

Influencing Factors of Acquired Immunity in Supply Chain Quality Management of Manufacturing Industry

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Abstract: With the acceleration of globalization, supply chain quality management has received great attention and companies need a supply chain-oriented perspective to solve the quality problems they encounter and achieve the goal of improving the overall quality performance of the supply chain. Supply chain quality management is constantly evolving and enriching, and many theoretical breakthroughs have been made. The result of the combination of immunity theory and supply chain quality management - the supply chain quality management immune system - is a new construction direction for all enterprises upstream and downstream after the transformation of the supply chain, providing a dynamic guarantee for the operation of activities in the process of supply chain quality management. Based on the research perspective of acquired immunity in manufacturing supply chain quality management, this study proposes the definition and framework of acquired immunity in supply chain quality management and summarizes the influencing factors of acquired immunity in supply chain quality management.

1. Introduction

With the changes in the global market, the external market environment and internal factors of Chinese manufacturing industry are also changing. The trend of counter-globalization is intensifying, and Western countries are deliberately promoting the phenomenon of "manufacturing back". Some developing countries are firmly occupying part of the manufacturing market with their low price advantage in labour cost, causing price pressure on Chinese manufacturing exports and making it difficult to form a comprehensive development trend in overseas markets. However, Chinese manufacturing industry has experienced the wave of reform and opening up, firmly grasping the opportunity of economic globalization, manufacturing policy innovation, continuous cultivation of industry competitiveness, firmly grasping the cornerstone of quality, and building the brand influence of Made in China with quality. The supply chain is one of the sources of forming the core competitiveness of manufacturing enterprises, showing strong efficiency advantages through the full participation of the members of the chain and a reasonable division of production.

The model of supply chain quality management has deeply influenced the development of the manufacturing industry. Looking to the future, the comprehensive integration of the digital economy and the supply chain provides more convenient management conditions for the implementation of the whole process management of supply chain quality management in the manufacturing industry; it also provides development conditions for the practice of immunization theory and supply chain quality management. Supply chain quality management immune system is a complex system, the reference and implementation of big data and information technology is conducive to the process of immune management in the supply chain system to achieve automatic response, reduce the human factor to promote the response, the memory of acquired immune response will become more advantageous in the database, and promote the high-quality development of the manufacturing supply chain.

This study focuses on the acquired immunity process of quality management in manufacturing supply chains. Using the literature extraction method as the main research method, the factors influencing acquired immunity in manufacturing supply chain quality management are identified and seven variables affecting acquired immunity are derived: innovation in quality management, quality management database, management level, quality management experience, the level of quality culture of enterprise personnel, quality performance evaluation mechanism, quality management system. The meanings of the seven variables are also explained. This study fills in the research on factors influencing acquired immunity in supply chain quality management.

2. Quality Management and Supply Chain Quality Management

From its beginnings as a term to measure the quality of a product, quality has been given new meaning. Nowadays, quality has moved away from the single definition of product quality and has been extended to include a more comprehensive quality such as service quality. In the context of the quality strategy, new requirements and new tasks have been put forward for quality management in enterprises. The core implementation body of the Strategy of “A Country Strong on Quality” is the enterprise, and the implementation of the Strategy of “A Country Strong on Quality” is a direct response to the quality efforts to implement Made in China. Quality is an important factor for the continuation of enterprises, and quality management continues to take on new life and vitality with the improvement of practice. The traditional competition for quality has risen from between manufacturing companies to between the entire manufacturing supply chain, and strengthening the role of quality control is something that every company must take seriously. With regard to the evolutionary process of quality management, there are four main stages as follows:

(1) Quality inspection phase. Recognising the impact of product quality on customer stability, companies set up quality inspection departments in their internal structures to grasp the overall quality pass rate of each product, recall defective products, ensure that the quality of the company's products is always maintained at a stage where the target customer is satisfied, and appear to attach importance to corporate image and reputation. The emergence of the quality inspection stage indicates a more accurate knowledge of the determination of product quality, the disadvantage is the need to invest huge human and material resources in order to test all products, the overall time requirements of the product is extended, the quality of the inspection is an afterthought, can't be controlled before the occurrence of problems and reduce losses.

(2) Statistical control of quality stage. The introduction of statistical sampling and other methods, the establishment of special quality control departments within and outside the enterprise, the inspection of product quality by batch or by type of sampling, saving manpower and material resources, reducing the overall time pressure on the product. The disadvantage is that defective

products can only be knocked back or destroyed, and there is no complete disposal system. The definition of the concept of quality is still stuck in the quality of the product.

(3) Total quality management stage. The whole staff is required to participate, quality is not just a departmental matter, but a common focus of all departments, the scope of quality management has achieved the whole process, the definition of quality does not only stay at the level of product quality, the study of quality concerns to the prior, but total quality management does not belong to its own core application tools, mainly relying on the collective quality awareness to achieve total quality management.

(4) Standardized management stage. International standards organisations, drawing on the quality management experience and requirements of various countries around the world, set global uniform standards and unified the quality measurement of products, which played an important role in promoting global trade.

The Deming PDCA ring, the Juran Quality Trilogy and Six Sigma Quality Management are the theories that have filled the gaps in the development of quality. The emergence of the Deming ring and the Juran Quality Trilogy establishes a working mechanism for quality work in companies and ensures that the entire quality system works well through a continuous feedback loop. Six Sigma quality management focuses on eliminating variation to improve customer satisfaction, with a greater focus on the customer. Data and facts are used to drive change for improvement. With globalisation, traditional quality management no longer meets the needs of the marketplace and quality management must break through from an internal corporate perspective.

In order to adapt to the changing external environment, quality management is gradually changing from an internal to an external perspective. The supply chain, as a network structure linking the various functions of the company, is managed from the source, from the production to the use of the product. For different types of manufacturing industries, their node types are also different. Supply chain quality management, as a new management model, has the advantages of shortening product cycles, saving human resources and reducing costs in actual operation. The supply chain-oriented perspective implements whole-process, whole-factor and whole-industry chain quality management, and implements activities such as participation in transformation and other operations, becoming a new direction for manufacturing enterprises.

3. Combining Supply Chain Quality Management with Immunization Theory

Traditional quality management has shifted from ex-post to ex-ante and from a phase to a whole process, but there is still a lack of dynamism in quality management for the enterprise. Quality improvement is a continuous process, as is the existence of the immune system. The quality immune system has the ability to identify problems, recognise them and evolve continuously. This is the advantage of organisational quality immunization compared to traditional quality management methods. The advantages of an immune system that is self-learning and adaptive are exactly what supply chain quality management needs.

The combination of immunity theory and supply chain quality management is in the development stage. Li et al. were the first to define the concept of immunity in supply chain quality management [1,2], regarded the supply chain quality management system as a complex system, constructed immunity in supply chain quality management under two theoretical dimensions, and unveiled the mystery of supply chain quality management. It is proposed that quality culture is the immune basis of the inherent immune system. It is argued that quality management practices are an important part of the acquired immune system of supply chain quality, and a detailed summary of the different views on the content of quality management practices by different scholars is given, giving their own insights on the content of quality management practices for subsequent studies. In

their study of supply chain product quality based on an immune perspective, Li and Sun et al. (2010) constructed a complete supply chain quality management model and introduced the response mechanism of the immune system into the study of the model, proposing four sub-processes of the immune response [1,2]. The model construction includes that the supply chain quality management immune system identifies factors that affect the quality of the supply chain product and determines whether they are harmful to itself, and the quality management practice initiates appropriate removal or retention actions for the influencing factors or events. The three components are learning and memory of quality management nodes and quality management node effect model. Li and Wang (2014) take the core manufacturing companies in the supply chain as the entry point to construct the basic structure of their quality immune system, introduce a classification of the types of immune responses into inherent immunity and acquired immunity [3], and compare the different types of immune response processes. Finally, suggestions for countermeasures to improve the immune response capability of enterprise quality management were made in three aspects: Expanding diversity, enhancing accuracy and improving timeliness. Ding (2013) defined the connotation of the concept of supply chain immune culture [4], and Han (2013) conducted an in-depth study on supply chain immune culture and proposed a construction method for its diffusion and penetration mechanism, through which path selection can achieve the transmission of immune culture down the supply chain, improve the efficiency of the supply chain quality management immune system in identifying and removing quality variants, and improve the combination of management practice and immunization [5].

The combination of immunization theory and supply chain quality management is an improvement and development of traditional supply chain quality management, absorbing the advantages of quality practices in traditional quality management and innovating quality practices on this basis. Supply chain quality management based on the immunity perspective is a gradual process, the level of immunity cannot be achieved overnight, but needs to be slowly formed and enriched by enterprises in practice. Just like the immunity formation of the organism relies not only on genes, but more on acquired vaccination, exercise and other ways to slowly increase the level of immunity in order to resist higher viral attacks and keep the organism in a healthy state.

4. Study on the Influencing Factors of Acquired Immunity in Supply Chain Quality Management

4.1. Concept and Response Mechanism of Acquired Immunity

Biologically, according to the different principles of immunity is divided into two kinds of specific immunity and non-specific immunity, Lv et al. (2009) used a combination of literature analysis method and enterprise interviews to classify the immune behavior of the organization, that non-specific is innate, the properties and characteristics of the organization own at the beginning of the establishment, specific immunity is the opposite, is the organization through acquired learning, in the changing environment gradually adapt and In contrast, specific immunity is an immune capability acquired by tissues through acquired learning and gradual adaptation in a changing environment [6]. Li's classification of supply chain quality immune response activity uses draws on this classification, divided into non-specific immunity and specific immunity [1-3], this study examines specific immunity, also known as adaptive immunity, acquired immunity, refers to the supply chain operation process, there will be things that have not been encountered between, more difficult obstacles, do not know how to carry out It identifies the characteristics of the source of variation, sees if it is relevant to the supply chain quality management activities, feeds back to the quality management personnel, who discuss and give a disposal strategy for the initial immune response activity, and after a successful response summarizes the experience and process of this

learning to enrich and After a successful response, the learning and process is summarised and the quality management criteria in the immunization database are enriched and improved. After a failed response, the lessons learned are fed back to the managers and the supply chain system, and preparations for a second response are made until the mutant is processed and the acquired immunization is completed.

4.2. Influencing Factors of Acquired Immunity

In the new management model of Internet + supply chain, the quality management acquired immunity activities are memorised and continuously improved, and the quality management database is constantly updated. The factors surrounding quality management practice activities are the main influencing factors of acquired immunity. This study summarizes the following influencing factors:

(1) Innovation in quality management. Quality innovation is the first driving force for the development of quality management. Innovation in quality management not only brings a fresh sense of experience to customers and improves the continuous improvement of product quality, but also is a process for the supply chain system to break itself and innovate and grow. Yang et al. (2021) revealed the effect of progressive and breakthrough innovation factors on organisational quality-specific immunity. The innovation factor variable, as an antecedent variable of organisational quality-specific immunity, has an important role in organisational quality-specific immunity. In the supply chain quality management acquired immune response, companies should pay attention to innovation in quality management technology and management model innovation [7].

(2) Quality management database. The construction of the supply chain quality database is the basis of the acquired immune response, and is the basis for the rapid identification of variant sources in the immune response. The robustness and richness of the database directly affect the identification process of acquired immunity, and indirectly affect the learning process of acquired immunity, resulting in serious lags in the memory and response of acquired immunity.

(3) Management level. The number of management levels refers to the number of people involved in quality control in the supply chain system from the bottom manager to the top manager. Quality management issues are different from other management issues and the number of management levels should not be too many, the more levels, the slower the speed of information transfer will be, thus affecting the response time of the supply chain quality acquired immune response, which poses a risk to the supply chain as a whole.

(4) Quality management experience. Quality management experience is mainly based on advance exercises based on possible quality risk events, familiar with the emergency response process, improving the experience of quality management practitioners and supply chain systems, or the valuable experience gained by supply chain managers in training, and internalising it into their own experience and integrating it into the quality management database, so that the system can constantly update its knowledge and absorb quality experience from outside. The system will be able to keep its knowledge up to date and absorb quality experience from outside for its own development.

(5) The level of quality culture of enterprise personnel. Quality culture is the further upgrading and condensation of enterprise culture, which not only affects the inherent immune response of supply chain quality management, but also affects the acquired immune response of supply chain quality management, mainly reflected in the quality culture level of enterprise personnel, individual employees' quality culture level is at a low level, thinking that one or two small problems will not have much impact on product quality, thus relaxing the supply chain quality Only if the quality

culture level of all members is at the same level, can we ensure that when problems arise, timely feedback is given to the system so that further immune response behaviours can be made, and enterprise personnel play a non-negligible role in identifying problems and contacting variant sources of events.

(6) Quality performance evaluation mechanism. The quality performance evaluation mechanism is the result of testing the supply chain quality management immunity, and the quality performance can also be useful for the supply chain quality immunity response, mainly in that, after the quality performance is improved, it will give incentives to the supply chain quality management immunity system, and the positive working attitude of the employees will be improved, and they will continue to maintain a good working condition in the next work to monitor the generation of supply chain quality variation, and the supply chain quality management immunity system will also get better and better under this positive cycle. The supply chain quality management immune system will also get better and better under this positive cycle. Therefore, it is important to establish a suitable quality evaluation mechanism. It is not a good idea to be too demanding or too loose, but to choose a suitable quality performance evaluation mechanism to ensure the health of the supply chain quality management immune system.

(7) Quality management system. The main immune response of the supply chain quality acquired immune system is formed by relying on the role of people, but the immunity itself has the advantage of dynamism, in addition to relying on the active role of people, the system itself will also produce the immune effect, when the external variation event breaks through the institutional standards of product quality guidelines, it will be regarded as a hazardous event, will be such a "source of variation When an external variation breaches the institutional standards of the product quality guidelines, it is regarded as a hazard and the "source of variation" is warned and stopped until it is eliminated, or until it reaches an acceptable standard of quality guidelines. The formation of acquired immunity in supply chain quality management is influenced by institutional standards such as product quality guidelines. An incomplete and imperfect system can, to some extent, carry out quality immunization activities, but the effectiveness of immunization is greatly reduced.

5. Conclusion and Prospects

The construction of a supply chain quality management immune system in manufacturing enterprises is very feasible and requires the development of theory and the combination of management practice to promote each other, so that immunity can be achieved to boost the realisation of quality control and achieve an advanced, self-organised quality immune system formation. However, there are still some shortcomings in the supply chain quality management under the perspective of immunization, and the exploration of its influencing factors is not comprehensive enough. The construction of the theoretical system of supply chain immunity still needs the participation of more scholars, the identification of the influencing factors of supply chain immunity, the selection of an index system for evaluation research and other work. In future research, the empirical research should be extended in terms of methodology to combine supply chain quality immunity with supply chain practice to be truly effective in supply chain operation.

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