

# *Research on the Influencing Factors of Proactive Green Innovation in Manufacturing Enterprises*

Shuaikang Wu\*, Hui Sun, Ming Liu

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

*\*corresponding author*

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**Abstract:** Under the strategic background of green competition and innovation-driven development, manufacturing enterprises carry out proactive green innovation to seize the green market. Based on the literature review of proactive green innovation, this study qualitatively discusses the factors that should drive enterprises to carry out proactive green innovation at the enterprise level, and gives strategic suggestions. This study argues that enterprise information advantage (information acquisition ability, strategic decision-making ability), enterprise scale economy advantage (enterprise internal scale advantage, enterprise external resource advantage) and organizational management system advantage (transformational leadership and proactive personality employees, enterprise green culture) can drive enterprise proactive green innovation. Enterprises should take the initiative to enhance their information acquisition and decision-making ability, seek technical cooperation and build green culture to enhance their green innovation ability, in order to obtain opportunities in the green competitive market.

## **1. Introduction**

In response to climate change and fierce competition in the market economy, China must strive to promote comprehensive green transformation of economic development. Under the pressure of environmental deterioration, China takes the initiative to assume national green responsibility, support green transformation and green development of enterprises, and strive to achieve carbon peak and carbon neutralization. In the new round of energy revolution and technological revolution, enterprises should firmly seize historical opportunities to reduce the black energy revolution and green energy transformation [1]. In the process of green innovation, enterprises are the main body of innovation and shoulder great missions. How to successfully turn Chinese development from black resources to green industry, so that China can win this historic opportunity of the green industrial revolution? How to make our enterprises occupy more resources and capabilities in the green consumption market? How to make our enterprise have long-term technological innovation ability, always standing in the forefront of green technology?

The main goal of enterprises is to strive for a large number of economic resources and consumer willingness in the consumer market, in order to seek long-term profit maximization. Under the background of green development, enterprises should implement proactive green innovation and obtain innovation advantages through green innovation. Under the background of green consumption, enterprises take the initiative to explore and implement green innovation strategy. While highlighting environmental awareness to attract more consumers, they can also obtain technical advantages to reduce technical costs and management costs, and highlight product differentiation advantages of enterprises [2]. Regardless of the innovation subjects at any level, compared with the active green innovation subjects, the passive implementation of green innovation strategy will be in a passive position in the future competition. The products with no environmental protection and high energy consumption or the old operation and management mode will eventually make enterprises at a disadvantage in the green consumption competition. An enterprise with green innovation opportunities will occupy the discourse power in the era of green revolution development.

## **2. Overview of studies on proactive green innovation**

### **2.1. Overview of Enterprise Green Innovation Research**

The green innovation of enterprises is a hot topic of social concern. With the progress of research, green innovation is also known as environmental innovation and green revolution, often associated with the ecological environment and sustainable development. Compared with foreign countries, the scope of green innovation in domestic enterprises is more extensive, including green process innovation, product innovation, management innovation, technological innovation and so on [3]. Liu (2012) divided green innovation into three dimensions, namely, green technological innovation, management innovation and cultural innovation [4]. Zhang et al. (2013) integrated research on green innovation, that the definition of green innovation mainly comes from three ideas: (1) Reduce adverse effects on the environment of innovation; (2) Introducing environmental performance into enterprise performance; (3) Focus on innovation along environmental improvement trends [5]. Research shows that green innovation is related to environmental performance and is committed to improving the ecological environment performance.

The existing literature on enterprise green innovation mostly stays in exploring its influencing factors. Based on institutional theory and market theory, Yang et al. (2015) investigated the green innovation performance of enterprises from internal and external aspects [6]. Based on enterprise green patent data, Li et al. (2021) explored the mechanism of green finance on enterprise green innovation [7]. From the perspective of environmental regulation, Tao et al. (2021) analyzed the influencing factors of enterprise green innovation under the target responsibility system of environmental protection, and thinks that in the case of generally low green innovation ability, the higher the quality of innovation activities is when the independent innovation ability of enterprises is strong [8]. Wu et al. (2021) studied the efficiency of green innovation in the Greater Bay Area and believed that the degree of industrial agglomeration, enterprise scale and government support had an important impact on enterprise green innovation [9]. From the perspective of enterprise management, Zhang et al. (2021) examined the influence of external management such as government management intervention and government financial subsidies, internal management such as senior management team background and organizational management mode on enterprise green innovation [10].

Enterprise green innovation is a hot research topic under the background of ecological construction and innovation driven. The research entry points of enterprise green innovation are mostly concentrated on its influencing factors. Green innovation under the pressure of

environmental regulations and policies is reactive innovation and catch-up innovation under the established background. Facing the green technology barriers and green management mode renewal of foreign enterprises, domestic enterprises should take the initiative to explore green innovation while learning, and take the proactive green innovation strategy as the green development strategy of enterprises.

## **2.2. Overview of the research on the connotation of proactive green innovation**

In the research of enterprise green innovation, scholars have gradually realized the importance of active environmental management. Sharma (2000) divided environmental strategy into proactive environmental strategy for active implementation of environmental control and reactive environmental strategy for passive response to environmental regulation [11]. From the perspective of natural resources, Tian et al. (2015) found that the implementation of prospective environmental strategy affects product innovation and technological innovation of enterprises. Prospective environmental strategy directly affects the green image of enterprises, and plays an important role in improving the green image and product competitiveness of enterprises [12]. Anupam et al. (2018) believed that the green supply chain management experience of top management team has an important influence on the implementation of proactive environmental strategy and the improvement of green innovation ability of enterprises [13]. Zhang et al. (2019) believed that in the context of green development, the proactive implementation of forward-looking environmental strategy has an important and indigenous impact on strengthening the relationship learning among enterprises, improving the green innovation ability of enterprises and improving the competitiveness of enterprises [14]. Enterprises take the initiative to carry out environmental management and seize the initiative of green innovation to a certain extent determines the development orientation of enterprises in the new round of scientific and technological revolution.

Some scholars pay attention to whether enterprises take the initiative to carry out green innovation has significant differences on the impact of enterprise innovation performance. Chen et al. (2012) divided the enterprise green innovation into proactive green innovation and reactive green innovation in 2012 according to the enterprise's external environmental regulations, market green competition and consumers' willingness to respond to green demands [15]. Cao et al. (2014) explored the influencing factors that drive enterprises to carry out green innovation from the perspective of stakeholders, and believed that the environmental pressure from internal and external stakeholders led enterprises to actively carry out green innovation, and forced enterprises to carry out innovation under pressure [2]. Chan et al. (2016) found that the pressure from external environmental regulations or policies can promote green innovation, but the driving effect of this passive and reactive innovation on the green innovation performance of enterprises is not obvious. On the contrary, the influence of proactive green innovation on the innovation performance of enterprises is more obvious, indicating that proactive green innovation with the willingness of enterprises to actively innovate is more likely to obtain core advantages in the market competition than reactive green innovation [16]. Chen et al. (2016) believed that proactive green innovation has a positive impact on green innovation capability and green product development performance. It is suggested that enterprises should actively carry out proactive green innovation rather than reactive green innovation, and actively join the green technology trading market to enhance green innovation capability and improve green product development capability [17]. Adomako et al. (2020) found that the impact of proactive environmental strategy on corporate performance was amplified in imitation-oriented enterprises, but not significant in non-imitation-oriented enterprises [18].

### **2.3. Research on influencing factors of proactive green innovation**

Proactive green innovation is crucial to the future performance of enterprises, and its related influencing factors have always been a hot topic for scholars. Chen et al. (2012) found that from the enterprise internal environmental leadership, environmental culture and environmental capacity and from outside investors, customers, environmental laws and regulations can catalytic reactive green innovation, only the enterprise internal cultural construction and organizational management can catalytic enterprise proactive green innovation [15]. On the basis of Chen, Cao et al. (2014) studied the impact of green pressure from enterprise managers and employees, corporate shareholders, consumers and media on proactive green innovation from the internal and external perspectives [2]. Tian et al. (2015) from the company function level, strategic level analysis of enterprise development strategy, internal and external environment and other key factors in the enterprise green transformation mechanism [12]. Based on the cognitive evaluation theory, Yang (2021) explored the influence mechanism of regulatory pressure on enterprise's prospective environmental strategy, and thinks that the promotion incentive or inhibition evaluation of regulatory pressure on top management of enterprises has a 'double-edge sword' effect on enterprises to actively implement green innovation [19]. Karra (2021) examined the green behaviour taken by enterprises to protect the environment. It is believed that enterprises' active consideration of environmental problems, the adoption of practical technologies that have an impact on pollution and the adoption of green marketing models have a greater impact on enterprises' green strategic intent. Green strategic intent can promote enterprises to create environmental culture and enhance green innovation capability [20].

Chen et al. (2012) believed that internal factors play a key role in the process of proactive green innovation [15]. To sum up, most of the research on prospective environmental strategy and proactive green innovation focuses on foreign countries, and most of the existing research focuses on the mechanism of proactive innovation on enterprise innovation performance. There is still a lack of relevant research on proactive green innovation and its influencing factors. This study will analyse the impact of internal management factors and technical factors on proactive green innovation from the perspective of enterprise strategic management, and explore the catalytic mechanism of internal key factors and external auxiliary factors on proactive green innovation. Based on Chen's [15] definition of proactive green innovation, this study argues that proactive green innovation is an innovative behaviour for enterprises to actively advance green management innovation and green technology innovation in order to gain competitive advantage.

## **3. Factors influencing proactive green innovation**

### **3.1. Information advantage**

The proactive green innovation is that enterprises take the initiative to carry out green innovation in order to occupy a larger green consumer market or long-term green benefits. The first priority for enterprises to carry out proactive green innovation is "proactive", which means that enterprises' proactive innovation in the field of green products or green technology precedes other enterprises in the market or competitive enterprises in the same industry. From the perspective of proactive, the key factors affecting 'proactive' are: Enterprise information acquisition ability, strategic decision-making ability.

#### **3.1.1. Enterprise information acquisition ability**

The competitive advantage of green innovation of enterprises first comes from the information advantage. From the perspective of information complexity, enterprises with different information will have different basis and accuracy in dealing with problems. The key point of competition in the information age lies in the ability to obtain information. Enterprises should quickly obtain the following information : Environmental regulation policies issued by the government, green tax incentives, and strategic guidance for technological transformation ; green innovation investment, the latest green innovation patent achievements, the upcoming green new products and green new services and development strategies of enterprises competing in the same industry ; the enterprise and the competitive enterprise' s green business supply chain affordability, raw materials and new energy prices, green supplier business conditions, the number of customers of the seller ; the enterprise green development of the latest situation and management changes. This information relates to the green development of the country, industry and enterprises themselves. Whether enterprises can accurately obtain this information and the depth of information are related to the follow-up short-term or long-term green environmental strategic decisions of enterprises. Information advantage affects the timeliness and proactiveness of green innovation of enterprises.

### **3.1.2.Strategic decision-making capacity**

The implementation of proactive green innovation strategy requires the guidance and leadership of the strategic decision-making committee of the enterprise. The strategic decision-making leadership of the enterprise analyses and makes decisions on the green innovation information obtained by the enterprise. The view and judgment of the enterprise strategy level on the direction of market development affect the relationship between cooperative enterprises and competitive enterprises in the long future, and have direct power and responsibility for the development of enterprises. Therefore, the decisions made by senior executives must be relatively accurate and strategic. Enterprises with high strategic decision-making ability and enterprises occupying information advantages will take less detours and wrong roads in the green innovation behaviour of enterprises. Looking at the green development direction of the industry, rationally planning enterprise resources, green product innovation and green technology innovation are carried out earlier than other enterprises.

## **3.2. Scale economic advantages of enterprises**

Enterprises' initiative to promote green innovation also depends on their economies of scale. The number of green technology patents, the number of green R&D personnel, production management methods, enterprise capital reserves, the number of advanced manufacturing equipment, the utilization of new energy and black oil energy, the level of external supply chain resources, market consumer resources, and the tendency of policy subsidies all affect the speed, progress and depth of proactive green innovation to a certain extent. Here the enterprise scale economy advantage is divided into internal scale advantage and external resource advantage.

### **3.2.1. Internal scale advantage of enterprises**

Advance green technology innovation and advance green product innovation belong to advance green innovation. Advance green innovation depends on the internal scale advantage of enterprises. When the number of green technology patents is high, it shows that the green technology level of enterprises is at a high level. The number of green R&D personnel is the human resource guarantee of green new technology R&D and new product development. A large number of researchers and staff diversity can carry out green product R&D and green services from different consumers and consumer markets; under the background of the new energy widely welcomed and the energy crisis

of black fossil energy shortage, the energy use transformation and production equipment renewal of enterprises need to consume a lot of funds and time. In the process of proactive green innovation, insufficient funds and large transformation costs are easy to make green innovation unsustainable. Enterprises with larger internal scale advantages have greater resilience when facing the wave of external market guidance, and are good at capturing the trend of green consumption market and making timely adjustments.

### **3.2.2. Enterprise external resources advantage**

The enterprise's proactive green innovation is affected by internal scale and external resources. China has policy subsidies for green and innovative enterprises, and certain financial subsidies for tax revenues of high-tech enterprises, intelligent manufacturing enterprises and employees in industrial parks, which is equivalent to financial support and human resources attraction for enterprises. Gathering the same type of enterprises or enterprises with strong green innovation ability together can enable enterprises to obtain external resource support from knowledge spillover effect and technology spillover effect to a certain extent. The different consumption habits and choices of market consumer groups affect the innovation direction of enterprise proactive green product innovation. Enterprises should carry out proactive green innovation before other enterprises enter the consumer group or product field. In the social cooperation network, enterprises always tend to choose partners with larger degree or betweenness. Strong raw material supply network and sales network make enterprises have greater invulnerability when facing risk interference in proactive green innovation. Enterprise external resources are the source of enterprise resources, which has great significance to promote enterprise proactive green innovation.

### **3.3. Advantages of organizational management mechanisms**

Efficient management mechanism is the guarantee for enterprises to implement proactive green innovation and the object of proactive green management innovation. Implementing proactive green innovation strategy is a long-term work, and corporate culture will be a long-term catalyst for promoting green innovation. Appropriate organizational structure will enable green innovation departments to obtain the necessary support and leadership. The complex relationship between leaders and employees, such as transformational leadership, proactive innovation personality and incentive mechanism, plays an important role in proactive green innovation.

#### **3.3.1. Transformational leadership and proactive personality employees**

Green innovation plays a key role in organizational leadership's management and technological innovation in order to meet the market trend or strive for market competition status. Transformational leadership plays a key role in proactive green innovation behaviour. Advance green innovation consumes large amounts of financial and human resources. The management structure of the organization needs to be changed, the production equipment needs to be updated, and the raw materials need to be green. The conservative personality of traditional leaders has an obstacle to organizational innovation. Transformational leadership dare to innovate, actively grasp the market direction, and carry out green innovation before competitive enterprises.

Employees with proactive personality are crucial to the supportive proactive behaviour of green innovation. Employees are in the first line of production and sales. They have unique insights and deepest insights into green production, green management, green quality and green marketing, and can directly get consumers' consumption demands and willingness. It is crucial for enterprises to listen to the opinions of proactive employees for proactive green innovation behaviour.

### **3.3.2. Enterprise green culture**

Enterprises to take forward green innovation is the allocation of power and resources, to institutionalize, cannot change. The proactive green innovation involves proactive green management innovation and proactive green technology innovation. Green culture affects product quality management standards and technological R&D. Green culture catalyses enterprises to streamline procedures, green production, green management and green R&D. Shaping green culture and employees' innovation consciousness can promote enterprises' proactive green innovation level.

## **4. Conclusions and prospects**

### **4.1. Research conclusions**

From the internal perspective of enterprises, this study analyses the influencing factors of proactive green innovation of enterprises in the competitive environment, and believes that the information acquisition ability and strategic decision-making ability of enterprises are the tentacles of enterprises, which determines the perception and feedback decision-making of enterprises to the outside world, and thus enterprises conduct information collection and strategic decision-making of proactive green innovation. The internal scale of enterprises is the human resource basis and technical resource basis for enterprises to carry out proactive green innovation, and enterprises carry out proactive green innovation according to their own resource levels. The external resource advantage of enterprises is the resource advantage that enterprises can strive for according to their internal technical scale and management scale. The external resources that enterprises can mobilize reflect the market expectation and development height of proactive green innovation. The advantage of enterprise management mechanism is the enterprise's 'software' change of proactive green innovation. Leadership type, employee innovation level and enterprise green innovation culture are the most valuable source of green innovation in the long run.

### **4.2. Strategic Suggestions for Promoting Green Innovation Capability**

Based on the influencing factors of proactive green innovation discussed above, this study puts forward the following strategic suggestions:

#### **4.2.1. Strengthening information construction and enhancing information decision-making capacity of enterprises**

To carry out the strategic decision-making work, the first step is to set up the information department, investigate the main stakeholders inside and outside the enterprise, and grasp the first-hand accurate information. In order to improve the decision-making effectiveness of enterprises, adopt more scientific and strategic decision-making methods, firmly grasp the development of capital market, abandon misleading information and short-term benefit information, and carry out proactive green innovation ahead of other enterprises in the market.

#### **4.2.2. Seeking technical cooperation and giving full play to the advantages of enterprise scale economy**

Integrating internal resources of enterprises, actively seeking advanced green technology and innovative talents outside enterprises, leading the establishment of green technology cooperation network, and capturing green knowledge and green technology brought by knowledge spillover and technology spillover effect from collaborative innovation network by using scale economy

advantages. Communicate with capital market and local government actively, get green R&D fund support and green tax policy preferential treatment in advance.

### 4.2.3. Building green culture and shaping enterprises' green innovation consciousness

Integrating green ideas into corporate culture, not taking corporate profits as the only goal, focusing on long-term benefits. To reform the enterprise leadership, enterprises should take green innovation as the guidance, attract transformational leadership and employees with proactive innovation personality to join, and shape the enterprise green innovation consciousness.

### 4.3. Deficiency and prospects

This study only analyses the influencing factors of enterprise proactive green innovation from the perspective of internal and external from the qualitative point of view, and has not yet been specific to the micro level of enterprise data for empirical research. In future research, it will analyse the proactive green innovation from the enterprise level, in order to study the influence of various dimensions of factors on enterprise proactive green innovation.

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