

# The Impact of Supply Chain Environmental Collaboration on Company Green Innovation

Min Li, Qi Qiu

Guangdong Mechanical and Electrical Polytechnic, Guangzhou, China

**Keywords:** Environmental collaboration with supplier (ECS); Environmental collaboration with customer (ECC); interpersonal relationship (IR); green innovation (GI);

**Abstract:** The purpose of this study is to investigate the relations among environmental collaboration (EC) with partners in supply chain, interpersonal relationship (IR) and green innovation (GI). We use the Structure Equation Model to test the influences among variables. The results show that: (1) EC in supply chain has a positive and significant effect on GI. (2) The influence of IR on EC with customer is not significant. The promotion of IR to EC with supplier has been verified. (3) The moderating role of IR on the relationship between EC and GI is verified partially, the effects on upstream and downstream have different results. The segmentation study in this paper gives some theoretical value and instructive on research of supply chain environmental collaboration and green innovation, and enriches the empirical research of these areas to some extent.

## 1. Introduction

The rapid development of economy not only make world more prosperous, but also brings serious environmental problems. Some people believe that environmental protection and economic benefits cannot coexist. However, innovation makes it possible. The practices of many countries prove that innovation of energy, technology, equipment and green product, can offset the cost of environmental protection. Chinese government has proposed “innovation-driven” and “green development” as two important basic guidelines. Therefore, it is important for companies to gain competitive advantage by strengthening green innovation.

This study will explore how environmental collaboration with suppliers and customers contribute to manufacturer’s green innovation under “win-win” strategy. In order to meet China's management situation better, the role of interpersonal relationship is also considered. This study proposes a research on the basis of resource-based view theory, the ecological modernization theory and combining literature reviews, which can respond to the above questions by analyzing data from 271 companies in mainland China.

## 2. Theoretical background

Green innovation is a multidimensional concept<sup>[1]</sup>. Following the research of most scholars, this study divides green innovation into three dimensions: green product innovation, green process innovation and green management innovation.

Studies have shown that companies will be more active in environmental innovation if they pay attention to the collaboration with external partners<sup>[2]</sup>. Although most studies focus on the role of collaboration with the outside world, they pay attention solely to the influence of upstream suppliers, or downstream customers, lacking of equal weight to both. Therefore, this study believes that it is not enough to consider the motivation of green innovation from internal factors alone, and it is necessary to consider the impact of upstream and downstream environmental collaboration simultaneously.

In addition, the relationship between companies which links internal and external resources is also a very important factor since considering the context of supply chain. For Chinese company, it has not only a formal contract relationship, but also has an informal interpersonal relationship.

Therefore, our research also introduces interpersonal relationships as an important variable. At the same time, it considers the direct effect of interpersonal relationship on companies green innovation and its moderating effect in the relationship between supply chain environmental collaboration and company's green innovation.

### **3. Research hypotheses**

#### **3.1 Relationship between environmental collaboration in supply chain and green innovation**

According to the resource-based theory, the resources that one company can control can bring the company first-mover advantages. The resource that one company can control is not limited to its own resources, it also includes those come from other partners. All these resources can be used and created value for company. Studies have shown that company which emphasizes collaboration with others is often more active in environmental innovation<sup>[3]</sup>. The upstream supplier master lots of input resources, more environmental friendly upstream inputs can directly promote manufacturers' green products and process innovation. From the perspective of management, the environmental collaboration with suppliers enables company to obtain more green innovative technologies and advanced production equipment, which is conducive to company to carry out various green innovation activities and adopt new environmental management methods.

Therefore, we propose hypothesis:

H1: Environmental collaboration with supplier has a positive effect on company green innovation.

On the other hand, environmental collaboration with customer can maximize customers' demands for green attributes of products, thereby reducing production and rework costs. It can help company cope with market competition, and learn more about competitors' dynamics and occupy the market faster<sup>[4]</sup>. In addition, collaboration with customer can provide company some inspirations and specific solutions to various problems in the innovative process. The commitment and trust come from the collaboration are also effective ways to stimulate green management and innovation. Therefore, we believe that:

H2: Environmental collaboration with customer has a positive effect on company green innovation.

#### **3.2 The role of interpersonal relationship between companies**

Collaboration is an interaction between companies in supply chain that is influenced by the relationship<sup>[5]</sup>. In particular, the interpersonal relationship between companies is considered to be a supplement to the formal relationship (ie, contract) of Chinese company. According to the theory of Chinese Guanxi, interpersonal relationships between companies will also be affected by "Renqing". Managers of different companies have obtained common views and conclusions on certain issues through continuous compromise in the process of mutual interaction. Such compromises are often based on a harmonious and good relationship between the two contact persons<sup>[6]</sup>. In the practice of green supply chain, the good communication can help companies avoid environmental risks, which is beneficial to the sharing of environmental knowledge and experience between companies<sup>[5]</sup>. Therefore, we propose:

H3: Interpersonal relationships have positive effect on EC in supply chain.

Specifically, the sub-hypotheses include:

H3-1: Interpersonal relationships have positive effect on ECS.

H3-2: Interpersonal relationships have positive effect on ECC.

In the studies of organizational relationships and organizational behavior, relationships can not only directly affect company behaviors, but also act as a mechanism. We believe that the effect of supply chain EC on green innovation will be promoted when interpersonal relationships are better. The reasons are as follows: First, this "informal, unwritten reciprocity, fairness, trust, patience" relationship makes partners have more willing to face risks together under China context<sup>[6]</sup>. Secondly, the greater relationship two companies have, the more beneficial knowledge sharing and

problem solving company will have. Good interpersonal relationship also makes the management communication and measures implementation easier. Therefore, we propose:

H4: Interpersonal relationship(IR) plays a positive role in the relationship between supply chain environmental collaboration(EC) and company green innovation.

Specifically, it includes sub-hypotheses:

H4-1: The better the IR, the greater positive influence of supplier EC on manufacturer’s green product innovation.

H4-2: The better the IR, the greater positive influence of supplier EC on manufacturer’s green process innovation.

H4-3: The better the IR, the greater positive influence of supplier EC on manufacturer’s green management innovation.

H4-4: The better the IR, the greater positive influence of customer EC on manufacturer’s green product innovation.

H4-5: The better the IR, the greater positive influence of customer EC on manufacturer’s green process innovation.

H4-6: The better the IR, the greater positive influence of customer EC on manufacturer’s green management innovation.

Based on the hypotheses above, we propose a research framework as follows:

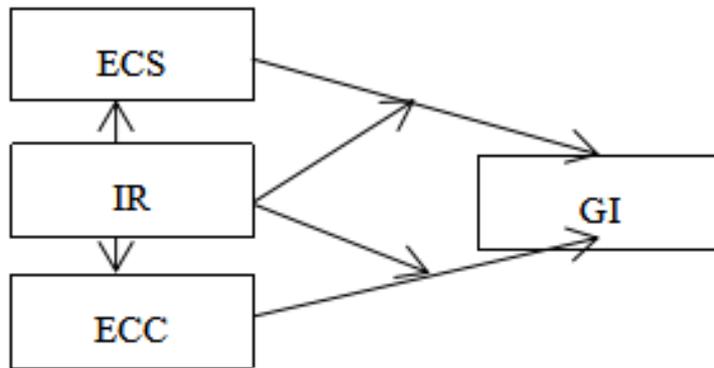


Figure 1 The Research Concept Model

## 4. Research Design

### 4.1. Variables Measurement

This study use maturity scale from prior studies to assure the validity and reliability of the measurements. Senior managers from different industry were asked to answer the questions according to the actual situation, using seven point Likert scale where “1” indicates “strongly disagree” and “7” indicates “strongly agree”.

We measure ECS(ECC) from joint planning and decision-making, information sharing, and incentive alignment. IR is measured from an informal interpersonal perspective<sup>[5][7]</sup>. We measured GI from three dimensions- green product innovation(GProdI), green process innovation(GProcI) and green managerial innovation(GMI)<sup>[11]</sup>. Company’s nature, company’s age and employee numbers are used as control variables.

### 4.2. Data and Sample

This study mainly selects manufacturing companies in the two economic regions of China-Pearl River Delta and Yangtze River Delta-for questionnaire distribution and recycling. 611 questionnaires were sent to different companies. Finally, we get 271 valid questionnaires.

## 5. Analysis and Results

### 5.1. Data analysis

By analyzing the valid sample data, we found the Cronbach's alpha values of each variable were greater than 0.7. So the internal consistency of constructs' measurement was good. The combination reliability and the internal consistency of the scale were good too. Test also shown the values of AVE for all variables exceeded 0.50. Therefore, the convergent validity was good. In addition, the square roots of AVE values were greater than any of the correlation coefficient of two components, so the discriminant validity was demonstrated too.

### 5.2. Hypotheses test

After the path test using AMOS, the direct effects are shown in the following figure:

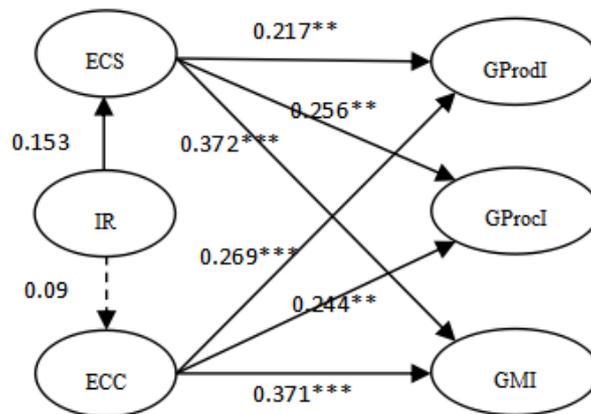


Figure 2 The AMOS-SEM Results

It can be seen that the supply chain EC has played a significant direct role in the three dimensions of GI, and the IR had a significant direct impact on ECS, but the impact on ECC was not significant.

We used SPSS to test the moderating role, the results showed that the IR has played a positive moderating effect on the relations between ECS and GProCI ( $p=0.045$ ), but has no significant moderating influence on the relations between ECS and the other two dimensions of GI. In addition, the IR positively adjusted the relations between ECC and GProDI at a confidence level of 0.1 ( $p=0.079$ ).

## 6. Conclusions and Discussion

### 6.1. Research results and discussion

We have following conclusions:

(1) Hypothesis H1 is supported, that is, ECS has a positive and significant effect on GI. (2) Hypothesis H2 is verified, that is, ECC has a significant promoting effect on GI. (3) Hypothesis H3 is partially supported. The influence of IR on ECC is not significant. The promotion of IR to ECS has been verified. (4) Hypothesis H4 is only partially supported because the moderating role of IR is only related to the relationship between ECS and GProCI, but the relations between supplier's collaboration and other dimensions of GI are not affected. Similarly, the moderating role of IR is only related to the relationship between ECC and GProDI, while the relations between customers' collaboration and other dimensions of GI are not affected.

These results show that companies green innovation will be stronger when they strengthen their environmental collaboration with supply chain partners. The results also indicate that ECS is equal importance with ECC. Manufacturer should not only pay attention to environmental protection needs of customer which will directly affect market performance, but also value collaboration with

supplier who can offer green technology, resource and equipment. At the same time, the results also show that interpersonal relationship has a significant impact on upstream EC, but the impact on downstream EC is not significant. This conclusion does not indicate that interpersonal relationship with customer is not important. This is mainly caused by following reasons: upstream suppliers mostly master input resources from the perspective of resources. The acquisition of input resources will be more reliable when the interpersonal relationship is good. It thus makes the collaboration more stable. However, downstream customer master result resources, so the impact on collaboration behavior is not significant.

## **6.2. Theoretical contribution**

This study promotes the basic theoretical research of green innovation and reveals the mechanism of action between company behaviors in supply chain (environmental collaboration) and the results (company innovation). Different from the other researches, the detailed study explains the influence of Chinese interpersonal relationship on company environmental collaboration behavior in supply chain and green innovation more deeply, thus enriching and deepening the collaboration theory and Chinese Guanxi theory in the context of supply chain.

## **6.3. Managerial implications**

The empirical conclusions of this study confirm that company can reduce the impact on the environmental from the source through the environmental collaboration with other companies and their own active green innovation. Therefore, the support from government should not only be reflected in one single company, but also make more favorable policies like as “Economic Subsidy” and other supports from the perspective of whole supply chain. It also helps to reduce the serious situations, such as “subsidies deception” occurring in individual company, by monitoring and stimulating the entire supply chain. In addition, the conclusions indicate that interpersonal relationships with supply chain partners are very important. In conclusion, companies should appropriately create the conditions to increase informal meetings and contacts with other companies (especially between their managers), thereby increasing the intimacy of the relationship and creating opportunities for more resources and information.

## **6.4. Limitations**

This study collects time-point data rather than period data. Therefore, it is only possible to judge the environmental impact change and competitive advantage change brought by innovation in the early stage from a single point. It should make the results more convincing if we collect data from a period of time.

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