quality management, enhance market competitiveness, and ensure that the quality of products or services meets standards and customer expectations, so as to

achieve sustainable development and growth [3]. The core ideas of the quality immune system include: prevention first: emphasizing that prevention is better than cure, and preventing the occurrence of quality problems and reducing adverse effects through the establishment of a standardized quality management system and process. Full participation: All employees are required to participate in quality management [4], establish the quality awareness of all employees, and jointly maintain and improve the quality of products or services. Rapid response: Flexible adaptability, able to respond to market changes and quality risks in a timely manner, and make rapid adjustments and improvements. Risk management: Pay attention to the management and control of quality risks, establish an effective risk assessment and response mechanism [5], and ensure the stability and safety of products or services.

## 3. The Concept of System Resilience

System resilience refers to the ability of a system to maintain its functional, structural, and performance stability and adaptability in the face of internal or external pressures, shocks, or changes [6]. A highly resilient system is able to effectively respond to challenges and uncertainties, quickly return to normal operations, and learn from them to improve for future robustness. The concept of system resilience mainly includes the following aspects: Tolerance: the ability of the system to withstand stress or shock, that is, the system can tolerate a certain degree of interference or failure without completely collapsing [7]. Resilience: The ability of a system to recover from an emergency, that is, the ability of the system to quickly return to its normal state from stress or shock. Adaptability: The ability of the system to adjust and adapt in the face of environmental changes [8], that is, the system can flexibly adjust its structure and function to adapt to new conditions [9]. Learning: The ability of the system to learn from challenges and failures, that is, the system can continuously improve and enhance its resilience through experience accumulation and feedback mechanisms. Complexity management: The management ability of the system to cope with the challenges of diversity and complexity, that is, the system can

effectively manage multi-level and multi-variable relationships and influencing factors to ensure the stability and reliability of the overall operation of the system [10].

From the perspective of technological innovation and GVC embeddedness, system resilience refers to the ability of an enterprise's quality management system to respond to internal and external changes, challenges and risks to ensure product quality, improve production efficiency and maintain market competitiveness. Specifically, system resilience includes five aspects: holistic thinking and rapid response ability. First of all, system resilience requires enterprises to regard quality management as a whole system, and all links are interrelated and affect each other, and synergies are needed to improve the resilience of the enterprise's quality immune system. Secondly, enterprises need to have the ability to respond quickly, find quality problems in time and take effective measures to solve them, so as to ensure product quality and customer satisfaction; Thirdly, the resilience of the quality immune system of enterprises needs to be flexible and adaptable, and be able to make adjustments according to market demand and technological changes, continuously improve quality management practices, and maintain competitiveness. Then, system resilience emphasizes that enterprises should have the ability to learn and innovate, continuously improve quality management practices by summarizing lessons and lessons, and introduce new technologies and new concepts to improve the level of quality management. Finally, in the global value chain, companies need to work closely with suppliers and partners to jointly address quality risks, share information and resources, achieve synergies, and improve the quality level of the entire value chain [11].

#### **4. The Formation Mechanism of Enterprise Quality Immune System Resilience**

From the perspective of scientific and technological innovation and GVC embeddedness, scientific and technological innovation has brought advanced production technology and management methods to enterprises, and improved production efficiency and product quality. Participation in global value chains enables enterprises to integrate into a global competitive network and

access a wider range of resources and market opportunities. In addition, technological innovation and GVC embedding promote organizational change and process optimization within the enterprise. Enterprises accumulate experience in continuous practice, establish a flexible response mechanism and a culture of continuous improvement, so that they can quickly and effectively adapt to changes in the market environment. Technological innovation and GVC embedding provide multi-faceted support for the resilience of the enterprise's quality immune system, including improving the level of quality management, resource integration, flexible adaptability and continuous improvement mechanism, etc., which form the mechanism of the resilience of the enterprise's quality immune system under the combined action of these factors.

(1) Scientific and technological innovation promotes the improvement of quality management: active scientific and technological innovation can improve the production process, improve product quality and innovation ability of enterprises, so as to enhance the quality management level of enterprises. A high-level quality management system can help enterprises better respond to external risks and challenges, and improve the resilience of the quality immune system.

(2) GVC embedding promotes resource integration and information sharing: By participating in the global value chain, enterprises can obtain more resources, technology and information, and strengthen cooperation and coordination with supply chain partners. This kind of resource integration and information sharing helps to build a sound quality management system, improve the efficiency of quality monitoring and feedback mechanisms, and enhance the resilience of the quality immune system of enterprises.

(3) Flexible adaptability: Technological innovation and GVC embedding make enterprises more flexible and adaptable, and can adjust strategies and measures in a timely manner in the face of market changes and risks, so as to ensure product quality and customer satisfaction, thereby enhancing the resilience of the quality immune system.

(4) Continuous improvement and learning mechanism: Enterprises from the perspective

of technological innovation and GVC embedding usually have a culture of continuous improvement and learning, and constantly optimize product design, production process and supply chain management to adapt to changes in market demand. This continuous improvement and learning mechanism is conducive to improving the resilience of the quality immune system, so that enterprises can better adapt to changes in the external environment.

### 5. Conclusions and Prospect

From the perspective of scientific and technological innovation and GVC embedding, the resilience formation mechanism of enterprise quality immune system involves many factors, firstly, scientific and technological innovation can improve the production efficiency and product quality level of enterprises, thereby enhancing the quality immune system of enterprises and making them more resilient to external risks and challenges. Secondly, the embedding of GVC enables enterprises to obtain more resources and information, strengthen cooperation and coordination with supply chain partners, so as to build a more complete quality management system, improve the efficiency of quality monitoring and feedback mechanisms, and further enhance the resilience of enterprises' quality immune system. At the same time, working closely with partners in the global value chain to build a resilient supply chain can effectively reduce supply chain risks and ensure the quality of raw materials and components under control. In addition, attaching importance to the construction of quality culture, continuously improving the importance and awareness of quality within the organization, and taking quality as the responsibility and mission of full participation, is also an important part of the enterprise to build a robust quality immune system.

Looking forward to the future, with the continuous progress of science and technology and the deepening of globalization, the resilience of the quality immune system of enterprises will face more challenges and opportunities. In the future, enterprises need to pay more attention to digital transformation, with the help of big data analysis, artificial intelligence and other technical means, to build an intelligent quality management system,

real-time monitoring, early warning and analysis of quality data, so as to find and solve quality problems more quickly and accurately. At the same time, enterprises also need to strengthen collaboration and communication with global supply chain partners to build a more flexible, transparent and sustainable supply chain system to improve the quality, stability and reliability of the entire value chain. In addition, cultivating a quality culture, strengthening quality awareness and responsibility, and integrating quality management into all aspects and levels of the enterprise will also be an important guarantee for the resilience of the quality immune system of the enterprise in the future. In short, technological innovation and the development of global value chains provide new opportunities and challenges for the resilience of enterprises' quality immune systems, and enterprises need to continuously improve their quality management mechanisms, strengthen supply chain cooperation, and cultivate a quality culture to cope with market changes and challenges, maintain competitive advantages and achieve long-term sustainable development.

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